People and the environment: a geoarchaeological approach to the Yorkshire Wolds landscape

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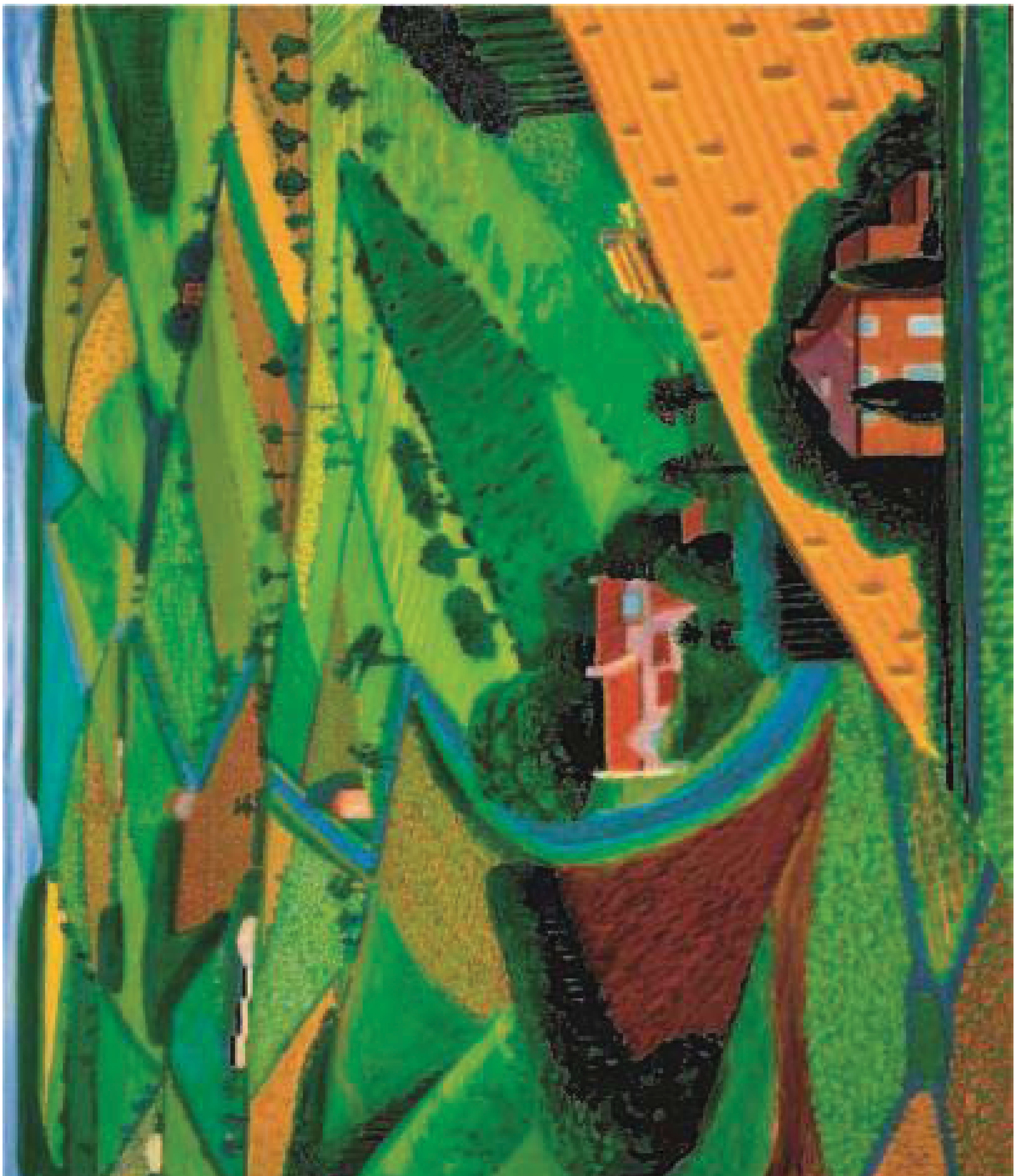

Frontispiece

David Hockney
"The Road Across the Wolds" 1997
Oil on Canvas
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Abstract

Catherine Neal *'People and the environment: a geoarchaeological approach to the Yorkshire Wolds landscape'* 2 volume PhD thesis.
xxiv + 411 pages, 132 figures (70 in colour), 27 tables, 7 appendices, 1 CD and 25 pages of references.

The Yorkshire Wolds chalkland is a well-studied archaeological landscape which is of particular significance for the prehistoric to medieval periods. The approaches taken to the archaeology of this area have mainly focussed on site-based, period-based archaeological investigations or on post-processual landscape archaeology but there has been little geoarchaeological research undertaken.

Drawing on the substantial body of dry valley research from the southern English chalk this thesis characterises the nature of dry valley colluvial deposits in several locations on the High Wolds and relates them to geomorphic and human modification processes. The deep deposits on the Wolds top, which have always been assumed, may not be as widespread as once thought and the variability of deposits within short valley reaches is high. Different modes of erosion and deposition can be seen and are related to the steepness of slope, the deposit nature on interfluve slopes and land use practices. The lack of dateable material found within the colluvium has limited the opportunity for dating phases of increased erosion and accretion. A lack of preservation of land snails, which are one of the key palaeoenvironmental indicators in calcareous landscapes, may be linked to an increase in acid rain during the last few decades. A review of the past evidence for the palaeoenvironment and land use on the Yorkshire Wolds has found that this data is limited and can not be relied upon.

Although the methodological challenges of this research have been high, our ability to answer environmental questions on the Yorkshire Wolds appears to depend on a change of theoretical approach, away from a traditional culture historical account and with caution toward post-processual landscape archaeology. A multidisciplinary landscape archaeological approach, with a focus on geomorphology and the currently uncharted palaeofeatures of the region, offers significant scope for future work.

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Author's declaration

This thesis is based upon original research by the author who takes responsibility for any errors or omissions. The pilot study, discussed in Chapter 4, formed the body of an MA dissertation (Neal 2004) and papers deriving from this were published in two journals (Neal 2006; Neal 2007).

Neal, C. 2004 *The dynamics of human activity and landscape processes on the Yorkshire Wolds; an assessment of dry valley deposits at Cowlam Well Dale* Unpublished MA Dissertation, University of York

Neal, C. 2006 'Dry valley research; a case study from the Yorkshire Wolds' *Papers from the Institute of Archaeology* 17, 86–92

Neal, C. 2007 'The dynamics of human activity and landscape processes on the Yorkshire Wolds; an assessment of dry valley deposits at Cowlam Well Dale' *Yorkshire Archaeological Journal* 79, 1–18

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1.0 INTRODUCTION

The Yorkshire Wolds have been studied in a traditional archaeological manner for over a century but the past hydrology and palaeoenvironment of this region remain poorly understood. The archaeological explanations offered for settlement patterns and preferences on the Yorkshire Wolds have been largely environmentally deterministic and are often based on current preconceptions of social, economic and environmental marginality. In these explanations there is little acknowledgement that the landscape and environment have changed over time, nor is there any indication that people were innovative and were able to use what they had creatively, or to manipulate and alter their surroundings. Previous research has been concentrated on locations that have clear archaeological significance. These are often monuments on eroding hillslopes, or sites that have a restricted chronological focus.

In order to address these issues I have undertaken three complimentary strands of research in the northern High Wolds area. Firstly I have investigated the topography and the sediments by undertaking auger transects, test pits and soil samples from dry valley deposits in an attempt to find evidence for environmental change and to provide evidence for altered settlement distribution patterns that are not based solely on preferentially visible and eroding 'sites'. This is a key part of this research because there is little specific work on dry valley sediments on the Yorkshire Wolds and these locations are corollary evidence for the preferentially studied areas on slope tops. This work is informed by a body of dry valley geoarchaeological research from the southern English chalk that has been successful in challenging traditional settlement distributions and in altering and enhancing the understanding of past environmental conditions. Secondly, I have sought to integrate evidence from a range of agencies, from historic documentary sources and also the knowledge and experiences of local people, to use contextual data might add to the story of the Wolds landscape in the past. The third strand of research has been to assess and to critique the evidence on which previous explanations have been founded on the grounds that they are often based on single examples of elements or on a partial consideration of the evidence, focusing mainly on the availability of surface water and soil quality and depth.

The archaeological evidence is situated within a wider theoretical framework that considers the role of landowning, antiquarianism and the county society as critical to the development of archaeology on the Yorkshire Wolds. I have attempted to integrate scientific techniques with broad archaeological questions and in relation to the development of archaeological practice, considering commercial archaeology, for example, and the general history of archaeological theory.

An overarching aim of this research has been to highlight that combining different data sources and incorporating different disciplinary approaches allows us to develop a more holistic and coherent view of the past. This broad approach emphasises the dynamic relationship *between* people and their environment rather than seeing people as passively reacting to environmental conditions. A geoarchaeological approach to this research aims to place archaeological sites within a framework of spatial, temporal, cultural and non-cultural processes and to relate landscape scale processes to the archaeological record.

1.1 OUTLINE OF THE REGION

The chalk Wolds of East and North Yorkshire comprise a lightly settled rural landscape that is today dominated by agricultural activity. The Wolds exhibit a strong topographic unity, rising from vales and plains to the east, north and west to a maximum height of 250 m above ordnance datum (m AOD). The area is characterised by deeply incised dry valleys (slacks or dales, as they are known locally) and low rolling hills. There are considerable geological contrasts in this region, with the soft drift of Holderness, the chalk Wold ridge and the sandstones of the North Yorkshire Moors compressing a wide range of landscape diversity into a relatively small area (Roberts and Wrathmell 2000, 47). There is a general absence of surface watercourses on the Yorkshire Wolds, with the Gypsey Race the single exception.

This area, well known for its archaeology, is dotted with prehistoric monuments and this has led to comparison with prehistoric Wessex. In addition to the prehistoric barrows, linears and cursus monuments there are exceptional features from other periods such as square barrow cemeteries, ladder settlements, chariot burials, villas, deserted medieval villages and Anglian cemeteries. An assessment of the Yorkshire archaeological resource has found that the Wolds landscape contains large volumes of artefacts representing all categorised periods from the Neolithic onwards (Roskams and Whyman 2008).

1.2 IDENTIFICATION OF THE PROBLEM

The richness of archaeology found on the Wolds has attracted study since the antiquarians of the nineteenth century and research continues today, facilitated by a lack of intensity of modern settlement that would potentially destroy or mask archaeological features. Despite the history of archaeological study, the region has not benefited from a rigorous programme of environmental work and the palaeoenvironmental context of the archaeology is relatively unknown. The lack of environmental evidence has not prevented strongly deterministic environmental explanations from developing for many settlement locations and subsistence choices. For example, a recent publication begins:

The chalk Wolds of East Yorkshire are a generally waterless environment, and natural ponds, together with the relatively few surface watercourses, ***must always have been*** *strong attractions for human settlement*

Wrathmell 2005,1

Wrathmell's assessment (my emphasis) shows no cognisance of the changing hydrological conditions of the chalk aquifer; these have been exploited most markedly in modern times and the assumption that the modern conditions reflect the past regime is prevalent in archaeological discourse for the Wolds. A different perspective is presented in the same volume; research at Wharram Percy in the 1970s around the pond area found an area of boggy ground. Experimental work saw a temporary dam constructed across the narrowest part of the valley and the area was transformed, almost immediately, into a body of standing water (Treen and Atkin 2005, 23). This experiment shows quite clearly that with human effort surface water could be made available where previously it was not.

Previous research has sought to analyse and integrate Holocene palaeoenvironmental evidence from East Yorkshire, including the Wolds, and has found generalised habitat loss but has not been extensively published (Wagner 1992). Comprehensive research has transcribed and interpreted large volumes of aerial photographic data for the Wolds and has produced some excellent results (Stoertz 1997) but this research has led to some inertia on the landscape scale of study. A tendency has developed to regard this work as a conclusion to understanding the landscape and past settlement rather than a beginning, even though it is based on partially visible, fragmented and potentially misleading sources of evidence.

An aim of this research is therefore to synthesise what we really know about the past environment and settlement on the Yorkshire Wolds based on the evidence, and to highlight some of the myths that have developed in the absence of substantive evidence. Part of this process will be to locate and assess the quality and relevance of previous work, published and unpublished. I aim to identify gaps in knowledge and assumptions by this means and to formulate an agenda for future research.

It has been suggested that the key to understanding past land-use on the Yorkshire Wolds lies in the dry valleys (Buckland 2002, 33), and the dry valley deposits on the Wolds are certainly an under-exploited resource. Given the current state of knowledge this research project aims to complement the long tradition of site-based archaeology on the Yorkshire Wolds by considering the potential evidence from dry valley deposits that have not, with very few exceptions, been studied previously. The lack of study and understanding of landscape processes and the dry valleys on the Yorkshire Wolds has been problematic for scholars from the earth sciences and from archaeology for some considerable time (Lewin 1969, 3; Foster 1985, 206; Hayfield and Wagner 1995, 49; Manby *et al.* 2003, 113). A geoarchaeological approach allows us to consider landscape evolution over a long period and to link phases of human activity and settlement with landscape morphology, without the impediment of a predetermined chronological focus. The study of past communities and settlements cannot be separated from the environmental and land-use history of a place. A geoarchaeological approach can be characterised by its impact on three themes; the recognition and interpretation of landforms and their transformation, the impact of human activity on the landscape and the effects of the hydrological regime and burial environment on the deposits studied (French 2003, 9).

The dry valley and slope fills in the south of England have been intensively and extensively studied and contain deposits that are crucial to understanding the way the land has been used and settled, and in understanding the formation of the archaeological record (Bell 1983; Allen 1988, 1992; Preece 1992; Wilkinson 2003). A prediction that colluvial studies will form part of the standard archaeological suite of methods has not held true for chalklands in the northern counties of England (Allen 1994, 428). On the Yorkshire Wolds there has been an intensification of arable farming, which has led archaeologists to concentrate on the superficially obvious and the partly destroyed; this has distorted the distribution of activity and settlement that we see, and therefore find, in our research.

An assessment and analysis of soils and sediments is critical to understanding the Yorkshire Wolds landscape. In 1987 the United Nations estimated that approximately 11.3% of the earth's surface is suitable for agriculture; in Europe the causes of soil degradation include deforestation, overgrazing, agricultural mismanagement and bio-industrial activities (Fullen and Catt 2004, 2). A complex series of processes lead to erosion, desertification and the contamination of soils with salts. The only way to understand soil behaviour is to undertake large-scale spatial mapping of soil properties and research the processes that affect them (*ibid* 12). The physical and structural properties of soils and sediments are determined by their formation environment and the modifying processes that have affected them. This means that the study of soils and sediments has great potential for understanding and reconstructing past environments (Wilkinson and Stevens 2003, 50).

The overarching aims of this research are an assessment of a series of colluvial deposits from dry valley sites on the high Wolds and an assessment of the potential of previous environmental data from the Wolds. This will be supplemented by the location and an assessment of the quality of previous unpublished work, a challenge to stated environmental assumptions and, ultimately, the development of a future research agenda for environmental reconstruction on the Yorkshire Wolds.

1.3 THESIS STRUCTURE

The Study Area defined throughout is the area of primary field investigation centred on Thixendale village and covers a small area of about 15 km². This area is investigated in detail in the results section, but the general literature review and discussion consider the area of interest to be, broadly speaking, the Yorkshire Wolds as a whole. The primary study area is augmented by analyses from two other sites (Figure 1).

The formation and importance of chalk landscapes in Britain will be discussed at the beginning of Chapter 2; this considers the nature of dry valley formation and the types of palaeoenvironmental evidence found on the chalk. The previous research on chalk landscapes and environmental reconstruction from other areas of England will be discussed and synthesised in Chapter 2. These detailed studies, and their results, have a substantial bearing on the approach taken to this research project and act as a comparison for the results and interpretations. These studies provide a 'tried and tested' methodology that has now been applied to the Yorkshire Wolds area. They also highlight some of the limitations of this type of approach.

The Yorkshire Wolds region as a whole will be introduced and discussed in Chapter 3. This chapter begins with a consideration of the geographical and topographic setting of the Wolds and a review of the adjoining landscape blocks, the Vale of Pickering, Vale of York and the plain of Holderness. Following a necessarily brief chronological review of archaeology on the Yorkshire Wolds, the specific evidence for some of the themes I have identified as important will be reviewed. These include water, past environment, settlement patterns, linear features, policy and the role of antiquarianism and regionalism. The specific geographical, geomorphological and archaeological research relating to dry valleys on the Wolds is considered in Chapter 4 along with a discussion of a pilot study at Cowlam Well Dale that was undertaken as part of a Masters degree in 2004 (Neal 2004). The results from Cowlam Well Dale have a bearing on the design, expectations and the results of the current research.

In Chapter 5 the methods that were utilised and the project design for this research are discussed. This includes an outline of the research aims, the desk-based methods, field and post-excavation procedures. The identification and allocation of resources is also considered here. This chapter will therefore highlight some of the limitations and opportunities of this project.

Chapter 6 is a comprehensive report on the results of the primary research undertaken, including desk-based assessments, fieldwork results and the subsequent analysis of different classes of evidence on a site-by-site basis. In Chapter 7 the results from some secondary research opportunities will be reviewed. The results presented in Chapters 6 and 7 inform the range of questions, issues and themes that were originally outlined in Chapters 2 and 3. Following a summary of the main results for each location, I will consider some of the key findings in relation to specific geoarchaeological methods including sedimentary analysis, landscape morphology and taphonomy, land snail analysis and methodological concerns. Later in Chapter 8 the more general themes introduced in Chapter 3 will be reviewed once more in light of the evidence and the results allowing us to assess the effectiveness of the research.

A conclusion to the research process is presented in Chapter 9 and highlights the applicability of the methods to the problem, reinforces the key results and findings and proposes approaches for the future. This provides an agenda for environmental research on the Yorkshire Wolds to take us forward.

1.4 SUMMARY

The soil is the great connector of our lives, the source and destination of all

Berry 1997

The key issues for examination as part of this thesis are the need to assess the potential of dry valley research on the Yorkshire Wolds, utilising tried and tested approaches that have been developed since the 1980s for the southern English chalk. This is undertaken with due consideration of the specific local conditions including the nature of the archaeological record, current land-use practices and land ownership, which are particularly relevant. In addition to the differences of a geological and land use nature between the Yorkshire Wolds and the southern Chalk, there is an intellectual, methodological and, to some extent, a theoretical difference in approach. The intensity of current settlement and the opportunities for development, research and for the protection of this historically and environmentally sensitive landscape type are very different for the north and south. Any comparison must be cognisant of the varied and enduring differences between the Yorkshire Wolds and the southern English chalk.

As part of the assessment of the palaeoenvironment, an aim of this research was to locate and assess the quality and potential of work not published and to review the nature of the evidence on which current interpretations are made. This leads onto a challenge to the current environmental assumptions about past land use and conditions.

A full review of the sedimentary evidence and an appreciation of the way that Yorkshire Wolds archaeological research is situated within a regional historical, social and theoretical framework allows me to suggest future directions and to flag up the examples of good practice that are currently being employed.

2.0 CHALK LANDSCAPES AND ENVIRONMENTAL RECONSTRUCTION

During the first half of the twentieth century an awareness of the permeability of chalk and limestone geologies led to the assumption that these areas had not been subject to erosion and hillwash processes (Bell and Walker 1992, 192). Dry valley and slope fills have since been found to contain deposits that are crucial to understanding the way the land had been used and settled, and in understanding the formation of the archaeological record (Bell 1983; Allen 1988, 1992; Preece 1992; Wilkinson 2003). The methodology and intellectual agenda adopted in this research are largely based upon the body of dry valley and downland research that has been undertaken across England. This approach, its application and limitations, are of central importance to this research. Therefore, this chapter begins by considering the nature and the extent of the chalk landscape in Britain. Following this is a discussion of the formation of the dry valley systems, which are of critical importance to chalkland archaeology. There will then follow a review of the types of evidence preserved and utilised in chalkland archaeology. The major section of this chapter is devoted to a consideration of the evidence from sites across the country and, whilst it is not a comprehensive review, it covers the key sites and themes of the research already successfully undertaken. The specific off-site dry valleys studied in the Yorkshire Wolds are not considered here but in Chapter 4 as a discrete group. At the end of this chapter there is a summary of the main themes arising from the evidence.

2.1 THE EXTENT OF CHALK LANDSCAPES

During the Late Cretaceous period, approximately 100 million years ago, the area surrounding the North Sea lay 10° further south and the sea level was several hundred metres higher than at present. This had the effect that Norway, Sweden, The Grampians, The Massif Central and The Bohemian Massif were the only land surfaces above sea level in the region (Hancock 1993, 16). Over a period of approximately 35 million years, the skeletal calcite from planktonic algae (coccoliths) was laid down in this warm sea to become the form of soft limestone that we now know as chalk (Downing *et al.* 1993, 1). Chalk is an Old English word that denotes 'softness' and therefore serves as a differentiation between chalk and limestone lithology (Hancock 1993, 14). There is a great distribution of chalk because exceptionally high seas carried pelagic chalk onto continental shelves, there was very little erosion of the exposed land surfaces and therefore no sedimentary deposits formed. These factors, along with an increase in coccoliths, led to the formation of massive chalk beds (*ibid* 15). Consequently the entire region around the North Sea, including England, France, Germany, The Netherlands, Belgium, Denmark and Sweden, is underlain by Cretaceous chalk. Under the North Sea the chalk can be up to 2000 m thick, but onshore it is more likely to be less than 300 m thick (*ibid* 31). The chalk was not laid down in a constant stream and the top layer of chalk ooze would have been incoherent and resedimented on many occasions. The time-scale for the deposition of the coccoliths is very long and can be contextualised because experiments have shown that the time taken for the smallest skeletal parts to descend to the deepest part of this ocean would have been in the region of 28 years (*ibid*).

The chalk downland of Britain is mainly concentrated in the south-eastern and eastern regions of England (Figure 2). The Upper Cretaceous chalk has been traditionally described as Upper, Middle and Lower members but the chalk beds are variable across the country; for example the chemical analysis of chalk from Yorkshire suggests that the Lower Chalk and Middle Chalk are not significantly different from one another (Pitman 1978, 99). Moreover, the similar clay mineralogy for all three chalk bands in Yorkshire suggests that it is compositionally more homogenous than the southern chalk, with chemical weathering leading to an increase in soluble residues and therefore an increase in clay content (*ibid*). The stratigraphic model for Upper Cretaceous chalk is complex and a recent review of the old classifications of Upper, Middle and Lower Chalk has now resulted in the division of Britain into three chalk provinces, Northern, Southern and Transitional (Hopson 2005) (Figure 3). The distribution begins in the west in Dorset and Wiltshire, before crossing the Hampshire Downs, Surrey, Sussex and Berkshire and finally across to Kent in the east, forming what is known as the Southern Province. Further outcrops are found in the Chilterns and East Anglia forming a transitional zone before reaching the Northern Province, which consists of chalk outcrops in Lincolnshire and Yorkshire, and limited exposures in the Scottish Hebrides and Northern Ireland.

The regional variation in the composition of chalk is high. Although generally 89–90% of chalk is composed of biogenic skeletal fragments, the amount of clay in the chalk is variable, with 12% on average in the south of England but between 20% and 65% in Lincolnshire (Hancock 1993, 22). Initial diagenic processes that took place soon after formation increased the porosity in the chalk, and then secondary diagenesis, caused by the weight of overburden, thermal influx or tectonic stress, hardened the rock by reducing porosity and permeability (*ibid* 33). In the case of the harder chalk found in Humberside and East Yorkshire there is an absence of any tectonic or overburden explanation, and this has led to the suggestion that there must have been an increase in heat flow during the Tertiary period in this region (*ibid* 34).

2.1.1 Dry valley formation

Dry valley systems occur most frequently on chalk but have also been identified on a variety of other rock types (Goudie 1990, 177). From a geographic perspective, the dry valley networks that lie on the chalk are one of the most widespread and discussed features of the English landscape (*ibid* 176). Several hypotheses have been suggested to explain the presence of dry valleys. An uniformitarian explanation stresses the action of normal environmental processes over time, for example chalk joint enlargement by solution. Marine hypotheses have highlighted the lack of valley adjustment to falling sea levels. The most widely accepted explanation is palaeoclimatic, relating to periglacial activity and glacial erosion (*ibid* 178). No chalk lithology is found in the current periglacial zones and dry valleys of the Arctic or Antarctic, therefore there are no current analogous valleys and consequently discussions about formation and change over time remain theoretical (Foster 1985, 206).

The dry valleys in the Chilterns are not related to a sub-surface chalk-jointing pattern, which is indicative of periglacial formation processes by surface torrents with the ground surface under permafrost. Periglacial conditions also help to explain the widespread asymmetry in dry valley morphology where some slopes are regularly exposed to sunlight whilst others are not; this causes a differential freeze–thaw and altered slope development during periglacial periods (Goudie 2001, 181). Change in mean sea level partially accounts for dry valley development during the Early

Pleistocene. The high stand of sea level at this time meant that chalk groundwater levels were also high and therefore it is likely that streams flowed on the surface of the chalk (*ibid*). In the north of England the nature of the dry valleys cut into the Carboniferous Limestone of the Dove-Manifold and Lathkill systems of the southern Pennines have been examined (Warwick 1964, 116). The system here is dominated by a NW-SE trend and is related to the downcutting of major streams, during sea level change, which led to a lowered water table and increasing desiccation of the valleys (*ibid*). The preservation of Pliocene age pollen from a large doline suggests the valley desiccation here occurred before the Pleistocene (*ibid* 122).

2.1.2 The chalk as an aquifer

The chalk has always been recognised as a water source, initially because of visible spring activity and by 1613 artificial channels were created to bring chalk spring water into London via the New River (Downing *et al.* 1993, 10). This developed further, and by the mid-seventeenth century a series of wooden pipes distributed chalk groundwater across central London. Chalk is today the central aquifer in the UK, supplying 55% of the total water supply (Lloyd 1993, 220). Although the chalk has a porosity of 30–40%, the amount of water available in wells is limited to 1–2% due to the fine-grained chalk matrix (Downing *et al.* 1993, 10). Recent studies show that there has been an increase in the permeability of the chalk since 5000 BP and that the recharge of the aquifer has been lower than average in recent years (Lloyd 1993, 270). Increasing demand for water from the chalk aquifer during the twentieth century has led to a fall in levels with a reduction in spring activity, groundwater-fed rivers and saline intrusion in coastal chalk areas (Downing *et al.* 1993, 11). This situation has led to regional management systems for the aquifer since the mid-1960s to ensure accountability and a balance between water need and the ecological effects of abstraction (*ibid* 12).

2.1.3 Sources of evidence

In this section the role of erosional products, buried soils, land snails and pollen analysis in the examination of colluvial deposits will be reviewed.

The impact of people during the Holocene has influenced natural geomorphic processes by reducing the grassland and woodland vegetation cover and thereby increasing the loss of soil on slopes due to increased runoff and wind erosion

(Roberts 1998, 50). This net erosion and net deposition leads to degradation on the slopes and accumulations of deposits elsewhere, creating materials suitable for analysis. Modern analogues were once seen as central to understanding past erosion episodes (Allen 1988, 76). This had led to the archaeological analysis of modern agricultural regimes. Modern actions, including increased field size, the cultivation of gradients and greater mechanisation, all increase the likelihood of erosion significantly (Boardman 1992, 14). This means that, although the prehistoric stone-free loess on the South Downs would have been susceptible to erosion, the small fields with intact boundaries would have mitigated against this (*ibid*). Therefore, the application of modern analogues to past erosion is limited, but basing landscape reconstruction on purely what remains is equally problematic (*ibid* 18).

The use of caesium 137 has determined the levels of erosion since the 1950s at Littleor, Perthshire. This study concludes that in the extensively arable farmed area of eastern England and Scotland the levels of erosion recorded are generally coincident with an increase in the discovery rates for archaeological sites by aerial photography (Davidson *et al.* 1998). The rates of erosion determined were 0.5 mm/a since 1953 for mean net erosion, with around 1 mm/a for the break of slope (or steep slope), which is in stark contrast to the suggested figure of 0.1 mm/a for the UK generally (*ibid*).

When monitoring water-induced erosion on arable farms, approximately 80% of erosional events were on land planted with winter cereals, initiated between October and January, and 30% were linked to valley floor features that accelerated run-off (Chambers and Garwood 2000). It was estimated that 37% of arable fields suffer from high levels of erosion and that an increase in precipitation could have a dramatic effect on erosion rates (*ibid*).

The buried soils that are found beneath monuments or in association with colluvial and alluvial deposits contain a record of prehistoric land-use practices and past environment but have not been systematically exploited by archaeologists (French *et al.* 2007, 1). In order to understand the development of colluvium it is vital to recognise the pulses of deposition, which are indicative of past land surfaces, and may be signalled by differences in stone content or sorting (English Heritage 2003, 3). Within colluvium these horizons are often weakly developed and it can be difficult to differentiate between accumulations and pauses (*ibid* 4). Buried soils are particularly important archaeologically as they can indicate periods of stability, which often contain evidence for landscape evolution and past environmental conditions (French 2003, 41). When examining buried soils beneath colluvium a key consideration is that whilst the autochthonous assemblages found in buried soils generally have low spatial variability the largely allochthonous material in the colluvium has a high spatial variability (Evans and O'Connor 1999, 87).

Experimental earthwork studies on open chalk downland at Overton Down have assessed short to medium term environmental processes by investigating an earthwork on a progressive scale of time intervals to reveal how the archaeological record is formed, preserved and recovered (Bell *et al.* 1996, 11). Extremely detailed observations have been made, and erosion was found to occur in the first few years after construction with the compaction and subsequent movement of a range of mapped, buried material (*ibid* 3). After 32 years the changing profile of the ditch and bank was evident, and the buried land surface could be seen in the bank. The buried soil depth had been reduced up to 50% due to compaction and faunal activity, including active mole runs and earthworm sorting (*ibid* 76).

Calcareous deposits rarely preserve pollen so there has been a continued emphasis on molluscan analysis for landscape reconstruction in dry valley situations (Wilkinson 2003, 725). Land snail analysis has allowed environmental archaeological techniques to be used and interpretations to be made for areas of chalk- and lime-rich landscapes that have little other preserved palaeoenvironmental data (Evans 1972, 16).

Molluscan analysis relies on the application of uniformitarian principles to fossil evidence, and applying our knowledge of modern organisms to past population means that we can have a degree of confidence in environmental reconstructions (Lowe and Walker 1997, 162). The number of current species in England, at 135, makes the method particularly straightforward to apply, as a good field guide, binocular microscope and reference collection are all that are required to identify to species. The objectives of ecological modelling, including malacoarchaeology, include the characterisation of environments related to archaeological sites, the consideration of the impact of resource exploitation on the environment and to build longer term sequences of environmental change that help to model relationships between people and the landscape (Harris and Thomas 1991, 93). The significant advantage of molluscan analysis over other types of evidence is that the shells can frequently be identified to species level. They often occur in oxidised, calcareous deposits where little other fossil evidence is preserved (Lowe and Walker 1997, 203). From the late Holocene the interpretation of molluscs becomes more problematic due to the effects of human activity on species distribution. The patterns found can be a reflection of climatic or anthropogenic changes, or both (*ibid* 208). Human action has introduced a range of habitats not previously seen, for example the use of sheep and rabbits on pasture has greatly affected molluscan faunal composition (Evans 1972, 127). In addition the liming of soils and the quarrying of calcareous rocks has potentially increased the number of mollusc-friendly habitats (*ibid* 128).

Research by Carter (1990) found that shells from buried soils may represent a series of discrete episodes of deposition rather than a continuous sequence, as is often implied. The variation in levels of preservation between large/robust and small/fragile species is also problematic. The leaching of sediments commonly results in decalcified deposits even on areas of calcareous solid geology (Murphy 2001, 2). The prediction of areas of likely preservation is very difficult because indicators such as pH and base status are not fixed and undergo significant changes related to weathering, leaching and the re-absorption of metallic cations. This can create shell-rich layers interleaved with shell-free layers (*ibid*).

Pollen analysis is considered the most important palaeoecological technique for the Pleistocene and Holocene periods and has been widely applied in Britain (Roberts 1998, 29). The pollen grains and spores produced by plants can be incorporated and preserved within deposits, and then recovered and analysed at a later stage. Of the many issues associated with pollen analysis is the wide variation in pollen production from one species to another (often dependent on the difference between insect or wind pollination) and the route of dispersal, which affects pollen concentrations (*ibid* 30). The limitation of the method for this research is that pollen is poorly preserved in calcareous sediments but is found occasionally in specific burial environments, for example within acidic brown forest soils which protect against the high pH values of the surrounding calcareous material.

2.2 CHALKLAND GEOARCHAEOLOGY IN ENGLAND: A REVIEW OF THE EVIDENCE

This review of the most significant chalkland archaeology will consider the origins of this methodological approach and will then go on to discuss some of the key issues identified from this approach to the landscape.

Kerney was the first researcher to recognise the relevance of geological work during the 1960s as critical to understanding prehistoric sedimentary sequences that could be dated by the Neolithic pottery and occupation deposits contained within dry valley fills (Bell 1983, 119). The geological analysis at Brook, Kent, investigated the morphology of the chalk escarpment that forms the edge of the North Downs (Kerney *et al.* 1964). A series of late glacial deposits were cored and analysed. Radiocarbon dating of marsh deposits produced a date of 10,000–8800 BC and the later coombes were cut in the period 8800–8300 BC (*ibid* 136). The reconstruction of the environment at Devils Kneadingtrough indicates that the spring lines on the edge of the chalk downland have not moved and have not been the source of erosional events (*ibid*); however, significant hillwash deposits cover the periglacial chalk rubble. Molluscan analysis indicated that these deposits were associated with two clearance phases, the first in the late Neolithic and the second during the Iron Age. The second clearance phase produced rapid hillwash deposit formation, and may have been linked to an increase in arable land on the slopes and allied to a deterioration in the local climate (*ibid*).

Bell built on the work of Kerney and established research that aimed to broaden archaeological study away from a site-based focus, considering the impact of landscape history and palaeoenvironmental evidence on archaeological understanding. A key aim was to establish whether the main cause of colluvium was climate change or land-use change (Bell 1983). Colluvium is poorly sorted sediment that has been transported downslope, gradually, by gravity. This process can occur by a variety of mechanisms, including rainfall, freezing and thawing and faunal action, but can most significantly be increased by cultivation and tillage (Bell 1982, 127). It is now argued that chalk colluvium is mainly the result of fluvial processes (sheetwash) rather than predominantly soil creep as was previously thought (Allen 1994, 402).

Bell concentrated his research on the South Downs of England. The South Downs is a long narrow band of chalk that runs from Hampshire, across West Sussex and then to the sea in East Sussex and is characterised by a prominent chalk outcrop that rises from the southern coastal plain. This dramatic and well-defined chalk landscape comprises rolling arable land with close-cropped grassland, interspersed with high ridges and dry valleys (Countryside Agency 2005). This area is a remnant of the extensive chalk dome that covered the Wealden district, but the central portion is now eroded leaving just the North and South Downs. A number of deep water-bearing valleys cut across the chalk but they are much earlier in date than the dry valleys (Gallois 1965, 75). None of the dry valleys carry permanent streams today but many of their flat floors contain well-rounded water-lain gravels, deposited at a time when the water table in the chalk was higher (*ibid* 63).

Three archaeologically investigated locations were selected and machine-cut excavation trenches were placed across the valley profile; they were cleaned by hand and then drawn (Bell 1983, 120). At selected points in the stratigraphic sequence the sediments were described and sedimentological and molluscan samples taken. The colluvial deposits were interspersed with palaeosol horizons that represent periods of landscape stability. A strip of land, adjacent to the trench, was excavated by hand and each artefact found was plotted in three dimensions (*ibid*). The sediments were subject to particle size analysis in an attempt to understand the range of depositional processes and the molluscs were identified using taxonomic classifications. Charcoal found securely within the section was collected, and radiocarbon determinations were found to correlate with the chronology implied by the ceramic assemblage (*ibid* 129). The pottery chronology was based on the 3278 artefacts that had been recovered by hand. The pottery was subject to microscopic analysis of the fabric, form, inclusions and fillers and this was used to propose an independent chronology based on the stratigraphic position of distinct pottery groups (*ibid* 123).

The valley fill could often be closely correlated with the settlement evidence from nearby archaeological sites (Bell 1983, 146). The excavation of a Bronze Age settlement site on Itford Hill during 1957 found little preserved environmental material and several truncated deposits. The evidence from the valley fill at Itford Bottom was able to enhance the record for settlement and land-use on the archaeological site in this locality that had been investigated some years earlier (*ibid*). The discovery of large volumes of Middle Bronze Age pottery in the valley fills supports the practice of the deliberate use of ceramics to enhance arable land during this period (*ibid* 143). Molluscan and radiocarbon dating of the fills from Itford Bottom is suggestive of late woodland clearance dated to 1770±120 bc, with episodes of vegetation burning from the Early Bronze Age (*ibid*).

The deposits at Kiln Coombe revealed Beaker artefacts and occupation horizons that were undetectable from the surface or by geophysical survey, indicating the potential impact of colluvium in both increasing archaeological preservation and reducing visibility (Bell 1983, 147). Some of the early soils found at Kiln Coombe and Chalton were loessic in nature. The discovery of even thin layers of loess means that prehistoric soils were of better quality than today's rendzinas (*ibid*). Significant lavant streams were probably responsible for the removal of conventional settlement deposits from the Bronze Age to the medieval period at Chalton. The analysis of the erosional events in the corresponding dry valley suggests that there was intensive arable activity here since the Bronze Age (*ibid* 146). It has been postulated that the stony lynchets found represent deliberate prehistoric stone casting to ease a combination of stony soils and erosional processes (*ibid*). Although this research identified a close link between land use and colluviation, severe climatic events can account for significant erosional processes and should not be overlooked in explanation (*ibid*). Dating evidence can be skewed because the means of incorporation into the deposit can be unclear. Incorporation can occur by direct deposition near to the valley floor, by erosion and redeposition, or by spreading ceramics with manure on the fields; these then erode downslope (*ibid*). The early work of Bell has served as an exemplar for continued research in dry valleys, focusing as it did on off-site locations, considering human action as a cause of erosion and demonstrating that erosional events have occurred on the South Downs since the Bronze Age. Although largely successful in revealing the benefit to site-based archaeology from off-site geoarchaeology, the research has also highlighted some of the limitations and inherent problems of such an approach, including the critical problem of dating sequences.

The limitations of artefact dating as encountered by Bell can be alleviated, to some degree, by the additional use of an absolute dating method (Allen 1988). Allen's work on the South Downs had a specific remit to address sediment dating and to produce a regional model of environmental exploitation (*ibid* 70). Allen attempted to date sediment from two sites by recording the palaeomagnetic field, as used for lake sediment dating. We know that the latitude of magnetic north has varied throughout the earth's history and so, by recording the declination, inclination and intensity of magnetism in the body of sediment, we can determine a depositional age (Bell and Walker 1992, 21). Continued remnant magnetism at one site suggested continued sediment deposition, so the lack of Romano-British pottery here was likely to be related to manuring and waste patterns, rather than an absence of occupation (Allen 1988, 70). The palaeomagnetic dating, combined with a magnetic susceptibility assessment of pedogenic processes, was problematic due to taphonomic processes, which can increase or deplete iron concentrations in the soil, and also due to the inclusion of lithorelicts that produced, in this case, anomalous results (*ibid*).

The issue of dating the sedimentary sequences was unresolved and Allen noted that most colluvial studies have been dated by the distribution of datable artefact sequences, but this does not help to define some of the more complex issues, such as the rate and mode of deposition, and can also be distorted by the inclusion of residual material (Allen 1992). Allen began a programme of work in Wessex, studying a series of colluvial deposits in order to understand the complexity of erosional and depositional regimes (*ibid* 37). Without a clear understanding of the processes involved in eroding and redepositing material, reconstructed land use patterns are inaccurate and can mislead. The examination of a wide range of deposits in Wessex emphasised that the depth and type of colluvial deposits on the chalk is extremely unpredictable. For example, a subtle valley near Salisbury Plain was unrecognised until trenched by a JCB, and then found to contain 3 m of colluvium, whereas the well-defined valley at Stonehenge Bottom contained little deposit, despite suitable topography and morphology (*ibid*).

Issues of accurate dating were also uppermost in the mind of Preece when he began work in Kent. He considered that the archaeological understanding of the dry valleys of south-east England has been impeded because many sediments now lie above the water table and are oxidised, resulting in a lack of datable material (Preece 1992, 175). A rescue excavation, funded by Eurotunnel in 1987, investigated two small dry valleys at Holywell Coombe, Folkstone, Kent. A detailed borehole survey was undertaken in advance of excavation that consisted of 180 boreholes with a concentration of intervention intervals on the valley axes, aiming to locate organic deposits (*ibid* 177). Solifluction deposits were found to form wedges on each slope, but the hillwash deposits were found to thicken both downslope and down valley. The hillwash is probably related to forest clearance. Geoarchaeological analysis of the landform and the boreholes identified large landslips. Some of the landslips had marsh deposits beneath them that indicated a landslip age of 12,000–13,000 years before present (*ibid*).

The excavation of specific locations at Holywell Coombe revealed a detailed environmental sequence based on 24 radiocarbon dates and a scheme of molluscan zonation. The results of this scheme were that between 11,500 and 11,800 BP there was active erosion and climatic deterioration, followed by a period of stability (Preece 1992, 179). The hillwash silts contain two distinct palaeosol horizons. The basal palaeosol contained Neolithic and Bronze Age pot-sherds and a single microlith (*ibid*). Artefacts from the second palaeosol were Iron Age in date and magnetic susceptibility was enhanced at this time (*ibid*). Dating the palaeosols was, however, problematic. The charcoal from the basal palaeosol was radiocarbon dated to 5620 ± 90 BP, with shell from the same horizon to 4470 ± 90 BP (*ibid*). At Holywell Coombe there is evidence for two distinct interstadials that have not been identified in other regions. Preece suggests that this is because, in areas of chalk or frost-sensitive geology, the climatic signals are amplified and cause large solifluction deposits, unlike areas with hard geology (*ibid* 180). This study was very successful in recognising the relationships between deposits and geology that illustrate the complexity of formation processes and also in determining the chalk as a sensitive measure of climatic variability and change. In the south of England soil horizons have been found between layers of solifluction gravel but none have yet contained archaeological material that represents a fossilised Pleistocene land surface (Evans 1972, 289).

Quarrying activity on the Chilterns led to the discovery of an exposed buried soil with subsequent archaeological investigation. The Chilterns run from the Thames in Oxfordshire to the west, then eastwards across Buckinghamshire, Hertfordshire and Bedfordshire. They are formed above the Vale of Aylesbury by a chalk down covered by up to 4 m of clay-with-flints (Countryside Agency 2005). There are several permanent river valleys in the Chilterns and some spring-fed seasonal streams, but recently these have been reduced by over-abstraction from the chalk aquifer (*ibid*). At Pitstone, Buckinghamshire, a buried early postglacial palaeosol was exposed during quarrying work. When studied this feature was found to occur with coombe rock deposits beneath it and a ploughwash deposit above (Evans and Valentine 1974, 345). Although a single Romano-British artefact was found, there was a charcoal deposit associated with the buried soil (*ibid* 346). One hundred kilogrammes of buried soil were required to obtain a suitable size of charcoal sample for dating, and the result of this was 3910 ± 220 BP. The mollusc fauna comprised temperate species. Underneath the palaeosol the assemblage contained woodland species, indicating forested conditions, and the calcareous silty loam covering the palaeosol contained open country species, indicating clearance and farming activity (*ibid* 350). The very different environmental conditions are clearly identified by the molluscan evidence at this site and, whilst absolute dating has been achieved, it would seem unusual to take a 100 kg sediment sample.

As this type of research has progressed, different types of chalkland environments have been investigated. The chalkland prehistoric landscape change has been assessed in the Test Valley, Hampshire (Davies and Griffiths 2005, 97). The ostracod and mollusc assemblages from Holocene tufa deposits both indicate a changing regime. Initially lightly wooded, a phase of woodland clearance is related to a charcoal peak before a return to woodland. Tufa analysis is useful because it comprises a sedimentary record for the period 10,000–4000 BP (*ibid* 98). Most frequently the assemblages indicate a lightly wooded or open environment (*ibid* 107). This is the first time that tufa development has been associated with light woodland in southern Britain. The tufa was formed under open conditions by groundwater precipitation rather than fluvial influence, during the Mesolithic period (*ibid* 108).

The off-site approach has identified problems with traditional methods of plotting site distributions for different periods. A recent synthesis of dry valley Beaker settlement sites deduces that archaeologists have generally been looking in the wrong places, concentrating on exposed valley tops rather than sheltered valley bottoms (Allen 2005, 223). This work catalogues 35 previously unknown settlement sites on the southern chalk downlands from valley bottoms but concludes that the situation for Bronze Age and dry valley sites in the rest of Britain is unassessed and unknown (*ibid* 237).

A recently published study has used a variety of archaeological and palaeoenvironmental data sources to suggest a model of landscape development on downland that does not correlate with the earlier regional model, or a local model proposed following archaeological work in the 1980s (French *et al.* 2007). The study area is an 8 km by 2 km swathe of the upper river Allen valley in northern Dorset and constitutes a classic chalk downland landscape associated with a significant prehistoric monumental landscape (*ibid* 1). A combination of molluscan, palynological and micromorphological analyses in addition to the archaeological and landscape assessments has revealed a complex environmental history and erosional/depositional regime.

The results of the investigation imply that an area around the valley head had already undergone a soil change from brown earth to rendzina by the fourth millennium BC so that open areas already existed during the Mesolithic period (French *et al.* 2007, xix). This situation means that some areas may not have developed well-structured argillic brown earths but instead thin brown earths due to a lack of woodland cover. Thinner and less developed soils mean that the presumed extensive soil erosion and the concomitant formation of deep valley deposits during the Neolithic and Bronze Age period may never have occurred here. Further downstream mixed deciduous Mesolithic woodland was evident that became more open during the early Neolithic period, eventually becoming dominated by grassland. The evidence for an increase in arable land was not observed until the later prehistoric and early historic period. In fact the analyses of ditch fills from across the whole study area are highly suggestive that colluviation did not occur to any great extent or in any significant volume until the historic period (*ibid*). This throws into question the assumptions of previous dry valleys studies that have proposed an increase in erosion from the Neolithic period as the norm and as indicative of the impact of human agricultural regimes.

The success of these dry valley and downland studies has resulted in the acceptance of colluvial studies as 'mainstream' archaeology and therefore inclusion within the planning process (Allen 1994, 428). The success of this work has resulted in a geoarchaeological assessment on Salisbury Plain that aimed to establish a sedimentary history for the site of Boscombe VI and V (Norcott and Allen 2005). Work by Wessex Archaeology on Boscombe Down air-base land has revealed a Roman cemetery and village, and a mass grave from the Bronze Age that contained seven individuals and was dated to 2300 BC (Wessex Archaeology 2005). The grave contained eight Beaker pots, six of which had the rare continental plaited cord decoration, and five 'barbed and tanged' arrowheads giving rise to the description 'The Boscombe Archers' (*ibid*). In the associated geoarchaeological assessment, the deposits from two dry valleys were mapped and analysed. They were found to contain colluvium, valley gravels, solifluction gravels and a relict brown earth soil (Norcott and Allen 2005). The archaeological evaluation at Boscombe IV and V consisted of over 100 machine-cut sections and these interventions were then extended by hand, with artefact distributions mapped in three dimensions and sediment descriptions and sampling (*ibid*). The sequence from the base of the deposit was a solifluction gravel formed before 10,000 BP. The first Holocene deposits in the southern valley were patches of reworked valley gravel that have been ascribed to the Mesolithic period (*ibid* 2). Brown, clay-rich, deposits were found in the involuted surface of the coombe rock and appear to be the remnants of a brown forest soil. The presence of argillic brown earth is suggestive of Neolithic woodland, with charcoal and Neolithic pottery found in one involution. The erosion of the soil into the involutions may be indicative of early Neolithic woodland clearance. Above this layer in the northern valley, and in parts of the southern valley, was a brown earth buried soil. The soil was pitted and worm sorted, indicating an open landscape, and tentatively dated to the middle Neolithic. The truncation of this deposit is seen in a dense layer of brecchiated flint gravels probably eroded by overland water flows from winterbournes (*ibid* 3).

The Holocene gravels were overlain by a series of colluvial deposits that were more humic than the truncated soils below, and probably represent the erosion of the A and B horizons from the brown earth soils on the slopes above. Both the Holocene gravel and colluvium contained worked flint, and immediately above the colluvium was a gravel fan containing Beaker pottery resulting from Early Bronze Age agriculture and erosion (Norcott and Allen 2005, 3). Above this was colluvium with Late Bronze Age and Early Iron Age pottery, interleaved with silty lenses, indicative of rill wash. Above the gravel fan was a silty ploughwash with Beaker to Romano-British finds sealed by an A horizon. This represents a stable and established landscape with field boundaries and systems preventing erosion into the valley bottoms. Additionally it is possible that large and infrequent erosional episodes may have channelled the deposits along the valley floor and out of the dry valley system altogether (*ibid* 3). Indeed an assessment of chalk dry valleys in Champagne, France, found that although accumulation had been a stronger influence than erosion in the dry valleys themselves, a reasonable proportion of the eroded material had passed out of the immediate valley system following flood events (Buckland *et al.* 2006). The issue of dry valleys being described as 'closed systems' due to an absence of surface water sources is an important perceptual problem that will form part of the discussion.

The past perception of erosion and soil quality has been discussed briefly by some researchers (Bell 1992, 21) but there is a lack of any overarching theory in the dry valley work from the south of England. Re-analysis has considered past perception of the environment much more fully, but lacks an explicit theoretical framework (Wilkinson 2003). Environmental archaeology can contribute to a phenomenological approach particularly because past landscapes were often different from today, making accurate reconstruction a necessary starting point for considering past experiences and perception (Wilkinson and Stevens 2003, 265). Research agendas within archaeological science often relate to the methods and techniques, rather than addressing archaeological questions by the application of scientific techniques (Mellars 1987, 2; Bell 1992, 22). A Weberian approach to the complementary roles of science and politics would see archaeological science as establishing the 'social facts' but failing to establish the 'social values' (Wilkinson and Stevens 2003, 263). In order to use facts to reach past meaning, environmental archaeologists must familiarise themselves with, and use, social science theory in their explanations, unless their role is to be purely technical (*ibid* 263).

The attempt to emphasis regional models within geoarchaeology in southern England can, in part, be attributed to the widespread model-building paradigm within archaeology that developed during the 1970s (Wilkinson and Stevens 2003, 254). Some researchers have suggested that large-scale clearance occurred mainly during the Late Bronze Age, resulting in increased hillwash, and that this can be supported in a region-wide assessment (Allen 1988, 85). Recent evidence indicates that this is a generalisation, with local cultural and environmental factors affecting the development and synchronicity of dry valley sequences in this region (Wilkinson and Stevens 2003, 77; French *et al.* 2007). In keeping with the findings of Allen in Wessex, this recent review states that intra-valley variation is high and so landscape reconstruction using valley fills can only be safely used at a single valley level (Wilkinson 2003, 750). Attempts at defining a regional model have failed, largely due to the local variation in the chalk valley system. From an archaeological perspective regional overviews are problematic because it is unlikely that prehistoric people experienced or perceived landscape change at a regional level (*ibid*).

In contrast to the extensive work discussed above for the south of England, there has been significantly less work of this nature in the north of England, but at least an occasional study in Lincolnshire. Rising to 150 m above sea level on the western scarp, the Lincolnshire Wolds is an intensively farmed arable landscape that is sparsely settled (Countryside Agency 2005). Towards the southern end of the Lincolnshire Chalk there are exposures of Lower Cretaceous strata including sandstones, clays and gravels. In the valley bottoms and at the base of the scarp there are numerous landslips, springs and exposures of Lower Cretaceous sediments (*ibid*). In Lincolnshire the analysis of molluscs and ostracods from the calcareous tufa of several sites in the river Ancholme valley is suggestive of woodland clearance towards the end of the Bronze Age, and this is corroborated by a single radiocarbon date of 3410 ± 80 (BM1795) (Preece and Robinson 1984, 319). Tufa formation was found to lack synchronicity across the sites (*ibid* 347). The molluscan zonation scheme suggested by Kerney for Kent, was found to be generally applicable to the fauna found in Lincolnshire; however, there were some recognisable differences, especially in the late glacial zones where there was an increase in diversity, coupled with a reduction in open ground species (Preece and Robinson 1984, 348).

There is evidence for landscape change in north Lincolnshire based on the molluscan data from two long barrow sites. The excavation of a long barrow at Hoe Hill provided a chance to reconstruct the environment of the chalkland based on Mollusca (Phillips 1989). The most significant samples were those below the barrow construction and in the ditch fills (*ibid* 94). Based on these samples a model of environmental change was formulated that suggested that there was prebarrow clearance of rich grassland, with isolated trees. This woodland was then regenerated during the late Neolithic. It was subsequently cleared again during the Roman period. In the post-Roman period an episode of significant ploughwash activity begins and is followed by the establishment of stable pasture land (*ibid* 103).

Similarly the recording and analysis of a plough-damaged Neolithic long barrow at Skendleby in south Lincolshire was undertaken during 1975–1976 (Evans and Simpson 1991). The prebarrow soil was a rendzina but in some areas this was thicker and less decalcified, representing a calcareous brown earth (*ibid* 2). The molluscan assemblage from the buried soil indicates open country species with a possible arable emphasis. Tree hollows beneath the prebarrow soil contain assemblages dominated by woodland species (*ibid* 7). This has led to the interpretation that deciduous woodland was cleared around 3500 bc (dated by *in situ* Peterborough Ware) and the land was later cultivated. The later Neolithic activity on the site may have taken place in a secondary woodland environment.

2.3 SUMMARY

Chalklands are some of the most intensively studied areas of Britain; however, there are many aspects that are not well understood, for example, whether the erosion seen is incremental or pulsed (Allen 1994, 403). Moreover, the mechanism of local diversity and complexity in colluvial sequences and the environmental history of the southern English chalkland is not fully understood because the majority of evidence comes from archaeological sites, predominantly based on contexts from beneath Neolithic monuments that are data poor and biased by extensive human modification (Davies and Griffiths 2005, 97).

The primary evidence for past land use and landscape change has been the examination of buried soils and land snails, and phases of increased erosion events associated with an increase in agriculture. There is a wealth of environmental and landscape scale evidence to add to the traditional archaeological analysis of sites. There have been substantial issues concerning the dating of colluvial sequences and there has been wide variability in the patterning within valleys and the visibility of relevant sedimentary units.

The formulation and applicability of regional models has been questioned in the past, and more recently French *et al* (2007) have challenged earlier assumptions about the formation and modification of sediments on a regional and local scale. Dry valley studies in the south of England have highlighted the complex and unpredictable nature of colluvial deposition. Moreover, they have revealed the great potential of dry valley studies for archaeology, especially in identifying land use change and buried sites.

3.0 THE YORKSHIRE WOLDS

This chapter introduces the Yorkshire Wolds as an historical and cultural entity, goes on to consider the area in relation to the surrounding land blocks and will then review the archaeology of the region. The vast majority of the archaeology undertaken on the Yorkshire Wolds is both site and period specific therefore, following a short chronological overview, the archaeology will be reviewed thematically with a focus on landscape and palaeoenvironmental perspectives. The themes selected include the issue of archaeological visibility and settlement patterns, the role of water and its availability, the widespread linear features and their functions and the environmental context. Implicit within these themes are wider assumptions and preconceptions regarding marginality and risk. The archaeology undertaken on the Yorkshire Wolds has been limited by a narrow period-based focus and in the second half of the chapter I aim to explain how the antecedent social, economic and political conditions, such as landowning and regionalism, have affected the archaeology undertaken. The theoretical perspectives that have been employed are situated within this wider social and economic framework and have reinforced the current lack of palaeoenvironmental study and broader landscape research scope.

3.1 INTRODUCTION TO THE AREA

The Yorkshire Wolds are the northernmost expanse of English chalk, situated in East Yorkshire forming an arc between the Humber estuary and Flamborough Head (Lewin 1969, 1). The Wolds cover an area of 1350 km^2 with elevations between 50 and 200 m above sea level creating a distinctive landscape unit compared with the surrounding vales and plain (Stoertz 1997, 3). Administratively the Yorkshire Wolds lie predominantly in the East Riding of The Yorkshire Unitary Authority but with a northern portion lying in North Yorkshire (Countryside Agency 2004).

The Yorkshire Wolds comprise mainly of a chalk landscape which rises in a steep escarpment from the western Vale of York and the northern Vale of Pickering (Figure 4). Towards the east the Wolds hills fall away more gently eventually merging with the Holderness Plain. The Hull valley, Holderness, Humberhead levels and Vale of York are four physiographic areas around the Wolds with a height below the 10m AOD contour (van de Noort and Davies 1993, 3). The distinctive inverted L shape of the Yorkshire Wolds results largely from the folding of the chalk that took place during the Tertiary period, and resulted in the shallow syncline that forms the Lincolnshire and Yorkshire Wolds (Catt 1987, 13). Towards the east, and Holderness, the chalk dips below substantial Quaternary deposits and towards the west, for example in the Vale of York, there are a series of rocks which are significantly older than the chalk mainly Triassic (*ibid* 16). The nature of the chalk landscape gives a unity to the area similar to the chalk downlands in the south of England (Countryside Agency 2004). Steep dry valleys are a common feature on this land, creating complexity, and sometimes containing remnants of unimproved chalk grassland. Settlement is considered light and scattered by modern standards and this is attributed, in part, to the lack of surface water (*ibid*). Natural woodland is limited but estate landscapes, villages and woodlands are common. The High Wolds are generally open although Parliamentary Enclosure created a range of straight droveways and enclosure roads, hedges and farmsteads. In more recent times the landscape has become more open due to the expansion and intensification of cereal cultivation (*ibid*) (Figure 5).

In addition to prehistoric and historic landscape modification, significant landscape changes have influenced the Yorkshire Wolds in the last century. The chalk grassland that was once the predominant mosaic vegetation now covers just 1.3 % of the Yorkshire Wolds due to an increase in arable land during the twentieth century, and also because of changes in the methods of farming as part of agricultural intensification (English Nature 1997, 3) (Figure 6). Although there has been significant habitat loss many manmade habitats such as disused quarries, railway cuttings and scree surfaces now provide typical grassland habitats, demonstrating the complex relationship between people and the places they modify. Sparse woodland is present here with calcareous ash woods, shelter belts and dale head plantations, but habitat diversity is considered low due to farming methods. The use of agricultural chemicals and widespread reseeding has led to a 35 % loss of calcareous grassland habitat during the 1980s alone (*ibid* 9). There remain however 20 Sites of Special Scientific Interest (SSSIs) on the Wolds testifying to the importance of this landscape for ecological and environmental heritage and equilibrium. The hawthorn hedgerows, that were the result of Parliamentary Enclosure between 1750 – 1850, are now being removed because of intensification and this is considered to be returning the Yorkshire Wolds to some earlier, open landscape character.

A combination of agricultural and central abstraction has lowered the water table and caused springflow reduction, thereby lowering the levels in seasonal streams or winterbournes. Additionally water quality in this substantially agricultural area is easily contaminated by the use of the chemicals associated with agricultural intensification, such as farm effluent, pesticides and leachates, and this leads to eutrophication (English Nature 1997, 15). There has also been the widespread loss of dewponds (man made ponds lined with layers of quicklime, straw, clay and chalk rubble), with an estimated 80% of the total falling out of use between the 1950s and 1980s (*ibid* 11).

Administratively the majority of the Yorkshire Wolds lie in the East Riding of Yorkshire Unitary Authority but a smaller proportion lies within the North Yorkshire County Council area, within Ryedale District Council so the records for the Historic Environment are split between the two authorities. These areas are sparsely populated with the Wolds ward of Ryedale District Council having a population of 0.11 per hectare, and the East Wolds and Coastal ward of the East Riding of Yorkshire having 0.35. This is compared to 3.22 per hectare for the Yorkshire and Humber region and 3.77 per hectare for England as a whole (Office of National Statistics 2004).

During the thirteenth century the Yorkshire Wolds were described in an Icelandic saga, indicating that they were conceptualised as a distinctive region at this time (Fox 2000, 50). Wold derives from Old English 'wald', meaning wood and is usually applied to lightly spread woodland, often described as 'wood-pasture', with little or no plough land (*ibid* 51). Because of the lack of woodland mentioned specifically in Domesday it has been suggested that 'wald' may have instead been derived from the Latin *gualdus*, this refers to land rights over marginal areas that were in Royal control but had common access rights (Fenton Thomas 2005). It is thought that some ancient woodland survived into the seventeenth century and that several of the Scandinavian place names, including the deserted medieval villages of Argam and Skali, mean 'on a seasonal basis' indicating a transhumanant mode of settlement (Fox

2000, 52). Some scholars suggest that there were few permanent settlements on the Wolds during the seventh and eighth centuries (Fox 2000; Fenton Thomas 2005) but others believe that the fertile valleys have had a long, continuous and successful settlement history (Jennings 2000, 66). The idea of the Wolds as a bleak, and relatively barren, landscape can be traced back to the descriptive account of 'sheepe walks' given by Arthur Young in his Northern Tour of 1771 (*ibid* 66). For example, the inscription on the well at Sledmere praises the work of the landholding Sykes family in improving and enclosing the unpromising local parish land between 1700 and 1801 (*ibid* 71). However a contrasting view of the Yorkshire Wolds is given by William Marshall, Youngs contemporary, who saw the Wolds as similar to the Surrey Downs, but on a grander scale:

the moſt magnificent aſſemblage of chalky hillſ the iſland affordſ. The featureſ are large; the ſurface iſ billowy, but not broken; the ſwell reſembling Biſcayan waveſ half pacified. The ground in general is particularly graceful…

Marshall 1796, 6

This evidence, mainly from text, but also based on the regionally unusual chalk, emphasises the marginal character of the Yorkshire Wolds landscape for settlement and the continuing debate about the possible continuity of settlement in the area since prehistoric times. Whilst we know that there is a concentration of prehistoric monuments on the Yorkshire Wolds, we have little understanding of whether the intensity of human activity was concentrated around these monuments and what their relationship to the wider landscape was (Bradley 2002, 41).

The Yorkshire Wolds, in some respects, resembles other chalk landscapes but there are significant differences. In Lincolnshire for example there are the presence of several permanent river valleys, for example the Bain and Lymn, whose marshy corridors support alder carr and acidic mires (Jennings 2000, 62; Countryside Agency 2005). In the south of England there are also river bearing valleys and the nature of the chalk itself is different. Issues of land-use and climate are also critical in the assessment of the similarity of geographically distant but geologically similar landblocks.

3.2 THE WIDER LANDSCAPE SETTING

The Yorkshire Wolds exhibit a topographic unity that is in contrast to the surrounding vales and plains. Not only does this define the Yorkshire Wolds as a contrast to what surrounds it but it also has a significant impact on the archaeology of the Wolds; the areas are different from each other geologically, and to some extent administratively, and are often studied as separate entities. Many of these divisions are recent and influence our current perception of life here in the past. Ethnographic evidence suggests that hunter-gatherers particularly use a variety of ecotones or types of landscape for different resources or purposes and it is unlikely that for large periods of human history formal boundaries were in place. The three adjoining land blocks are discussed below (Figure 7).

3.2.1 The Vale of Pickering

The Vale of Pickering is a small east-west lying plain which is defined to the south by the escarpment of the Yorkshire Wolds and to the north by the limestone foothills of the North York Moors. The area has been the location of one of the longest running programmes of archaeological work in Europe. The Heslerton Parish Project (Powlesland *et al.* 2006) was established in 1980 following the discovery in 1977 of a multi-period settlement and cemetery at West Heslerton during quarrying activity. West Heslerton lies at the southern edge of the Vale of Pickering at the foot of the Wolds scarp at 70 m AOD and is a geologically complex area with pure sands to the north of the settlement area, gravels and clays centrally and hillwash and frost shattered chalk to the south (Powlesland 1998). A rescue excavation began and the data generated since this time includes 1000 hectares of gradiometry and 200 hectares of sub-surface mapping revealing a settlement area in excess of fifteen hectares. The use of multi-spectral imagery has been a key aspect of the research, including aerial photography and Lidar imagery, which has attempted to understand the buried archaeological resource which is overlain by colluvium and aeolian sand masking but protecting the settlement areas (Powlesland *et al.* 2006, 291). For the first time in archaeology the density of distribution of Anglo-Saxon grubenhaus structures indicates that the past settlement during this period in the Vale of Pickering is very similar to current settlement density (*ibid* 292). Although this research has predominantly focussed on the Anglo-Saxon period it has been a true landscape scale multi-period study which emphasises the need to understand the archaeological resource in order to manage it. Linking research to curation this research has found evidence for late Neolithic and Early Bronze Age monuments, cremations and a post-built cursus, evidence for Late Bronze Age and Early Iron Age settlement evidence. Another landscape aspect explored by the project has been the relationship, preservation and archaeology encountered in six different landscape zones; the wold top, wold scarp, wold foot, aeolian deposits, dry vale and wet vale (*ibid*). Implicit within this research is the recognition of the contemporary usage of different landscape zones and the way in which landscape processes need to be fully considered in order to understand archaeological patterning and visibility.

Another current landscape project of some significance in the vale is the work of the Vale of Pickering Research Trust, which is supporting a collaborative re-examination of the early Mesolithic site, Star Carr. The work being undertaken by the universities of Manchester, York, UCL and Cambridge began in 2003 and is building on the work of Clark by examining the site itself but also the wider landscape context of Star Carr. The main finding is that the site is just one of a number of early Mesolithic sites around the palaeolake, Lake Flixton, in an area of human activity much more extensive than previously recognised (Taylor 2007). A review of environmental evidence found that a late Mesolithic rise in water levels led the fen carr to be replaced by reedswamp and that it was this sequence of interleaving peats and muds that became so important for preserving a rich assemblage of ecofacts and artefacts. The analysis of micro and macro scale charcoal has led to an established chronology for the site based on radiocarbon dating. This suggests the site was occupied on two separate occasions; the first settlement here was around 8970 cal BC for approximately 80 years and then a second occupation sequence begins in 8790 cal BC and lasts for around 130 years. Whilst the extensive burning of the phragmites reedswamp took place in both phases of occupation the rich material culture that has been associated with Star Carr was mainly deposited during the first occupation phase. This deposition took place in an area of willow and aspen woodland on the lake margin (*ibid*).

3.2.2 The Vale of York

During the Devensian glaciation ice occupied the coastal zone of the Yorkshire and Humber region blocking the drainage of the proglacial 'Lake Humber', situated in the southern part of the Vale of York. Glaciolacustrine deposits associated with the lake occur from south of York to the Humber Estuary. As the glaciers retreated laminated clays with sand were deposited from Thirsk to north of Knaresborough. The deposits associated with Lake Humber, which can be up to 10 m thick, are called the '25-foot drift' as they lie at a height of about 25 feet AOD, and they consist largely of clays, silts and sands with some pockets of coal (British Geological Survey 2004). This shallow alluvial basin of the vale is underlain by Triassic sandstones and marls and is now cut by a series of rivers forming the Yorkshire Ouse basin. The rivers across the vale, the Aire, Ouse and Derwent, were all incised during the late glacial period. The Humber Wetlands Project identified that the potential for archaeological features and preservation in the vale was high but this was under-exploited and the history of the region rather patchy (van de Noort and Davies 1993).

Although archaeological research is patchy across the region as a whole, our understanding of the city of York is comparatively good. This area has been relatively intensively studied, partly due to the formation of York Archaeological Trust. This sustained period of high quality research has resulted in a wide range of publications about the city during different periods including the *Archaeology of York* series of publications from York Archaeological Trust, and a series of period-based publications (see Nuttgens 2001; Ottaway 2004 and Dean 2008).

The vale extends to an area of 1120 km² and offers a region of contrasts with drift and alluvial deposits combining to make the region an area of extensive agriculture but also one of strong industrial heritage, based on coal mining and power stations (Whyman and Howard 2005). More recently the commercial work of York Archaeological Trust has explored the area outside the city walls, discovering Roman and Anglian settlement (York Archaeological Trust 2004, AYW2) and a second century Roman camp at Monks Cross. This camp is underlain by evidence from the Neolithic through to the Iron Age in the form of pit alignments and flint assemblages (York Archaeological Trust 2005, AYW4). Recent work at the Heslington East development site for the expansion of the University of York has provided evidence for a complex multi-period landscape along the southern edge of the York moraine. The work of York Archaeological Trust on the site, along with that of the Department of Archaeology, University of York has identified a range of stone tools and debris which date from the Mesolithic to the post medieval period. Excavation and evaluation work has found evidence for settlement from the Bronze Age through to the Roman period. The most intriguing of these is the presence of an Iron Age managed springhead and a series of enclosed round house complexes all set within a series of palaeochannels which created a wetland mosaic on the site. Waterlogging has led to exceptional preservation and the analysis of a range of organic remains is currently taking place. Upslope from the concentration of Iron Age features is a Roman masonry building that dates to the third or fourth century AD and is bounded by ditches containing Roman material. The assemblage from the site is that of domestic refuse and items including some high status and imported materials. Such a complex site was not anticipated from the evaluative and reconnaissance work undertaken and is indicative of the problems associated with archaeological visibility especially in relation to commercial projects which are frequently delayed by inaccurate evaluation. Wherever commercial work has taken place along the line of the York moraine field walking has recovered quantities of worked flint indicating the importance of this landscape in the prehistoric past.

More recently the Aggregate Levy Sustainability Fund (ALSF) has funded a programme of work in the Vale of York and this has led to the reappraisal of the archaeological features in the area. The study finds that due to recent mapping of aerial photography and commercial work all periods from the Neolithic are represented in the Vale of York. However there is an issue of visibility due to alluvial deposits obscuring sites, possibly from the Mesolithic period onwards. There is far less archaeological research undertaken in the Vale of York than in some other parts of the Yorkshire region (Whyman and Howard 2005).

The Foulness Valley project is a long-term landscape scale study in the Vale of York that began in 1980 (Halkon 2003, 261). This study has shown that the preference for prehistoric settlement is on soil with good drainage properties, on ridges or banks of aeolian sand, and also emphasises the role of the river Foulness and its associated watercourses as a focus of human activity and settlement continuity (*ibid* 274). This research project has carried out an archaeological and palaeoenvironmental scheme over a number of years whilst maintaining a community participation and local education role.

3.2.3 The Holderness Plain

The low-lying plain of Holderness is sandwiched between the Wolds to the north and west and the North Sea and Humber estuary to the east and south. Solid geology here is Cretaceous chalk as on the Wolds but in Holderness the chalk is beneath deep glacial deposits which are often incised by kettle holes and meres, and the area is drained by the River Hull. The coastline of Holderness is formed from soft boulder clay and is the most rapidly eroding area in the world, currently estimated at 2 m per year, and since the nineteenth century, local people have written about the lost villages, roads and churches which have fallen into the sea here (University of Hull 2002).

Drainage in the area was initiated by monastic houses and landowners in the Middle Ages, with later piecemeal attempts to improve the area's poor drainage, but it was not until the establishment of the eighteenth century 'drainage boards' that flooding in Holderness began to be controlled. This improvement led to the land described as 'waste' being converted to agricultural land but also caused the disappearance of one of Holderness's main landscape features, its meres. The permanent lakes of the area are only represented at Hornsea today (Kent 2002). The inadequate drainage of much of Holderness caused large areas to be left unimproved (whilst agriculture was the dominant economy in this area) as marshland, carrs and moors until comparatively recently. Evidence for changes to land-use and agricultural practice in Holderness is poorly documented and there appears to be little historic employment in the area that was unconnected with agriculture. Bricks were made from the local clay in small works and the extraction of sand and gravel expanded from small beginnings to large-scale working during the twentieth century, most notably at Catwick and Brandesburton (*ibid*). During gravel extraction at Gransmoor, the excavation of a Devensian late glacial deposit led to the discovery of a well-stratified Upper Palaeolithic barbed point.

Recent funding for the Humber Wetlands Project (HWP) by English Heritage has resulted in the reinvestigation of parts of the Holderness landscape. This has included the examination of worked flint distribution which shows a zone concentrated around flowing meres and estuarine inlets, the investigation of an eroding cliff face midden at Kilnsea which contains material dating from the Early Bronze Age period through until the Late Iron Age period and a reanalysis of the 'lake dwellings' of Holderness (University of Hull 2008). Five prehistoric sites were identified in Holderness during the nineteenth century and were published in 1911 interpreted as a series of lakeside dwellings. The re-excavation and re-examination of the sites by the HWP found that none of the sites were similar to the Alpine lake settlements with which they had originally been compared. They were also found to be unlike Scottish or Irish crannog sites and in fact represented quite different features which ranged from trackways across the mere to platforms and terrestrial settlements (Fletcher and van de Noort 2007). The re-analysis of these sites emphasises the impact of current perceptions on the interpretation of archaeological evidence.

3.3 ARCHAEOLOGY ON THE YORKSHIRE WOLDS

The archaeological importance of the Yorkshire Wolds for British prehistory is considered second only to the Wessex region and this has been recognised since the nineteenth century (Stoertz 1997, 1; Powlesland 2003, 277). Despite this recognition our archaeological understanding of the region is far from complete (Ottaway *et al.* 2003, 5; van de Noort 1996, 18). It is suggested that this results from the application of period based archaeological studies and a focus on particular research interests. This situation is further exacerbated by current land-use patterns, and their effect on archaeological visibility, resulting in uneven and unrepresentative knowledge of the archaeological evidence for the Yorkshire Wolds. There has been a concentration on the visible, superficial and eroding elements of archaeology, as has been noted in the south of England (Allen 2005, 237). This situation, it is suggested, can only be countered by a broad approach to the evidence (Manby *et al.* 2003, 113). Apart from this 'broad approach' many other specific factors need to be considered including; an appreciation of the antecedent conditions, theoretical limitations, the role of research agendas, the effects of developer funding and regional differences. Recent research investigating the use of visual patterns associated with 118 round barrows in a 10 km × 10 km window on the Yorkshire Wolds indicated that fieldwork in this area has been 'meagre' and that the palaeoenvironmental data is scant (Llobera 2007, 54).

William Greenwell, Thomas Bateman and John Robert Mortimer all carried out extensive excavation and recording of prehistoric sites on the Yorkshire Wolds during the nineteenth century (Addyman 2003,13) and whilst their work has been discussed and reinterpreted by scholars subsequently, the general context and social importance of antiquarianism has been largely ignored by archaeologists and historians. It has been suggested that the work of nineteenth century barrow diggers has had a direct impact on recent and current archaeology as it was so prolific and dominating that 'it left a feeling that everything had been achieved on the Wolds' (Manby 1980, 68).

3.3.1 A chronological overview

Although the Yorkshire Wolds is rich in archaeological remains it has been characterised as a special landscape, different from the surrounding land blocks, and containing evidence for ceremonial monumentality, particularly funerary ritual across different periods. The paucity of settlement evidence, for some periods, compared with the numerous upstanding monuments and cemeteries has led to the view that settlement on the Wolds is different from elsewhere. The lack of surface water is frequently invoked to support the notion that the Wolds was not settled but was a ritual landscape at certain times in the past.

The effects of repeated episodes of glaciation make the discovery of evidence for Palaeolithic activity on the Yorkshire Wolds less likely than in other locations but two hand axes found in the area, one near Bridlington and one near Hotham, appear to signal Palaeolithic activity in the region (Gaunt and Buckland 2003, 22).

There are over 100 Mesolithic sites in East Yorkshire, but they are mainly clustered in Holderness and there is a significant lack of sites on the High Wolds (Hinchcliffe and Schadla-Hall 1988, 25; Roskams and Whyman 2008). It is suggested that this distribution is reflective of current fieldwork activity and visibility rather than Mesolithic activity. In order to begin asking and answering interesting questions about this time period we need to have a programme of more systematic fieldwork in the region (Schadla-Hall 1988, 25). Although Mesolithic settlement evidence is generally underrepresented on the Wolds, significant Mesolithic flint scatters have been found incidentally at Wharram le Street, Vessey Ponds and Kilham (Hayfield *et al.* 1995, 396; Manby 1976, 111). This highlights the difficulty with looking for evidence that does not conform to our ideas about 'sites' and where they should be, based on our current perception. When recovered as part of development opportunities Mesolithic materials in northern England tend to be predominantly found in lowland contexts however some upland sites at up to 480 m AOD (e.g. Otterhole Farm, Derbyshire) have provided substantial quantities of late Mesolithic material (Blinkhorn 2006, 54). There is however an absence of sites at altitudes of between 180 and 300 m AOD which may be reflective of a lack of planning projects occurring at these heights (*ibid*). A review of all Mesolithic findspots from northern England finds that they do occur across the Wolds but are not classified as 'sites' (Blinkhorn pers comm.), there appears to be a cluster towards the east of the Wolds centred on Thwing and nearby Octon where various tools have been found including axes, arrowheads, cores and microliths.

The village of Rudston in the Great Wold Valley is the location of a monument complex whose concentration is unequalled in the British Isles (Manby *et al* 2003, 51). The Rudston-Burton Fleming complex consists of five inter-related cursuses, five barrows, a henge monument and the 8m high Rudston monolith. This Neolithic ceremonial complex appears to be related to an acute change in the direction of the Gypsey Race in the valley. On Rudston Wold a programme of fieldwalking found Neolithic pit alignments and post holes and associated pottery and flint (*ibid* 72). Great barrows occur around the Rudston landscape with Willy Howe the largest, nearby South Side Mount, and Duggleby Howe, with 37m diameter, at the centre of a concentric ditched enclosure (*ibid* 73).

Mortimer's (1905, 42) investigations at Duggleby Howe resulted in a large volume of data which he felt would 'remain in some degree as a memorial of the savage customs and low culture under which this early people lived'. A combination of the size and position of Duggleby Howe makes it most similar to the henges of Durrington Walls and Avebury (Stoertz 1997, 30). The change from emmer wheat and naked barley in the Neolithic, to naked barley and hulled barley in the Bronze

Age and then to emmer wheat and hulled barley in the early Iron Age (evidenced by grain impressions on pottery) occurs across the country but there is a strong concentration of evidence in Wessex and on the Yorkshire Wolds (Jessen and Helbaek 1944, 35).

As part of his compendious assessment of burial mounds on the Wolds Mortimer (1905, 1) identified the Towthorpe Group. These are a group of 21 barrows, identified and excavated by Mortimer, which run parallel to the presumed ancient trackway, Sledmere Green Lane. Mortimer found that there was variability in the composition of the barrows and that many of them contained a layer of Kimmeridge clay. Barrow 7a, which overlooks Thixendale village, had a turfline which lies 12 inches higher than the current landsurface (this was during the nineteenth century) (*ibid* 22).

Evidence for settlements from the Iron Age and Roman periods on the Wolds has been greatly overshadowed by evidence for burial and military installations, and whilst there have been several excavations of Romano- British settlements there have been few attempts at wider landscape studies (Hayfield 1987, 4). Square barrow burials date to the mid-fifth to the first century BC and represent the largest group of Iron Age burials in Britain (Bevan 1999, 132). The majority of these cemeteries occur in valley bottoms or sides (*ibid* 137) and comprise of a burial below a mound and set within a square or rectangular enclosure. Sometimes these burials have been associated with carts and have similarities with contemporary continental burials rather than other British Iron Age burials.

Recent research has explored the impact of Rome on Late Iron Age societies in Britain by taking a landscape approach to the rural settlements of East Yorkshire rather than the traditional archaeological focus on central and high status sites in the south-east of England (Atha 2007, 12). Historically archaeological study on the Yorkshire Wolds has historically had a bias towards Middle Iron Age burials and Roman structures and therefore the Late Iron Age and Early Roman transition has been defined by its absence (*ibid*). The study of ladder settlements, a linear arrangement of enclosures fronting onto a trackway or road, formed the basis of this study. Atha finds a dichotomy in the Late Iron Age/Early Roman settlement pattern as the area around Wharram Grange Crossroads and Wharram le Street has a rich concentration of ladder features, but to the south-west towards Aldro, and the south-east past Fairy Dale is 'devoid of settlement' (*ibid* 218). Our limited understanding of the internal space with ladder settlements can be augmented by considering the location of excavated gullies, at Wharram Grange Crossroads these indicate structures within the enclosures that can be interpreted as farmsteads (*ibid* 353). A consideration of materials suggests that the Wolds heartland exhibited continuity from the Late Iron Age to the Early Roman period (*ibid* 354).

In the pre-Roman period the principal routeways ran from east to west, but as Malton grew in importance during the Roman period a shift in the route culminated in the creation of the north-south running road (the B1248) which cut across the earlier trackways and boundaries (Hayfield 1987, 201). It seems likely that there was an expansion of settlement during the Roman period with the discovery of several new farmsteads (*ibid*), however as Atha states, the picture is one of continuity and so the degree to which the farmsteads discussed by Hayfield are new settlements and the degree to which they are a structural changes to existing patterns of settlement is key.

The sites of 130 deserted settlements are located in the East Riding and there probably remain many more that are not known (Neave 1996, 54). Although the Black Death of 1349–1351 decimated the local population there is no evidence for the traditionally held view that the villages became depopulated at this time. The causes of depopulation from the late fourteenth century through to the seventeenth century relate to economic changes including the enclosure of arable land and the conversion of land to sheep pasture (*ibid*). The medieval landscape of arable and sheep farming which has persisted and altered into the modern period on the Wolds is in contrast to earlier periods and the mixed economies of early communities here. The study of the spatial relationship between 28 manor houses, churches and settlements on the Yorkshire Wolds appears to have had continued relevance from the early to late medieval period (McDonagh 2006).

Seventy percent of the Wolds landscape was enclosed by the Act of Enclosure commissioners, with the eastern and western slopes enclosed generally in the 1760s and 1770s (Crowther 1996, 66). The High Wolds were enclosed during the middle period of enclosure which occurred between 1780 and 1819 and was related to the increase in corn prices during the Napoleonic wars (*ibid*). A measure of population density has been made using hearth tax returns for East Yorkshire and show that in 1672 the Wolds and Vale of Pickering were the most sparsely settled areas in the region (Neave and Neave 1996, 44). By 1743 the hearth tax returns show that across most townships and parishes there is a decline in populations rather than a rise (*ibid).* The nationwide picture was fluctuating at this time showing sporadic population growth and intermittent decline. The pull of the towns was certainly an influential factor in rural population decline but this was coupled with a push from the countryside in the form of direct actions by landowners to reduce tenancy and increase arable and pasture to take advantage of the market (*ibid).*

Land-use and cropping data for parishes demonstrates that by 1840 approximately 66% of the East Riding was arable, with 29% grassland, 3% woodland and just 2% remaining as common land (Harris and Kain 1996, 70). The tithe commissioners' report also comments that by the mid-nineteenth century the chalk soils around Wharram le Street on the Wolds had 'been much improved within the last 20 years, since the introduction of Swedish turnip and bone' (cited in Harris and Kain 1996, 70).

The role and importance of land ownership in the social and landscape history of the East Riding is very clear. The location of seats of the gentry was critical because of the widespread effect that this had on the local population (Neave 1996, 64). In the late seventeenth century the Wolds had virtually no resident gentry, their residences were off the chalk at locations in East Yorkshire such as Burton Constable Hall, Londesborough Hall and Bishop Burton Hall. However by the late nineteenth century this had changed with the general relocation of the gentry from the lowland to upland country houses that were mainly built between 1750 and 1830, and on the Wolds this included Sledmere House and South Dalton Hall (*ibid*). Nineteenth century estate villages saw political, leisure pursuits and religious freedom curtailed and controlled but this can be measured against the improvements seen in domestic accommodation, education facilities and employment opportunities (*ibid*). By the mid-Victorian period, and with the rise of agrarian capitalism, the East Riding of

Yorkshire was associated with large-scale arable production and because of this was seen as one of the more progressive regions in England (Moses 2002, 61). Around this time the tenant farmers began to develop a more assertive and independent attitude, forming local Chambers of Agriculture, and were less prepared to accept guidance from the church and landowner dominated Agricultural Societies (*ibid* 78).

3.3.2 The environment

The lack of pollen preservation in the calcareous deposits of the Yorkshire Wolds means that vegetational and land-use history are particularly poorly understood (Fenton Thomas 2003, 23). The problem of finding sites representative of a range of differing time periods has been highlighted, even in places that have been relatively intensively studied (Allen 2005, 223). Although there has been an increase in multidisciplinary work generally, the effective combination of geoarchaeological research and pollen analysis is rarely seen in northern England (Usai 2002). Archaeologists have preferentially studied the south of England, and the findings of research undertaken in southern England are often extrapolated to the north (Foster 1985; Bush 1986). The southern emphasis and focus is especially apparent in palaeoecological and geoarchaeological texts published recently (for example see French 2003 and Wilkinson 2003). The palaeoecological background to the archaeology of the Yorkshire Wolds has been inferred from sites in the south-east of England, however the Wolds are 340 kms away with different precipitation, daylight hours, geology and are further away from the European landmass (Bush 1986, 343). Although there is little pollen evidence many environmental archaeologists assume that the Wolds remained cleared during the post-Roman period (Richards 2000, 28).

A research project aiming to locate, retrieve and analyse palaeoenvironmental evidence from the Yorkshire Wolds collected a large range of molluscan and coleopteran evidence and found that although clearance certainly began in the Neolithic period it may have continued for some time rather than been related to specific time periods (Wagner 1992). There is a problem correlating palaeoenvironmental sequences in this area with the archaeological evidence when the preserved pollen evidence for Neolithic agriculture comes mainly from the plain of Holderness or the North Yorkshire Moors but the Neolithic sites appear to be predominantly situated on the Wolds chalk (van de Noort 1996, 18). Pollen sequences for the late glacial period have been recorded in the land blocks surrounding the Wolds; the Holderness Plain, the Lincolnshire Marshes and the Vale of York. All these studies show a similar pattern of a pre-interstadial phase of climatic amelioration in which tree birch, willow and juniper pollen increase with a concomitant decrease in non-arboreal pollen (van de Noort and Davies 1993, 40). This is followed by a climatic deterioration in which the tree birch and juniper pollen declines whilst non-arboreal pollen increases. The first clear anthropogenic effects on the woodland of Holderness and the Vale of York are the 'elm decline' dated to 5000 BP, with a major clearance at 3600 BP, and then complete deforestation attributed to the Roman or Iron Age period (*ibid* 40).

The vegetational history of Yorkshire as indicated from palynological sources was recently documented (Atherden 1999). Pollen rich deposits have been discovered on peat moors, flood plains and former lakes. This has resulted in 130 sites in Yorkshire which have pollen cores (*ibid* 138). However the distribution of this material is skewed with a concentration of sites on the North Yorks Moors and Teesdale and very few on the Yorkshire Wolds or in the Vale of Mowbray (*ibid* 139). Investigations show that the limestone pavements of Craven once supported forest cover, early postglacial forests have been found in the form of timber beneath blanket peat on both sites in the Pennines and the North Yorks Moors (*ibid* 143). Pollen diagrams indicate that the upland areas were less densely covered with woodland than lower altitude sites.

The general pattern in northern Europe is for two distinct warm phases during the last glacial but in north-western England this appears to be a single interstadial, and Yorkshire has evidence for an intermediate environment with interstadial temperatures similar to today, however all the evidence for this phase all comes from lowland sites (Atherden 1999, 142). For much of the late glacial period the recovered vegetational sequence would have been out of synchronisation with the rapidly changing climatic regime, moreover vegetation is now considered a poor indicator of the rate of the changing climate. By the late Holocene the nationally recognised elm decline has been dated to 4720± 90 bp at Fen Bogs on the North Yorkshire Moors, and woodland cover was gradually replaced by moorlands and grasslands on the uplands and by farmland in the lowlands (*ibid* 143). In the later Mesolithic period pollen evidence from the uplands of the Pennines and the North Yorkshire Moors is indicative of human disturbance during the early postglacial, with charcoal and soot deposits seen and a delay in the establishment of deciduous woodland (*ibid* 145). Some parts of the Yorkshire region provide evidence for large scale woodland clearance during the Early Bronze Age, for example in the Pennines where a date of 3600±89 bp has a link with the monumental landscape at nearby Thornbrough Henges (*ibid* 146). Similar evidence is available from the North Yorkshire Moors but is less intensive. Pollen evidence from Yorkshire also demonstrates the change in vegetational biodiversity. In the early postglacial period biodiversity decreased as forest cover dominated the landscape. Human activity including hunting and farming later led to an increase in biodiversity that reached a maximum in the early nineteenth century. Since this time there has been an accelerating decline in diversity due to intensive agriculture and habitat loss (*ibid* 150). The analysis of peat cores from May Moss, North York Moors, including macrofossil and testate amoebae analysis, has identified several episodes where a wetter/cooler climate follows warmer periods from AD 260 through to AD 1800 (Chiverell 2001, 9).

The majority of environmental evidence directly from the Yorkshire Wolds comes from the buried soils that have been found beneath prehistoric monuments, for example the Brown Forest Soil found at Kilham and Willerby Wold (Manby 2003, 70). The evidence for the existence of woodland during the Neolithic period on the Wolds comes in part from the discovery of land snails during the excavations at Willerby Wold and is combined with the evidence for the existence of Brown Forest Soils buried beneath Willerby Wold long barrow (Manby 1963, 204). Thin section analysis revealed a non-calcareous brown soil with a blocky structure indicating a mature brown earth which was buried during the construction of the earthwork at Willerby Wold (*ibid* 201). A report on the land snails by Castell lists the species discovered but does not mention any sampling strategy, recovery method or show any graphic results (*ibid* 204). The snails total 68, as listed below:

40 *Arianta arbustorum*

20 *Helix (Cepaea) hortensis*

1 *Discus rotundatus*

2 *Vitrea contracta*

5 *Oxychilus celliarus*

There is also the comment that this represents 'a sample of snail shells from filling of façade bedding trench' followed by the interpretation of the assemblage which is 'damp woodland conditions are indicated' (*ibid* 204), and this is the complete interpretation. The quantity of snails is few and includes a high proportion of larger land snails which may have been hand recovered, skewing any results and reducing the accuracy of any interpretation. The highest numbers of snails are from the two species *Arianta arbustorum* and *Cepaea hortensis* and both of these species have a habitat preference of a catholic nature, tolerating a wide range of environmental conditions (Kerney 1999). Of the remaining eight snails, *Discus rotundatus* is known to favour leaf litter, which can lead to it being described as a woodland species, however it can also be found in long grassland. The two remaining species are both from the Group Zonitidae and are associated with woodland, however they are not restricted strictly to woodland (Evans 1972, 198). A recent update on the distribution and ecological requirements of British and Irish land snails found that *Vitrea* sp. has 'a wide variety of terrestrial habitats…. base-rich grasslands' whilst *Oxychilus* sp. prefers sheltered places, ground litter, crevices and caves (Kerney 1999, 138). Given the few snails recovered with habitat specific requirements, the lack of sampling strategy, the lack of stratigraphic or recovery data and the uncertainty as to the proportion of the total assemblage that this represents, this evidence should be treated with the utmost caution. Whilst this is a subsample of the surrounding mollusc assemblage it is impossible to generalise about the wider landscape context of the earthwork construction and does not appear indicative of damp woodland.

Kilham Long Barrow was originally excavated in 1868 by Greenwell and then a detailed analysis of the barrow, the timber mortuary enclosure ands its immediate surroundings was made between 1965 and 1971. The barrow is located on the wold top and the long mound was created in chalk rubble with flanking ditches created in two phases (Manby 1976, 111). Beneath the barrow a 'brown earth type' buried soil was discovered and analysed by taking a series of soil samples for pollen analysis at 2 cm intervals (*ibid* 144). The results of the research at Kilham Long barrow are used to suggest that the Wolds were forested at the time of the earliest prehistoric settlement but that woodland clearance began soon afterwards with this pattern repeated once more (Manby 1976, 111; Stoertz 1997, 6). However if we look at the evidence from Kilham in more detail the story is not so simple. A series of 2cm pollen samples were taken in a contiguous column through a buried soil. Although pollen grains and fern spores were in each sample, they were very low frequency (Evans and Dimbleby 1976, 151). Although it was possible to count 150 grains on the upper six samples and the final sample, the intervening three samples had negligible amounts of pollen and were not counted (*ibid* 152). The boundaries between some of the samples were not clear but they were divided into zones; the upper six samples, the middle three without pollen and the final sample. The middle zone is almost devoid of pollen. The lower zone (one sample) has much in common with the upper zone but is considered distinct enough to make it unlikely that the pollen could have been derived from the upper zone. The single sample representing the first phase of cultivation consisted of 158 grains, of which 74 were ferns/bracken spores, the tree pollen consisted of seven grains and the cereal pollen three (*ibid* 155). In the upper zone there were ten pollen grains across six samples representing the second phase of cultivation. Across all the samples there were 6 *rumex* sp grains. One of the pollen-rich samples was comprised of 50 % fern spores. It is generally considered necessary to count 200 pollen grains in any sample to ensure that it is representative (Roberts 1998, 31).

The buried soil lacks an A horizon, which could be due to truncation or reworking, and 'the nature of the original soil profile prior to cultivation can only be guessed at' but was probably a Brown Forest Soil (Evans and Dimbleby 1976, 154). Despite these limitations the researchers go on to say 'the pedological and pollen-analytical evidence suggest two phases of agriculture' (*ibid*). The closing summary states that the suggested environmental events are as follows; periglacial chalk rubble; covered by a layer of aeolian silty loam; the possible formation of a Brown Forest Soil; a phase of cultivation; the possible formation of a *sols lessive* and woodland regeneration; the second phase of cultivation in a large forest clearing and then abandonment of the site for cultivation before the construction of the long barrow at 2880 ±125bc (*ibid* 156).

Whilst the record from Kilham Long Barrow is rare and important the complex and detailed interpretation, based on 13 cereal pollen grains across seven samples, appears optimistic and fails to include a caveat referring to the limitations or any discussion of the spatial scale of the proposed model. The complex depositional environments underneath monuments mean that land snails and pollen analysis can only usually answer part of the question about landscape change in the past and need to be part of a mixed-method approach in order to be successful (French and Lewis 2007a, 2).

By 1988 the environmental evidence from Kilham Long Barrow was being described thus:

> *large areas of forest had been cleared from the Wolds by the time the long barrows were constructed at Willerby Wold and Kilham Long Barrow. Good evidence of an earlier pattern of cyclic land use, of clearance, cultivation and abandonment was obtained at Kilham Long Barrow*
>
> Manby 1988, 44

Whilst there are many pollen sequences from the North Yorkshire Moors there is a single example on the Wolds from a site near Bridlington, at Willow Garth. The site is an ancient wetland carr bounded by the seasonal stream, the Gypsey Race (Bush 1988a, 455). A total depth of 1.18 m of organic sediment was found and sampled across the site with 64 boreholes and two excavated sections (*ibid* 456). Ten radiocarbon dates were obtained and the base of the peat was dated to 9640 ± 80 BP, but there were several gaps in the pollen and macrofossil record, especially from 7980 BP to 4400 BP (*ibid* 457). An increase in sedimentation at Willow Garth, from 2200 BP is associated with increased erosion, perhaps due to more intensive arable farming (Bush and Ellis 1987, 52). The peat accumulation witnessed from 9460 ± 80 BP (dated by radiocarbon from *Alnus* fragments) indicates a sudden change in hydrology which resulted in extensive moss development at this time (*ibid* 50). The extent of forestation during the Boreal and Atlantic period is still unknown and the speed of clearance is suggested as 'in excess of one hundred years', although on what evidence this is based is unclear (Bush 1986, 349).

The interpretation of the evidence from Willow Garth is that relict grassland persisted on the Wolds from the end of the last glaciation largely due to the intervention of Mesolithic communities who prevented the expected succession of woodland species. This represents the establishment of an anthropogenic landscape as early as 8900 BP (Bush 1988a, 460; Goudie 2000, 81). However, this interpretation has been critiqued. The significant gaps in the pollen record were problematic, macro fossil sequences were judged secondary to pollen sequences, and the proximity of the watercourse was not taken into account in the interpretation of the pollen evidence. Finally, and perhaps most significantly, there was no direct anthropogenic evidence in the area to correlate with the palaeoenvironmental record (Thomas 1989, 550). Bush does acknowledge the need to discover Mesolithic sites/ activity on the Wolds but this is expressed as an afterthought to the rest of his thesis (1986, 351). Some authors have felt quite strongly about the quality of this research 'there is absolutely no evidence for Mesolithic man affecting the vegetation on this site' (Wagner 1992, 74). The strength of the evidence gathered from Willow Garth is described as the opportunity to integrate many different evidence types (Bush 1986, 2), however what becomes clear is that the discussion and interpretations made in the thesis are based solely on the pollen evidence. The numerous insect remains constitute an insufficient sample (*ibid* 351) and the mollusc concentrations of up to 1600 shells per litre are barely discussed. The thesis includes no raw data for the invertebrates and so is not amenable to re-examination and interpretation (*ibid*). Although Willow Garth represented a rare opportunity to examine invertebrates from a waterlogged Yorkshire Wolds context the failure to undertake a systematic analysis means that the opportunity is lost (Kenward 2006, 114). Where invertebrates have been recovered and identified elsewhere on the Wolds, for example at Cottam, they have appeared to be modern assemblages (*ibid* 413). Evidence for the hypothesis that grassland persisted on the Yorkshire Wolds needs to be tested by the recovery of suitable assemblages from the region (*ibid* 422).

Although the palynological record for Britian is vast there are areas of the country where this evidence is concentrated and the lowlands remain particularly 'blank'. This is especially true for calcareous grasslands throughout the entire country (Edwards 1999, 531). This is relevant for the Wolds where Bush's pollen study probably represents on-site grasses in the carr rather than a local chalk downland environment and where hiatuses in deposition may, in fact, mask woodland phases. The extrapolation of pollen data findings onto adjacent areas of vegetation are fairly common but problematic and this affects the confidence we can have in environmental reconstructions (*ibid* 531). These types of problems with the data mean that we need to be critical when small amounts of evidence are presented (*ibid* 532). The insects and pollen from the lowest sediments at Willow Garth indicate a dry, open cold-climate grassland flora with substantial amounts of bare ground (Innes 2002, 441). However, the evidence is diminished in its importance since there are sedimentary discontinuities which leave a significant gap in sediment accumulation between c.8000 and c. 4300 years BP. The lack of completeness of the Willow Garth sediments means that the site is seen as controversial and further work is needed at Willow Garth and elsewhere where preservation is good enough to allow reconstruction to take place (*ibid* 442).

Place name evidence allows us to consider, to a limited extent, the past environment and the importance of landscape features in determining settlement names. The most common problem with this approach is our interpretation of the significance of the feature, after which a settlement is named. For example, if an oak tree gives it name to a settlement (Aughton) then does this mean that it was a single oak amongst many other tree types, or that it was the only tree for miles around, or that oak trees were a common feature on this land? The link is difficult to make without other evidence. Within the place names of the Yorkshire Wolds we have a preponderance of names pertaining to water; Beverley ('beaver stream'), Burnby ('stream settlement'), Kirby Grindalythe ('crane or heron valley'), Givendale ('valley of the lost river Gaevul'), Sledmere ('valley pool') and Fimber ('wood-pile pool') (English Place Name Society 2006). There are also trees used as markers of settlement in East Yorkshire; Bishop Wilton ('willow tree settlement'), Heslerton ('hazel place farm') and Skirlaugh ('bright wood clearing') but these places are all just off the chalk escarpment. The number of references to trees is far less for the chalk Wolds than it is for the rest of East Yorkshire, just onto the Vales and plains.

Although by world standards erosion in Britain is relatively low, the coast of Holderness is rapidly eroding and the areas of arable farming most at risk have been identified by the Soil Survey of England and Wales and the Ministry of Agriculture, Fisheries and Food. These include the chalk soils of the Yorkshire and Lincolnshire Wolds, Hampshire and Wiltshire (Boardman and Evans 1997, 119). The main agent of erosion seen on these soils is run-off with some wind erosion although an assessment of all the factors involved shows the clearest association is between increased erosion and the growth of winter cereals (*ibid* 124). Although soil erosion can be the result of incremental and accidental activity arising from weather events it can also be the product of deliberate social transformation, but this is rarely emphasised (Bell 1992, 21). Research by geographers has revealed that erosion and deterioration of the soil on the Wolds has taken place for at least the last 3000 years, probably related to cultivation practices, and that this has transformed the Brown Forest Soils into the rendzinas we find today (Ellis and Newsome 1991, 59).

When we reconstruct past environments it is difficult to understand human responses to elements such as erosion because they may not have been perceived as hazards. The archaeology of a given region is often of insufficient quality to allow us to consider issues of perception and hazard response in detail (Bell 1992, 22). Yet this is often what we aim to do, as to merely record the evidence without interpreting it in the light of human agency would be limited and to some extent futile. Temporal scale hampers the evaluation of hazard perception and response, with archaeological scale often of unreliable resolution (*ibid* 22).

The significant macroscale environmental impacts, such as the postglacial sea level rise and the major Holocene climatic variations, have influenced the activites of human populations (Halkon and Innes 2005, 226). This is of particular relevance for the lowlands of East Yorkshire and although geographic determinism has become an unpopular explanation for human behaviour, it should not be ignored. Halkon and Innes note that significant cultural change appears to have frequently been heralded by environmental change; for example the Mesolithic- Neolithic transition at the time of marine transgression and the Bronze Age to Iron Age change at a time of climatic deterioration (*ibid* 249).

3.3.3 Water

Today, surface water is scarce on the Wolds and the glacially derived ponds are not particularly well understood (Hayfield and Wagner 1995, 49). The failure to address issues of palaeohydrology on the Yorkshire Wolds has been reinforced by narrow, period based, archaeological studies which have not sought to understand the landscape context and resources available on the Yorkshire Wolds in a wide or overarching sense (*ibid*). The amount of available water is critical for settlement and agriculture and over the last century there has been a significant increase in water extraction from the chalk aquifer in the Wolds (Fenton Thomas 2003, 22). There is a 'striking lack of knowledge' about ancient hydrology and it is entirely possible that the dry valleys were wet until fairly recently (*ibid*). Misconceptions about the availability of water on the Wolds are common. The idea that there are no springs on the 'Wolds proper' and that the only springs are located on the edge of the chalk where it meets with other geology (Fenton Thomas 2005, 18) is incorrect. There are springs arising in several places and this is with a current water table drop; active spring-fed ponds can be seen at Burdale Water, Fairy Dale, Thixendale and Wharram le Street to name but a few. Natural clay filled dolines, such as those at Vessey Ponds, have probably resulted in the placenames Sledmere and Fimber and accessible water sources that were originally apparent are not obvious to us today (Manby *et al.* 2003, 70).

Geologists have discussed for some time the possibility that the larger valleys may have carried intermittent streams (or gypsies as they are known locally) in the past and recognised that the form of the meanders in the Gypsey Race must have been created at a time of much higher water flow (Dakyns and Fox-Strangways 1886, 1). Evidence from the barrow cemetery at Garton Slack confirms the presence of water as at the base of some of the barrows a black peaty deposit was found which was attributed to flooding of the gypsies in the valley bottom; this evidence was not found where the barrows occurred on higher ground (Mortimer 1905, 233). Although the Gypsey Race had a seasonal quality to the strength of its flow, it did flow all year round and so was not, strictly speaking, a seasonal stream (Dakyns and Fox Strangways 1886). The Gypsey Race is described as having 'great impact' on settlement patterns, with ribbons of villages sited along its' course, however it is still accepted that many other villages, such as Fimber, are on exposed Wold tops and must therefore have used water from meres (Hayfield *et al.* 1995, 394).

Gypsies are first described by William of Newburgh in 1198 who saw them as a marvel (Smith 1970, 5). The Old English term gipps or gipian means 'to yawn' whilst gayspe means to gasp and therefore this term has been used for seasonal streams (*ibid* 5). Many authors discuss the disappearance of the streams and it has been argued that diversion and canalisation of many streams began in the medieval period along with other agricultural improvements, such as ditch cutting, in the seventeenth century (Giles 2000, 104). Along the Great Wolds valley most of the square barrows can be seen to align with the Gypsey Race, and because of the liminal and intermittent nature of water on the Wolds it is said to have a symbolic quality (*ibid* 106). Bevan analysed the relationship between square barrow cemeteries and water sources finding that 41.3 % of the larger cemeteries (10 or more barrows together) were 50 m or less from a *possible* water source (Bevan 1999, 138) but Giles thinks it unlikely that all valleys and dales contained streams (Giles 2000, 106*)*. Many valleys have a layer of chalk gravel in their base which would not support a watercourse of any kind (*ibid* 107). It has been suggested that the round barrows of the Neolithic and Bronze Age appear to concentrate around watersheds and natural crossing points, on the dip-slope of the Wolds valleys (Dent 1998, 5). However, we should remember that during the Neolithic period the landscape was significantly different from today (Manby 1988, 39).

Commercial excavations undertaken across the Rudston A cursus monument at Pits Plantation have examined an area of valley associated with the Gypsey Race and discovered a number of prehistoric features and pits (Abramson 2001, 1). The siting of the cursus is thought to be closely related to the course of the Gypsey Race especially as the stream turns sharply at this point and cursus monuments have been found to contain areas of contrasting relief thus creating a swathe of upland, slopes and valley bottom (*ibid* 18). The features examined include two palaeochannels recorded to a depth of 1.2 m. The palaeochannels were found to mainly contain a combination of fine sand and silt sized particles with no gravel component present, and a single context produced clay deposits (Chapman and Ellis 2001, 16). A small Beaker rim sherd was discovered in one of the palaeochannels. The method of infilling for the palaeochannels was considered and an absence of bedding planes suggested that alluvial activity was not the likely cause. The limited degree of sorting argued against an aeolian origin, therefore a colluvial mechanism was proposed which would integrate wind, water and other slope process in the sediment transfer (*ibid* 17). It is probable that the channels had a late Devensian origin with periglacial meltwater activity, but by the more temperate Flandrian period, with a lowered water table, the channels may have become inactive and began to fill with material. Whilst it is difficult to ascribe a time period to this process the actions of people in either forest clearance or cultivation would have accelerated this process (*ibid* 17). Pollen from both the palaeochannels and the cursus ditches yielded pollen but in very low quantities, with just three grains from one context, only one context had sufficient pollen to be used as a palaeoenvironmental indicator and this was from a cursus ditch and consisted of 200 grains from 8 slides (*ibid* 17). Generally, the pollen data is suggestive of wetland species but this is complicated by the relative abundance of these species found in a complex depositional environment and the uncertain chronological sequence of this data.

At Park Grange Farm, Beverley, an archaeological discovery of some unusual features led to an interdisciplinary study and a better understanding of past hydrogeology (Younger and McHugh 1995, 59). The site is located in a peat-filled valley, on the boundary of Pleistocene tills and Cretaceous chalk, with the site itself on a chalk-head, which forms part of the Yorkshire Wolds aquifer. A drought during the 1990s led the groundwater to fall by 20 m and raised concerns about the hydrological regime on the chalk (*ibid* 60). The sedimentary features studied were subject to analysis of particle size, heavy mineral extraction, clast composition and orientation, and micromorphology. A dozen sand cones were found, and they contained fragments of Romano-British grey ware, Samian ware and bone. Buried timbers were dated to 5840 BP by dendrochronology (*ibid* 63). The sand cones are the remains of former springs that were formed by a rapid and violent expulsion of water. Peat analysis evidenced periods of slow, and then rapid development, related to the changing hydrological conditions. This analysis clearly demonstrates that there was a significant variation in groundwater discharge since at least 5840 BP, and that widely fluctuating water tables have been the norm for this region rather than the exception, as part of a long term process (*ibid* 66). The dry valley system at Park Grange remained above the regional water table throughout the three modelled episodes of high water table as part of the study. Only when the highest possible recharge rate is applied, in the 5000 BP model, does groundwater rise to intersect the lowest part of the valley floor.

Water supply has been described as a limiting factor in settlement, with the sinking of wells and pumps only provided by wealthy landowning families as part of a swathe of nineteenth century 'improvements' (Manby 1977, 67). Different solutions have always been possible to address water shortage, including the naturally occurring ponds, meres and hollows. The excavation at Staple Howe, on a knoll of solid chalk on the Wolds escarpment, found some unusual features which was difficult to account for within the usual interpretations of such sites (Brewster 1963). Associated with Iron Age settlement structures were, what have been described as, 'channels and tanks' which appear to have no other function than to collect and store water, despite the fact that they were not clay lined (*ibid*).

Two Roman villa sites near Wharram le Street were investigated in the 1980s, and their differing topographic situations were discussed (Rahtz *et al*. 1986). The first villa is in a shallow dale close to the source of the Gypsey Race at 120 mAOD. The second villa, at Wharram Grange, is on a spur of land at 150 mAOD; this location was described by the investigators as windswept and the nearest *current* water source was noted to be downslope at 125 mAOD (my emphasis). This, it is suggested, is an unlikely situation for a Roman villa but is 'at least defensible'. Both sites had pre-Roman occupation but the villa close to Wharram le Street is described at the more attractive site due its close proximity of the stream. By the fourth century both settlements appear to have villa status but the villa near Wharram Grange is described as a native villa site originally. This interpretation appears to be based primarily on the environmental and topographic situation, which was not perceived as a good choice by our perception of Roman standards. This is reinforced because the Wharram Grange area does not survive as a settlement site whereas the more attractive villa site, Wharram le Street, does (*ibid*). The number of Roman villas on the Yorkshire Wolds is unknown and there are possible villas at Birdsall High Barn and Burdale Tunnel Top but the availability of water is often seen as the limiting factor, some villas had wells but others did not (Gore 2002, 74).

During the late eighteenth and early nineteenth centuries, agricultural improvement included the provision of dewponds. When the Ordnance Survey began mapping ponds only those over 20 feet in diameter were recorded. This may account for some of the apparent mapping anomalies with many fewer than were known to exist being recorded and mapped (Rackham 1986, 347). The number of ponds found in different regions has been calculated from the 1920-mapping programme and the average number of ponds for England and Wales is 5.8 per square mile. The Vale of York has between 4 and 8 per square mile and the Yorkshire Wolds between 8 and 16 per square mile (*ibid* 348). Ponds are more frequent in woods, on commons and around villages, but whether human activity created the ponds, or whether the activity was concentrated in an area with a natural pond, which was then exploited, remains to be seen. A dell is a dry natural dip on chalk, and, although dewponds are a class of created ponds on the chalk they tend to be constructed by exploiting natural dells, thereby preventing us from separating natural and cultural processes relating to water provision. Dewponds were professionally constructed by gangs of 'dewpond diggers' in East Yorkshire, Dorset and Sussex up until 1939 when they became increasingly obsolete due to the availability of pumped water (*ibid* 368).

In recent years domestic and to some extent industrial/commercial water needs have been met by pumped water from the chalk aquifer. This type of substantial and fundamental difference in subsistence strategy is indicative of how much of a change there has been in water supply and water availability since Iron Age times (Buckland 2001, 97). Water availability may have altered considerably on the Yorkshire Wolds in the past, just as it has in the recent past (Allison 1976, 56). The increase in erosion due to vegetation removal and increased agricultural activity could well mask water sources and springs that lie in the valley bottoms (Hayfield and Wagner 1995, 51).

The abstraction of water from the chalk aquifer has been governed by legislation since the 1950s and on the Yorkshire Wolds the scheme is the Catchment Abstraction Management Plan for Hull and the East Riding (Environment Agency 2006). This scheme will control abstraction in the area until 2011. In order to protect the environment the Environment Agency can now issue a 'hands-off flow' licence which means that when groundwater or surface water falls below a predefined level any abstraction has to stop (*ibid* 9). The North East management Unit of the Plan covers the area that contains the Gypsey Race, and at present this has an availability status of 'overlicenced' which means that at low flows there is no water available due to current abstractions so this means that no new abstraction licences will be granted and there are already very few abstraction licences on the Gypsey Race (*ibid* 12).

It may seem from this management plan that there is sufficient protection for the aquifer and groundwater sources. However licences are not required for anyone wishing to abstract less than 20 m^3/day, therefore it is easy to see how in an agricultural landscape, where the majority of water will be required for local irrigation and husbandry practices, large numbers of individuals wishing to abstract small amounts of water could, in effect, cause similar problems to a large volume user who would be legislated against and whose ability to abstract would be restricted.

A problem documented in the High Wolds area is that of periodic, and often catastrophic, flooding. Langtoft village for example lies at the confluence of three steep dry valleys (Allison 1974, 264). At Mr Storks house in Langtoft village there is a marble plaque in the wall of the house, eight feet from the ground, which records the fairly constant high water level of the 'great floods' of 1657, 1888 and 1892, when the flood waters created a wall of water down the main street (Figure 8).

Oral histories have been considered important correlates for palaeoenvironmental evidence for some time. Research has aimed to correlate ethnohistorical records with palaeoenvironmental data and has found that there appears to be a good level of accuracy for periods of time up to 400 years (Bell 1992, 23). In 1853 May thunderstorms and floods were so severe that an overflow of surface water for the next 33 years was attributed to them (Hood 1892, 22). In 1888 on June the 9th at Round Hill, near Langtoft, a deluge of water poured from a water column, interpreted as a 'waterspout' (*ibid* 24). Three fissures were created on the hillslope, measuring 150 feet in length and seven acres of crop were washed away. The stream created as a result of this event was 40 feet wide when it reached Langtoft and was tasted by the vicar of the parish, Reverend Speck, who declared it had come from the sea, being 'brackish' in nature (*ibid* 28). The day of Sunday 3rd July 1892 was remembered for its golden weather and oppressive stillness which came before the dense and dark cylindrical columns of water seen in the clouds; these were recorded in drawings by several local people (*ibid* 3). Mr Cayley described the flood of 1892 as 'the day of the great water spout' and he observed that the main force of the water falling was at Langtoft (*ibid* 24). At Wood Hill, near Cowlam, one column of water was observed as it fell and instantly scooped out a chasm in the chalk that measured fifteen square feet. The event resulted in approximately £1000 damage to Mr

Marshall's farm, and the torrent of water created flooding at Driffield, some 11 km to the southeast (*ibid* 54). In 1910 it was noted that yellow sediment stained the floodwaters that reached Driffield. When they receded this left a total of 2 feet of sediment in the streets, a child had drowned inside a home and the bodies of many livestock and a quantity of furniture was washed into the Hull.

In Langtoft village planning permission was granted in 2006 for the development of a disused Methodist chapel in Back Street, St Marys, into light industrial premises for Cambrai Aircraft Covers. When the floor was taken up a substantial layer (c. 5 cm) of silty clay was encountered across the entire chapel building, which had entered through the vent bricks to circulate air underneath the wooden floor and I was invited to inspect this deposit (Figures 9 and 10). St Marys was built in 1874, accommodating 300 people, and it was known from local folklore to have been affected, along with the rest of the village, by the flood of 1892. Local people had discussed how much damage had been inflicted on the village and the quantities of sediment that were removed from the village streets by people with carts following the flood in 1892 (Michael Whitley pers comm.). This was the first primary evidence seen for the volumes of sediment coming down from the surrounding hillslopes during a severe, but one-off, flood event. An area of Langtoft village from Back Street to Kilham Road is still classified as Flood Zone 3 (high risk) today despite the absence of a surface watercourse (East Riding of Yorkshire Council 2008). The recent analysis of severe flooding in North Yorkshire has led some journalists to reflect on the way that some places are more susceptible to flooding than others, and that in the case of Langtoft village this seems to be based on a meteorological and topographic susceptibility with no river or stream passing through the village (Northern Echo 8/7/05).

Whilst some catastrophic flood events have been described in the Yorkshire Wolds, there has been little study of erosional events in this area (Foster 1978, 157). Freak weather conditions during the end of September and beginning of October in 1976 allowed an episode of gullying to be witnessed first hand, 3 km from Great Driffield, just off the chalk. The soils of this area are flinty sandy silts and some silty clays. The field in which the gullying occurred had been harvested of barley and the stubble burned, leaving ground cover of less than 2% in total (*ibid* 158). Traces of earlier furrows became surface streams during the flooding and large-scale sheetwash occurred. The movement of chalk gravel was high with the intensity of rainfall measured at between 2.00 and 5.00+ mm per hour. A volume of soil was deposited as a fan near the foot of the slope, where a hedgerow impeded the flow (*ibid* 160). On one evening of rain a quartzite pebble, measuring 2.5 cm in diameter, was observed to move 62 m downslope and the suspended sediment load at this time was measured at 571 mg/litre. The research concluded that the effects in this single bare field were exaggerated, compared with surrounding fields, and that had the surface been ploughed or sowed the result would have been different.

The effects of the erosional events witnessed and recorded by Foster were so great that it can be assumed that many of the colluvial deposits found in the base of dry valleys developed in this way (Foster 1978, 157). In an extreme rainfall event, with high intensity over 24 hours or less, research has shown that overland flow is the dominant process and for short to medium-term storms, this type of erosion is the commonest (Wainwright 1996, 1024).

3.3.4 Settlement patterns

The past settlement patterns seen on the Wolds are influenced predominantly by land-use, which can mask sites and by the archaeological activity of groups and individuals which reveals a distorted sample of sites. Sedimentary processes are also responsible for masking sites and result in poor archaeological visibility (van de Noort 1996, 18). In the past settlement sites were, in some situations, located in the valley bottoms and this is evident today in continuing villages, such as Thixendale and Leavening. It is also evident from the recognition of largely abandoned villages such as Fordon which, with traces of ridge and furrow in the valley bottom, suggests the utilisation of dry valleys for cultivation during the medieval period (Allison 1976, 24). The concentration of archaeological research on visible and eroding sites in high areas has skewed the settlement patterns for Bronze Age Britain where, for example on the south chalk downlands, 35 sites have been discovered in recent years by research in the valley bottoms (Allen 2005, 234). It has been estimated that approximately one fifth of the available downland for prehistoric settlement is now obscured by valley bottom deposits (*ibid* 233). The discovery of a range of flint cores, tools and debitage of non-local origin on high ground at Vessey Pasture certainly suggests wider land-use than had previously been supposed (Wagner 1992, 251). On the High Wolds approximately 85% of the land is arable which means that it is particularly amenable to aerial photography, however this is limited by the stands of woodland, the unresponsive crop types often grown, ridge and furrow and other deep deposits such as colluvium which can mask sites (Stoertz 1997, 9). A more critical approach is needed than the view from three decades ago, which states that:

Aerial photographs allow us to reconstruct a virtually complete Romano-British landscape

Allison 1976, 39

Iron Age villages have been discovered at Wetwang, Bell Slack and Burton Fleming on the Wolds. They are up to 1.7 km long, exhibit a morphological unity and tend to be located in marginal situations, leading to the suggestion they were the result of the first deliberate planning of settlement on previously unoccupied land (Dent 1998, 8). This explanation depends on ones conception of marginality, which is a cultural construct, and is related to current perceptions of marginal situations and environments. The arrangement of the Iron Age 'square pit' alignments seen in East Yorkshire appear to incorporate elements of Wold and Vale landscapes together although they are often considered as discrete units for research purposes, which does not facilitate their comprehension (Powlesland 1988, 103). The evidence from the Heslerton project is extensive and shows continuity from the later prehistoric period to the post-medieval period across the separate, but connected, landscape zones (Powlesland 2003, 284).

Wharram Percy is best known as the site of the excavation of a deserted medieval village but has also been the site of the chance discovery of settlement evidence covering many different periods, although work has been undertaken with a specific chronological focus. The analysis of Wharram Percy, and other similar sites, has led to a greater understanding of the processes, and complexity, of desertion. However, geophysical survey identified several Iron Age enclosures, with subsequent Roman alterations and trial excavations, aimed at elucidating earlier time periods, revealed Anglian activity (Richards 2000, 29). Bronze Age flints were unexpectedly found at Wharram Percy under metres of colluvium during the excavation of the deserted medieval village (Hayfield *et al.* 1995, 394).

The Wharram Parish Survey, which began in 1974, was designed to place the results of the excavations at Wharram Percy village into a wider geographical context aiming to study settlement and land-use in a broader fashion, without a chronological focus and covered the two ecclesiastical parishes of Wharram Percy and Wharram le Street (Hayfield 1987). What began as a fieldwalking survey became a multidisciplinary study generating plenty of data and new sites but was considered, even at the time of publication, to be far from complete (*ibid* 2). Particular periods, such as the Iron Age, Roman and Saxon periods, were studied largely by fieldwalking and aerial photography that was sometimes complemented by magnetometry and excavation.

The principle aim of Fenton Thomas' work is to challenge the misconception that the Wolds have been continuously settled since prehistory (Fenton Thomas 2005, 25). Fenton Thomas states that although archaeologists have looked for evidence of Anglian settlement it does not exist in any volume, and the same can be said for the Iron Age when the Wolds were a place of remote pasture and the only burials those of enemies or criminals (*ibid* 147). There are however Anglian sites on the Wolds proper at Cowlam and Cottam, and more recently at Burdale. Stoertz also finds evidence for presumed 'grubenhaus' in crop mark evidence (Stoertz 1997, 59). Fenton Thomas believes that phases of open pasture were repeatedly replaced by periods of intensive arable farming and settlement (*ibid* 27), however when reading his work it is difficult to see on what evidence his assertions are based. When discussing the division of the land by linears in the Late Bronze Age Fenton Thomas claims that prior to this 'prehistoric communities had probably used the area for pasture and burial' (*ibid* 31) but this is based purely on an absence of evidence which we know, due to archaeological visibility, is a problematic way of understanding settlement patterns. The evidence on which he bases his assertion for the lack of prehistoric settlement appears negligible. The proposed long distance trackways are cited as supporting a pastoral economy and transhumanant movement but the trackway is undated and its use does not presumably preclude settlement. Although Fenton Thomas attempts a narrative account for the whole region this seems to result in a range of ill-founded generalities and some inaccuracies.

Where dry valley bottoms have been excavated there have been surprising and interesting results. At Garton Slack and Wetwang Slack the opportunity arising from large-scale gravel quarrying led to the discovery of a buried archaeological landscape which was excavated over a 16-year period (Dent 1983). The excavations revealed extensive and multi-period valley bottom settlement, burials and material culture from the Neolithic, Early Bronze Age, Iron Age and Roman periods. The spatial patterning in the settlement evidence demonstrates that there have been changing land-use decisions made at different times (*ibid* 8). The range of sites discovered during gravel extraction include the Iron Age cemeteries at Garton Slack, Wetwang Slack and Danes Graves, the Early Bronze Age barrows and Iron Age landscape at Swinescaif Quarry, Welton Roman villa and the prehistoric dyke system at Greenwick Quarry, Huggate (Brigham *et al.* 2008).

Commercial archaeology in advance of a 240 km gas pipeline across the north of England from Easington in East Yorkshire to Morcambe Bay has uncovered unexpected archaeology. The work, undertaken by Network Archaeology, commenced in 2006 and the results are expected to be complete and published in 2010 (Mike Wood pers.comm.) Known archaeological sites were avoided when the pipeline was planned but as excavation began in advance of the work unexpected sites were discovered along the entire route. This entailed 500 trenches approximately 2 m × 30 m long and resulted in the identification of 65 new sites which were excavated and recorded (Moore 2008). Of significant relevance to this research project was the discovery of an Iron Age to Roman settlement of national significance near to the village of South Newbald, on the southern edge of the chalk. Unexpected settlement and burial evidence was found in a dry valley at High Hunsley under between 250 and 750 mm of colluvium (Mike Wood pers.comm.). The settlement covers the excavated area of c. 35 m × 300 m and is adjacent to the main Roman Road from Brough on Humber to York. Cropmark evidence and geophysics had indicated a linear bank and ditch and an old streambed here in advance of the excavation but as the archaeological features were buried under colluvium they were only fully appreciated during the excavation of evaluation trenches (Moore 2008). The most significant features were the discovery of three Roman masonry buildings, surrounded by a cemetery of 100 burials including both crouched inhumations and cremations (Figure 11). Alongside the adult burials there was an area of infant and childrens burial concentrated towards the streambed on the southern edge of the site.

In addition the carcasses of 60 domestic animals were discovered as discrete burials. The interpretation of the site is that the square masonry buildings are temples or shrines associated with the burials but there is a later phase of building with a corn-dryer and some domestic structures on the site (Moore 2008). The site is not yet well dated but the linear features are thought to be Iron Age and the main Roman activity fourth century. At present a quarter of a tonne of pottery is being analysed and will provide more detailed information on dating, site use and function (*ibid*).

3.3.5 Linear boundaries

The establishment of boundaries has generally been described as a feature of territoriality and increased competition, but this has also been seen as an economic, political and ideological function operating to emphasise social divisions (Wileman 2003, 60). It is clear that whatever the original meanings behind the construction of boundaries, other meanings can be ascribed as time passes or situations change and the original meanings can change, or be lost (*ibid* 65). Ramm (1978) interpreted the linear features on the Yorkshire Wolds as the work of colonisers who were dividing up the landscape with what can only be described as military ditches. Similarly the dykes were probably built as a military safeguard to defend a ridge or slope against enemies and the associated barrows were the burial mounds of Iberians or Celts, the long-headed race (Brockbank 1913, 22).

Population growth, a concomitant pressure on resources and an increase in warfare have been used to explain the increase of boundary demarcation in late prehistoric East Yorkshire. However Giles (2007a) sees these divisions and demarcations of land in the context of long-term social transformations; that is in terms of changes to community, tenure and inheritance. The act of monumentalising thresholds enables trespass to occur and so the establishment of boundaries can be seen as a political act (*ibid*). Often the linears have been studied from aerial photographs that are known to conflate many different phases and different time periods into a single entity (*ibid*). Where the junctions of enclosures have been archaeologically investigated they tend to show piecemeal growth with accretions and subdivisions over many generations. The position and nature of the earthworks suggests movement from sheltered to exposed ground via a combination of monumental paths and droveways (Giles 2007b).

Fenton Thomas (2005, 31) claims that the linears bear some relationship with the dry valley system, either following the line of the valley along a contour or dividing up the interfluves or joining the valley heads. The idea that the linears mimic the topography leads him to state with alacrity 'there can be no doubt that the linears and banks were laid out to follow the valleys' (*ibid* 43). Whilst it is true that there is a relationship between the type of linear form (single, multiple etc.) and its topographic usage (*ibid* 43), that there is a relationship seems largely inevitable since the linears and the dry valleys cover the Wolds landscape in a concentrated manner. Although it is true that the patterning seen is not random, it is not simply that 'the ditches were simply expressing the natural boundaries in a more permanent form' (*ibid* 45) either. When we look at the patterns of the linears there are two points to remember, they are a partial record and they are not all contemporary. As the evidence from Burdale (that will be discussed in Chapter 6) demonstrates, some crop marks interpreted as linears are features of another kind, including settlement, when they are excavated.

Part of Fenton Thomas' assessment of the Wolds landscape as a gradual and constant adaptation involves studying enduring features which can be traced in the modern landscape such as the two long-distance trackways, the Towthorpe Ridgeway and the Sledmere Green Lane (*ibid* 49). These two trackways are undated, but appear to line up with the two glacial moraines in the Vale of York thereby providing a convincing argument for a prehistoric origin as concentrations of worked flint are found along the moraine and also along, at least, the Towthorpe ridgeway.

There is evidence that many of the linears or dykes were originally constructed in the Iron Age period and were modified in the Roman period especially at Wetwang Slack (Giles 2007a). However other researchers feel that the linears represent a sudden and large-scale landscape change which is probably Bronze Age (Fenton Thomas 2005, 132); pottery found beneath the linear at Sledmere is described thus 'could date to the Late Bronze Age' (Dent 1983, 6). Others have gone further in suggesting that the Bronze Age estates were delineated by linear boundaries which were constructed in an open landscape and that the flint scrapers found during fieldwalking indicate that the economy at this time was based on livestock and not cultivation (Muir 1997, 48).

At Fimber the excavation of sections of linear bank and ditch has failed to reveal any dateable features or artefacts (Ehrenberg and Caple 1983b). A substantial section of triple linear ditch and bank was excavated by Network Archaeology in 2006 at Bishop Burton Wold, west of Walkington village, as part of the Easington pipeline. This excavation failed to find any material that would allow dating of the construction or use of the linear feature (Figure 12)(Gerry Martin pers.comm).

The analysis of the distribution of linear features finds them most strongly associated with Bronze Age findspots and they often have pit alignments along them, which appear to represent a specific phase in their construction (Stoertz 1997, 41) (Figure 13). A Bronze Age date correlates with the ranch boundaries found in Wessex and the earthworks found in the Tabular hills, North Yorkshire but they do not appear similar to the linear features found on the Lincolnshire Wolds (*ibid*).

3.4 THEORETICAL UNDERPINNING

As is implied by the previous section, the theoretical approach taken to the archaeological evidence is crucial to the interpretations made, and this is also linked to the social and political milieu in which researchers work. For this reason a review of particularly relevant archaeological theory is presented below.

From the late nineteenth century there was an increasing reliance on diffusion and migration as explanatory devices and the development of the concept of culture; this could be seen in the work of geographers and ethnographers across Europe (Trigger 1981, 151). Aligned with history, the culture historical approach had a lack of concern with change from the inside, innovation, and instead concentrated on diffusion which has been expressed as a 'non-explanation' (Trigger 1989, 206). The 'culture-history style' questions about ethnicity, invasion and diffusion are non-questions and limit the nature of archaeology that we are able to undertake (Giles 2007b). Even recently, the 350 square ditched barrows found in East Yorkshire (with some also found in North Yorkshire) from the fourth century BC have regularly been described as representing a distinct cultural group, the Arras Culture (van de Noort 1996, 24).

As Giles (2007b) observes, invasionary models of change have been frequently invoked in the analysis of the East Yorkshire Iron Age. The question of ethnicity is one which has 'obsessed' East Yorkshire archaeologists and antiquarians since the eighteenth century until the present day, most recently seen in the desire to assign ethnicity to the occupant of the cart burials discovered in 2002. Indeed the tension exhibited between indigenous continuity and cultural invasion is something that has come to characterise Iron Age studies generally in Britain for the last 20 years (*ibid*).

Culture history is defined as an approach to archaeological interpretation which uses the same mechanisms as a traditional historian. It tends to describe a particular event and uses the event to infer some generalisations. The greatest weakness of the approach is the need to explain change or stability by diffusion, migration or invasion and moreover the use of the 'common sense' view of the past; this indicates that that our view of the world today can be used to interpret the past and needs no explanation, analysis or justification (Gamble 2001, 23). This historical tradition, which emerged during the Enlightenment, described human progress as a state of savagery through to civilisation. An emphasis on progress was vital to enable the middle classes to see that social superiority over others was not transitory or atypical but was rather the continuation of how things had been since the beginnings of 'time' (Trigger 1981, 141).

The advent of New Archaeology during the 1960s saw improved scientific rigour, the application of general laws to archaeology and an emphasis on patterning and function. This ultimately led to the development of new approaches to the archaeological record including the study of site formation processes and taphonomy and the emergence of sub-disciplines including environmental archaeology and geoarchaeology. The empirical rigour associated with new or processual archaeology, it has been suggested, led to a concentration on methodological issues and technical skills whilst explanation and interpretation have been played down.

Since the advent of New Archaeology during the 1970s many practitioners believe there has been a shift from culture-historic explanations but in fact culture history has been described as the 'default setting' for the majority of archaeology that is undertaken in this country (Trigger 1981). Moreover our experience of mainstream education in history, the use of museums and the reading of narrative historic accounts all serve to reinforce culture history as the usual, or indeed, natural paradigm.

Postprocessual archaeologists have sought to use explanations for change such as human agency, but this has been described as an unsophisticated paradigm, having a variety of meanings and therefore ambiguity (Dobres and Robb 2000, 3). Arising from philosophical and Marxist traditions, the paradigm considers social institutions (structure) and self–determination (agency) as the way to understand change and reinforce elements of social practice (*ibid* 4). Many of the difficulties with using agency come from a disagreement about the scale on which agency operates and the role of intentionality (*ibid* 10). Allied to agency is praxis which is the relationships created during everyday material production and agency only exists in its relationship to structure so is related to historically specific and changing conditions which need to be understood (Johnson 1999, 213). In relation to Yorkshire Wolds archaeology, a post processualist approach can most clearly be seen in the work of Giles and Fenton Thomas. The results of the application of this type of approach can be very different however with Giles linking archaeological evidence to the lived experiences of people in the past and Fenton Thomas emphasising a generalising approach which does not appear to take full account of the range of evidence nor the limitations of the archaeological evidence used to support his case.

Part of the critique of processual archaeology has emphasised the over empirical nature of landscape archaeology, where Cartesian approaches are seen to dominate (Fleming 2006, 267). Therefore, landscape archaeology, as practiced by post–processual archaeologists, has distanced itself from this approach and has tried to go 'beyond the evidence'.

It is argued that archaeology needs to make itself a more socially relevant discipline because in the past it has served the interests of specific groups (Duke and Saitta 1998). Archaeological knowledge can be oppressive, or emancipatory but it is striking that, although it has been used as an emancipatory element in the struggles of indigenous communities and gender issues, archaeologists have singularly failed to address the issue of social class. This is an important issue as social class is central to social marginality and is linked to notions of identity and culture (*ibid*). Class is often denied within archaeology due to the study of 'pre-class societies' but even within historical archaeology it is played down. Various reasons have been suggested for this unnatural absence and the most plausible is that the social status of those entering archaeology, especially in Britain, who are wholly unrepresentative of the social and ethnic composition of the general population (Frazer 1998) forming part of a dominant ideology. Allied to this denial of class in archaeological explanations is the lack of unionisation in archaeology when we know that working conditions are often poor. If we lack the political will to change our own working conditions then it is not surprising that class is so often denied in the past (*ibid).* Class position or domination is an important concept within agency because the idea/perception of free association and choice is central to considering how change occurred in the past (*ibid*). In the Yorkshire Wolds there are a number of large land holding estates and the formation and movement of villages has been dependent on the wishes of the local elite. In this location and situation the need to consider aspects of class would seem vital. Permission still needs to be sought from landowners to undertake archaeological fieldwork and certainly in the past the sense of self-determination for local tenants was limited.

Historians and archaeologists have been responsible for promoting an uncritical acceptance of the actions of the gentry and in many cases the use of historical prose to maintain class relations, for example this description of Sir Tatton Sykes:

between him and his admiring tenants there existed a bond of unity reminiscent of the older feudal North

Dickens 1954, 42

or Mortimer (1905 xil) 'the noble munificence of Sit Tatton Sykes' for his financial backing.

3.5 ANTIQUARIANISM AND THE YORKSHIRE WOLDS

The effects of antiquarianism and the county society have been seen as important for establishing and promoting Yorkshire archaeology (Manby 1980, 67; Wrathmell 2003, 363; Addyman 2003, 13). Indeed 'looking back on 450 years of Yorkshire archaeology it is always individuals who have made the difference' (Addyman 2003, 15). However these effects and contributions need to considered in a critical manner, especially as the landed gentry have maintained significant landowning on the Wolds (Birdsall Estate, Sledmere Estate, Garrowby Estate and Londesborough Estate) unlike some other regions.

The emergence of antiquarianism has often been seen as a response to the political and religious conflicts of the seventeenth century (Sweet 2004, xix). Starting as it did, a pursuit of the landed elite, it was important as a way of legitimising power and maintaining social order (*ibid*), but antiquarianism also had the ability to confirm and illustrate history, providing detail where there were few historic facts (Rosenheim 1998,13). The after-effects of the civil war and the need to control popular opinion were the historical impetus which led the landed elite to antiquarianism (*ibid* 174). Antiquarian research was often undertaken as part of a wider research into natural history and this adopted a regional and topographic approach (Lucas 2001, 3). As part of this process there became a division between 'in the field' or 'collecting' and the intellectual analysis, with 'in the field' seen as an area of social development and character building for men. In spite of the lack of dangerous wild animals in Britain there was, at least, always the weather to contend with (*ibid* 6).

When the landed gentry emerged in the fourteenth century, they were distinct from the nobility but they had a social role in national politics, local and country affairs. The two groups were gradually conflated and by the seventeenth century had become increasingly coincident; they had in common 'a collective awareness of inherited and unworked-for superiority' (Rosenheim 1998, 2). By the end of the seventeenth century, the conditions were created for the study of antiquities to proceed and liberate archaeological studies from the binding nature of purely literary sources or the search for respectable ancestors (Piggott 1976, 20). This change came about due to enlightenment, empiricism and the formation of groups such as the Royal Society (*ibid*). The Grand Tour encompassed the contradictory elements of wishing to travel and see other cultures and places, but seeing Britain, and moreover England, as superior; 'many returned to Britain as better informed xenophobes' (Black 1992, 235). Domestic antiquaries did not have the same level of conspicuous consumption as those undertaking the Grand Tour, however the pastime still endowed an individual with a social role that required leisure time, resources and education, reinforcing unequivocally both a frame of mind, and a way of life.

The eighteenth century county history became an important geographical element of the same process, demonstrating the longevity of the gentry class and legitimising a family's place in regional society. Strong county associations were demonstrated amongst the landed elite (Piggott 1976). The county history was a celebration of power and wealth, or in other words, pedigree. The establishment of county societies were part of Victorian social life but have scarcely been considered by archaeologists or historians (*ibid* 171). During the Victorian era the tendency towards these groups is striking but it would be wrong to think of this as merely social. Mining companies were involved, from inception, with the establishment of the Geological Society and the Cornish Society, and Josiah Wedgewood took great interest in Greek antiquities, prior to the Greek style being used in his manufacture of fine china (*ibid* 172). So we can see the links between the establishment of such groups and societies with more commercial interests and economic control. An awareness of this should stop us from seeing such groups as benign observers of regions and their antiquities and make them an integral part of the political, social and economic life of British society in the nineteenth century.

Religion formed a vital part of British life during the Victorian era and 'church men' affected much nineteenth century thought (Piggott 1976, 172). Movements such as the Tractarians, a fundamentalist religious movement, had a strong impact on British local archaeology between 1840 and 1860 and used local groups to emphasise local issues (*ibid* 183). Between 1845 and 1855 a dozen new archaeological societies were formed and, unsurprisingly, all were in places dominated by the Anglican church (*ibid* 191).

The work of William Greenwell and JR. Mortimer is often referred to today as it forms a corpus of evidence on which we can draw as archaeologists and represents a class of evidence which is now largely destroyed. Greenwell was born on 23rd March 1820 in County Durham and had a strong family history in this area (Durham University 2005). During his lifetime he became a Justice of the Peace and also a Canon of Durham Cathedral in 1854. A member of the Royal Society he began exploring his family's extensive estate, excavating a Roman Camp with his brother. Eventually he became a prolific barrow digger, his technique was to put a trench across the centre of the barrow to retrieve artefacts, and he is thought to have looked at around 290 barrows in this way, describing features such as associated linears as part of a military defence.

At this time it was common to study human skeletal morphology and Greenwell was no exception, concentrating on skull morphology to assign racial affiliations. The Greenwell Project is a Leverhulme Trust Project which aims to publicise Greenwell's work and history in a positive light (Durham University 2005). However his work as a collector working with dealers and selling artefacts, although common for its time, needs to be reviewed critically. Greenwell was a consummate collector removing, for example, at least six of the Hogbacks from St Thomas Church Brompton for display at Durham Cathedral. Such is the current assertion of the positive nature of antiquarianism that Greenwell has been heralded as the forgotten saviour of heritage and indeed did 'more to save the Nations Heritage than any other individual' (Newsquest Media Group 2005).

J.R. Mortimer was from a different background; he lived from 1825 to 1911 and became a corn merchant in Driffield. Unlike many of his contemporary antiquarians, he was of the merchant class and combined his business enterprise with his interest in the past. Mortimer did however begin his interest with collecting and described his 'competitors' as 'overbidding us and running up the prices' (Harrison 2001, 47). Over the first decade he and his brother collected 10,000 items and this suggests that acquisition was the main driver, but by 1863 the brothers had made the transition from collectors to barrow diggers (*ibid* 48). After seeing the Great Exhibition and The British Museum during 1851 he became very enthusiastic in his archaeological pursuit although he saw progress as an evolutionary sequence and material culture change as evidence for invasionary forces (Mortimer 1905). Both collection and barrow digging need to be seen in the light of post-enclosure land-use change which allowed the damage and exploitation of monument sites. This change brought vast swathes of land into arable production, creating more surface finds and the destruction of both upstanding monuments and buried features on a scale never witnessed before (Harrison 2001, 48).

Mortimer took a different approach to Greenwell in that he was a meticulous recorder of detail and considered other factors in the landscape aside from artefacts.

Mortimer was responsible for building and stocking the Driffield Museum of Antiquities and Geological Specimens near his home in 1877. He did this at his own considerable expense, but as a private enterprise with no evidence for civic enrichment or philanthropic aims (Harrison 2001, 49). By 1887 Mortimer was declared bankrupt, largely due to the agricultural depression of the 1880s, and he was to spend the rest of his life trying to keep his collection together and in the county of its acquisition, unlike Greenwell whose collection is in the British Museum (*ibid* 59).

The recent portrayal of Greenwell as a 'saviour' of heritage and Mortimer as 'the father of Wolds archaeology' (Fenton Thomas 2005, 22) is indicative of a focus on high status and high profile individuals within archaeology rather than an analysis of the influence and impact of antiquarianism. It is not that these individuals did not contribute to understanding the past but that their motives and actions need to be understood not as a passive or neutral activity, but as social and political actions that have been used to articulate social position and power. In the case of Greenwell's work, a member of the clergy with significant family wealth and a spacious seat, his interest in collection but not in recording suggests that this is not archaeology at all. Indeed Sweet (2004, 346) states that antiquarianism should never be equated with fieldwork and the development of archaeology.

Giles (2006) has reviewed the life and times of J.R. Mortimer and is skilful at examining the relationship between his antiquarian activities, the wider social and political context of Victorian discourse, and the role of collecting and curating in defining identity. The class difference however between Mortimer and his fellow collectors is emphasised as if in some way this negates or elevates Mortimer's actions as a member of the merchant class rather than gentry. The aggrandising behaviour of Mortimer is a self-seeking and political statement as he attempts to align himself publicly with those who have the means and the status to carry out this type of work.

Another prominent Wolds landowner and trader of antiquities, Lord Londesborough, was also a Master of Freemasons. Whilst this movement was founded on liberal and charitable principles the way it operated was increasingly associated with exclusivity and secrecy until eventually it was perceived as a form of nineteenth century bourgeois liberalism. The County Society found expression with the founding of the Victoria County History in 1899 and this group sought to present local history from the original documents. Implicit within Victoria County History writing is the idea of a factual past that can be described by reading old documents. Undergoing a current revival, Victoria County History projects include History Footsteps, a series of educational projects aimed at children. One of the examples is from the village of Warter on the Yorkshire Wolds and attempts to explain what life was like in an estate village (Neave and Neave 2005). Although this project draws attention to the massive and enduring class differences between the estate owners and the workers this is achieved by a largely neutral descriptive account. When archaeologists write about landowners this has generally been characterised by deference where notions of benevolence, munificence, innovation and improvement are emphasised (Manby 1980, 67; Mortimer 1905). This is in keeping with the archaeology of rural settlement which has generally tended to reinforce and maintain a traditional historical account with an uncritical acceptance of elements such as clearance and improvement (Dalglish 2003, 34).

The Mortimer Collection is now housed at Hull Museum but it is 'an expression of the predominantly acquisitive culture in which it was accumulated' and represents, quite effectively, the role of material culture in promoting and protecting provincial culture and local identity during the late nineteenth and early twentieth century (Harrison 2001, 60). Sheppard was the curator at Hull Museum who inherited Mortimers collection after his death, but as an inveterate collector himself he is noted to have discouraged other fieldworkers by his 'proprietary' control of the material (Manby *et al.* 2003, 38). Whilst we might use the materials that were collected by Mortimer for archaeological purposes his actions were not archaeological and should not be conceived or described as such. As archaeologists we should be emphasising the role and use of material culture and collecting in establishing social status and negotiating power relations rather than expressing a misguided appreciation for its collection.

Into the twentieth century, the archaeology of the East Riding continued to be heavily influenced by Greenwell and Mortimer; 'it was then one of the tenets of faith for local archaeologists that the subject remained under their domination' and this was to result in a lasting bias in the recovery of materials from funery monuments on the Wolds (Wright 1990, 74).

3.6 REGIONALISM

As suggested by Usai (2002), the effective combination of geoarchaeology and pollen analysis is rarely seen in the north of England and the lack of geoarchaeology generally in the north is apparent when the case studies in print are considered (French 2003; English Heritage 2004). It would be fair to say that the archaeology of the south has formed, and remains, the 'dominating force' in British archaeology (Mercer 2002, 10). It may be this domination and a perceived inequity in resources that results in the vigorous promotion of the Yorkshire region by archaeologists such as Addyman and Wrathmell.

We can consider the development of Yorkshire regional approaches to archaeology by thinking specifically about the dominant theoretical paradigms at various times during the history of archaeology in the region. The 'north' and Yorkshire can be seen as representing as a strong culture historical approach to the archaeological record. Some of the environmentally determined explanations for the Wolds archaeology suggests that the functionalist or New Archaeology paradigm is dominant in this region.

It has been suggested that the north of England has an intensified 'sense of place' which arises, in some respects, from a strong sense of regional identity (Rawnsley 2000, 3). The North is an area of a wide range of geographic and topographic variation and of classes and cultures. The Industrial Revolution was a fundamental factor in the construction of 'The North' because it intensified regional culture and economy by the distinguishable industrial specialisation of each area leading to regional coherence which was aided by the development of the canal and railway system within each region and then developments such as regional newspaper production (*ibid* 6). Since the nineteenth century there has been a continuous and, to some extent, coherent image of the north as different to the south of England. More recent economic disparities between the north and south during the 1980s represent large geographic inequalities (Shields 1991, 237). The state was highly instrumental in the process of industrialisation, and regionalism was increasingly used by the state for political purposes. The boundaries that separated space were not inert, they are defined as the 'ideological contours of dominant values and beliefs…' (Rawnsley 2000, 12).

'The North' is an example of how a region can be represented as 'other', a foil to the romanticised images of London and the south (Shields 1991, 207). The emergence of the north of England is a historic product of messages, intellectual and literary, which project the North as an image in sharp contrast to the south. The dichotomy of north and south was enshrined in literature during the nineteenth century which was itself responding to the rapid industrialisation of the north and the emergence of an industrial elite which challenged the landed elite of the south (*ibid* 208). Regional emphasis in literature and poetry reinforced the north as a place of the working class during the nineteenth century industrialisation. The use of fiction had a strong influence on reinforcing images into the popular imagination as used by Mrs Gaskell, Disraeli and Dickens (*ibid* 209). London's East End was in fact the largest centre of urban poverty by the end of the nineteenth century but this was not acknowledged, as it was the stereotype of London's wealth that was contrasted with the bleak and impoverished North (*ibid* 211). Cultural stereotyping and the development of the industrial working class were in a sense the construction of 'the northerner' as an entity. Social identity was linked to labour and notions of community, and elements such as regional dialects were not only associated with pronunciation but with cultural inferiority, thus establishing a cultural hierarchy based, to some degree, on geography (Rawnsley 2000, 8).

A response to this stereotype was the establishment of a 'cult of northerness' which was a northern view of northerners as warm-hearted and hard working as opposed to the snobbish and lazy southerners (Shields 1991, 212). An archaeological assessment of northern space is badly needed to understand how the literary tradition developed, either as a myth or as a reflection of something more tangible. The myth of the British North is a fundamental part of the process of social spatialisation and cultural identity which locate the industrial working class in opposition to other classes and groups both spatially and hierarchically; this gives social class a spatial quality (*ibid* 245).

Major regional differences persist to this day in the arts, transport and planning spheres (Harding 2002, 5) and an assessment is now needed of the impact of regionalism on archaeology. There are archaeological differences too in the north, such as the lack of Palaeolithic evidence and the rich, but poorly studied, Mesolithic period compared with the south of the country (Mercer 2002, 6).

Post processualism allows for a diversity of local response, which is relevant to all researchers in regions across the country, and allows emphasis on the interaction of the environment and human agency.

3.7 POLICY AND ARCHAEOLOGICAL RESEARCH

Changing funding arrangements and priorities have had a profound impact on archaeological research since central funding commenced during the Second World War (Thomas 1993, 137). Legislative change in 1990 firmly set the archaeological agenda within the planning process and the advent of developer funding and competitive tendering under PPG16 has had widespread consequences for local research priorities (*ibid* 146). Prior to this, archaeological work had been carried out by local units with local knowledge and contacts but with developer-funding came an increase in small-scale and fragmented research output which failed to utilise local links and knowledge (Grenville 1993, 127). Central funding via English Heritage now accounts for approximately 30% of archaeological intervention nationally with the remaining funding allied to development (Thomas 1993, 148). A recent review of the archaeological workforce found that, with the primary source of funding within the private sector, commercial organisations currently employ 58.6 % of the archaeological workforce (Aitcheson and Edwards 2008). In an area like the Yorkshire Wolds with light settlement and predominantly agricultural land the opportunities for developer-funded projects is limited.

The setting of research priorities by defining agendas has become a fundamental element of archaeological practice, often allied to competition for funding. Research agendas set within archaeological science have often been criticised for emphasising the methods and techniques themselves rather than addressing any overarching archaeological questions by using a scientific approach (Mellars 1987, 2; Bell 1992, 22). Regional research frameworks are being developed to address the fragmentation which has followed developer funding. Universities have also been seen as central to the continuation of archaeological research which did not arise from development opportunities, but local universities in Yorkshire have been criticised for failing to take sufficient interest in the archaeology of their own region (Selkirk 2003, 394). More generally northern projects with bases in southern universities are seen as problematic in terms of the dissemination of results and the relevance, involvement and understanding of local issues and people (Harding 2002, 6).

The current emphasis on a multi-agency approach to land management and conservation on the Wolds has led to an overall lack of focus in the region (Yorkshire Wolds Heritage Trust 2004). In 1991 the Yorkshire Wolds Heritage Trust was founded, as a coordinating body and registered charity, after a study into a church redundancy found that there was a lack of coordination between all sectors including the Local Authority, heritage agencies and conservation bodies (*ibid*). A decision was taken that an integrated approach was the only way to protect and promote the unique environment of the Yorkshire Wolds.

3.8 SUMMARY

An assessment of the Yorkshire archaeological resource has found that the Wolds landscape has large volumes of artefacts from all periods from the Neolithic period onwards (Roskams and Whyman 2005, 39). However, despite being a core study area for the region the visibility is patchy with preferential visibility on the Wolds tops and possible preserved, undamaged but invisible and inaccessible evidence in the valley bottoms (*ibid* 43). That this inaccuracy exists throws doubt onto archaeological explanations which use topographic features as the motive for settlement (i.e. along the springline), and means that prehistoric distribution maps are likely to be inaccurate. Narrow period based studies are limited archaeologically and cannot hope to emphasise the relationship of people to their experienced landscape; change occurred irrespective of chronological divisions (Fenton Thomas 2005, 145).

The social and intellectual forces which led to the early formation of local societies and formed the framework for our archaeological activity were of their own time and such an approach cannot now accommodate all the changes in society and archaeology that have occurred since the nineteenth century (Piggott 1976, 193). It is therefore time to acknowledge and critique the role of antiquarians, and to separate ourselves from them and their explanations. The strong and vocal county society has been credited with the promotion of vibrant archaeology in Yorkshire (Wrathmell 2003, 363), however it appears that, with its roots in antiquarianism and a strong culture historical approach, we could equally suppose that the county society is part of the process which has constrained the archaeology of Yorkshire.

The north of England has not been studied with the same methodologies and approaches as the south, nor with the same intensity. This is a situation which needs to be understood more fully. The influence of archaeological theory on the research agendas for Yorkshire Wolds archaeology has been limiting, coming from a strong culture historical base. The landscape studies of Powlesland and Halkon in the area have both been successful in demonstrating the breadth of settlement evidence, whilst emphasising the interconnectedness of different morphological landscape blocks. Whilst they have not been environmentally deterministic they have legitimated the role of environmental considerations in archaeological studies. Generalising post-processual analysis of the Wolds landscape as a whole has resulted in a series of inaccurate and unempirical statements and analyses. It is only in the last decade that archaeologists have successfully employed an overtly post-processual approach to the Yorkshire Wolds which emphasises both the fieldwork evidence and the lived experiences of people in the past to give a more cogent overview of settlement evidence for this area (Giles 2007a, 2007b). This approach to Yorkshire Wolds archaeology offers a way forward that will allow us to consider the entire landscape rather than the preferentially visible and obvious sites. However, important aspects of control and change on the Wolds relating to land ownership, the gentry and tenurial relationships need to be fully considered as the forces and relations of production are central to this predominantly agricultural area.

The history of the region, theoretical approaches, landowning and funding regimes have all had significant impact on the archaeology undertaken on the Yorkshire Wolds and the way that it is interpreted. The archaeological record has been well-studied from a culture historical and, to some extent, functional perspective. Post processualism offers some landscape scale and agency assessment but in some cases this work has taken a generalising approach, which has failed to give cognisance to the evidence. The environmental evidence on which the history of land use is based is of a limited nature, in terms of size and quality, and has been accepted uncritically by many researchers.

4.0 DRY VALLEY RESEARCH ON THE WOLDS

Now that we have reviewed the potential of dry valley studies and chalkland archaeology in Chapter 2 and the previous archaeology of the Yorkshire Wolds in Chapter 3 we can turn our attention to the application of dry valley research methods to the Yorkshire Wolds landscape. I will discuss here the previous targeted research, which is sparse, before reviewing a pilot study undertaken in 2004. The pilot study attempted to test out some of the methods previously used in the south of England by applying them to a small valley, Cowlam Well Dale, close to Sledmere village. The summary indicates the lack of dry valley work here and the need for further research in this area.

4.1 GEOLOGICAL AND GEOGRAPHICAL RESEARCH

The nature of the pre-Quaternary landscape of northern England is difficult to establish due to successive regional ice sheets and large-scale glacial erosion during the Pleistocene. Despite a significant research into the pre-Pleistocene evolution of northern England, where many concepts and hypotheses have now been discounted, there are still many more questions than answers about the overall development of the north during the Tertiary period (Huddart and Glasser 2002, 29). The cliffs at Sewerby, East Yorkshire, are of national and international importance containing evidence for environmental change since at least the last interglacial (Evans 2002, 71). The features seen include Ipswichian interglacial beach deposits dating to c. 132,000 m.y.a., sediments resulting from the drop in sea level at the beginning of the last glacial period and evidence for the advance of ice into the area during the Dimlington Stadial (*ibid* 71). Many of these deposits contain faunal remains and sedimentary classes which help our understanding of conditions during these events. Moreover, the site is of considerable importance for our understanding of the palaeoenvironmental and sea level history of East Yorkshire (*ibid* 77). Thermoluminescence dating of quartz and feldspar particles was applied to the blown sand units and found a period of deposition 120,840 ± 11,820 with no demonstrable strata within the sand but a phase of continuous and rapid aeolian deposition at the end of the Ipswichian interglacial (Bateman and Catt 1996, 394). Falling sea levels led to a beach deposit, which was interdigitated with lens of colluvium, but could not be dated (*ibid*).

The chalk escarpment of Yorkshire dates to the Tertiary period when the chalk was uplifted and folded to form a shallow syncline. To the east, the chalk dips beneath deep Quaternary deposits in Holderness (Catt 1987, 15). Towards the centre of the syncline the chalk is circa 500 m thick but at its southern limit is anything from 50 to 230 m thick (*ibid* 16). Drift deposits are rare on the Wolds and are restricted to two units of glacial till occurring in Holderness and the lower part of the Wolds dip-slope (*ibid*). Although the Yorkshire Wolds were unglaciated during the Devensian, as a periglacial region the subsoil would have remained frozen throughout the entire year (Ahnert 1998, 103). It is however entirely possible that some of the dip-slope features may have been caused by the full glaciation of the Yorkshire Wolds, and this has not been conclusively discounted (Lewin 1969; Foster 1985, 36). Recent geomorphological and sedimentary analysis demonstrates that the ice had advanced further into East Yorkshire than had been previously appreciated (Foster 1985, 1). An attempt to delineate the advance of the Late Quaternary ice sheet in the Yorkshire Wolds was unsuccessful due to the poor quality of the data retrieved. The analyses revealed higher blown sand content than had been expected which is probably indicative of a glacial outwash deposit (*ibid*). Unsurprisingly this study found a close correlation between the underlying tectonic framework and the landscape development of the Yorkshire chalk.

Versey considered the nature of hydrology in East Yorkshire in 1949, and provided detailed calculations demonstrating the ability of the chalk Wolds aquifer to provide all the mains water required for domestic and industrial needs in the East Riding and Hull. However, he also described the problem of understanding the perched water tables within the aquifer which arise from the marl bands which separate layers of chalk. These marls represent the insoluble residue of dissolved chalk and the resulting clay deposits frequently seal the joints between the chalk layers. Even when the marl band is very thin, it may be sufficient to form a watertight barrier to percolation (Versey 1949, 239). It is this effect that results in very different results for water table heights between boreholes which are very close geographically. The quality of water available from the chalk aquifer is more potable than surrounding water sources such as the artesian water of Holderness which is often ferruginous or sulphurous due to the effect of the Kimmeridge clay (*ibid* 244). A groundwater model for the Yorkshire Chalk was undertaken in 1996 and has been recently published (Salmon *et al.* 2007). The extent of the chalk aquifer in the Yorkshire Wolds and the Holderness Plain covers an area of 2000 km^2 and the only surface flow on the outcrop is the Gypsey Race in the Great Wold Valley, with the river Hull rising as a series of springs south of the chalk outcrop (*ibid* 413). The chalk here belongs to the ill-defined northern chalk which is materially different from the chalk in the south of England (*ibid*). The hydrogeology of the area was assessed and the study found pronounced fissuring and the development of secondary permeability especially within a zone of water table fluctuation within the dry valleys themselves (*ibid* 414). There was also an absence of modern water intrusion and marked seasonal variation in the springflow and stream length; the application of a numeric model underestimated low flows in the seasonal stream the Gypsey Race and in the streams and becks that issue from the chalk edge (*ibid*). As most drainage through the chalk is by fracture flows, which are enlarged by carbonate dissolution, understanding the fracture pathways is key to understanding contaminant pathways. A current doctoral research project is examining boreholes on the Yorkshire Wolds to determine the origins, development and lateral extent of the highly permeable horizons within the chalk, which increase the risk of contamination via fracture flow (Alison Parker pers.comm.).

At the beginning of the Devensian glacial advance between 30 and 50 cm of loess were deposited on the Wolds (Catt 1978, 15; Ellis 1996, 4). Some of the loess which was deposited on the chalk was then removed by solifluction processes, but the contribution of loess to the development of chalk soils is undoubted (Limbrey 1975, 180). Even thin layers of loess indicate improved soil quality in the past due to the benefits of enhanced soil hydration and aeration (Bell 1983, 147). The clarification of the distribution of loess has been described as an important research aim in itself (Catt 1978, 19).The development of Brown Forest Soils involved the decalcification of the chalky loessic material and the formation of a clay mineral B horizon (Limbrey 1975, 134).

In the nineteenth century the Reverend EM Cole of Wetwang became the first to specifically comment on the formation of the East Yorkshire dry valleys. He deduced that erosion responsible for valley formation had occurred largely by annual meltwater runoff from an active area of Devensian regional permafrost. Following the Rev Coles initial discussion of the formation of the dry valleys by sub-aerial, submarine and glacial erosion. This theme was taken up by Mortimer in the late nineteenth century. As part of his discussion into the formation if the valleys Mortimer mentions 'the very few existing streams now running for short distances along some of the valley bottoms' and that they could not be related to the vast numbers of water sources needed to excavate the valleys themselves. Mortimer (1885, 30, 31) states that such imaginary streams would have to, in any case, 'run in opposite and in every direction'. Mortimer felt that the valleys themselves were 'preglacial' by which one can assume he means before the last glaciation. Mortimer suggests that the valleys were created by cracks and fissures in the chalk surface due to the elevation of the chalk onto dry land, and that the cracks have been subject to natural forces which have subsequently widened them. In his view it was the upheaval of fractures, contortions and displacements that caused the current pattern of dry valleys. Mortimer's field investigations also determined that the lobes of chalk commonly seen usually only on one valley flank were formed by the mass slippage of chalk gravel and that the hollows on Raisthorpe by subterranean solution (*ibid* 34).

Versey suggests three likely explanations for the range of dry valley axes seen in the Yorkshire Wolds. Firstly, the obsequent valleys (flowing into another stream but in the opposite direction to the slope of the land surface) are most likely developed due to spillover lines from an ice front to the west of the Wolds escarpment. Some others seem to have been formed by the erosion of frozen chalk and others still by the collapse caused by solution hollows (Versey 1949, 242). It is at the base of the dry valleys that the largest springs are found (*ibid*).

A topographic field study of the geomorphology of the dry valleys in the Yorkshire Wolds was undertaken three decades ago (Lewin 1969). The unexceptional nature of the dry valleys in the Wolds has led to a lack of study with the dip-slope and valley morphology similar to those in the south of England. The escarpment features are, however, unique, making analogy with other regions problematic (*ibid* 17). Water moves through the body of the chalk via joints which are often identified by looking at valley axes, but in the Wolds there is no consistent valley direction to imply sub-surface jointing patterns (*ibid* 4) suggesting a similar periglacial origin as the patterns on the Chilterns.

Lewin made an assessment of the shapes and slopes found in all the dry valleys on the Wolds but he found that these typological classifications were of limited use as the valley networks vary so considerably in the Yorkshire Wolds, in terms of size and shape, that they are not typologically similar to each other (Lewin 1969, 46) Lewin found that most dry valleys are developed irregularly and abruptly onto otherwise smooth slopes giving the appearance that they are a late addition to an earlier landform (*ibid* 51). The three factors that he found of particular relevance were that there is a general angularity of confluences. He found that adjacent valleys often ran in a consistent direction but that neither angularity nor alignment is in sympathy with the general slope and this is more closely related to joints and faults in the underlying chalk (*ibid* 47). The third significant finding relating to valley patterning is that the valley heads are very variable, being either rectangular, sharply cut or dendritic onto the adjacent interfluve.

The features arising from solution collapse on the Yorkshire Wolds are on a massive scale that is unique for England (Lewin 1969, 56). To the north and west the chalk rests on impermeable rocks and here the water is thrown out via springs. The valley networks themselves are variable, with frequent dendritic and converging systems (*ibid* 38). Drainage densities are difficult to assess because of the variability in valley size from the head to mouth, and surface density estimates are limited because the water movement is largely underground (*ibid* 39). Looking at the morphology of a valley can give an indication of past landscape processes, for example the five large meanders in the Great Wold Valley suggest very high water flow at some point in the past (*ibid* 51). Whilst the valley floor gravels here are waterlain the upper surface has been altered by cryoturbation during periglacial conditions (Foster 1987, 37).

Drainage patterns are determined by slope or structure, rivers initially follow a slope and then adjust to the underlying structure as they incise the bed (Twidale 2004, 159). An insequent stream is one that conforms to neither the slope or to the underlying structure. Where the patterns are parallel the flow downslope is controlled by gradient (*ibid* 167). Dendritic patterns with channels orientated in a wide variety of directions are common in areas of slight slope and little structural influence, for example on coastal mudflats, and they are often developed secondary to main valleys. The ephemeral but high discharges that cause multi-channelled streams can have several causes (monsoons, freeze-thaw) and are typical of periglacial areas (*ibid*).

4.2 DRY VALLEY AND MOLLUSCAN STUDIES

The archaeological examination of dry valley deposits on the Yorkshire Wolds is rare. The examination of a dry valley section at Fimber Nab found poorly sorted chalk gravel with loess, and some sherds of Roman grey ware, but there were no secure dating opportunities (Buckland 2001, 97). It is suggested that throughout the Holocene little had happened at Fimber Nab until a period of soil erosion ascribed to 'the Roman period or later' and possibly associated with extensive ploughing or a change in cropping behaviour (*ibid* 98). The valley bottoms may have become agriculturally important after this period of erosion, with the slopes useless until post medieval improvement (*ibid*).

A research excavation of linear earthworks at Westfield Farm, Fimber, was undertaken during 1982 and 1983 (Ehrenberg and Caple 1983a, 1983b). Although the research was unsuccessful in securing the primary aim of rediscovering a Bronze Age metalworking site unearthed by Mortimer in 1869, the earthwork was examined and, during the second season, the colluvium was analysed. The earthwork consisted of four banks and three ditches, with the easternmost bank best preserved and still serving as a field and parish boundary. A buried soil beneath the bank contained some calcite gritted ware and some small stakeholes (Ehrenberg and Caple 1983a). In Wandale, under 2 m of colluvium, the earthwork was seen to continue across the valley base as a low chalk rubble spread. The earthwork was probably destroyed by ploughing before the hillwash developed and the ditch contained no dateable artefacts. The hillwash contained a few medieval sherds of pottery (Ehrenberg and Caple 1983b).

On the Yorkshire Wolds there have been three notable studies using molluscs to analyse past land-use. The first, Hotston (1985), aimed to apply the methods of molluscan analysis from the south of England to the colluvial deposits on the Yorkshire Wolds. Three test pits were excavated at Fairy Dale and they were described, drawn and sampled (*ibid).* The results showed some mixing of xerophile and shade loving species in the same samples, which was not thought to be related to the scale of sampling interval (*ibid* 40). In terms of both abundance and their ecological groupings, all the assemblages indicated a very general colluvial stratigraphy (*ibid* 41). Layers thought visually, in one test pit, to represent a more stable surface horizon could not be traced with any certainty in the other test pits, and additionally appeared to be associated with a drop in mollusc frequency, contrary to the accepted pattern for landscape stability (*ibid* 42). There were clear ecological changes in species distribution throughout the sequences but due to the lack of dating evidence and the complications discussed above it was not possible to postulate why or when the environmental change took place (*ibid* 43).

An experimental study into mollusc distributions was carried out at Birdsall on the Yorkshire Wolds (Milburn 1991). The aim was to see how closely mollusc distributions reflect habitat exclusively defined by vegetation type. Transects of turf samples were collected at regular intervals, from meadow, spring and managed beech wood locations. The assemblages were examined statistically by Cluster Analysis using the CLUSTAN computer programme. All the woodland samples had more than 100 molluscs per sample and the other samples all contained less than 30 molluscs per sample (*ibid* 32). The results showed distinct woodland and meadow groups, with very close associations between mollusc distribution and vegetation cover (*ibid* 53), however the role of abundance and diversity indices was not considered.

The British Museum East Yorkshire Settlements Project, which initiated excavation around Rudston in 1989 and 1990, has led to the recovery of dateable land snail assemblages from the late Bronze Age, Iron Age and early Roman period (Wagner 2004). The results from all the samples and locations show that the area was predominantly grassland, except for the lower ditch at Hanging Cliff, which was subsequently dated to the Neolithic period by an associated decorated plaque (*ibid* 89). This assemblage was dominated by the shade and damp loving *Phenocolimax* sp which has a fragile shell and this assemblage appears distinct from all others in the country.

4.3 THE PILOT STUDY

The pilot study discussed here was undertaken as part of a Masters Degree programme at the University of York during 2004 and is available as an unpublished MA dissertation at the University Library. It has also been published as two short reports (Neal 2006, 2007). Here I intend to outline the aims of the project, the methods used and a discussion of the results.

On the northern central Wolds, at approximately 200 m above sea level, lies Cowlam Well Dale with the hamlet of Cowlam Manor at its head. Today Cowlam Manor consists of eight dwellings, including two farms, and the church of St Mary.

4.3.1 The project design

The Wolds Research Project was established in 2002 by the Department of Archaeology, University of York to investigate the interaction of human settlement with natural processes focussing on the period from the Iron Age until the present day (Roskams 2003). A theme within the project was the investigation of taphonomy and archaeological visibility, and the relationship of the landscape to settlement evidence, and this was my focus. The research project was question, rather than hypothesis, led. The broad questions were as follows.

- How do we think this landscape has evolved, and how has it been managed over time?
- What are the nature of the deposits in this dry valley, and how do those deposits near to known areas of human settlement at the head of the valley vary from those in the lower valley reaches?
- To what extent can we link the deposits to phases of human activity and trace chronological changes?
- What methods and techniques are best suited to studying dry valley deposits and what are the limitations?
- How do the deposits on the Wolds differ from those found and studied in the south of England?

4.3.2 The method

In order to address these questions the project commenced with a consideration of the background literature and research, followed by a desk-based analysis of the historiography and archaeology of the defined study area. In the field the topography and morphology of the landscape was surveyed and recorded. The deposits were assessed by means of an auger survey and test pit excavations in three selected areas in the upper, mid and lower reaches of a single valley. The test pit excavation were drawn and photographed and the separate layers were sampled with 1 kg samples for soil chemistry tests and mollusc abstraction. A series of close samples were taken for magnetic susceptibility testing.

Almost all the previous fieldwork in the area had aimed to elucidate our understanding of specific periods and had been directed at discrete 'sites'. A central aim of this project was to consider all time periods, up to the current day, thinking about the multiple time-scales that are represented by the different processes that we encountered and investigating 'off-site' areas of the valley.

4.3.3 Desk based assessment

Cowlam is known from early sources as Colume, Coleham or Kollum, and the name is thought to have a Scandinavian root, meaning 'top of a hill' or 'at the hill tops' but the Kollum spelling does not correlate well with the Domesday spelling of Colnun (Smith 1970, 126). There is a single reference to Cowlam in the Domesday Book where it is given that Ketibjorn and his brother have 6 carucates of taxable land, enough for three ploughs (Faull and Stinson 1986, 301b). The village was recorded as having 14 households in 1672, reduced to 'the parson and two shepherds' by 1690 (Pevsner and Neave 1972, 392), and at this time the area had 600 to 800 sheep and a rabbit warren of 1500 acres (Jennings 2000, 69). Historic sources suggest village desertion between 1674 and 1680, based primarily on Hearth Tax Returns, but this can at least be partly explained by amalgamations and expansions (Hayfield 1988, 105). In 1783 Cowlam Farm comprised 1900 acres of land, with 1500 acres of rabbit warren, 200 acres of arable and the rest left as sheep walks (Harris 1958, 99). Subdivision of the land and hedging took place between 1783 and 1844, so that by 1844 most of the warren had gone and all the hedged fields were under the plough (*ibid*).

Canon Greenwell excavated four square barrows at Cowlam in c.1877 (Stead 1979, 3). Greenwell never recorded the location of his excavations, nor an accurate plan of what he found, making the analysis of these sites problematic. Kemp Howe barrow at Cowlam Farm was excavated during the later nineteenth century and found to contain six Anglo-Scandinavian burials without grave goods (Mortimer 1905, 336). Cowlam Cross Barrow had a diameter of 50 feet and underneath the mound was a cruciform excavation into the chalk bedrock that was seven feet deep. This grave contained human and animal bone, potsherds and arrowheads (*ibid* 338). In 1968 Brewster excavated three round barrows at Cowlam but there are no publications related to this fieldwork (Manby 1988, 2). In 1969 and 1972 six square barrows were excavated at Cowlam. They included four that had been previously excavated by Greenwell, during the nineteenth century, and they ranged from 7 to 14 m across. They include an early La Tene grave group making Cowlam the site of the earliest square barrows discovered in Yorkshire (Stead 1979, 30).

Brewster undertook a rescue excavation of the deserted medieval village at Cowlam in advance of deep ploughing between 1971 and 1972. Another author published the results of this work and found that no measured location plan had originally been made (Hayfield 1988, 21). Brewster identified the earthworks at Cowlam as a courtyard farm of a single period, based on analogy with other contemporary excavations, but a careful review of air photographs illustrated that there were, in fact, at least two separate farmsteads (*ibid* 103). Although a number of buildings were excavated at Cowlam the chronological relationships and the structural model for the development of the village remains complex and unclear (*ibid* 105).

A search of the Humber and East Yorkshire Sites and Monuments Record found that within a 1.6 km radius of Cowlam Manor there are 45 entries. These include four buildings and three findspots, with the remaining records pertaining to monuments including a beacon site, the deserted medieval village, two Roman roads, dykes and linear ditches and a ladder settlement. The evidence from the documentary sources and the SMR suggests that in the past Cowlam was more densely populated than it is today.

A review of the ancient, geological and hydrogeological maps found that their large scale format meant that they were difficult to apply to a small, and well-defined, study area. The soil survey data from field sheets revealed very shallow deposits along the roadside, and this is illustrative of the problem associated with mapping in which only the most accessible topographic units are sampled. The National Mapping Programme for the Yorkshire Wolds was consulted at the Aerial Survey Department at English Heritage in York and revealed the extent of cropmark evidence surrounding the valley.

Building analysis by the University of York Archaeology Department, during 2003, investigated the parish church of St Mary, which was threatened with redundancy. The church contained, a previously unrecognised, but substantial amount of twelfth century fabric in the northern wall and the building morphology was suggestive of an incorporated earlier church. In 2004, the additional discovery of a small fragment of medieval wall painting supported the conclusion that the church was not rebuilt in 1832 as previously thought, but was rather substantially altered at this time. An Anglian occupation site was detected at the head of Cowlam Well Dale by geophysical survey and during 2003, this was excavated by the Department of Archaeology from the University of York. The excavation revealed a sunken floored building approximately 5 m × 3.5 m in size with associated Anglo-Scandinavian material culture (Hummler 2004).

4.3.4 Discussion of results

The first 'artificial' feature that was recognised during the survey was the area of profound disturbance at the head of the valley, the result of archaeological activity during the 1970s when the deserted village was investigated. Two quarries were surveyed and the quarry cutting has created soil-thinning, erosion and landslips on a localised level. Although one quarry was mapped in 1890 it is unclear how recent the quarrying episodes were and whether their purpose was for masonry, as seen in the farm buildings at Cowlam, or for more general hardcore and metalling purposes. The management and use of the track way along the valley floor was a problem not envisaged at the outset of this research. The track is used regularly for heavy farm machinery and has been subject to episodes of clearance in modern times. It may also have been periodically metalled. When making an assessment of colluvial deposits recent interference is a complicating factor, with truncation a well recognised difficulty in assessing deposition (Bell 1983, 146).

The water sources have been managed at Cowlam by the establishment of a well and by the placement, and maintenance, of ponds. During the survey we were able to measure the difference in height between the extant and redundant pond, and found that the current pond is approximately 50 m lower than the redundant one mapped by the Ordnance Survey in 1890. The link between the current pond, the spring line and the redundancy of the pond, on higher ground, at the valley head corresponds to the falling groundwater levels in the chalk aquifer described by Downing *et al.* (1993). Evidence for recent environmental change was identified in the form of a water-cut gully in the woods on the eastern valley flank and an associated alluvial fan on the valley floor. This discovery correlated with the documentary sources from the nineteenth century for severe local flooding. The regular floods of 1905, 1892 and 1888 suggest that this type of event may have occurred regularly throughout the valleys history and could be responsible for scouring the valley floor of deposits, which would eventually be deposited out of the area. The fan, dating from a flood of 1905, has been named by local people 'watterwash', and evokes a folk memory, even for those born 50 years after the event (Diane Atkin pers.comm.). This indicates the importance of landscape features for local people. Underneath the fan was a 20 cm deep buried soil. This was distinctive in the field and was confirmed as an entity in the laboratory by the soil test results. The depth of deposit above the buried soil is 80 cm and this gives an indication of the rate of deposition at the time of the flood, and then since this time. The units immediately above the buried soil exhibit some sorting of the chalk gravel and may therefore represent a series of events of different intensity. Although not dated archaeologically this example reveals the creation and preservation of buried land surfaces on the valley floor in this area; this means that there is potential for the discovery of earlier soils. Vegetation and tree cover ameliorates erosion and the placement of the wood on the eastern scarp is potentially indicative of past understanding of the need to prevent erosion on more unstable slopes, that have thin soils. The study of the placement of historic woodlands would make a useful line of enquiry for the future study of dry valleys, to see whether there is a correlation with different soil types, soil depths or valley orientation.

The characteristics of the deposits at Cowlam Well Dale were striking with deep orange loess-based sediment encountered especially in the middle section of the valley. The top of the western valley slope had a thicker lobe of deposit (c.3 m maximum), associated with high plateaus of ploughing above and this formed a lynchet. The deposit is in-situ at the top of the slope suggesting some degree of stability, this is important if we recognise that the colluvium found on a slope generally represents the minimum quantity derived from a higher point (Goudie 1994, 251). Downslope from the lynchet deposit there was either a decrease in the depth of deposits encountered, or a continuation of the same depth formed by solifluction debris in lobes. The difference in the valley deposits from west to east and the discovery of a primary loess deposit are evidence for the aeolian loess deposition which we know occurred on sloping plateau surfaces on the Yorkshire Wolds in a thin, continuous sheet (Catt 1978, 19). A substantial depth of solifluction debris was also encountered on the slopes to the west reflecting a similar situation to that mapped in Holywell Coombe, Kent (Preece 1992, 177). The deposit of primary loess found during the steel auger survey is evidence for glacial activity and soil development, and provides a dating opportunity. The loess found could provide an absolute date but would be most promising if it were juxtaposed with a cultural deposit, but this did not appear to be the case from the auger survey. If the dating of the loess deposition on the Wolds were a research priority, we now have a National Grid Reference for a primary deposit which could be investigated in the future.

The auger survey is a standard technique for the characterisation of deposits and is usually the most cost-effective and resource-effective way of characterising sediments over an extensive area. We were aware at the outset that the Dutch auger had limitations but as the research progressed we were surprised at the scale of the inaccuracy witnessed. The opportunity arose to compare the Dutch and a continental steel auger (kindly provided by Holger Kessler, British Geological Survey) and this was informative. The Dutch auger survey suggested that there was negligible deposition on the valley floor in the lower reaches of the valley, however when the survey was repeated with the steel auger there was a substantial depth to the deposits here. In assessing and characterising the deposits the auger survey was the most efficient method. The test pit excavations were important in revealing artefacts/ecofacts and in exposing stratigraphic sequences for sampling but were costly on time resources. In the future, therefore, more complete coverage of the valley could be achieved with an auger survey and a more judicious approach to the use of test pits could be applied. This was the approach taken to a very large valley area by Preece (1992).

At Cowlam despite sampling and suitable soil pH insufficient molluscs were found to warrant statistical analysis. Milburn (1991) recovered significant assemblages at Birdsall, and the recently excavated ladder settlement at Wharram Crossroads also exhibited substantial preservation throughout the profile. *Sols lessives* are usually devoid of snail shells because they are decalcified during formation (Evans 1972, 217). Frost shattered solifluction debris is also known to be devoid of shells (*ibid* 289). At Cowlam two clay rich sediments were encountered and solifluction gravels were common, so this may account for the paucity of shells in some of the sedimentary units. The hard and brittle nature of Yorkshire chalk can also give rise to non-calcareous soils despite shallow sediments which do not preserve shell (*ibid* 24). The discovery of mixed, diffuse bone is indicative of manuring in this landscape and the lack of concentration in specific areas would indicate that the assemblage recovered is the result of overburden erosion and colluviation from the arable land at the top of the slope.

In addition to evaluating the archaeology and landscape processes of Cowlam Well Dale this study is situated within the wider context of the past perception of land-use, in what is today, a sparsely populated area. The issue of past and current perception can be examined by considering archaeological theoretical perspectives and the change in social theory that now regards human activity and landscape development in a dynamic, and mutually contingent, relationship (Thomas 2001, 166). Fenton Thomas (2003) has suggested that archaeologists have difficulty in perceiving the Yorkshire Wolds as a settled and lived landscape due to current land-use and the current emphasis that society places on commodity. This appears to be a convincing explanation for some of the deterministic interpretations and explanations that have been expressed. Although not situated in a 'settlement corridor' the evidence from Cowlam indicates that the valley had thick fertile soils in the past and also a spring, ponds and eventually a well, with a long history of archaeological evidence for continued settlement. Marginality is a culturally determined concept that arises from human perceptions, both in the past and today (Young and Simmonds 1995, 12). An awareness of such perceptions, in the context of wider social theory, is therefore central to the scientific analysis of dry valley sequences within an archaeological framework.

The Yorkshire Wolds are different from the south of England in terms of geology, dry valley axes, archaeology and the availability of surface water making comparisons between the regions problematic. The deep colluvial deposits seen in valley bottoms in the south of England were not evident at Cowlam, although there were thickened deposits near to the track but the truncation and management of the track itself complicated this. The recovery of significant mollusc assemblages was not possible, and nor was the discovery of a range of highly stratified and dateable artefacts.

As Wilkinson (2003, 750) has clearly demonstrated, dry valley deposits are highly variable even within a single valley system and our ability to predict where useful deposits might be located is problematic. The attempts at regional model building on the southern chalk have failed due to chronological variability and this bears out Foucault's opinion that things generally turn out differently in different places (Philo 2000, 209). The research at Cowlam Well Dale is therefore reflective of this valley and would need to be compared to further research before any limited generalisations or comparisons could be made.

4.3.5 Conclusion

The results from Cowlam Well Dale help us to understand the way in which the landscape has evolved, beginning with the formation of the valley itself by periglacial activity, the deposition of a blanket of loess which helped to improve soil quality, and the periglacial features which preceded the earliest cultural deposits discovered. They also demonstrate widespread evidence for erosion caused by human activity and natural processes working in concert. The features revealed include periglacial features, gully formation, faunal disturbance and the management of woods, ponds and tracks. The deposits were successfully characterised in three reaches and revealed episodes of erosion and buried land surfaces, also elucidating the nature of soil formation and distribution in this locality. The lack of secure dating evidence is a key issue both for this project and for future research. An artefact dating approach has not been possible at Cowlam Well Dale, or previously Fimber Nab, due to the small number of clearly reworked ceramics found. Mollusc preservation was poor, limiting the opportunities for environmental reconstruction. This research informs current perceptions of environmental and social marginality; the documentary and archaeological evidence all point to a landscape that was settled and productive, with a reasonable degree of continuity, and possessed several water sources and a relatively deep fertile soil.

The potential of dry valley research has been illustrated during this project but needs to be developed further by considering other valleys (preferably without used and managed trackways) that are close to traditional archaeological 'sites' and can allow a comparative characterisation of deposits and features. The methodological advance of using a continental steel auger on chalk and gravel deposits means that in the future more confidence can be placed on the characterisation of deposits and subsequent terrain modelling.

This project aimed to complement the long tradition of site-based archaeology on the Yorkshire Wolds by considering the potential geoarchaeological evidence from the colluvial deposits which have long been neglected by archaeologists. This research has above all, emphasised the importance of taking an 'off-site' approach to the study of archaeology.

4.4 SUMMARY

An antiquarian interest in the dry valleys of the Yorkshire Wolds was followed by continued interest from geologists and geographers in the twentieth century. The role of the dry valleys and their sedimentary histories from an archaeological perspective have been considered by very few researchers, the exceptions being Buckland and Ehrenberg and Caple. The documented studies of dry valley deposits and molluscan analysis on the Yorkshire Wolds discussed here appear to be the few examples of research from this area following an exhaustive review of the literature and indicate that the area has not been studied with same methods or intensity as the southern chalk. A body of environmental evidence has been identified that has not been brought to publication but provides an overview of various aspects of Yorkshire

Wolds landscape history and a critical review of some of the widely accepted environmental studies (Wagner 1992).

As a result of the small quantity of work previously undertaken the pilot study from 2004 at Cowlam Well Dale represents a significant contribution to understanding the landscape and sedimentary history of this dry valley. The study did however suffer from a number of problems including the truncation of deposits, methodological difficulties in assessing deposits below chalk gravel and the failure to identify in situ cultural material so that not even a relative dating scheme could be suggested.

5.0 METHODOLGY AND PROJECT DESIGN

The format that I have followed in this chapter is based on good practice guidance in the form of the MAP 2 document (English Heritage 1991) and sets out my project and research design, and methodology.

In order for archaeological investigations to be effective it is recommended that they take place in planned phases of activity, and the first of these phases is a project design (English Heritage 1991). The project design comprises three main components. Firstly, a research design should demonstrate the contribution of the project to current archaeological knowledge. Following this, the methodological issues should be considered and described, setting out clearly the proposed strategies for investigation. The final part of the planning phase is the identification of the necessary resources for the completion of the project.

5.1 RESEARCH AIM AND QUESTIONS

As previously mentioned The Wolds Research Project, University of York Department of Archaeology, was established in 2002 with a general aim 'the archaeological investigation of the complex interaction of human settlement and natural processes from the Iron Age to the present day' (Roskams 2003). A specific aim is an understanding of landscape processes over time, including taphonomy and visibility, and relationship of landscape to settlement evidence, including notions of abandonment and continuity. The question of settlement pattern needs to be considered in light of tenurial relationships, changing local hierarchies but also the role of the environment. It is widely acknowledged that fundamental questions regarding the palaeoenvironment, including woodland cover, land-use and vegetation on the Wolds, have not been answered.

It has long been recognised that dry valley colluvium has distinct advantages for the study of past land-use and environmental change because the deposits are often seasonal, resulting from overland flow, and this can result in high resolution sedimentary and palaeoecological records. This research aimed to characterise the nature of the deposits in dry valleys, assessing the degree to which we can link the deposits to phases of human activity and trace changes over time. The sediment samples obtained were examined for palaeoenvironmental data including sedimentary analysis and land snail abstraction was undertaken. The deposits found on the Wolds were compared to those found and studied in the south of England. Additionally an assessment of sites with potential wet deposits for palaeoenvironmental indicators was made. It is important to recognise that there is frequently a tension between what it is that we aim to do and what it is possible to do on the ground, often requiring us to adapt and change our plans to accommodate new opportunities, potential and limitations. Secondary to this phase of primary data gathering some assemblages arising from other research projects was assessed and finally a reconsideration of palaeoenvironmental data arising from past research on the Wolds was made.

5.2 DESK BASED METHODS

5.2.1 Documentary sources and previous records

A range of documentary sources were utilised, and are detailed and referenced in the text. The majority of the older sources were found at Beverley Library, although J.B. Morrell Library, Kings Manor and York City Library were also used. Inter-library loans were requested for some sources and internet sources were used.

The Historic Environment Record (formerly the Sites and Monuments Records) for North Yorkshire was consulted and produced large quantities of data. The search for data for an area centred on Thixendale (as an arbitrary midpoint) produced 347 pages of records that indicate the volume of archaeology in the vicinity of the study. At its western edge the primary study area lies close to the county boundary with East Yorkshire so the Multi-Agency Geographic Information for the Countryside website and search engine was also consulted, and provided detailed information on the historic environment of the local area including the portion lying in East Yorkshire (www.magic.gov.uk).

5.2.2 Mapping

Antiquarian maps of Yorkshire were consulted in the York City Library, and historic Ordnance Survey maps on the Edina Digimap web service. British Geological Survey maps were reviewed on the Edina Digimap service. The National Soil Resource

Institute at Cranfield University provides a database of soil cover on its website, and this was investigated and was complemented by the provision of a field-recording sheet from the archive (Appendix A) for the area SE86.

Land height data and other spatial data were downloaded from the Edina Digimap website and were used to construct a digital elevation model for the Wolds and surrounding landblocks. A more detailed 10 m download was undertaken to construct an accurate digital elevation model for the study area itself.

The Hydrogeological Map of East Yorkshire (1: 100,000) produced by NERC in 1980 shows groundwater levels, but these are described as 'approximations' due to the nature of the evidence. This map was used to identify spring-lines and ponds/wells and the current knowledge of the perched water table on the Wolds.

The national record for borehole and well data is held by the British Geological Survey (BGS) and was consulted at their headquarters in Keyworth. A significant proportion of local borehole information was categorised as confidential when it was acquired and is consequently inaccessible. Two records were seen for north Driffield which were made in the nineteenth century at farmyards during well digging. They recorded the solid geology (chalk) and then 'boulder clay' and so were not particularly useful for archaeological purposes (Jon Ford pers.comm.). The series of BGS memoirs had been suggested as a source of evidence for this research as they have been extremely useful in the south of England but memoirs are not available for the Yorkshire Wolds.

The Natural England website and database of Sites of Special Scientific Interest (SSSI) were used to locate and research the SSSI at Vessey Pasture Dale.

5.2.3 Aerial sources

Oblique aerial photographs for the study area from the National Mapping Programme were appraised in digital format at the Aerial Survey Unit, English Heritage, Tanner Row, York. The verticals required to look at the palaeotopography of the area were not available locally, and consequently the widely available satellite imagery from Google Earth was used as the resolution and coverage are good and it is freely available (Dave McCleod pers.comm.). Additionally, detailed ground surface data was sought from Lidar recording but the range of the data on the Wolds was limited geographically, did not cover the study area and the cost was prohibitive.

Many of the oblique aerial photographs reveal the extent of cropmark evidence surrounding the valleys in question. The abrupt cessation of features in the aerial photographs is more indicative of the edge of cropping than the edge of the visible feature (Boutwood pers.comm.). Similarly, the 'absence' of any activity in the valley itself is usually a reflection of the crop mark method rather than absence, per se. Archaeologists should not rely on negative evidence from aerial photography, such is the limitation of the method. The Stoertz (1997) volume of aerial photographic morphology was consulted.

5.3 FIELD PROCEDURES

Prior to the fieldwork Risk Assessments were completed in discussion with the departmental Health and Safety Officer and submitted to the Health and Safety Committee of the University.

5.3.1 Topographic survey

Limited topographic survey was undertaken as a background to the auger survey. This provided some familiarity with the terrain before the auger survey commenced and allowed any specific landscape features to be mapped, including earthworks and geological features such as the Fairy Stones; some unusual brecchia outcrops. The scale of the valleys themselves prevented a more detailed topographic survey as the extent of them was so great that to survey them in detail would have prevented any other fieldwork taking place. Where recorded topographic points were recorded at approximately 10-m intervals. In 2005 a combination of GPS and a Total Station theodolite were used whereas in 2006 we relied solely on differential GPS. The results of the limited topographic mapping were so restricted that they were not used in the results or discussion chapters of this thesis.

5.3.2 Auger survey

Research on archaeological sites has compared coring, shovel pits and augering as a means of assessing deposits and has deduced that shovel pits provide the most effective technique (Roskams 2001, 49). For the recording of sediments over a large area the use of an auger is more generally accepted as the most efficient method. It is an inexpensive and adaptable way of assessing site stratigraphy and the depositional processes based primarily on the assessment of soil colour and textural variations (Stein 1986, 523). Because of the difficulties encountered during the pilot study a continental steel auger was used. The placement of each auger point was decided upon on the grounds of topography and morphology and not on regular measurement, and the number of auger points taken was flexible. The Soil Survey Field Handbook (Hodgson 1997) was used to record stoniness (Appendix B), a Munsell Colour Chart was used to record numeric colour classification and a hand-texturing flowchart (Rowell 1994) was used to assess particle size. All the records were made in a weatherproof field notebook.

When the steel auger and Teflon hammer were used, the location was assessed with a deep penetrating magnetometer to guard against interference with, or danger from, unidentified buried objects or services.

5.3.3 Test pits and sections

The test pits were positioned on the auger points where there was most variation between points but as with the auger survey, this involved judgement sampling. We aimed to open test pits roughly a metre square, excavate them by hand, retrieving any artefacts or ecofacts and then record them in measured drawings (1:10) and photographs. The excavation team aimed to begin, complete and back fill each test pit within a single day due to the presence of livestock.

The soil profile is made up of classified horizons but for practical reasons and for the sake of consistency we recorded the soil horizons as numbered units from 1 down through the profile in the field.

At a later stage, the sedimentary units in each location were given a number to allow a matrix to be proposed for each location, which identified the type of soil horizons encountered. When the pits were complete a series of samples were taken from the drawn face which consisted of 1 kg samples in 2005 for bulk sampling and soil analyses. The numbers of the sedimentary layers is generally coincident with the sample numbers which were recorded for each layer. The 1 kg samples taken provided a few grammes of sediment for chemical analysis, the rest of the sample was then weighed and formed the bulk sample for mollusc retrieval. Initial assessments of mollusc numbers indicated a similar level of preservation to the pilot study and led to the decision not to undertake numerous close samples but rather to take bulk samples from each stratigraphic unit.

In 2006 the test pits were essentially five separate metre-wide sections which were within the cut face of a mechanically excavated section, and were labelled A to E running downslope. The section that was cut was stepped to provide a safe exit route for excavators and was surrounded by fencing for the protection of livestock. The bulk samples in 2006 were approximately doubled in size from the previous year to improve the likelihood of mollusc assemblage retrieval. Samples were taken avoiding stratigraphic boundaries, as recommended for mollusc retrieval (Evans 1972, 41).

5.4 POST EXCAVATION PROCEDURES

5.4.1 Survey and field data

The GPS data was post-processed by Ben Gourley and the orthometric heights were converted to the OS Geoid Model, (OSGB02). All survey data is viewed and presented in ArcMap, a component of the ArcGIS programme. The test pit drawings and photographs were standardised and annotated in Adobe Photoshop and Illustrator. The location of the interventions is provided for the reader in a map format. The coordinates that this mapping is based on are provided as an appendix (Appendix C). The location of the 1-m square test pits is based on a single point recorded for the associated auger point at each location, and this point represents a corner of the test pit.

5.4.2 Sedimentary processing and analysis

The standard tests undertaken included the recording of colour and texture, pH, phosphate spot test, calcium carbonate estimation, loss on ignition and estimation of coarse component. The sediment was air-dried and a fine fraction was produced by using a rubber pestle and mortar and a series of sieves.

Soil colour is a reflection of the chemical, biological and physical formation and modification processes that have affected the soil. Generally, a darker colour denotes a more organic deposit. As iron is the primary colouring material in the subsoil a light colour usually denotes a loss of iron oxides and clay minerals. The hue, value and chroma were assessed for wet and dry air-dried sediments using a Munsell chart.

Texture was assessed by using a hand texturing chart, as in the field, as this is the most suitable method for Particle Size Analysis (English Heritage 2004, 21).

Soil pH is one of the most commonly recorded soil properties because it reflects many important characteristics of the soil which indicate the degree of physical and chemical processes taking place, these processes affect solubility, nutrient availability and soil fertility (Huckleberry 2006, 344). Soil pH can change very quickly and it is important to recognise that agricultural soils rarely reflect the other local soils present (*ibid*). The pH was recorded by suspending sediments in distilled water and using a calibrated pH meter. A phosphate spot test measured the proportion of available phosphorus as a qualitative measure by using ammonium molybdate, hydrochloric acid and ascorbic acid and a reaction chart (English Heritage 2004, 28). The calcium carbonate content was measured by the addition of dilute hydrochloric acid to the fine fraction and using a reaction chart. The organic content was assessed by measuring the loss on ignition by heating a pre-weighed volume of the fine fraction in a crucible to 850 degrees centigrade for two hours and then re-weighing.

Although magnetic susceptibility has been used with success at a range of sites (French 2003, 68) a problem with the results during the pilot study, related to either the highly calcareous samples or internal equipment errors, led this test to be omitted on this occasion. The appropriate safety measures were taken for dealing with potentially hazardous chemicals, and a risk assessment was undertaken and adhered to.

5.4.3 Molluscan retrieval and analysis

The dried bulk samples were disaggregated using dilute hydrogen peroxide (30%) (Evans 1972, 44) and were sieved through a 500 μm mesh. After drying the snail shells were stored in soda glass tubes.

The resulting mollusc assemblages were identified using Kerney and Cameron 1979; Kerney 1999; Evans 1972; Beedham 1972; and the University of York, Department of Archaeology Reference Collection. Identification was made using a binocular microscope and an examination of the shell size, morphology and microstructure and significant proportion of the identifications were double checked by Professor O'Connor. The Biological Records Centre (formerly the Centre for Terrestrial

Ecology) was consulted and Adrian Norris kindly provided information regarding modern mollusc distributions for the study areas (Appendix D).

All artefactual and ecofactual material was retained but the gravel residue was discarded after processing.

5.4.4 Thin section analysis

In section C at Whay Dale 2006 a series of three small sedimentary profiles were sampled with Kubiena tins and sent to Stirling University for thin sectioning.

The analysis of the three resulting slides was undertaken in the Bioarchaeology laboratory, University of York, using a polarising microscope under the direction of Dr Usai. The slides were visually inspected and counts for porosity were made using a grid and count sheet. A recording sheet was devised for the analysis of the slides.

5.5 RESOURCE ALLOCATION

5.5.1 Site selection

The sites for primary investigation were on the northern central Wolds close to the western escarpment, to correspond with the Wolds Research Project area, and were deep, steep sided valleys with flat-bottomed profiles. They were all in close proximity to recognised archaeological sites and activity.

The single largest determining factor in site selection was land ownership and access. This was advanced on this occasion by a long and successful collaboration between the Department of Archaeology, University of York and the Birdsall Estate, along with the inter-institutional Wharram Research Group. Permission was received from the Birdsall Estate and from Charles Brader of Thixendale. My initial enquiry letter to two other large estates elicited no response. Permission was sought from English Nature to undertake research in the SSSI at Vessey Pasture Dale and was given conditionally (Appendix E).

The discovery of land snail shells during excavations at Wharram Grange Crossroads (Department of Archaeology, University of York) and at Thwing (Department of Archaeology, University of Cambridge) led to the opportunistic appraisal of these assemblages. Several other sources of data were sought but were unsuccessful and are discussed in Chapter 7. The Environment Agency supplied a range of numeric data pertaining to water and environment on the Yorkshire Wolds which will also be reviewed in Chapter 7.

5.5.2 Personnel

Fifteen individuals undertook a total of 142 days work to assist in the completion of the research. All those participating in the project were undergraduate and postgraduate students from the Department of Archaeology, University of York. Everyone gave freely of their time and some of the undergraduates undertook individual projects as part of this research that formed a summative assessment towards their final degree classification.

5.5.3 Equipment and subsistence

All the necessary survey and excavation equipment was loaned from the Department of Archaeology, University of York. Several individuals, with the means, provided the transport to site. Accommodation was freely provided at Vessey Pasture by the Wharram Research Group, and was kindly arranged by Paul Stamper. A contribution towards food and petrol expenses was generously provided by the Department of Archaeology, University of York through its funds for encouraging practical training and projects for undergraduate students.

5.5.4 Specialist assistance

A number of specialists were approached to help give advice and practical help, especially during the post excavation period and were mainly found within the academic community of the Department of Archaeology, University of York. Dr Usai gave geoarchaeological advice, Dr Harland statistical assistance, Dr Hall assessed seeds and Prof O'Connor faunal and land snail identification. Dr Penkman undertook amino acid racemization of a slug plate for dating purposes. The Geoarchaeology Laboratory, Stirling University undertook the thin section production. Dr Mainman of York Archaeological Trust kindly assisted with pottery identification.

5.5.5 Archive management

The archive produced from fieldwork will be housed at The Hull and East Riding Museum, along with a copy of this thesis. The production of the archive will be in line with the specification for site archives (English Heritage 1991) and also the requirements of Hull and East Riding Museum, who provide the archive service for researchers free of charge (Martin Foreman pers. comm.). A digital copy of the thesis will be archived with Archaeology Data Service in the Library Collection and following the guidelines produced for digital data by the Archaeology Data Service.

6.0 PRIMARY FIELDWORK RESULTS

All the fieldwork sites are in an area known as the High Wolds (Figure 14), this is an ill- defined central area on the chalk, towards the western escarpment, at heights of up to 250 m AOD. As discussed previously, the solid geology is traditionally identified as Middle Cretaceous Chalk and this is overlain by little drift geology and a series of shallow calcareous soils. The thin soils of the Wolds are of the Icknield Series, a well-drained, stony loam or a silty rendzina from chalk (Matthews 1975, 106). This soil was originally formed about 18,000 years ago from a combination of soliflucted chalk, boulder clay and windblown silty loess which was derived from the North Sea basin (English Nature 1997, 4) and this has since developed into a mature soil. The deeper Wolds Series soil is a well-drained brown earth from plateau drift over chalk, occurring to a depth of approximately 60 cm (*ibid* 107).

The Historic Environment Records Officer for North Yorkshire County Council searched for relevant Historic Environment Record data (HER and formerly the SMR) on the 19th May 2005 (extract in Appendix F). This led to 327 pages of records for a study area, generated by exeGesIS HBSMR software, for Thixendale village (SE841615) which was a central, but arbitrary, point for the Vessey Pasture, Fairy Dale, Whay Dale and Burdale intervention sites. The records generated included the relevant codes for the Wolds National Mapping Programme which, under the RCHME, carried out the transcription of aerial photos from the Yorkshire Wolds between 1981 and 1991. The majority of the HER data pertained to antiquarian records of barrow openings in the area and also records large numbers of linear earthworks, as discussed in Chapter 2, which are frequently recorded as 'crossdykes'.

First Edition Ordnance Survey maps for each study area were consulted on Edina Digimap and Landmark Information websites, and extracts copied where necessary. Antiquarian and historic maps of the area were consulted at the City of York Reference Library. The earliest were Speede's Yorkshire of 1610, Blaeu's 'Ductus Eboracensis' of 1645 and Morden's 'The East Riding of Yorkshire' of 1695. These maps and those from 1736, 1750 and 1808 all emphasise administrative boundaries and represent topographic features in a stylised manner. There is nothing directly pertinent for this research which can be deduced from these maps. However, the representation of the Gypsey Race in Speede's 1610 map as a river of equivalent size to the Derwent and the Hull is of interest. This may be a feature of the mapping style but may also be an indication that before the drop in the water table, and the widespread abstraction, the flow of current small streams was not dissimilar to some of the regions more modest rivers.

The entire Wolds is covered by a combination of shallow lime-rich soils over chalk and freely draining lime rich loamy soils (Figure 15). The Field Sheet for SE86 and the relevant literature (Jarvis *et al.* 1984) show the soils of the study area to be 3.41c, 3.43h and 511c. 3.41c is an Icknield Association shallow, stony, well drained silty soil on chalk usually confined to steep slopes and chalk escarpments and this is a thin rendzina. 3.43h is an Andover 1 Association soil which is a shallow well drained calcareous silty soil on crests and deep calcareous, and non calcareous, fine silty soils in valley bottoms. 511c is a Panholes Association soil and is a well-drained stony calcareous soil that occurs most commonly on gently sloping land. Some outcrops of Kimmeridge Clay (a Jurassic sedimentary marine clay) are known just north of the study area at Birdsall Brow and Wharram Grange.

The fieldwork took place during 2005 and 2006 and the team comprised of a range of undergraduate and postgraduate archaeology students from the University of York. Between the 9th and 24th June 2005 a team of twelve volunteers worked a total of 80 days undertaking interventions and surveying at Vessey Pasture (Thixendale Parish) and at Fairy Dale and Whay Dale, both part of Burdale township. The following year, between the 12th and 26th May, eleven volunteers worked a total of 62 days. The fieldwork in 2006 was centred on Burdale and was linked to the excavation of an Anglian settlement site by the Department of Archaeology, University of York in the main Burdale valley (see Figure 14). The geoarchaeological section, forming part of this research was cut in the adjoining valley of Whay Dale.

The fieldwork in 2005 took place in warm, bright and dry conditions which posed some problems for the methods and especially for accurate recording. During 2006 the weather was predominantly wet and relatively cold (for the time of year) and flooding in the trench, followed by the collapse of parts of the section, became increasingly problematic.

6.1 VESSEY PASTURE DALE

6.1.1 Desk based assessment

Vessey Pasture Dale (SE 832621, 165 m AOD) is a dry valley site in Thixendale parish. Thixendale is renowned as the most isolated and remote of Wolds villages and is enclosed by 16 converging dales. The name Thixendale first appears in Domesday as "Xistendale" and by 1695 is spelt "Thistendale". One common explanation locally for the Thixen pre-fix is an association with the 16 dales surrounding the village but it is suggested that this is more likely to arise from a Norwegian name Sighsten (Smith 1970, 133). The area of land from Vessey Pasture Dale eastwards to Raisthorpe, to the north at Birdsall Brow and to the west as far as Aldro contains no less than 14 bowl barrows. The barrows are often associated with the crossdykes (linears or entrenchments), and a combination of crossdykes and prehistoric trackways appear to enclose Vessey Pasture Dale (Figure 16). The concentration of monuments in the locality and the nearby Vessey Ponds have led to the suggestion that this was a Late Bronze Age 'estate' of an extensively cleared agricultural and pastoral region, containing the only permanent open water for some miles around (Hayfield *et al.* 1995, 402).

To the east of Vessey Pasture Dale the Aldro earthwork group comprises a scheduled linear boundary, cross dyke and nine barrows. These earthworks are so extensive that they cross four parish boundaries. Mortimer investigated the linear boundary here during the nineteenth century. He found that it was constructed later than the barrows but that, where they occur in close proximity, the linear respected the barrow locations. Further to the east is the circular site of Mount Ferrant. This motte and bailey castle is built upon a spur of chalk on a promontory, which forms a naturally defensive position. Documentary sources suggest that Nigel Fossard built the castle in timber but that it had gone out of use by 1150. Extensive remnants of the timber foundation structure and occupation debris lay undisturbed on the site. The most significant monument for the study area is the cross dyke from Birdsall Brow to Vessey Pasture Dale incorporating two bowl barrows and a further cross dyke extending towards Vessey from Water Dale (Monument Number 20471) (Figure 17). The cross dyke is still visible extending down the centre of Vessey Pasture Dale and has been altered by subsequent agricultural activity, not least of which is the current electric fencing which is dug into the ancient boundary (Figure 18). This is the line of the modern parish boundary, and also signifies different landholding, demonstrating the longevity of many of the ancient boundaries. The earthwork consists of parallel ditches, which are largely infilled, and a bank of between 0.3 and 0.5 m in height between the ditches. At Backdale, which adjoins Vessey Pasture Dale, Mortimer cut three sections across the line of a natural mound in 1879 to assess the geology and process of chalk mass slippages downhill slopes in the Yorkshire Wolds. Completely coincidentally, the first section exposed an oval grave cut which contained the remains of three individuals, an infant, a young female and a youth (Mortimer 1905, 19). The grave also contained a crushed drinking cup, a Beaker type vessel and some burnt wood and calcined bone (*ibid* 19). There are examples of large stable chalk lobes to be seen on the valley side/base today (Figure 19).

In Stoertz (1997) there are few transcriptions of aerial photographic data for the valley itself, with a single linear running from above the northern slope, where it is associated with two circular features on the interfluve before joining the valley at a right angle running downslope towards the base of the valley. The current earthwork that runs north from the Vessey Earthworks via a small side arm of the valley towards Toisland Wold is dissected by another linear from aerial photography which runs obliquely and at the visible tumuli this earthwork meets a variety of triple and single linear features and a range of circular features. On the southern interfluve are traces of two circular features on the highest land. What the aerial photography transcription for this area shows very effectively at nearby Water Dale, Thixen Dale, Long Dale and Back Dale is that the linears are visible only as cropmarks across the arable interfluves. However, on the valley sides they are frequently preserved as visible earthworks (Figure 20). The Ordnance Survey map of 1893 shows the position of a round barrow in the valley, six chalk pits and five ponds including Vessey Ponds but by 1977 mapping records two disused pits and two ponds in the valley, Vessey Ponds are not mapped although satellite imagery shows them clearly. Trackways that led up to Vessey Ponds and from the farmhouse are no longer mapped by 1977, although they are represented on earlier maps.

In 1991, and then again in 1994, a fieldwalking programme was undertaken in the field surrounding Vessey Ponds (or Vessey Hollows as they are also known), two natural chalk depressions above Vessey Pasture Dale to the east of the farmhouse known as Vessey Pasture (Figure 21) (Hayfield *et al.* 1995, 395). The programme was carried out by the Wharram Research Group and found a total of 260 flints from a random survey, 253 from a gridded survey and 1288 from a transect survey. These stone tools represent the period from the Mesolithic through to the Bronze Age and statistically have the greatest density around the ponds themselves (*ibid* 396). The farmstead at Vessey Pasture was also studied by the Wharram Research Group and has as its northern boundary a prehistoric routeway, the Towthorpe Ridgeway. A small High Wolds farm of c.200 acres (approximately 80.9 hectares) it is relatively isolated from the surrounding road network and the buildings are plain and modest (Hayfield 1998, 109). This farmstead is of interest as it is a post-enclosure farm that remained in permanent pasture even after Parliamentary Enclosure. The pasture land at Vessey and neighbouring Aldro is almost certainly the heath land and pasture that was the subject of a boundary dispute in 1268 between the Abbott of St Marys, York and Peter Maulay of Birdsall and this led to a trial by combat which Peter's knight lost (*ibid* 111). The next text that refers to this land, is the record of a purchase of a sheep pasture at Thixendale by William Vessey in 1694 (*ibid* 112).

Built in 1802, the design and layout of the farmhouse is an interesting example of building form reflecting social and economic changes. The archaeological study and recording of the range of buildings has revealed several phases of development related to changes in the prosperity of the Estate and the management of these type of farming estates, with living space enlarged to accommodate 'farm lads' during times of high agricultural yields (Hayfield 1998, 119). Census returns for 1841 show that a tenant farmer, Henry Megginson, lived here with his family, two male farm hands and a female servant but that by 1851 this had increased to four servants, a groom lad and a female servant (*ibid* 120).

Vessey Pasture Dale and Backdale is a 25 hectare Site of Special Scientific Interest and was first designated in 1985 due to the presence of rare calcareous grassland which had developed due to the long term absence of heavy grazing or fertiliser applications (Figure 22). The type of grasses featured here include, on the south-facing flank of the valley, brome, salad burnet and dropwort. The north-facing slope is less calcareous but also has a selection of rare fauna including pignut, devils-bit scabious and tormentil (English Nature 1997).

The mosaic of diverse grassland that once dominated the Wolds landscape is now reduced to around 1.5% coverage mainly due to agricultural intensification and the increase in arable land provision (English Nature 1997, 3). Research has revealed a 35% loss of calcareous grassland during the 1980s, due to an increase in agricultural activity and intensity. This took place at a time when awareness of, and management plans for, rare habitats was being developed but had not yet been implemented (*ibid* 9). An assessment of the grassland at Vessey Pasture in 2005 found that it was in an unfavourable condition, but recovering, and an active management agreement plan was in force between Natural England (formerly English Nature) and the landowners, Mr Brader of Thixendale and the Birdsall Estate. Scrub land tends to encroach on and threaten chalk grassland but is, in itself, still part of habitat diversity. The long distance walk 'The Wolds Way' runs for 127 km from the Humber to Filey and passes through Vessey Pasture Dale bringing with it a small, but regular, number of visitors.

6.1.2 Field results

The valley at Vessey Pasture Dale is a branching valley from the main Thixendale valley and runs almost west to east, with a slight WNW-ESE trend, mirroring the main Thixendale valley axis. Within the area investigated, the height difference from the top of slope to the base was divided by the distance in metres across the ground surface. This gave a gradient of sorts that could then provide a comparison from slope to slope. Although based on the distance over the ground surface rather than the actual distance we found that the northern flank had a gradient of approximately 32%, whilst the southern flank had a shallower gradient of 25%. The maximum height from the top of slope to the base of the valley was 33 m, with the southern slope c. 7 m higher than the northern slope.

The slopes are reasonably uniform and appear mainly straight sided on both flanks except for specific areas where there has been mass slippage and lobes of chalk are visible. The valley head can be described as fishtailed which is the same shape as the main Thixendale valley. Some relict palaeochannels appearing as rills, gullies and dendritic heads can be identified on the satellite imagery (Figure 23).

Seventeen auger points were recorded at Vessey Pasture Dale in two transects (Figure 24). Many of the attempted auger holes were unsuccessful due to the loss of dry deposits following very dry weather experienced during the preceding winter and spring. Remedial attempts were made to pour water down the auger chamber to consolidate the dry sediment but this failed. Consequently the auger records themselves are frequently the result of three separate attempts and an occasional spade pit, which was used to augment the record for the uppermost part of the sequence. Therefore, significantly fewer auger points were recorded than had been proposed at the outset and this was essentially a change to the planned methodology. A further factor affecting progress at Vessey Pasture was the quantity of cattle, all of which were cows with calves, and for whom our activities provided a focal point (Figure 25). The first auger point recorded was an auspicious occasion with an approach from a passing walker on The Wolds Way who was recording a programme for BBC Radio 4; our dismay on finding the auger chamber empty was recorded for all to hear.

The two auger transects ran from the top of the northern slope to the valley base, crossing the earthwork and up to the top of the southern slope and were spaced approximately 40 m apart. Care was taken to avoid interference with the scheduled monument as permission had not been sought to investigate this.

The topsoil was classified as very dark greyish brown to dark brown silty loam across the site, at the top of the northern flank this rests on chalk gravel at depths of between 9 and 70 cm (Table 1). The southern flank had around 80 cm of silty loam underlain by up to 70 cm of silty clay loam. In the valley base, close to the earthworks, there was between 11 and 65 cm of silty loam underlain by up to 1.2 m of very dark greyish brown to dark yellowish brown silty clay loam. In several places this was underlain by a c.70 cm deposit of clay loam or silty clay which was yellowish brown. Where chalk was hit at 9 cm, on several occasions, a spade pit was dug to confirm a significant lens of chalk gravel. The degree of stoniness due to chalk gravel was variable but seemed to occur most commonly at 88–90 cm depth (Figures 26 and 27).

Three test pits of approximately 1 m^3 each were hand excavated (Figure 28). Test pit (hereafter TP) 1 was at the top of the northern slope was 85 cm deep and comprised five layers (Figures 29 and 30). The basal layer was not sampled as it comprised predominantly soliflucted chalk gravel. Above this lay a 20 cm layer of silty clay loam which was overlain by brown silty clay loam and then a stony, brown silty clay loam which lay below the topsoil. The final layer was a thin (10 cm) topsoil of dark brown silty loam. Within the topsoil of TP1 was a fragment of brick/tile and a small piece of slag.

Test pits 2 and 3 (TP 2 and TP3) were both situated towards the bottom of the valley floor close to, but not encroaching on, the earthwork. TP2 was below the higher southern slope and had basal layer consisting of a dark yellowish brown silty clay loam with small gravel and above this lies a dark yellowish brown silty clay loam. Above this lies a dark brown silty loam and then a brown silty loam topsoil (Figure 31). TP3 began with a chalk gravel layer with a negligible matrix of yellowish brown silty clay loam/loam. Overlying this was a dark yellowish brown silty clay loam, which was beneath a dark brown stony silty loam. Finally, there was a thin, dark brown silty loam (Figure 32). In TP3 the boundary between the third sedimentary layer and the fourth gravel layer exhibits the undulating appearance of periglacial involutions which can be clearly seen in section and has a very sharp boundary (Figures 33 and 34). It was just above this boundary that a shiny black pebble was found which was completely different to all the other lithology seen in this area, although not classified as an artefact this was kept as part of the assemblage from this site. Some bands of colouration were seen in the clay loam in these test pits but were ephemeral and were not defined as stratigraphic entities.

6.1.3 Sedimentary results

The twelve samples taken from Vessey Pasture for laboratory analysis and mollusc extraction totalled 8.5 kg in weight but the weight of each independent sample was variable and dependent on the ease of sampling, the depth of the layer and the amount of chalk gravel (Table 2). As can be seen for the coarse components recorded in the laboratory all the samples were stony, as classified by the Soil Survey Field Handbook (Hodgson 1997), and the amounts of stoniness ranged from slightly stony at 7.5% to extremely stony with a maximum rate of 88%. This is without a sample for the chalk gravel in TP1 which was considered almost exclusively stone and therefore not sampled. All the sedimentary units in TP1 had coarse components of over 50% when analysed in the laboratory. TP2 and 3 both had a low percentage coarse component for the topsoil, but in subsequent layers this increases to a maximum of 88%. The volume of chalk gravel has an inevitable impact on the progress of hand excavating and the likelihood of finding useful deposits but as was discovered during the pilot study, at Cowlam Well Dale, buried soils can be found underneath substantial pulsed gravel deposits.

Coarse component or stone shape (sphericity or angularity) and size were assessed in the laboratory using the charts from Hodgson (1997). In TP 1 there was a variation in shape from sub-rounded to sub-angular and then angular, with some layers having a combination of all shapes. The topsoil here had a size range of very small to medium whilst, as expected, sizes towards the bottom of the sequence ranged from very small to very large. TP 2 had a sub-rounded layer, followed by a sub-angular layer, then a sub-rounded layer again and finally a sub-angular layer. All the sizes in this test pit were from very small through to medium with only small or very small stones in the top two layers. In TP 3 all the stones were angular or sub-angular with very small to small stones in the topsoil and small to very large in the subsequent layers.

All values for calcium carbonate estimation were unsurprisingly high except for the three units which were either slightly, or in one case moderately, stony. The dry sediment colour recorded for each sample revealed some very pale brown and light grey shades but the wet colours were comparable with those seen during the auger survey, predominantly dark brown or yellowish brown.

Phosphate levels were variable between test pits but in every case they increased the further down the sequence, with the maximum value in the basal layer, even though this is predominantly gravel, and in spite of plenty of surficial cattle waste. The 'loss on ignition' values all lay within a close range 7.45- 22.81 % and in TP 2 had the highest value represented in the topsoil. In TP3 the values were closely clustered in all layers ranging from 12.14-18.87% but showing no trend in rising or falling values and in TP1 the value in the third layer was 22.81% which was higher than the upper layers (16.4 -16.66 %) but not significantly so.

Overall, the pH values recorded for Vessey were low for calcareous grassland particularly in TP2 (samples VP 5–9) where they were 5.41 for the topsoil and then 6.3 and 6.75 for the next two layers. Only the basal layer contained a basic sediment with the pH at 8.53 and this was comprised of mainly chalk gravel. In TP2 and 3 the pH values ranged from an almost neutral 7.54 through to 8.71.

6.1.4 Molluscan analysis

Following the processing of the 8.5 kg of sediment from Vessey Pasture Dale there were just three land snail shells recovered from Samples 1 and 2 (Table 3). These snail shells were therefore in the topsoil and stony topsoil layer and could therefore have been incorporated within the sediment during the excavation. Although these were shells rather than live snails, they could have been deposited relatively recently. This would seem the most likely explanation for the preservation of so few snail shells amongst all the sediment examined. These sediments must presumably have undergone a widespread episode of decalcification in the past and, in light of the current pHs recorded, continuing hostile conditions for the preservation of shells in some areas. One shell is that of *Helicella itala* which is not on the current distribution charts for Thixendale, this is the closest location with a modern mollusc distribution record (Appendix D).

6.1.5 Summary

Two of the test pits have a Cr base layer which is predominantly a chalk gravel which is likely to have weathered in situ (Figure 35). Solifluction gravels are not solid geology in the strictest sense but are formed from parent material which is redeposited and/or weathered. In the cases considered as part of this research, substantial lobes of solifluction gravel are described as Cr-horizons. In TP1, this layer was exclusively chalk gravel and was not sampled, but in TP 3 the gravel predominated within a matrix of yellowish brown silty clay loam or loam. Above this is a B-horizon, a stony silty clay loam which is greyish brown or yellowish brown in colour and is a maximum of 35 cm deep. The A horizon is a silty loam with a stony A-horizon beneath, this horizon is between 20 cm and 40 cm thick.

Despite the location of the test pits at Vessey Pasture being close to an existing system of ancient and complex earthworks, an ancient water source and the valley being the location of an isolated burial site in the past there was no suggestion of any anthropogenic activity during the auger survey or test pit excavation, apart from generalised agricultural activity. Recent agricultural activity and boundary demarcation here has damaged the earthwork and has potentially reduced the calcareous grassland to unfavourable conditions by the application of acidic fertilisers. This is represented in the evidence for low pH results for a calcareous landscape and the lack of mollusc preservation.

6.2 FAIRY DALE

6.2.1 Desk based assessment

The Fairy Dale dry valley is part of the broader Burdale valley (SE871631) (see Figure 14). The Fairy Stones are located 35 m above the valley floor and are designated as a Regionally Important Geological Site (RIGS). They are composed of breccias formed by ice wedge fissures developing in the chalk during the Devensian period and then subsequently being filled with gravel, flint and quartzite sedimentary rocks which were then subject to calcite cementation when the warmer interglacial period arrived (Gobbett 2004). Similar to the other breccias on the Wolds the Fairy Stones are associated with mystical powers and connections as they are in stark contrast to the surrounding ubiquitous chalk (Figure 36).

The Burdale Tunnel is almost a mile long and was cut through the western flank of Fairy Dale as part of the construction of the Malton & Driffield Junction Railway line. The pools of spring water seen today near to the tunnel entrance are just a hint of the inherent problems with the construction and maintenance of this tunnel during the 1850s. The railway was sited here to provide transportation for the chalk from the Burdale Quarry at Fairy Dale. The chalk in the north of the Wolds is hard enough to be used as building stone (clunch) but it can also used for liming and in many industrial processes. At its peak, between the 1920s and 1950s the almost pure chalk from Burdale Quarry was predominantly bound for the steel works of Redcar where, once reduced to lime, it was used industrially to remove the sand and silicates from metal ores. At this point, 50,000 tons of chalk per year was quarried at Burdale, and the mineral trains were known locally as 'Chalkies' (LNER 2008). It was the quarrying activity, rather than the passenger service, which ceased in 1950, this led the railway at Burdale to continue in use until 1955. The quarry closed in 1955 and the tunnel was eventually sealed in 1958, following a roof collapse, in a pre-Beeching move to reduce the number of under utilised branch lines (Figures 37 and 38). Recent interest in rebuilding a heritage railway line from Wharram to Burdale and Fimber has resulted in a public meeting and a campaign of fundraising. There is also a discussion, in these circles, of a possible subterranean lake at Fairy Dale (presumably a water filled solution hollow) which is thought to influence the longstanding drainage and water problems (LNER 2008).

The Burdale Quarry at Fairy Dale has two current designations; it is a RIGS because it has exposures of Turonian chalk (along with Beacon Hill and North Ormsby Marl) and it is also a Site of Importance for Nature Conservation (SINCS), registered by Ryedale Council due to the species rich calcicolous grassland and wildlife, especially butterflies (Figure 39). As part of the SINCS designation process it was determined that the area of the Dale and the quarry comprised 17.5 hectares of semi-improved grassland and 16.1 hectares of unimproved grassland. The agricultural improvements had meant that until 1993 there had been areal fertiliser applied which had led to the development of species poor swards of grass at this time. Since 1993 the land has been part of a stewardship agreement and has been lightly grazed with no further fertiliser applied (Countryside Commission 1998).

From an archaeological perspective, the nearest monuments to Fairy Dale are the group of barrows on Wharram Percy Wold (Monument Number NY745). They are approximately 200 m from the north-western edge of Fairy Dale. A few hundred metres to the north-east are a group of seven barrows on Towthorpe Wold which are along the current county boundary (Monument Number 26540). These monuments were investigated by Mortimer in the nineteenth century and are today much reduced/damaged by agricultural activity. They form part of the chain of 21 barrows, named the 'Towthorpe Group' by Mortimer, which lie above Fairy Dale and stretch for approximately four miles (Mortimer 1905, 1) (Figure 40). It has been estimated that 70 tonnes of grey clay were required for barrow building at this site and it is likely that this came from Burdale (*ibid*).

The most comprehensive archaeological survey of the area comes from the Wharram Parish Survey of 1974 (Hayfield 1987). Three areas of settlement were defined around Burdale, including a fourth century Roman farmstead which was found at 185 m AOD just above the western flank of Fairy Dale (SE869633). This site was originally identified due to the recovery of 600 pottery sherds found during a programme of field walking, with the main class being 283 pieces of hand made calcite-gritted ware, with the commonest recognisable vessel dating to the fourth century AD. This site was later confirmed by cropmark evidence for a sub-divided rectilinear enclosure and a possible double ditched trackway which appears to head down the valley side of Fairy Dale although the evidence is partial (*ibid* 128) (Figure 41). Activity on the site is noted to range from the Iron Age until the fifth or sixth century AD (*ibid* 132). The proximity of this activity to the prehistoric trackway, the Towthorpe Ridgeway, which runs just north, is felt to be significant.

To the west of Fairy Dale are a series of short and long double linears which run from just above the Fairy Stones towards Bella Farm and Wharram Percy. Across the adjacent Raisthorpe Wold a series of unaligned linear features and associated circular features proliferate, but do not appear to follow the topography. From the head of Fairy Dale a single linear runs north a short distance before joining other linears to form a triple feature, where this feature meets other similar features it turns sharply west towards Bella Farm and Wharram Percy. A small rectilinear enclosure adjoins the linears just north of Fairy Dale close to the cluster of barrows on Towthorpe Wolds (Stoertz 1997). Historic maps for this location show that in the late nineteenth century (1890) the area was more settled than today with a group of cottages, Tunnel Top Cottages (with rectangular plots and lying above the Fairy Stones) and a single cottage, Fairy Stone Cottage, above Fairy Dale. By 1977 there is no trace of any of these dwellings. A pond and a chalk pit visible in 1890 have disappeared from the map by 1977, and the many small field boundaries visible in 1890 have been lost, resulting in massive fields especially over Kirk Hill to the west of Fairy Dale.

6.2.2 Field results

The Fairy Dale valley has a kink and the axis shifts from an initial trend E-W to a largely N-S axis before finally swinging around to a NNW-SSE direction and joining the main Burdale Valley at a shallow angle. The valley slopes are asymmetrical at Fairy Dale and the valley head ascends sharply to a single point. The height of the valley base towards the valley head is 146 m AOD compared with a height mid way along the valley base of 117.6 m AOD. This is a height difference of almost 30 m for one portion of the valley. The valley slopes are of a complex form with a mainly straight-sided flank to the east and slight convexity at the top of slope. The gradient on the eastern flank is 36 % with the corresponding western flank, close to the Fairy Stones, an extremely steep gradient of 46%. The height difference between the two flanks is almost 13 m difference with the western flank higher. The western slope is predominantly straight sided with marked concavity in the area of the Fairy Stones and a linear depression that looks indicative of water movement close to the stones themselves and the satellite imagery for the Fairy Dale, Whay Dale and Burdale area shows relict channels especially to the north-east of Whay Dale (Figure 42).

The placement of the auger transects at Fairy Dale was dictated by several elements. A key factor was avoiding the disturbance associated with the railway tunnel construction, the quarry and a garden area in the valley bottom. Another consideration was the topography and changes to the profile of the valley floor and finally the location of the monuments and Roman settlement site on the slope above the valley to the west.

Two transects were run from the top of the eastern scarp to the top of the western scarp above the Fairy Stones. Two extra points were carried out at the valley head, towards a gully that was recorded, and where the relationship of the valley sides to base was particularly acute (Figure 43). The valley slopes are asymmetrical with the western slope 13 m higher than the eastern edge. The height from the top of the slope to the valley base is a maximum of 58 m.

The first transect commenced at the top of the eastern slope. The first auger point revealed 109 cm of sediment (silty clay loam, clay loam and silty clay) onto chalk gravel but the next point was unrecordable after four attempts (Table 4). The next point downslope had 150 cm of silty loam and clay loam which was the maximum extent of the auger. However the remaining points on this slope all contained less sediment than the maximum possible, and even in the base of the valley 132 cm was the maximum recorded and this was a silty clay loam. Small traces of charcoal were seen in auger point 1/7 at a depth of between 26 and 74 cm. It was not possible to record any points in the area Ag 1/8 and 1/9 (sediment not in chamber on more than three occasions) and there was then a large gap in auger records until 1/11 due to a large area of disturbance from an active badger sett (Figure 44). A second transect ran from the top of the eastern slope, about 30 m distant from the first transect, and up the western slope past the Fairy Stones. Towards the top of the eastern slope, a distinctive dusky red silt rich sediment was recorded between 44 and 75 cm. The topsoil in this area is comprised of a very dark greyish brown or dark brown silty loam underlain by a silty clay loam which ranges in colour from a very dark brown to a dark yellowish brown. This is then underlain predominantly by a clay loam which tends towards yellowish brown (Figure 45). At the top of transect 1 this is underlain by a light yellowish brown silty clay (FD1/1). This is also seen high up the slope in transect 2 (FD2/1 and 2/4). The two auger points recorded at the valley head (FD3/1 and 3/2) contained large quantities of chalk gravel from 40 cm below the ground surface (Figure 46).

Four test pits were hand excavated at Fairy Dale. These were approximately 1 m^3. A gully, near the valley head, was also recorded and sampled as an additional test pit (Figure 47). TP 1 (Figure 48) was excavated in the base of the valley, on the eastern flank, and had a simple profile beginning with a yellow brown silty clay loam which was 50 cm deep, above this was a stony silty loam and this was overlain by a brown silty loam topsoil, the boundaries were diffuse (Figure 49). The overall depth of this test pit was 92 cm and at the base of the silty clay loam, a horse tooth was found within a few centimetres of the soliflucted chalk gravel that lay beneath.

TP 2 (Figure 50) was situated close to the Fairy Stones and aimed to examine an area towards the top of the slope which was relatively close to the Tunnel Top Roman farmstead. This test pit comprised a basal layer of brown silty clay with burnt stones and charcoal flecks, overlain by stony silty loam, with a pocket of yellowish brown silty clay loam (Figure 51). The topsoil was a very dark brown silty loam and most of the sediments were dark here probably due to charcoal throughout the profile. Unsurprisingly this test pit, located close to the Fairy Stones, produced the greatest amount of artefactual material (Table 5). The topsoil contained modern ceramic fragments and a piece of modern glass along with four pieces of brick/ tile. The stony layer beneath contained a single piece of calcite gritted ware and an unidentified fragment of ceramic material in addition to six assorted bone fragments. These fragments included a roe deer metatarsal and a water vole incisor in addition to the more usual domesticate bone fragments. Within the yellowish brown silty clay loam were several bone fragments and a single piece of Iron Age or Romano-British pottery. The basal layer with the charcoal flecks and burnt stones did not produce any artefacts.

The gully section was then recorded (Figure 52). The sediments here were very stony throughout the profile. The base was a pale brown clay loam surrounding large angular chalk blocks, this was overlain by a grey brown silty clay loam (which was the matrix) around a predominance of angular chalk gravel (Figure 53). The topsoil was 15 cm of stony brown silty loam, a thin rendzina. A piece of modern glass was found in the topsoil and four unidentifiable bone fragments in the subsoil. The sediments seen in this gully section were very much paler that those seen elsewhere, and were pale brown even when wet. As the sediments were texturally similar to the other test pits this led us to surmise that the unusual colouration may be due to the extended recent weathering and exposure of this profile rather than any specific or important sedimentary difference from the rest of the sequences. This process of eluviation is the translocation of minerals and humic material, however the loss on ignition results were not dissimilar to the other test pits in this area and will be discussed in the next section.

TP 3 (Figure 54) was located at the base of the western valley flank and began with a basal layer of greyish brown silty clay loam. This was overlain by yellowish brown silty clay loam, followed by a silty clay loam and the final layer was brown silty loam topsoil (Figure 55). All the layers in this test pit were very stony but the size of the stones was small, and therefore different from the angular pieces of chalk gravel commonly seen in the other test pits. The interfaces between layers in this test pit were difficult to establish due to gradual horizons with an appearance of heterogeneous unsorted colluvial material. The photographs taken of this test pit do not give the additional information one would hope for due to the light conditions and the shade created within the test pit on the day of recording. Cultural material found in the test pit consisted of an abraded Roman amphora fragment found at 31 cm below the current ground surface and a probable Iron Age or Romano-British ceramic fragment at 50 cm below the ground surface (Figure 56).

TP 4 (Figure 57) was undertaken at the top of the eastern slope to investigate the deep overburden deposits seen during the auger survey in FD1/1. This test pit was 90 cm deep and comprised a base of angular chalk blocks with a series of interleaved layers of brown to yellowish brown silts and clay loams above which contained varying amounts and concentrations of small chalk gravel, and sharp boundaries (Figure 58). No cultural material was found in this test pit. The depth of deposit at the top of slope is suggestive of an overburden deposit forming a type of lynchet.

6.2.3 Sedimentary results

There was a wide variation in the sediment colours recorded mainly due to the colouration in the gully, as already discussed. The dry colours recorded in the laboratory ranged from very dark greyish brown through to light yellowish brown and very pale brown (Table 6). Wet colours ranged from predominantly very dark brown to pale brown. As predicted all the test pit sediment had high calcium carbonate values and reasonably high phosphate values, except for TP 4, where two stony samples (16 and 18) had very low calcium carbonate and phosphate values. The pH values recorded were all basic, and ranged from 7.34 through to 8.88. The loss on ignition values ranged from 10% through to 27% with the expected pattern of the highest values towards the top of the sequence and then decreasing values down through the profile. The loss on ignition results for the gully are between 14.82% and 27.14% which is comparable with the other test pits in this area and do not therefore show the loss of humus associated with the muted colouration observed. Apart from two slightly stony top soils, the rest of the sediments at Fairy Dale were moderately, very or extremely stony. Phosphate levels were variable, but were generally between 2 and 5 except for TP4 at the top of the eastern slope where all the phosphate values were low at 1 or 2.

TP 1 contained small to large sub-angular to sub-rounded chalk fragments with the more rounded components lower down the profile. In a reversal of this TP 2 contained small sub-rounded stones in the topsoil and then very small through to large angular stones lower down the profile. In TP 3 the uppermost three units contained very small through to large sub-rounded stones whilst the basal unit contained small to medium angular chalk. TP 4 was unusual in that all the five layers contained angular stones and these ranged from very small in the topsoil through to very large in the basal layer. In the gully section, all of the stones were very small to medium and all were sub-angular to angular in shape.

6.2.4 Molluscan analysis

Nineteen samples, weighing a total of 17.5 kg, were processed in order to recover land snail assemblages, and this resulted in the discovery of 289 snail shells (Table 7). Whilst none of the individual strata have sufficient quantities of snail shells to be investigated statistically, some general observations can be made. The largest numbers of snails are those with a catholic habitat preference (*Trichia* sp. *Arianta arbustorum* and *Cepaea* sp.) which tolerate a wide range of conditions, although the presence of *Arianta* sp. suggests that conditions were never really dry, as it is not a drought tolerant species. Secondary to this group are a general spread of grassland preferring species (*Vallonia* sp. and *Pupilla muscorum*).

The highest concentration of snails was found in the colluvial deposit in TP1 (sample 3). Although many were *Trichia* sp., the rest of the assemblage consisted of either grassland or catholic species. In TP 2 in samples 6 and 7 there were a cluster of shade-loving snails, including *Discus rotundatus* and *Vitrea crystallina*, and this presumably reflects the local conditions, immediately next to the Fairy Stones, where the sediment is permanently in shade. If we correlate the numbers of molluscs found with the pH results then we can see that the samples with the greatest number of snails come from sediments with relatively high pH values; 121 snails from FD3 with a pH of 8.57, 42 snails from FD10 with a pH of 8.55 and 28 snails from FD14 with a pH of 8.65 (Figure 59).

The nearest modern mollusc distributions (Appendix D) are for Burdale (SE8763 and SE8762) and when compared to the assemblage from Fairy Dale we can see that most of the species identified are represented in the modern distributions. The species not represented in modern records are *Carychium tridentatum, Vallonia pulchella, Vitrea crystallina* and *Helicella itala*. Of these, two are shade preferring and two grassland species so it seems that this discrepancy is unlikely to be of any analytical relevance.

6.2.5 Summary

At Fairy Dale the relationships between test pits were more complex than at Vessey Pasture Dale (Figure 60), and two of the test pits recorded here did not reach a C-horizon. The types of sedimentary sequences in the test pits at Fairy Dale display a range of depositional and developmental differences. There is thin rendzina sediment onto chalk in the gully section, a heterogeneous silt rich overburden deposit in TP 4 at the top of the slope with clearly pulsed sedimentary phases, and in TP 1 and 3 at the bottom of the slope, there is an undifferentiated colluvial sequence with diffuse boundaries. Close to the Fairy Stones (TP2), the sequence appears quite disturbed with charcoal the full depth of the sequence.

The unsorted colluvial deposits in TP3 are from the bottom of the western slope below the Fairy Stones and Tunnel Top farmstead, and contain a selection of artefactual material dating from the Iron Age and Roman periods. There is some concavity to the slope here and the slope itself is the steepest of those investigated during the course of this research.

There was not an adequate number of land snail assemblage to make statistical tests but the assemblage does allow us to infer a general impression of the environmental setting that reflects the local conditions in the valley base and beside the shade producing Fairy Stones.

6.3 WHAY DALE 2005

6.3.1 Desk based assessment

The dry valley of Whay Dale (SE 878621) does not figure in the archaeological literature, nor is it recorded in any readily accessible documentary sources. Whay Dale lies immediately west of the county boundary between North Yorkshire and East Yorkshire. Anecdotal evidence from local farm workers suggests that there is a possible Roman kiln site up on the top of slope to the west of Whay Dale, and also that some undeclared burials were found during the relatively recent construction of a barn at a farm in the adjacent Middle Dale. However, the accuracy and detail of these claims are unsubstantiated. Approximately 1 km from the northern limit of Whay Dale lies the medieval settlement of Towthorpe which is a scheduled monument (32634) and is the earthwork remains of two rows of rectangular plots which were the site of sixteenth century courtyard farms. These type of dwellings are distinctly different from the longhouse tofts and crofts associated with Wharram Percy and other deserted medieval villages.

Whay Dale is mentioned in an appeal against a designated Right of Way in 2004 by the Birdsall Estate. The 30-hectare site is described as a steep sided dale running northeast to southwest and consisting of semi-improved grassland, however the improvement is so slight that the land has been categorised as closer to natural downland (www.arolygiaeth-gynllunio.gov.uk/access/appeals/northeast/documents /2400_decision.pdf).

Two slightly curving linear features run along the eastern side of Whay Dale and then appear to sweep westwards partly enclosing the valley head. One of these lines appears to continue west joining a partial linear above Middle Dale before possibly joining the complex set of double and triple features to the north of Fairy Dale. Running down at a right angle from the feature to the west of Whay Dale is another linear which runs across the interfluve but is not visible on the valley flank or as a crop mark (Stoertz 1997).

During the assessment prior to the fieldwork at Whay Dale in 2005 aerial photos were examined at the English Heritage regional office and recent photographs of the Burdale area were highlighted by Dave McLeod (Figure 61). These revealed a complex system of curvilinear features, with some rectilinear enclosures, in the main Burdale valley adjacent to Whay Dale and appeared indicative of Anglian settlement evidence, and possible earlier settlement, although some earlier crop marks had been recognised and fieldwalking had taken place (Hayfield 1987) the scale of the apparent settlement evidence was quite unexpected. During a 'walk over survey' of the site in spring 2005 the gamekeeper brought the site to our attention again and told us of the difficulties that the Birdsall Estate had been having with illegal metal detecting (nighthawking) on the field that contained the ancient settlement area. This information had a direct impact upon our decisions regarding auger survey transects in Whay Dale in 2005 and ultimately led on to the large-scale excavations by the Department of Archaeology, University of York, in 2006 and 2007 under the direction of Steve Roskams and Julian Richards.

6.3.2 Field results

From satellite imagery and mapping it appears that Whay Dale has a straight axis although on the ground this is not the case (Figure 62). That it appears this way is largely because the top of the valley sides are straight but the valley bottom is more sinuous. In the mapping and aerial photographs it is the more substantial edge of the valley top that is seen and predominates. The axis of this valley is NE-SW and it joins the main Burdale valley at a sharp 90° angle. On visual inspection the point where Whay Dale joins the main valley at Burdale is characterised by prominent chalk spurs (Figure 63) and these are indicative of the mechanism of valley system formation. Burdale main valley was the primary valley running W-E and then Whay Dale developed later, cutting into Burdale and running NE-SW. The Whay Dale valley also slopes down towards Burdale giving the impression of a hanging valley, although the effect here is slight rather than pronounced as seen in the examples that are often depicted in the geographical literature (Figure 64). The valley slopes are mainly straight with some minor terracing seen in places and the western flank has a gradient of 26%, whilst the higher eastern flank has a gradient of 31%, as measured over the current land surface.

Research at Whay Dale in 2005 consisted of four auger transects in the area of the valley mouth abutting the field which contains evidence for multi-period settlement (Figure 65). The first transect ran from the east to the west and encompassed the entire valley slopes. The eastern scarp was 25 m higher than the western summit and the valley base was at c. 101 m AOD. At the top of the slope there was a dark brown silty loam topsoil, onto a light yellowish brown silty clay loam and then resting on chalk at 113 cm. At the midslope, there was 10 cm of dark brown silty loam onto loosely consolidated chalk gravels that were penetrated for up to 60 cm (Figure 66). The eastern midslope and western summit produced empty auger chambers due to dryness which was probably exacerbated by the presence of shallow sedimentary deposits onto chalk gravel. The entire transect produced black to dark brown silty loam onto dark yellowish brown clay loam and then frequently onto a pale brown or yellowish brown clay loam in the base (Table 8).

Difficulties recording sediments on the midslopes (due to the aforementioned dry weather) and our prior knowledge of settlement in the Burdale valley bottom at c. 99 m AOD led us to concentrate our subsequent efforts in the valley floor where a further three short transects were recorded in an attempt to carefully decide where to place the test pits.

In the valley base, where the auger survey was concentrated, there were two relatively stoneless topsoil units (WD3/3 and WD3/4) and there was a charcoal rich topsoil and subsoil (WD 2/2) which, from speaking with the tenant farmer, was likely to be derived from relatively recent bonfire activity. The short valley bottom transects frequently filled the auger chamber to 1.5 m and were almost exclusively a dark brown silty loam onto a dark brown/dark yellowish brown subsoil and then onto a dark yellowish brown to a pale brown clay loam (Figures 67 to 69).

Three test pits of c. 1 m^3 were excavated in the base of Whay Dale and were placed in the valley bottom to exploit the potential for artefactual evidence from the adjacent settlement site and from the possible kiln site, as well as to investigate the deep yellowish brown clay loams (Figure 70). TP 1 was to the east of the central track in the valley bottom. This sequence began with a yellowish brown extremely stony clay loam. Overlying this was a similar deposit with a slight colour change. Above this was thin layer of extremely stony brown silty clay, and this was overlain by a very stony dark brown silty loam topsoil (Figures 71 and 72). There was some undulation at the boundary between the different layers as is seen with periglacial involutions. A single piece of Roman greyware was found in the stony layer below the topsoil in this test pit. As chalk gravel was not reached in this 85 cm-deep test pit the auger was placed in the base of the pit and recorded a further 1.5 m of silty clay with the frequency of chalk gravel increasing with depth. This gives a total sediment depth of 2.35 m for this pit, which was the maximum depth possible with the steel auger.

TP 2 was situated towards the west of the track and was 114 cm deep (Figures 73 and 74). This test pit had a base deposit of yellowish brown silty clay, overlain by very stony brown silty clay loam, with a moderately stony dark brown silty loam topsoil. The basal unit was classified in the field as relatively stone free, but the laboratory tests contradicted this producing a moderately stony numeric result 22.1%. This is probably because in the field stoniness was quantified subjectively in relation to the other layers in this test pit. The topsoil in this test pit produced a modern glass fragment, twelve fragments of brick or tile and a roof tile fragment. The subsoil unit contained a fragment of clay pipe and an unidentified ceramic fragment. The basal unit in this test pit contained two bone fragments, a charcoal fragment and two pieces of ceramic material. A piece of possible worn Anglian pottery was found at a depth of c.60 cm and a Samian ware fragment found at c. 85 cm (Table 9). The auger was placed in the bottom of this test pit and recorded 64 cm of silty clay before hitting chalk gravel abruptly giving an overall depth of recording of 178 cm.

TP 3 was situated towards the south in the direction of the settlement site. This test pit had a total depth of 95 cm and began with a layer of light yellowish brown clay loam, and above this was a very stony yellowish brown clay loam (Figures 75 and 76). Overlying this was a thin layer of very stony dark brown silty clay loam and finally slightly stony dark brown silty loam topsoil. The bottom layer of clay loam was recorded as relatively stone free in the field, but once again in the laboratory was found to be moderately stony. The topsoil of this test pit produced a charcoal fragment and two pieces of brick/tile. The charcoal found was largely fragmentary and was concentrated in the topsoil and subsoil and so was deemed a relatively recent addition. An auger record for the base of this test pit showed a continuation of clay loam until chalk gravels were encountered at 118 cm, giving over 2 m of sedimentation in total in this test pit.

6.3.3 Sedimentary results

The dry colours recorded in the laboratory ranged from very dark greyish brown to light yellowish brown and when wet from black to yellowish brown (Table 10). The pH values ranged from 7.05 through to 8.65. Two topsoil layers contained very low calcium carbonate results but other than that, values were high, as expected, and the phosphate results were varied showing no particular patterning to the values. Loss on ignition percentages trended downwards as expected, and the highest value, 40%, was the topsoil of TP 1.

In TP 1 the topsoil comprised very small to medium sub-rounded stones underlain by very small through to very large angular stones. The next test pit had small sub-rounded stones in the topsoil and then variously shaped small to large stones in the next layers. TP 3 contains variously shaped stones in the topsoil which are small to medium sized, the next two layers have very small to large sub-rounded stones and the basal layer has small angular stones.

6.3.4 Molluscan results

There were 11 samples weighing a total of 10 kg, containing 62 snail shells (Table 11). Fifteen shells was the maximum from any single sample, and a significant number of the total found (29 individuals) comprised the burrowing species *Cecilioides acicula*, which is disregarded for archaeological purposes. The pH values generally appear unrelated to mollusc preservation with a few preserved snail shells in the sample with a pH of 7.05 but none in a sample with a pH of 8.41.

The most notable species was from sample WD10 where a single example of the land snail *Cochlicopa nitens* was found at a depth of 50 cm below ground surface. This species is only found as a late glacial and early postglacial fossil from marshy, calcareous woodland sites with the most northerly extent of its distribution currently recorded in Lincolnshire (Davies 2008) (Figure 77).

6.3.5 Summary

The stratigraphic similarities are summarised in a matrix (Figure 78). At Whay Dale there were no test pits that reached parent material or a C-horizon, although all the test pits here were situated on the valley floor compared with Fairy Dale and Vessey Pasture Dale. The use of the auger in the base of the test pits gave sedimentary depths of up to 2.35 m however, it was very difficult to remove the auger from the base of these test pits due to the restricted area for leverage.

At Whay Dale, there was a silty loam A-horizon with a stony A- horizon beneath and then a silty clay loam B-horizon with angular gravel in all the test pits but in TP 2 and

3 there was a Bt-horizon below the regular B-horizon. This is an accumulation of translocated clay indicating soil maturity and prolonged weathering.

Although dateable artefacts were recovered at Whay Dale from different periods they were reworked rather than been in situ, and did not occur in any concentrations.

6.4 WHAY DALE 2006

In 2006, the geoarchaeological investigations at Whay Dale were allied to archaeological excavation in adjoining Burdale. As the limited background information for Whay Dale has been discussed in the previous section I will use this section to discuss in more detail the background to the site at Burdale. The main Burdale valley (SE 878620) is a broad flat based valley which runs NW-SE and is part of the main Thixendale valley system. To the south-west flank there is evidence for a straight sided valley but with severe erosion in places, revealing a bare chalk surface and terracing in other areas (Figure 79). The valley has several side-valleys that run from it, and the valley morphology has been significantly affected by nineteenth century engineering work including the cutting of the railway line and the construction of a station and several associated bridges.

The broad field in the base of the Burdale valley contains aerial photographic evidence for four short linears clustered towards the south-eastern end of the field and associated with some extremely small, possible circular features. One segment of the double linear in the centre of this group of cropmarks aligns with the linear east of Whay Dale and appears to continue to the south up the Burdale valley side towards South Heights (Stoertz 1997). Hayfields parish survey (1987) recorded a quantity of field walked material from this locality (Figure 80).

As previously discussed, during the examination of aerial photographs in advance of fieldwork in 2005 our attention was drawn to a series of photos showing dense activity in the valley bottom at Burdale (Dave Macleod pers. comm.) Following this, and whilst undertaking the interventions in the field during 2005, the tenant farmer and gamekeeper explained that the estate would like to see the features at Burdale properly excavated and recorded as they had been extensively nighthawked by unlicensed metal detectorists for the last few years. Professor Richards (University of York) was informed during the summer of 2005, and a dialogue began between the

Department of Archaeology, University of York and the Birdsall Estate about undertaking an excavation at Burdale. This led to the excavation of an Anglian settlement at Burdale during 2006 and 2007 as part of the Departmental undergraduate fieldwork training and a case study for the Viking and Anglo Saxon Landscape and Economy Project (VASLE) (Figure 81).

The transcription of the recent aerial photograph demonstrates clearly that the original transcription of the poorly visible data in Stoertz (1997) was inaccurate. In 1997 the partial linear marks were interpreted as single and double linear features, whereas the later, more detailed, evidence proves that the majority of them are the lines of complex enclosures. This is of significance as not only does this change the likely function of the features but it also changes the likely dating of it.

The use of fieldschool excavation resources in 2006 and permission from the landowner enabled a machine excavated trench to be dug (11 m × 3 m maximum), allowing an 11 m continuous profile of slope deposits to be examined. This study area is in the same geographical location as Whay Dale 2005 but also involved some sampling from the Department of Archaeology excavation, Burdale 2006.

6.4.1 Desk based assessment

Burdale is situated in the northern High Wolds, along the main valley from Thixendale to Fimber at a height of approximately 99 m AOD. It is likely that the current roadway follows the Roman trackway route (Hayfield 1987, 195), and was used in the nineteenth century as the route for the Malton & Driffield Junction Railway Line. Burdale is mentioned in Domesday; 'Ingifrith 10 bovates of land to the geld, land for 4 oxen' but the Domesday spelling of Burdale has varied from 'Bredale', 'Breddale' and 'Bredhalle' (Brooks 1986). It is suggested that the Old English name arises from 'Bred-' meaning plank board and '-dle' meaning dwelling and giving the place name a 'house of planks' (Smith 1970, 132). Although not discussed in place name research the recent discovery of Anglian settlement could presumably give a possible 'burh' root, as in 'Burford', for the origin of Burdale.

Burdale Water (SE872623) occurs at the junction of Fairy Dale and Middle Dale along the main Thixendale to Fimber valley. It is formed by a series of springs and was also fed by a stream that ran down the valley from Fimber. The stream was disrupted by the construction of the Malton & Driffield Junction Railway line, station and tunnel at Burdale in the nineteenth century and was eventually culverted (Wagner 1992, 78). The stream is illustrated on the Ordnance Survey maps of 1852, 1892 and 1893 but the clearest representation is on the 1:2500 map of 1892 (Figure 82). This map shows the steam running clean across the field of Anglian excavation evidence but on the maps of 1910, 1912 and 1952 the stream is no longer represented (Landmark Information Group 2004). Lester Bell, tenant farmer, observed that the stream did indeed run across the field containing the Anglian settlement evidence but that by the 1950s the watercourse had completely dried up. A small-scale investigation of the land around Burdale Water was made in 1974 consisting of a 50 m auger transect across the valley bottom to the west of the water. At the deepest auger point, a test pit was dug 1 m × 0.5 m and a series of five 5 kg samples were taken (Wagner 1992, 78). A coleopteran assemblage was retrieved and indicated slow moving, muddy, stagnant water margins on the very edge of spring activity. The top unit of sediment had little in the way of organic preservation suggesting that this unit had dried out (*ibid* 84). Iron workings found in the second unit down below the surface may have originated upslope and been deposited here by colluvial mechanisms.

An earthwork trench that runs from Fimber towards Burdale springs was investigated during the later nineteenth century and it was felt that the most likely purpose for this feature was to carry water to local outlying settlements, and this arrangement was considered at the time to be an improvement on the nineteenth century water provision (Mortimer 1905, 198).

As previously discussed, the main archaeological survey of the area comes from the Wharram Parish survey of 1974 (Hayfield 1987). There are three areas of settlement defined around Burdale. A fourth century Roman farmstead at 185 m AOD called Tunnel Top farmstead at Fairy Dale. The Burdale Crossroad site where an agricultural cutting revealed 540 large pottery sherds ranging from the Iron Age to seventeenth century (SE872623) and this is described as a village site. On the Burdale/ Fimber boundary at 93 m AOD (SE 881618) a farmstead was identified with a double ditched enclosure and material from the third and fourth centuries AD (*ibid*). The identification of the three sites in close association has led to the description of Burdale as 'a preferred settlement location' with a medieval vill, described in documentary sources, occupied until the sixteenth century and based on the aerial photographic evidence coupled with over 1200 ceramic fragments that were recovered (*ibid* 136). However, it has also been suggested that Burdale Township was abandoned in the fourteenth century when there are records that the land was turned over to pasture and a single farmstead remained (Hurst 1979). A rabbit warren was formed and maps at 1:10,560 from 1854 to the current day refer to 'Burdale Warren' from the east of Fairy Dale across Middle Dale and onto the western edge of Whay Dale (Figure 83).

Hayfield's work provides clearest evidence of the poorly visible settlement sites, spanning many periods, on the Wolds that have gone largely undetected and unrecorded. Much of the current settlement evidence for Burdale lies underneath farm buildings, pasture and the railway embankment.

Construction began on the Malton & Driffield Junction Railway Line in 1846 with the building of the Burdale Tunnel completed in 1853. The census of 1851 for Wharram Percy, Wharram Le Street, and Raisthorpe and Burdale was 489 persons, of whom half were temporary residents connected to the railway (Burton 1997, 5). Bulmers Directory (1892) describes Thixendale Parish as comprising two townships; Thixendale, and Raisthorpe and Burdale. The parish contained 3811 acres (1542 hectares) with a population in 1891 of 234 (Bulmers 1892, 719). The railway cutting has significantly altered the topography and slope profile of the valley bottom at Burdale. When the railway tunnel was completed, the effect of the springline in the chalk had been underestimated and it was necessary to continuously pump out water from the tunnel during the life of this line. The remains of the pumphouse are in Wharram village.

Archaeological investigation at Burdale by the Department of Archaeology from the University of York in 2006 revealed a system of curvilinear enclosures and pits containing a great deal of bone and some cultural material. This has been interpreted as a multiphase Anglian farmstead of sunken buildings, with preliminary dating to the eighth or ninth century AD. Further investigation in 2007 found large pits containing Late Iron Age and Early Roman ceramic material and a number of complete cattle skulls and articulated long bones. A large ditch running north to south appears to relate to the reorganisation of the landscape during the Roman period. Following this there are a series of curvilinear features which provisionally date to after the sixth century AD. A further phase of activity discovered in 2007 comprised sunken feature buildings in the centre of the site with bone combs, a silver ring and sceattas. This phase appears to date from the sixth to early ninth century AD. When both seasons are taken together the evidence from the Burdale excavations is for phases of activity, rather than continuous settlement, in the valley bottom from the Late Iron Age through to the ninth century AD (Steve Roskams pers comm.).

A combination of fieldwalked material from 2006 and geophysics results from 2007 has given a spatial distribution for the range of materials encountered in the settlement area. Fourteen pieces of prehistoric pottery were spread across the site with slight weighting towards the western end of the field. Sixty–eight Roman artefacts were found in a general spread towards the eastern end of the field. Two hundred and fifty early medieval sherds had a general spread but with three apparent minor clusters in the distribution. Three hundred and sixty one medieval sherds had a bias towards the eastern portion of the field and a total of 53 post-medieval sherds were identified. This analysis suggests settlement in the valley bottom, over long periods, in a ribbon arrangement along this important routeway (Gillott 2007).

6.4.2 Field results

The location of the excavated section was determined by the 2005 auger survey which was augmented with additional points taken during the spring of 2006. The final location encompassed the area of transect 2 from the Whay Dale 2005 investigations (Figure 84). Above the section was an area of flatter ground on the slope which when investigated with the auger was comprised of shallow gravels and appears therefore to represent a 'terrace' of chalk slippage, as discussed by Mortimer (1885) (Figure 85).

An auger survey was conducted in two transects close to the boundary fence alongside the Anglian settlement to assess the accuracy of the aerial photography in defining the northern limit to the settled area (Figure 86). The auger survey consisted of 18 points and revealed a silty clay loam topsoil between 26 and 74 cm deep, a silty clay loam or clay loam subsoil with chalk gravel reached generally at between 79 and 140 cm (Figures 87 and 88). The auger points generally recorded a silty clay loam onto a clay loam, of variable depth, occasionally more than the extent of the auger (150 cm) with chalk gravel (Figure 89). The topsoil was usually underlain by a stony layer (most probably due to earthworm activity). There was no evidence of any human disturbance or activity indicated by ceramic material, charcoal fragments or any disturbance to the stratigraphic sequence (Table 12).

Located on the western flank of Whay Dale, the section was cut on the lower part of the slope. The trench was stepped for health and safety reasons so there was a break in the 11 m long exposed section (Figure 90). The shallower, upper part of the section has a maximum depth of 1.2 m and the lower, deeper part ranges between 1.4 and 1.8 m in depth. The excavated section was dug back in five, 1 m-wide sections to facilitate three-dimensional recording of artefacts and the collection of 2 kg samples from each sedimentary unit (Figure 91). The metre-wide sections were excavated back by hand for approximately 0.5 m.

The profiles were photographed, described and drawn in the field from the north-east facing section (Figure 92 and 93). The stratigraphic sequence was analysed and is displayed in a matrix (Figure 94). The lowest part of the sequence is a layer of chalk gravel (Layer 12) with a brownish yellow matrix which appears to be a Cr-horizon. Lying on top of this is a confined silty loam deposit (Layer 11), constituting a B-horizon, which is overlain by solifluction gravel in a brownish yellow matrix which forms a short, tilted deposit (Layer 10). Overlying this is a discontinuous layer of yellowish clay (7 and 9) and as there is a break in the section the sequence from the shallower part of the section below layer 3 has been correlated with the deeper deposits further downslope to make an more continuous Bt-horizon. Above the Bt-horizon, in the shallower part of the section is a dark yellowish brown clay loam (Layers 5 and 3). In the lower, deeper section the Bt-horizon is overlain by a clay loam, which is predominantly a dark yellowish brown (Layers 6 and 8). Lying immediately above layers 3 and 6 is an almost continuous dark brown stony silt loam (Layers 2 and 4) which is overlain by a very dark greyish brown silty loam (Layer 1) and these are interpreted as A horizons (Table 13).

In the base of the excavated area, following machining, there appeared to be a square cut feature which measured 50 × 60 cm (Figure 95) which was filled with a strong brown clay (7.5YR 5/6). This feature appeared to continue beyond the limits of the excavation to the north and was excavated by half-sectioning. Upon investigation it seemed to be a natural feature, perhaps an unusually shaped periglacial feature, containing two grains of charred barley and a bulk sample was taken. The exposed basal surface of the trench was rippled and undulating and was drawn and photographed as a record of periglacial activity (Figure 96).

There was a single piece of abraded, probable Anglian, pottery from 28 cm below the ground surface in the subsoil. Several large pieces of modern metalwork were found in the topsoil that appeared to have broken from a plough. A worked flint was found at a depth of 123 cm, but this was on the surface following machining, and a small quantity of charcoal fragments and two charred grains were found at around the same depth (Table 14). It is entirely possible, and probably most likely in the absence of any evidence to the contrary, that the charcoal and grain elements were incorporated into the sediment as the result of earthworm rather than any anthropogenic activity or being the remnants of an earlier, pre-depositional land surface.

A small area of the main Burdale 2006 excavation site was sampled, drawn and measured as an adjunct to the 'off-site' trench (Context F1108). This was undertaken in order to give us an idea of the relationship and similarities between the on-site and off-site locations (Figures 97 and 98). F1108 is a cut into the chalk at the edge of the excavated area and is 2.7 m across, 1.2 m wide with almost vertical sides. The excavation records state that it is a maximum of 0.48 m deep with a sharp break to the base and is filled with a soft brown sandy clay loam with variously sized chalk fragments and some charcoal fragments. Below this is a dark brown silty clay loam and this forms part of 'Features south of enclosure 4' (Roskams 2007). The area that we excavated as part of this research was 50 cm wide and 80 cm deep. It consisted of a 14 cm deep silty clay loam topsoil, with some large stones, underlain by a less stony dark brown silty clay loam which was 13 cm deep. This was underlain by a brown silty clay loam with dense small stones with a maximum depth of 10 cm. This was underlain by a predominantly soliflucted chalk gravel in greyish brown matrix. Samples were taken from these deposits.

6.4.3 Sedimentary results

The separate sections were sampled (Figure 99) The results from the sedimentary analyses are presented in their relevant section groups (Table 15). All the pH results from Whay Dale 2006 were basic apart from the exceptional sample 23 which was a topsoil with 6.65. There are several increased loss on ignition results in various samples relative to the rest of the samples as a whole. In order to elucidate the interpretation of the results they are grouped into tables containing layers that are visually, texturally or stratigraphically similar (Table 16). This shows that the topsoil samples (1, 6, 11, 17, 23) predominantly have low phosphates apart from sample 11, and the loss on ignition results are very varied with a result of 9.15%, two results around 19%, a result of 34% and a result for sample 23 of 69.89%. It is most likely that this relates to the incorporation of recent organic matter, from livestock, into the topsoil in this area.

The next group of results from the stony topsoil samples (2, 7, 12, 18, 24) are unremarkable. They are characterised by their consistently high coarse components (44 - 71 % but mainly around 60%). The next group which represents the B-horizon consists of samples 3, 4, 8, 10, 13, 14, 19, 20, 25, 26. These samples have reasonably consistent results with similar values across all samples for pH and calcium carbonate. The results for loss on ignition, phosphate values and coarse components are variable. Samples 4 and 10, which appear to be stratigraphically continuous, have higher loss on ignition results than the other samples in these layers, at 33.67% and 37.79% respectively. Sample 20, was classified as a clay in the laboratory and had a marked colour difference a 7.5 YR colour.

The next group are the samples that form the clay rich Bt-horizon (5, 9, 15, 21). This group typically has low calcium carbonate values and consistent pH results. However, sample 5 does not seem to cluster with the other results in that it has a much higher level of coarse component than the other three samples, higher calcium carbonate levels and higher phosphate values.

The final samples are those from the chalk gravel layer (16, 22, 27) which is within a clay or silty clay matrix. Whilst the results for pH and coarse components are generally consistent there is a high loss on ignition value of 33.23% recorded in sample 22. The results for phosphates and calcium carbonate are variable.

The results for the square-cut feature in the base of the machine cut trench have a dry colour of 7.5 YR 5/6 and reveal a clay deposit with a pH of 8.23, low phosphates, low loss on ignition and a slightly stony matrix with 8.23% coarse components, the lowest recorded during the fieldwork.

The laboratory results for the deposits of the feature (F1108) on the Anglian site at Burdale 2006 (Table 17) show high values for calcium carbonate in these basic sediments and high phosphate levels throughout. This may be related to the thin soils of the field being used for arable production and the effects of artificial fertilisers. This was the only area sampled throughout the fieldwork where regular arable production has taken place on the sediments.

6.4.4 Molluscan analysis

The laboratory processing of 32 bulk samples produced 213 land snails from a total 63 kg of sediment (Table 18). The most commonly represented snail across all the samples is the burrowing, and disregarded, *Cecilioides acicula.* The sample with the most molluscs was sample 8 which had a pH of 8.4 and 32 snails shells but unfortunately 17 of these were *Cecilioides acicula.* The resulting spread of snails is so general with no clusters or concentrations and their relationship to the current distributions for Burdale are not informative leaving little of value for the mollusc record to add. The processing of sediment from the sediments adjoining F1108 resulted in the recovery of 10 land snails (Table 19).

6.4.5 Micromorphology results

Undisturbed samples from the north-east facing section at Whay Dale 2006 were collected with Kubiena tins, and three were sent to the thin section laboratory at Stirling University to be impregnated with resin and cut into three <40 μm thin sections. The samples were taken from Area C and from layer 9. This was a slightly stony clay loam recorded as Munsell colour 10YR 5/8, which is yellowish brown (Figure 100).

A gradual, patchy colour change within this unit was observed and was thought to reflect a possible early Holocene land surface/soil development (Terry O'Connor pers. comm.). The samples were taken from this area of the section as the colour change was most apparent here, however the changes were subtle and the location for taking samples was mainly determined by the quantity of chalk in the section and the ease with which the samples could be taken in a Kubiena tin. For this reason, the samples were not taken in a continuous vertical profile as is commonly seen in the literature (for example see Davies 2008). The samples were difficult to collect due to the high frequency of chalk fragments in the sediment and also the difficult weather conditions which had led some parts of the section to collapse due to waterlogging (Figure 101). The resulting slides have been examined and the results were analysed and discussed with the help of Dr Usai, University of York.

As can be seen from the photograph of the entire slides (Figure 102) there was a substantial loss of material on the third slide, this was a replacement slide as the earlier slide had also suffered sediment loss. Measurements from the slides were taken using a 6 and 140 μm mesh as a visual guide (Stoops 2003, 46) and recording was made with a range of magnification from 40× to 200×, using plane polarised and crossed polarised light. In crossed polarised light, the field of view of isotropic materials is "extinguished" (that is, seen as black). At the same time optically anisotropic materials, including many minerals, are able to twist the direction of propagation of light and are visible with colours and features which are typical of each mineral. Clay particles, for example, are mainly phyllosilicates and are therefore optically anisotrophic (*ibid* 18). The size of fabric units recorded follows the USDA system for comparability and abundance was assessed by using specially designed comparative graphs (*ibid* 48). The shape and the degree of roundness and sphericity are important indicators of pedogenic processes, sphericity is assessed by the use of value charts (*ibid* 53). Colour and limpidity (transparency) of the fine fraction on the slide was assessed in plane polarised light and described on the recording sheet. Interference colours were assessed in crossed polarised light and helped to identify the orientation of fabric particles.

The results from the analysis of the three slides are shown in tabular form (Table 20). The slide from the uppermost part of the sedimentary unit (slide α) has the same colour, interference colour, ped shape, size and development, as the slide immediately below (slide β). Their colour and the shape of inclusions are also the same, although in slide β overall inclusions are smaller. There are no coatings seen in either of these slides. The shape and size of voids are also the same in the two slides. However there is a higher count for porosity (31%) in slide α; this could be related to the larger pieces of chalk at the top of the slide. Slide γ differs from the slides α and β in that it has a different colour, smaller peds, larger voids and a count of 46% for porosity. In addition, occasional channel coatings are present in slide γ and large chalk pieces were seen. The regular black inclusions seen throughout the three slides could be indicative of organic matter (Figure 103). The loss on ignition result for this layer was 7.1% but the underlying layer downlope in the next section has a loss on ignition result of 33.25 %.

The presence of possible organic components seen on the thin section slides combined with the increased loss on ignition results in close layers indicates a higher organic matter content but this alone is insufficient evidence to suggest an early Holocene soil.

6.4.6 Summary

The features seen in the excavation, including the rippled chalk base, the square-cut reddy brown clay feature and the unusual tilting chalk deposit (layer 10) are all representative of the periglacial conditions during which this landscape formed. There were some increases in loss on ignition percentages across the section but they occurred in a variable pattern and were not confined to a single layer, or adjacent layers. Whether an early Holocene land surface ever formed and stabilised underneath the current deposits at Whay Dale has not been proved. The micromorphological analysis attempted to explore this question, and whilst the variation of the features seen in the slides could have been proof of Holocene soil development, the distribution of such features would need to reflect a model of spatial variation and anisotropy typical of soils (either horizonation or catenary variations). However, there is insufficient evidence for such a soil spatial pattern, and it is therefore not possible to prove the formation of a Holocene soil by any of the means available to us.

It is unsurprising that the lowest layers of the test pits contained the most angular stones. In some test pits, especially at Vessey Pasture there is the appearance of pulsed deposition containing varying stone densities and shapes; the interleaving of angular, sub-angular and sub-rounded stones in different layers. All of the layers contained stones that are either sub-rounded, sub-angular or angular with no evidence for rounded stones. The range of sizes was completely variable but the basal layers which had contained copious chalk gravel, when processed, contained very small stones in addition to the large and very large stones.

The most notable results were in TP 4 at Fairy Dale where all the stones were either angular or sub-angular. In TP 1 and 3 at Fairy Dale and TP 3 at Whay Dale there was a greater proportion of sub-rounded stones to the angular and sub-angular shapes.

7.0 SECONDARY RESULTS

During the course of this research, several attempts were made to find secondary sources of data to augment the primary research record. Part of this was concerned with finding deposits that could potentially contain palaeoenvironmental data and the other part, which was rather more successful, involved analysing assemblages or data collected by other researchers.

The first site visited, in 2004, was at Westow Farm on the Wolds and was a site the Department of Archaeology had been informed of by local people. A deep farm pit containing organic material had been discovered and offered the potential for preserved palaeoenvironmental evidence. On field assessment the pit was found to contain mixed, unstratified deposits and the organic material was therefore determined as being of relatively recent origin (Terry O'Connor pers.comm.).

Research by staff from the Department of Archaeology, University of Bradford in the Great Wold Valley attempted to identify and sample waterlogged deposits for analysis but the reconnaissance of several possible sites within the study area was unsuccessful. This was due to mixed strata or dried out deposits (Margaret Atherden pers comm. January 2007).

Following an excavation by Professor Millet of Cambridge University, in Thwing during 2006 an area of wet ground was identified just downslope from the village pond. Although the pond had regularly been cleared of material in the recent past, it was suspected that the area of wet ground might contain deposits of ancient organic material. Field investigations with a Dutch auger found that the water was pooling on the surface of the soil due to the high clay content of the topsoil and subsoil in this area. A brown silty clay loam was identified and chalk gravel was reached at 70 cm (Figure 104).

Following a review of the primary research output from Willow Garth (Bush 1986), and finding that the raw data for mollusca and invertebrates was not recorded and was not central to the discussion of past environment, the data appeared worthy of re-evaluation during 2005. Despite contacting several people at the Geography Department, University of Hull, it was not possible to locate the material and by

January 2007 Mark Bush was contacted directly in Florida, USA. He felt it was likely that the archive from this site had been destroyed following the departure of Dr Flenley from the University in the late 1980s (Mark Bush pers. comm.) and was unable to help us further.

Two molluscan assemblages, one from Thwing and one from Wharram Grange Crossroads, were identified and analysed. This description and analysis constitutes the core of this chapter. A body of data was also provided by the Environment Agency, and relates to rainfall, water levels and aquifer heights and this is also discussed here.

7.1 THWING

The village of Thwing is 8 miles to the west of Bridlington and takes its name from a Scandinavian root meaning 'strip of high land'. The village lies in the East Riding of Yorkshire and is approximately 23 km to the north-east of Burdale. From an archaeological perspective Thwing is best known for the excavation of a Bronze Age ring fort at Paddock Hill which is a type site for northern England (Manby *et al* 2003, 77). The satellite imagery for the area around Thwing is very striking with a great number of relict landscape features, some of these are undoubtedly archaeological and line up with current boundaries but there are also numerous palaeochannels and dendritic valley heads in addition to infilled valley branches (Figure 105).

In recent years a chance find of exotic materials by a farmer, including Greek marble, in a field to the east of the village (TA056698) has led to the current excavation of a high status Roman building by Professor Millett of Cambridge University. The building was found under a few centimetres of sediment and has undoubtedly been severely damaged by agricultural activity (Martin Millet pers. comm. August 2006). The excavation that took place in 2006 yielded some small mollusc assemblages that have been identified and will be discussed further. Two flotation samples (76/1 and 59/2) were examined from the excavations at Thwing in 2006. Sample 76/1 was from above the floor in the north end of the main building and 59/2 from the interior of the 'pavilion' at the southern end of the building (Martin Millett pers. comm.) (Figure 106). Concern was expressed, at the sample processing stage, about the possibility that the shallow deposits might give rise to mixed modern species in the assemblage associated with the building (Rachel Ballantyne pers. comm.).

The molluscs were identified using the reference collection at the University of York, Beedham (1972) and Kerney and Cameron (1979). Known modern mollusc distributions for the area of Fordon Bank (5.6 km from Thwing at TA0575) were kindly provided by Adrian Norris, Mollusc Recorder for the Yorkshire Conchological Society. However this is a specific habitat type, a nature reserve, rather than arable or pasture (Appendix D). Distribution, habitat preferences and ecological groupings were considered using Kerney (1999) and Evans (1972). Several charred seeds were found in the samples and were identified by Dr A. Hall, University of York, and Prof. O'Connor, University of York, kindly identified the small mammal bones (Table 21).

The burrowing species *Cecilioides acicula* was the main constituent of the assemblages (Table 22) and was disregarded, as it is highly likely to be intrusive. Although the quantities of snails from the samples were too small to be a valid representation of the original population, some general trends can be identified. The assemblage represents a full range of habitat preferences including woodland/shade preferring species (*Carychium tridentatum, Punctum pygmaeum, Vitrea crystallina, Aegopinella pura*) open grassland species (*Vertigo* sp., *Vallonia* sp., *Helicella* sp.) and catholic species (*Cochlicopa lubrica, Trichia* sp., *Limicidae* sp.). The fact that both *Carychium tridentatum* and *Vitrea crystallina* are represented here, and not in the modern assemblage, and that both have a shady preference may be of some significance. The presence of a single example of a sinistral *Vertigo angustior* is interesting as this species is currently under threat in the British Isles and is known to have existed in the Yorkshire region during the early postglacial period only (Kerney 1999, 101). This indicates either an early date for the snail assemblage examined, the unrecognised presence of this species throughout the Holocene or a movement northwards in the modern distribution.

The discovery of a single slug plate of *Limacidae* sp. presented the opportunity for dating using amino acid racemization and was analysed by Dr K. Penkman, Bioarchaeology, University of York. It is 50 years since amino acids were first separated from sub-fossil shells but the method is still being investigated scientifically today with researchers trying to establish the process of racemization which is affected by a number of factors including the amino acid sequence and the effect of pH and metallic cations upon the process (Penkman and McGrory 2007). In shell the amino acids occur within biomineral crystallites and it is the intra-crystalline protein fraction of the slug plate, isolated by bleach treatment, that is investigated using the relatively new method of high pressure liquid chromatograpy. Amino acid racemization converts the L amino acid into a combination of L and D isomer forms, although materially the same the isomers are visually distinct rotating to either the left or right in plane polarised light. With the passage of time and increases in temperature the proportion of D amino acid increases and it is this which is used for relative dating purposes (*ibid.*). In the case of the Thwing *Limicidae* plate it was determined as being of Holocene age, but a lack of modern slug plate reference material meant that the values measured could not be compared to modern values. However if the values are compared to those from snail shells the level of protein degradation is greater than modern specimens and more likely to be significantly older. It is therefore likely that the slug plate and the snail assemblage are contemporary with the excavated Roman building rather than modern intrusions into the archaeological deposits, irrespective of their depth (Kirsty Penkman pers.comm.).

In this instance the number of snails recovered unfortunately prevents us from analysing them using diversity indices or statistical packages, however the recovery of well-stratified and well-preserved mollusc assemblages from archaeological sites such as this continues to be a research priority for the understanding of the past environments of the Yorkshire Wolds.

7.2 WHARRAM GRANGE CROSSROADS

Wharram Grange Crossroads is an important crossing point on routeways across the High Wolds, both today and in the past. With access to springs on two sides, this area never became a medieval settlement, instead open fields for neighbouring parishes developed (Hummler 2004). Archaeological work began here under the direction of the Wharram Research Group along with the University of Sheffield in 1987 and resulted in geophysical survey and excavation which recorded multi-period enclosures and a drove way. This site (SE851650) is in the parish of Birdsall and during early summer 2004 a group of students from the Department of Archaeology

(University of York) carried out an excavation to assess settlement on the Wolds during later prehistory.

Two small areas along a ladder settlement that had been identified from aerial photography, fieldwalking and geophysical survey, were excavated. The first intervention (Area 7) aimed to elucidate the nature of a major linear boundary of the settlement area, and the second (Area 8) the relationship of a rectangular enclosure to the ladder settlement (Hummler 2004) (Figure 107). The excavation revealed that the linear boundary was in fact a series of large ditches that were recut several times and were joined to other ditches running north from the site. The assemblages found in the ditch fills were composed of domestic waste including Iron Age pottery with animal bones and land snails. The rectangular enclosure was dated to the Roman period (late second to early third century AD) (*ibid* 67). Some bulk samples taken from the site were found to contain land snail assemblages during processing at the university. Before the assemblages were put into storage four samples were retrieved for this analysis. The main factor limiting the analysis was the failure of the processors to record the sample weight on the processing sheet. The mesh size recorded on the processing sheets was 2 mm but this is clearly erroneous as many of the snails that were recovered are smaller than this. Upon checking with a member of staff involved in the processing it appears that all samples were recovered from flotation processing and therefore on either a 500 μm flotation sieve or a 2 mm residue mesh.

Four land snail assemblages were identified and analysed. Contexts 1033 and 1029 were from Area 7, and represent a primary ditch fill (C1033) and a secondary fill after re-cutting (C1029) (Figure 108). In Area 8, two ditch fill assemblages were analysed. These were an artefact rich deposit thought to represent primary backfilling (C2018) and a later deposit of silty clay loam containing chalk rubble and frequent finds of calcite-gritted ware, and sherds of Samian ware and greyware (C2023) (Figure 109). The snail assemblages were in good/ identifiable condition, and were from well-stratified and dated excavation areas. These factors coupled with sufficient numbers of snails to warrant statistical analysis led to the following analysis.

A small collection of other environmental material was recovered during processing and was identified by Professor O'Connor and Dr Hall (Table 23). The shells were identified to species by use of a low powered binocular microscope and using the reference books Beedham (1972), Kerney and Cameron (1979) and Kerney (1999). The University of York Archaeology Department Mollusc Reference Collection was used at this stage. Identification was undertaken with guidance and advice from Professor O'Connor. The result was a total of 2768 snails identified to species and representing 24 species groups (Table 24). A high proportion of juveniles were encountered and some snail eggs, although there remains ambiguity about which species were recovered by 500 μm sieve and which by 2 mm mesh due to the completion of processing sheets. The composition of the assemblages in terms of the number of snail eggs, neonatal snails and juveniles means that we can have a high level of confidence in the recovery and processing procedures. It also suggests that the deposit is stable with low transport of material. For the purpose of analysis *Cecilioides acicula*, an intrusive burrower, was excluded and the juveniles identified to species were incorporated in the species totals (Table 25).

A comparison of ecological requirements by species was made for each sample (Figures 110 to 113) and a rank abundance plot for each sample was drawn (Figures 114 to 117). The charts for ecological comparisons between species show that all the samples have snails representative of the range of ecological dry land groups; shade, open country, catholic and non specific. Whilst the number of snails from the open country group varies at a value of between 33% and 55% in C1029, C2018 and C2023, the clearest difference can be seen in the sample from C1033 where less than a quarter of the snails are open country and over 50% are shade preferring species. As C1033 is the primary ditch fill it could be argued that this assemblage represents the type of community found in shady, wooded settings, although there are none of the specific woodland indicator species represented here. It is therefore more likely that this community represents those snails that preferred to colonise the base of a shady ditch, in a highly localised ecological preference response. The rank abundance plots also support this explanation with the plot for C1033 exhibiting a sharp drop off in numbers following the numbers for *Discus rotundatus* and therefore showing the original colonisation of the ditch by this species, with a later infill species development leading to a stable community. Although not as pronounced, a similar picture emerges for C2018, which is thought to be a primary backfill deposit. The other two, stratigraphically later, deposits show a gradual decline in numbers for rank abundance.

With the help of Dr Harland (University of York), the statistical significance of inferences about the assemblage was tested by using a Chi-squared Test in SPSS. This test tells us if the relationship between the different categories is statistically significant. Significance is determined in this case by two elements, firstly by the size of the sample and secondly by the strength of the relationship (Shennan 1997, 113). Unfortunately the empty cells in the table prevented the test from running effectively and even when all '0' values were removed, the number of cells with low frequencies (1–4) was still too high to obtain a satisfactory result.

With the assemblage identified to species, I undertook Correspondence Analysis, using Minitab. Correspondence Analysis is used to identify patterning in counts. Correspondence Analysis is now one of the most widely used multivariate methods within archaeology as it allows the relationships between variables to be explored (Harland 2006, 80). Row profiles represent relative frequencies, and the row mass is equal to the proportion of points compared with the total number of points so that it is a measure of the importance of that row/column in the data set (*ibid* 81). The distances between the relative values in each column /row can be calculated and will add weight to the values. Therefore, any profile, which exhibits difference from the average, will be located some distance from the scatterplot origin, which is at the intersection of the axes (*ibid* 82).

In order to do this the family groups were removed from the table and the test was recorded for columns and rows. When reviewing the result for columns we can see that there appears to be the largest difference between C1033 and C2023 (Figure 118). This appears to be because whilst C1033 has the highest amount of snails those that are the highest values, for example *Carychium tridentatum* and *Vitrea crystallina* are very minimally represented in C2023.

If we look at the rows plot there is a clear outlier of *Arianta arbustorum* (Figure 119), but this is a single shell and because it is not represented in any other sample its position, furthest away from the rest of the assemblage, is exaggerated. If the rest of the group is considered by ecological requirements there is a general trend from wetter at the top of the plot, to drier at the bottom, but any specific clusters of ecological groupings is not illustrated here. This appears to be because although we have representatives of different ecological groups within each sample they are not consistently the same species. This level of variability means that the Correspondence Analysis is unable to show graphically the grouping of ecologically related species in clusters, as is sometimes possible (see Davies 2008, 106 and 107 for a clear exposition of this method).

It is the case that in any environment some species are very common, some moderately common, and the rest, usually the majority, are rare (Magurran 2004, 18). This can be measured by considering species richness (the total number of species in an area) and species evenness (a measure of how similar the different species are in their abundance); the opposite of evenness is dominance by few species (*ibid*).

Diversity indices are used to measure the species richness and species evenness and are frequently borrowed by archaeologists from the ecological literature (Baxter 2003, 237). Of the numerous methods that have been developed to measure diversity the Brillouin Index seemed the most relevant being not especially sensitive to sample size and having a mathematically superior formula (Magurran 2004, 114). The Brillouin Index has been used frequently for archaeological purposes especially where specific features are sampled (Zohar *et al.* 2001, 1044).

An Excel Add-In module produced by the University of Reading, Statistical Services Centre, was used to calculate the Diversity Indicator (www.ssc.rdg.ac.uk/software/diversity/diversity.html):

Brillouins Diversity Index (HB) = $1nN! - \sum 1n\ n_1!/N$

Brillouins Evenness (E) = HB/HB_{max}

$HB_{max} = {}^{1}/_{N}\ 1n\ N!/[N/S]!\ S\text{-}1\{[(N/S)+1]!\}$

The results for the calculations show (Table 26) that the maximum difference in the diversity index between samples is 0.280, and this is between C1033 and C1029 where as we have already discussed there is a fundamental difference in the species preferences and the character of changes to the composition of the assemblage. In examples where low to high diversity is expressed between assemblages from woodland and marshland, the HB result ranges from approximately 0.3 to 2.0 (Davies 2008, 91). Given the slight difference in HB and E for the Wharram Grange Crossroads samples the application of diversity indices does not appear to have added much value to the analysis. Allen (1997, 263) recommends using a combination of the Brillouin Index in conjunction with the Shannon Index to give a measure of the completeness of the sample. The difference between the two measures can also be indicative of ecological changes in colluvial sequences (*ibid*).

The results for diversity and evenness arising from this research were disappointing, and when coupled with the results for Correspondence Analysis the analyses appear to have added little to the study of these assemblages. This demonstrates that even with sizeable molluscan assemblages, the application of specialised methods of interpretation and display does not necessarily add significance to the results and means that it is particularly unlikely that any of the smaller assemblages identified as part of this research would have been amenable to this type of analysis.

7.3 THE ENVIRONMENT AGENCY

Over 38,000 aquifer level records from the Dalton Estate Well (SE965453) have been made available by the Environment Agency, but as the records amount to 11,008 pages they are not reproduced here but an abstract is included (Appendix G). The record began in 1901 and is measured daily in metres AOD, either manually by dip or, more recently, by automated logger (Ian Hampson pers.comm.).

The Dalton Estate is approximately 10 miles south-west of Driffield, includes the villages of South Dalton and Dalton Holme, and this is the nearest logging station to the study area. With suitable software there are a number of ways the data can be mapped and displayed and interrogated. At the simplest level, we can produce a mean for any month or year since 1901. Taking this approach, the mean water level for January 1901 was 18.88 m AOD but when compared to January 2001 the water level has risen to 22.02 m AOD. When looking at the result for 2005 (when it was so dry the auger survey was restricted) the figure for January had dropped to 15.99 m

AOD (Figure 120). The records were used to calculate eleven yearly aggregated results at decade intervals e.g. 1901, 1911, 1921. These years were chosen at random, and therefore, they may not represent the true patterning of all the data available. The resulting graphs demonstrate (Figure 121 and 122) a wide range in aquifer water heights over the decades, especially at the beginning of January, when the range is from 10.959 m AOD (in 1991) through to 22.126 m AOD (in 2001) due to the slow recharge following the generally drier moths of the summer. The results for 1991 are consistently the lowest, or nearly the lowest of all the readings, but the years either side (1981 and 2001) are consistently amongst the highest records. By the end of June, the range of results is narrower, from 14.134 m AOD (in 1921) through to 20.64 m AOD (in 1981). In general, the intervals do not appear to show any patterning or trends that are clearly discernable. In terms of climate change, the records for just a single century are of limited value but for aquifer management these types of record are vital. Changes deep in the aquifer could be taking place that will not be noticeable in the groundwater records for some time. These results show that a more complex and long term approach is needed to the data to make meaningful trends and interpretations of the groundwater levels over relatively long time periods.

Other recent data includes rainfall data from five locations (Birdsall, High Mowthorpe, Huttons Ambo, Scampston, and Sledmere) on the Yorkshire Wolds taken between 1907 and 2007. The records from High Mowthorpe reveal that between 1985 and 2007 there were 7958 records generated and that of these the occasions of particularly high rainfall on a given day all fall within summer months (25/8/86 53.4 mm, 21/6/90 40.6 mm, 30/6/03 47.2 mm) without an increase in precipitation generally on the days either side. The rainfall data is augmented by records of daily temperature from High Mowthorpe since 1993. A similar picture emerges from the Sledmere House rainfall records which highlight 75.2 mm of rain which fell on 14/8/80 and 69.8 mm on 3/9/84.

Two records for mean water flow in the Gypsey Race have also been received, comprising of flow rate in m^3/s and mean water height recorded daily; one was taken at Boynton from 1981 to 2007 and another from Kirkby Grindalythe from 1998 to 2007. The Boynton records from January 1981 total over 9000 entries and the mean water height is measured in metres AOD. This has a tight range of between 16.8 – 17.2 m AOD (Figure 123). Where records fall below 16.8 m AOD this is explained by a note to indicate a likely error with the logger, and the flat lines seen indicate that some of these lower records may have been removed. Without clearer understanding of the data and its collection, this data is diffcult to use but there appears to be a serious problem with the recording of water flow if the potential falls below 16.8 are discounted out of hand.

8.0 DISCUSSION

In this chapter I will begin by providing a resume of the results of my fieldwork on a site by site basis, before discussing the results in terms of the general findings. Following this I will examine in more detail the overarching themes identified at the outset of the research which concern landscape taphonomy, settlement, visibility, environment, water and the archaeological approaches to the evidence. I will go on to identify some of the changes in approach which could enhance our understanding of this complex and well studied landscape.

8.1 FIELDWORK RESULTS

8.1.1 Vessey Pasture

Vessey Pasture Dale has an important place in the history of the High Wolds as it is situated close to an ancient trackway, an ancient water source, has been the focus of activity during the Mesolithic period and it is the point at which a series of substantial linear earthworks converge. Hayfield *et al.* (1995, 402) suggests it was the centre of a Bronze Age estate. As a current SSSI it retains an important role as one of the few remaining sites of unimproved calcareous grassland in the north of England.

From a geomorphological point of view the Dale has some substantial chalk slippages and also has a degree of valley asymmetry with the southern slope less steep and 7 m higher than the northern slope. The auger survey helps us to appreciate that the difference between these slopes is part of the valley's substance with sedimentary expression. The shorter, steeper northern slope has shallower deposits which are identified in both the auger survey and the test pit, with a maximum sediment depth of 50 cm onto chalk gravel. In some places on this slope the auger indicates that the deposits are likely to be shallower than this. At the base of the northern slope the test pit reveals limited sedimentation, of up to 55 cm, lying above a chalk gravel surface which has the appearance of periglacial involutions. If this represents the total deposition arising from Holocene erosional processes, then we might consider it to be low. The boundaries between the horizons in TP1 and 3 towards the northern flank are sharp with a high volume of coarse components. TP 3 at the base of the northern slope contains all angular to sub-angular gravels ranging from very small to very large in size. Both these test pits have a base that is a Cr horizon.

The southern slope auger survey gives a materially different result with the auger recording silty loam and silty clay loam for its entire 150 cm length and failing to reach chalk gravel. The test pit at the base of the southern slope (TP2) has a different profile from the other two tests pits situated towards the northern flank. This test pit has no C horizon and has only diffuse boundaries in contrast to the sharp boundaries seen in TP1 and 3. Further contrast is seen in stone shape and size as this test pit has all sub-rounded and sub-angular chalk gravel and very small to medium sized stones. Additionally TP2 contains low pH values for calcareous grassland in the upper three layers, this corresponds with negative (<0.1) calcium carbonate tests in the laboratory and is indicative of a non-calcareous brown earth.

From a field workers perspective one of the most striking findings at Vessey Pasture Dale was that there were virtually no land snails recovered, and no animal bones preserved even where there were calcareous deposits. Additionally there were barely any artefacts with the only two objects coming from the A horizon in TP1. The proximity of the site to the Scheduled Monument and other sources of prehistoric activity had made it seem likely that there would be some direct trace of human activity in the valley bottom.

8.1.2 Fairy Dale

At Fairy Dale the location for the auger transects and the test pit excavation was carefully chosen to avoid the disturbance associated with the construction of the Burdale Tunnel and the station. Fairy Dale has an association with the Towthorpe Group, the Towthorpe Ridgeway, the Roman farmstead, the later railway building, and the provision of accommodation for engineers and labourers who were working on the railway and the quarry during the nineteenth century. This concentration of activity implies that it holds a significant geographical position close to important communication and transportation routes. This is difficult to appreciate today as it appears quite isolated.

The shape of the valley is quite distinctive with a sweeping curve and the slopes here are very steep, c.36% to the east and c.46% to the west. The valley floor is strongly sloping from its head, running in a general north-south direction. The auger survey across the valley demonstrates predominantly silty loam topsoil onto a silty clay loam or a clay loam subsoil. Midway down the slopes the records became slightly shallower with, for example, 72 cm of sediment onto chalk gravel.

Of the five sections recorded in the test pits we can divide the results into three distinct groups. The first is the gully section, which was unlike any of the test pits in that it had exceptionally shallow sediments, thin rendzinas, onto chalk. All the sediments recorded here were highly calcareous and were very or exceptionally stony. The B horizon is absent in this location. The colours of the sediments here were muted and whilst this may be related to weathering the loss on ignition results were not dissimilar to the other test pits in this area and so do not support this explanation.

The second group are TP2 and 4 and both are situated at the top of slopes, one to the west and one to the east. TP2 and 4 both have a C horizon beneath a yellowish brown clay loam or silty clay loam, and this is overlain by a brown silty loam. Both of these pits contain sharp horizons and have some discontinuous layers. The large chalk blocks seen in the bottom of TP2 were not like the weathered gravel Cr horizon seen elsewhere and may be structurally related to the nearby Fairy Stones. As the Fairy Stones are a RIGS we did not investigate this layer further to avoid unnecessary disturbance to the site. The artefacts recovered from this test pit were mixed and redeposited.

The last two test pits in Fairy Dale (TP1 and 3) were situated at the bottom of the slopes, one to the west and one to the east, and they can be grouped together as they have similarities. Both have diffuse boundaries, especially TP3 which is very stony in every layer, and they do not reach parent material in their bases. The material within both of them appears to be a poorly sorted heterogeneous colluvium.

Most of the basal deposits at Fairy Dale are clay loams indicating longevity of deposition and the translocation of clay particles down through the profile. Although the land snails are variably preserved here the lower colluvial layer from TP1 shows a grassland and catholic species composition compared with a very clearly distinct assemblage of shade lovers in TP2. The artefactual material recovered at Fairy Dale represents the chronological period from the Iron Age through to the modern period although the densities of the artefacts from any given sedimentary layer were low.

8.1.3 Whay Dale 2005 and 2006

The dry valley here lies adjacent to an area of intensive human settlement and also close to the site of a great deal of human activity in the nineteenth century. Similar to the Fairy Dale valley this valley slopes down sharply from its head towards the south. The valley flank to the west slopes at approximately 26%, and to the east at 31%. The eastern slope is c.25 m higher than the west. Although the auger record for the top of the eastern slope recorded over a metre of sediment by the midslope this had reduced to as little as 10 cm of sediment onto loosely consolidated chalk gravel. When the survey investigated the valley bottom there was generally 1.5 m of sediment in the steel auger chamber, which was the maximum possible. This was usually a brown silty loam onto a yellowish brown clay loam or pale brown clay loam.

There is variation in all three of the test pits at Whay Dale. TP1, below the eastern slope has a poorly sorted very or extremely stony sequence and a predominantly angular stone shape. When combined with the auger record for the base of this test pit the sediment continues for a total depth of 2.35 m. This test pit produced limited numbers of land snails in the lower three layer, had a high calcium carbonate value throughout and high loss on ignition in the topsoil only. The boundaries between these layers were diffuse but undulating and there is a Bt-horizon indicating longevity and weathering of the sediment. This test pit lies below the higher and steeper slope to the east with thin sediments on the slopes and this is indicative of substantial erosion by colluvial action.

In TP2 towards the western flank there is another colluvial sequence but this time with pulsed deposits and sharper boundaries. The base of this test pit undulates onto loosely consolidated chalk gravel but the use of the auger here revealed further deposition and a total deposit depth of 178 cm. Loss on ignition values here were lower than in TP1 and a single land snail was found in a sediment with a pH of 7.05, the lowest pH value from the samples from this valley. A range of artefacts and ecofacts were found throughout the layers of this test pit and whilst some were modern, the older artefacts were arranged in a sequence that made chronological sense, with the oldest nearest the bottom.

TP3 was south of TP2 and on the western flank. This test pit had clear horizons and pulsed deposition similar to TP2 and had an A, B and Bt horizon. Artefactual material was found only in the topsoil and land snails were found in small numbers in the lower three layers, which were strongly calcareous.

Whilst the sedimentary sequences in the test pits at Whay Dale are all different the levels of deposition are high and combined with the thin deposits on the midslopes this is indicative of unstable slopes and increased levels of erosion. To the east the deposits are indicative of a general slopewash mechanism of deposition and to the west a pulsed mechanism of deposition, which could relate to severe weather events or the effects of agricultural activity on the plateau above.

The 2006 season afforded the opportunity to examine the sedimentary sequences in a long section and to a greater depth than examined the previous year by auger survey and test pitting. The Cr horizon in the lower part of the section is the earliest deposit (layer 12) and this is overlain by a small area of silty loam (layer 11) which is then covered by another small lens of chalk gravel (layer 10). This appears to be evidence for periglacial activity which has interleaved and tipped the deposits on an axis which is not in sympathy with the direction of the slope. Layers 10 and 11 were not sampled as they were not major parts of the five sampled sections. In the upper part of the section the lowest deposits are represented by the very stony clay, layer 7. This is overlain by layer 5 which is a dark yellowish brown clay loam and then layer 9 which continues downslope and is a dark yellowish brown clay horizon. Overlying this is a widespread clay loam (layers 3 and 6) but downslope this has been further subdivided (layer 8). Lying above these clay rich B-horizons are two A-horizons, one of which is a discontinuous very stony silty clay loam (layers 2 and 4). The final layer is a silty clay loam or silty loam topsoil (layer 1). The B-horizon generally consists of a yellowish clay loam or a clay. Most of the clay loam B-horizon is a calcareous, moderately or very stony layer, compared with the Bt horizon which is slightly stony, has low phosphates, is non-calcareous and has a pH which lies between 8.27 and 8.35.

By comparing the two sections A and E and considering the depth of deposits and their makeup we can clearly see that the effects of gravity on the slope have led to a much greater build up of clay rich material further downslope in layers 9, 8 and 6. In section A there are five layers, but all the layers are of a reasonably uniform thickness of between 12 and 22 cm. When we get down slope to section E we can see that the stratigraphic equivalent of layer 3 (which measures 20 cm in section A) is layer 6 and this has a maximum depth of 80 cm.

Although attempts were made to identify and sample, micromorphologically, a buried land surface, this was unsuccessful. There is however a series of high loss on ignition results from the section. The high results come from the sample numbers A4, B6, B10, D22 and E23. The very high loss on ignition in E23 is coupled with a neutral pH of 6.65. This is topsoil and the decomposition of organic material can lead to an increase in acidity. Given the livestock problems that we encountered here, despite fencing, it seems that the surface decomposition of sheep waste is the most probable explanation for this result and for the high value in B6, which is also a topsoil unit. The other results for loss on ignition are more complex as all the samples are towards the bottom of the profile, two are from the same stratigraphic layer (layer 5) and all are very stony. There were no visual clues that the organic content would be high and it may be that there has been some translocation of organic material into the gravel. It is however noticeable that the yellowish clay loam of layer 5 (which has a high loss on ignition in sample A 4 and B10) lays upslope and in the overlying layer to the subsequent sample with a high result for loss on ignition, in D22. Perhaps the reworking of an organic deposit as it has eroded downslope is a possible explanation of this result.

The lack of dateable artefacts, ecofacts and the lack of any significant land snail assemblages has limited the interpretations from this section. The auger points at the field boundary here indicate that there is a clear limit to the settlement site which lies to the south of the field boundary.

8.1.5 Thwing

Although restricted in numbers the land snail assemblages examined from Thwing were interesting for a number of reasons. They provide evidence of species from a range of habitat preferences including shade preferring species, which are absent from the modern distribution records. The presence of a snail, which is only represented in Yorkshire from early postglacial contexts, is indicative of an early date for the assemblage despite the shallow nature of the deposits from which it derived. Amino acid racemization has confirmed that the snail assemblage is more likely to be contemporary with the Roman building than modern.

8.1.6 Wharram Grange Crossroads

This site is important for understanding the nature of settlement, and settlement change during the Late Iron Age and Early Roman period, and the quality and quantity of the land snail assemblages found within the ditch fills were excellent. Given the number of snails recovered, and with the benefit of hindsight, a more rigorous programme of snail shell sampling could have been employed here at the outset which may have yielded more accurate and detailed results. Equally, the future analysis of the entire molluscan assemblage from the site may also yield additional information. Given that the snails were largely identifiable to species, that recovery levels were good, with many juveniles and eggs seen, and that the numbers were amenable to a full programme of statistical analyses the results from the application of these methods were somewhat disappointing. Although amenable to the methods themselves the nature of the assemblage meant that the use of Correspondence Analysis and the Brillouin Index for species diversity and richness contributed little additional analytical or interpretational value. The differences between samples from the primary ditch fills and subsequent secondary fills were striking but these differences are likely to relate to the shady conditions in the bottom of the ditch than to any more general environmental conditions or interpretations. The differences between the samples and the nature of them suggest a series of stable deposits with low sediment transport.

8.1.7 Environment Agency data

Whilst this information was interesting to review and was particularly relevant to understanding the current monitoring and controls of the aquifer, the data itself did not contribute specifically to my study. In terms of my general research agenda investigating sources of evidence for landscape and environmental change this type of data is useful. The water levels recorded for over a century indicate a cyclical change to aquifer height rather than any significant change but it is widely recognised that irreversible changes to the aquifer water levels may take many centuries to become apparent.

8.2 SUMMARY: LANDSCAPE MORPHOLOGY AND TAPHONOMY

An assessment of the landscape morphology in the study area finds that there are many visible elements of the dry valley system described as characteristic of this region by Lewin in his geomorphological study of 1969. This includes the sharp angularity of confluences as seen at Whay Dale and two visible chalk ridges, representing here a possible later phase of valley development. The expectation that adjacent valleys often run in a consistent orientation is apparent at Vessey Pasture Dale, which runs almost parallel to Thixendale. The valley heads seen also follow from Lewins findings with some sharply cut, Fairy Dale and Whay Dale and some being a 'fishtail' shape as at Vessey Pasture and Thixendale. Dendritic valley heads which cut into adjacent interfluve areas do not usually exist as valleys today, but are seen locally in the satellite imagery of the area as cropmarks.

All forms of stratification are the result of cycles of erosion and deposition, a composite picture from both natural patterning and human modification. There are two main processes and mechanisms at work in eroding and redepositing material on the Yorkshire Wolds. The first of these is mass wasting on slopes, which can produce a shallow deposit, and is generally initiated because weathering is a continuous process. This material is termed colluvium and its movement can occur by falls, slides, slumps and creep/heave. The other main process is fluvial in origin and includes rain splash, sheetwash, rill erosion and gullies. Rills tend to be more ephemeral channels incised into the topsoil only, but as they deepen downslope they can cut into the subsoil and become gullies (Fullen and Catt 2004, 12). The main effect on erosion and deposition is primarily weathering and elements including axis, gradient, slope morphology and vegetation all exert an influence (*ibid*).

The slopes within the study area are predominantly steep, between approximately 25% and 46 % where measured, and the results of DEM analysis show the distribution of steep sided slopes in this area (Figure 124). The shape of slope is variable within the same valley reach and a combination of convex, concave and straight sides were encountered, with convex and straight-sided the most common. The steepest slope examined, which was also concave, to the west of Fairy Dale resulted in heterogeneous, unsorted colluvial deposits at the base of slope, although the concavity itself may be related to earlier erosion and may be a symptom of the instability of this steep east facing slope; an effect rather than a cause (Figure 125).

Asymmetry between valley flanks is apparent in the different heights and gradients encountered but also in the different sedimentary regimes discovered at Vessey Pasture, Fairy Dale and Whay Dale. At Cowlam Well Dale the valley asymmetry was also pronounced. The flanks at Cowlam Well Dale exhibited a 14 m height difference and the northern, shallower, slope contained, in some places, just 13 cm of sediment on top of the chalk gravel, compared with 133 cm on the southern slope.

The reason for the discovery of different deposit depths in valley bases and on the slopes, within the same valley location could have several explanations. It is possible that within a single valley, the original deposition of material that formed early soils was variable and led to the development of thin sediments on the top of some slopes (Cowlam Well Dale and Vessey Pasture Dale on the northern slopes), this in turn led to an absence of deposits in the valley floor. That the deep, loess based, soils did not develop here, as has been long assumed by previous research and conventional wisdom, is a hypothesis which has recently been explored in the south of England (French *et al.* 2007) where the evidence for the variability in the development of the original soil cover within a single valley system is compelling.

It is also possible that in some areas (Burdale and Langtoft) there were originally deep soils on the Wold top but that these eroded downslope and that, rather than forming deep deposits locally in the valley bases, they were washed out of the system usually by the action of water in the form of streams or flood deposits. The third likely mechanism for the development of sediments related to slope processes is that the instability of steep slopes (Fairy Dale and Whay Dale) has led to the formation of deep valley deposits in the bases, although substantial overburden deposits can be seen at the slope summit. The nature of these deposits is variable, incorporating different quantities of anthropogenic material and occurring either as a generally poorly sorted, stony, colluvial material or, as appears to happen clearly within deposition at the top of slopes, a pulsed system of deposition which has a different mechanism of erosion and accretion. It seems from the results of this research that the valley asymmetry and differential soil development is a significant factor in the mechanisms of erosion into the valley bottoms.

In summary, there is a variable pattern to erosion and deposition but generally, in keeping with the finding of the pilot study, there was the accretion of deep (i.e. more than a metre) deposits at the slope summit. This was usually sorted and stratified material. Commonly the back-slope and mid-slope of the valley flanks contained much less depth of deposit, and this could be as little as 10 cm. At the valley toe-slope and base there was occasionally shallow (50 cm) deposits onto chalk gravel, or more commonly, anything up to 2.35 m of deposit.

Other factors that are likely to affect this process locally are the areas of natural terracing which are widely seen on the Wolds and have been specifically encountered at Vessey Pasture, Burdale and Whay Dale. There is a severely denuded slope above the Burdale valley although the effect of both road building, railway cutting and tunnel cutting along this stretch of the valley make the landscape history of this area difficult to unravel and these activities may have ultimately destabilised a previously stable slope.

An assessment of vertical aerial photographs made from satellite imagery on Google Earth and Get Mapping has revealed evidence for a complex palaeosurface with rilling and gullying. The relict arms of dry valley channels represent a complex palaeotopography which does not appear to have been formally discussed or investigated before (Figure 126). These past landscapes are the records of natural processes and they have been barely considered by either archaeologists or geographers. This may be because it is only recently that widespread satellite mapping has become widely available for analysis. Certainly the NMP for the Yorkshire Wolds necessarily considered many of these features as part of the analysis of archaeological features, which were disentangled from the natural features, but as the natural features were not part of the research agenda they were relegated to a single sentence (Stoertz 1997, 10).

Archaeologists may be 'missing a trick' here as the features are thought to result from natural geological processes but may well contain evidence in the infill for the general climate at the time they of infilling, the nature of deposition into them (wind, water or slopewash) and the types of sediment prevalent, forming a sediment trap. This would help us understand the dry valley system in more detail and might give a more specific date to changes in the erosional - depositional sequence for this area. Research into the solifluction terraces and mass wasting products in the valley bottoms of the Cheviots found that below the solifluction sheets there lay three distinctive drift deposits (Harrison 1996, 1216). These were thought to be deposited by paraglacial (glacially conditioned) processes over a relatively short period and indicate that valley bottom deposits may be more varied that previously acknowledged.

Lewin made a comprehensive assessment of dry valley morphology on the Yorkshire Wolds, which resulted in detailed maps of geomorphological features (Figure 127) and the valley networks (Figure 128) but these do not appear to have been built upon subsequently. The analysis of a digital elevation model (DEM) at 10 m resolution with height data provided by Edina Digimap allows us to consider the satellite imagery in more detail. Many of the features seen in the satellite imagery that represent infilled valley channels are no longer extant as valleys now forming part of the arable landscape however some of these features still have a topographic signature as depressions when viewed in the DEM (Figure 129). There is a complex pattern to the landscape development seen here with some early valley features remaining active. Some depressions are visible on both the DEM and satellite imagery, but are incorporated into the productive arable landscape and there are others that no longer have any topographic impact. These channels are fully infilled and are visible purely as crop or soil marks on the satellite imagery, but not as morphological entities appearing in the DEM.

This type of approach to the morphology of palaeolandscapes can be seen today in several different research projects which are examining relict valley systems. One study, based in Antarctica, is conducting relict channel experiments in the McMurdo Dry Valleys to try and understand the long term ecology of the area and the response of dry valleys to climate change and water availability (McKnight *et al* 2001). The application of high-resolution sonar imagery to palaeosurfaces has arisen due to the aggregate resource potential of the buried valley systems in the English Channel. The aggregate industry has funded research into the palaeo-Arun and Solent and this is investigating a 400 km-long network of submerged and infilled valleys in order to reconstruct a prehistoric Pleistocene landscape (English Heritage 2003). The recent mapping of alluvial palaeosurfaces along the Trent valley has utilised a large volume of aerial photographic evidence in conjunction with Lidar imagery, collated in a Geographic Information System to give a more accurate and comprehensive assessment of the archaeology and landscape development of the Trent river system (Challis *et al.* 2006). There was a large discrepancy in the depiction of palaeochannels within the aerial photographic archive dependent primarily on the season and photographic conditions, with many more features apparent when aerial photographs were combined with Lidar data (*ibid* 20). Some of the relict channels, which were identified as cropmarks, no longer have surface topographic expression. This is similar to the findings for the relict dry valleys on the Yorkshire Wolds during this research.

There is a danger when thinking about landscape scale processes and morphology not to fully consider the human influences on the landscape when these can be significant and sustained leading to change on a variety of scales. In the study area the most obvious anthropogenic elements encountered during this research were the construction of the railway cutting, station, tunnel and a substantial quarry. Other types of human activity which have affected the study area in a more localised manner are the construction of barrows and monuments, which frequently involved moving large quantities of clay or chalk rubble but also preserved earlier land surfaces, and the formation of the rabbit warren, which was essentially the result of human and faunal processes in concert.

Changes to the nature and structure of farming affect the shape and condition of the land and can change the intensity of modifying processes, such as erosion and redeposition. The type of agricultural activity that we most commonly consider as archaeologists includes elements such as field size and boundaries, hedges and shelter belts. However, less obvious factors such as planting regimes, the effects of fertilisers, ploughing or deep ploughing regimes and grazing activity, which modifies the sward and tramples the topsoil, all play their part in altering the landscape. The silty nature of the Wolds soils make them particularly susceptible to wind and sheetwash erosion when they are left exposed, and so cropping regimes that include winter cereals make the soils more vulnerable.

On the Yorkshire Wolds the changes to agriculture can be seen currently in the rise of agribusinesses. These businesses take the piecemeal aspect out of the landscape hastening the decline of family farming patterns. The development of agribusiness (also known as corporate farming) is important as the system overwhelmingly relies on a vertical system that is run entirely for maximum profit and the rise of agribusinesses is known to undermine small farms by the appropriation of the largest sums of EU subsidy under the Common Agricultural Policy (Guardian 23/3/05). Warter Priory Farms on the Yorkshire Wolds is such an enterprise run by three businessmen and has received 1.6 million pounds in subsidies over 2 years. In America, a vocal lobby has developed opposing the development of agribusinesses and the academic, writer and farmer Wendell Berry was the founder of this movement.

Berry has devoted his life's work to thinking about how people live and work in 'place' and their relationship to the land. Although he accepts that farming is not 'natural' he claims that by adopting agrarian principles, values and responsibilities we can all become 'farmers' of a sort. He sees the contingent relationship between human agency and nature expressed by farming; we neither live in a wilderness nor in a factory but we all rely on cultivation in order to survive and therefore humans are agrarian beings (Berry 1997).

Berry's assertion is that farming requires a nurturer, not a technician, and that a farmer is a cultural product borne out of training but also from generations of essential experience and connection with the land (Berry 1997, 45). This experience can only be gathered, tried out, maintained and handed down in settled households and communities that are specifically native to their own ground; ground that was prepared in the past for use in the present and which the present must safeguard for future use (*ibid*). The concentration of farming into bigger holdings and fewer hands is allied to increases in overhead, debt and machinery and has a complex agricultural significance that cannot be disentangled from the cultural significance. Agribusinesses are able to achieve economic success by internalising benefits but externalising some costs and as a result of this some disadvantages fall outside of the firms responsibilities (pollution, waste, public services) but are a substantial cost to the wider community (*ibid* 171). Berry is persuasive in his arguments against intensive agriculture citing pre-industrial societies use of mixed crop regimes, share cropping and landscape zones to create an efficient and sophisticated farming system which utilises all the available land regardless of any limiting factors (*ibid* 185). The impact of agribusiness on the landscape emphasises the inter-twining of geomorphological and landscape change with political, economic and social change that are difficult to unravel.

8.3 SUMMARY: SEDIMENTARY ANALYSES

Many sedimentary analyses and questions can be answered in the field however these can then be augmented by the examination of sediments in the laboratory that allows a more detailed analysis. The soils formed on chalk or limestone contain naturally occurring calcium carbonate and are therefore easier to work and have improved structure compared with other soils. However it should not be assumed that all soils on chalk or limestone are calcareous. The sediments that are formed on the glacial drift or clay-with-flint deposits can be acidic despite the calcareous parent material (Natural England 2008). In chalk valleys and foot-slopes where the soils are deeper, the pH may be less than 6.5 giving rise to neutral, rather than calcareous, grassland (*ibid*).

The majority of sediments studied during this research were calcareous as identified by testing for calcium carbonate and by recording the pH value. Most soils in the UK, except those on limestone or chalk, are naturally acidic due to soil processes and the acidic effect of rainfall. The normal soil pH conditions for grassland communities are; Acid <5; Acid–neutral 5.0–5.4; Neutral 5.45–6.5; Calcareous >6.5 (Natural England 2008). Within unenclosed lowland grassland occurring on chalk the expected pH status is usually between 6.5 and 8.5, but this can drop as low as 5.0 (Joint Nature Conservancy Council 2006); as we discovered at Vessey in TP2 there were pH measurements of 5.41 and 6.30 which are acid-neutral to neutral. The occasional samples that had a neutral or an acidic pH value can be considered non-calcareous brownearths. The degree to which this is related to pedogenesis or to the application of artificial fertilisers has not been established.

The main influence on soil phosphate is the agricultural application of fertiliser or manuring and once added phosphates are highly insoluble and slow to leach. For example the 'super-phosphates' that were applied to many agricultural areas during the 1960s and 1970s are still affecting sediment phosphate levels today. The phosphate status of semi-natural, species rich grassland should be low at 0 (Natural England 2008). We encountered a range of phosphate levels from 1 to 5 and there did not appear to be any significant patterning to the distribution of different values with most test pits exhibiting wide variability.

A number of clay rich deposits were identified particularly at Whay Dale. Lessivation is the net movement of clay particles down through the profile and occurs in a brownearth where precipitation exceeds evaporation and transpiration (Evans and O'Connor 1999, 35). This produces *sols lessives*, also known as argillic brownearths (*ibid*). It has been suggested that the onset of the process of lessivation can be equated with a loss of tree cover and leaf litter (Evans 1972, 277). Whilst the small-scale changes in climate experienced during the Holocene have little impact on the chemical weathering of colluvium, any increase in precipitation has a strong impact on pedogenesis (Leopold and Volkel 2007, 135). This post-depositional transformation is clearly linked with levels of precipitation and has a climatic component. Attempts to use colluvium as a source of evidence for past climatic evidence has failed due to problems in isolating the data needed from the complex and incalculable factors involved in colluvial modification (*ibid* 139). Most of the sediments were silt rich indicating the periglacial legacy of aeolian loess deposition during the Dimlington and Loch Lomond Stadials (Ellis 1990, 32).

A means of dating the sedimentary layers was not identified during this research. It is likely that the fragments of charcoal and burnt seeds found at depth were deposited there by various faunal activities. The actions of earthworms have been examined by experimental work which found that a single burrowing earthworm could displace small mammal bones placed on the surface of the topsoil by up to 24 cm vertically, and 15 cm laterally, in a 2 year time period (Balek 2002, 42). Earthworm activity affects archaeology in a variety of ways; surface casting constantly cycles fine material from deeper levels to the surface and this causes the lines of stones often found below the topsoil (Canti 2003, 140). The constant cycling can bury surface finds and can disrupt stratigraphy, as seen in Roman and Saxon ditch fills where the stratigraphic boundaries were destroyed by earthworm movement (*ibid* 138). Cinders were spread experimentally on a land surface and were found at a depth of 18 cm after 18 years burial due to earthworm cycling (*ibid* 141). There is no accepted depth from which casts are brought up to the surface but they seem to be concentrated nearer to the surface, however other processes such as the burrows left by casting or mole activity can provide routes deep into the strata. Earthworm mixing can also affect sedimentary processes by, for example, preventing clay translocation and may be responsible for the destruction of buried soils beneath barrows in the absence of other explanations for their absence (*ibid* 142). The Experimental Earthwork Project found that whilst there was little disturbance due to earthworms on the acid soils at Wareham, the effects on calcareous sediments at Overton Down were pronounced. The mass of activity from earthworms and moles was responsible for destroying any clear stratigraphic boundaries (Bell *et al.* 1996, 237). Extensive evidence was found for the reworking of buried soils and their biota, and the subsequent decalcification of these land surfaces meant that no land snail assemblages survived for their distribution to be mapped (*ibid* 238).

Recent research has examined erosional processes and alluvial fan formation on the valley floors in north-western England and has had some success in radiocarbon dating the buried organic materials from beneath the alluvial fans (Chiverell *et al.* 2007, 317). Four phases of increased gullying and erosion were seen. By relating these phases to recorded human activity in the area it is possible to explain erosion from the hillslopes, during the Holocene, as primarily associated with increased human pressure from activities such as the expansion of agriculture. This type of project is key to understanding the temporal and spatial patterns of the exploitation of upland landscapes (*ibid*).

In the absence of any definite *in situ* organic material, the discovery of quartz or feldspar particles from within a primary loess deposit may have provided the opportunity for optically stimulated luminescence dating, but none was found. At the very least I hoped that relative dating could have been undertaken based on the location of any securely situated artefacts within the strata. However the volume of artefacts recovered was not sufficient to make this tenable. Simple attempts to measure the amount of deposit above an isolated artefact of a defined age, and to then presume that this is the amount of deposition since a particular date are fundamentally flawed. Hotston (1985, 25) does this at Fairy Dale where he found 80 cm of colluvium above a third century AD Roman pottery fragment and declares that this the amount of colluvium that has accumulated since this time. The main criticism of this argument is that, especially at Fairy Dale where we know that the settlement lies above the valley floor, the erosion and redeposition of the artefact into the valley floor could have taken place at any time since it was originally deposited. In this case, it is likely that Roman pottery was disturbed from plough soil above the valley during a period of agricultural intensification and that this process resulted in the redeposition of the item in the valley floor.

Despite evidence for an historic buried soil during the pilot study at Cowlam Well Dale, no further land surfaces were identified during this research. Attempts to identify them included the sedimentary analysis of loss on ignition and the collection of micromorphological samples. The loss on ignition results from the different locations vary; at Vessey Pasture the range is from 7.45- 22.81%, at Fairy Dale the range is 10.05- 27.14% and at Whay Dale 2005 7.92- 40.29%. Generally speaking the higher loss on ignition values are at the ground surface and the decrease towards the bases. At Fairy Dale there is a wider variation in the differences between the loss on ignition results for different test pits, for example TP1 has a range of 17.36- 22.81% whereas TP 4 has a range from 10.05- 18.62%.

The micromorphological slides from Whay Dale 2006 did contain evidence for some organic elements but the main element that distinguishes soil development from a weathering layer is the vertical anisotropy of the features, which are spatially arranged into soil horizons and these were not identified during this project (Raimonda Usai pers. comm.). Evidence from the Experimental Earthwork Project found that there was much greater mixing of the buried organic component than had been anticipated. This was largely due to water percolation and also due to decreasing particle size in the ditch fill, which when combined led to compaction and a general mixing of organic and mineral components (Crabtree 1996, 41).

Some phases of increased erosion and have been identified beneath agricultural slopes however in some valley bottoms there is an absence of significant deposition. It is unclear whether the sediments from these location have been washed out of the valley or whether, as suggested for some areas in the south of England, deep deposits did not develop here. Some deposits are pulsed indicating a more intensive episode of erosion and accretion whilst other are heterogeneous, deriving from sheetwash processes. A summary of interpretations from the test pit analysis is given in tabular form (Table 27). All the deposits encountered at depth were moderately to extremely stony except for the basal deposit at Whay Dale TP2 and 3 and towards the base of Vessey Pasture TP2, where coarse components were as low as 9%.

8.4 SUMMARY: MOLLUSCAN ANALYSIS

In general terms, few snails were recovered by the various phases of primary fieldwork. From the outset, the collection of land snail assemblages was problematic. The pilot study at Cowlam and the first few samples from Vessey Pasture indicated that few land snails were preserved and so to undertake close vertical sampling, as is the norm, would probably have been fruitless. A decision was made to take large samples from the different sedimentary units which would give a gross picture of change rather than the more detailed and nuanced sampling often seen (Davies 2008). The quantities of snails recovered from each sedimentary unit were limited, despite the larger samples and precluded any statistical analysis or detailed interpretation. General landscape trends were identified and were informative. The recovery of early examples of rare species was reassuring in terms of recovery and processing. Although not always correlating, the relationship between pH and shell preservation can be seen clearly in this graph showing all the samples across the test pit sites (Figure 130).

At Fairy Dale we were able to consider the mollusc assemblages we found in 2005 with the earlier mollusc study from this valley by Hotston (1985). The location of the test pits excavated in 1985 is not recorded but two were towards the valley head, on the valley floor, and a further pit was below the Fairy Stones in the valley base; the locations were not dissimilar to the 2005 sampling locations. Each sample in Hotston's study weighed 2 kg and whilst some of the samples were devoid of snail shells, most samples commonly had over 30 snails preserved, with a maximum of 367 from a single sample. Hotston's assemblages contain several snails which are not in the modern distributions for land snails, and were not found during the 2005 research but these are primarily single examples; *Succinea putris, Azeca goodalli, Acanthinula aculeate* and *Balea perversa*. Two of these species are worthy of comment as *Succinea putris* is a species associated with wet or marshy ground and *Acanthinula aculeate* is a shade preferring species typically found in deciduous leaf litter (Davies 2008). Although they are single examples, the recovery of these species demonstrates the likelihood of different landscape niches in the locality in the past. Hotston found significant numbers of snails in his test pit 1 from the ground surface to 1.55 m below ground level, in the bottom 50 cm there was a negligible amount. In test pit 2 there were lower amounts of snails overall, but there were some present from the ground surface to 1.3 m below ground surface, and none recovered for the last 40 cm. In test pit 3 there were significant snail quantities throughout the entire 2.2 m profile.

The reason that Hotston had success in recovering good volumes of land snail assemblages in 1985 and that the research in 2005 did not, can be interpreted in two different ways. Firstly, we could assume that this was a coincidence and that the places where we excavated our test pits were alongside mollusc rich sediments and we had merely looked in the wrong places. The second possibility is that there has been a material change in the condition of these valley sediments since the 1980s. This is unlikely to be a change in pH, for although Hotston did not record any, the deposits are still calcareous today, with predominantly basic pH values. The values of the current pH may be irrelevant as some of the deposits may not have contained land snails due to the development of the original loess or brownearth sediments which were acidic or neutral in the early Holocene, and have now become calcareous. Any period of non-calcareous sediment development will lead to a lack of preservation of land snails.

It seems that the change in mollusc preservation at Fairy Dale is due to either a period of decalcification, which would have had to occur between 1985 and 2005, or more likely due to the loss of organic material by the leaching of a mildly acidic precipitate, which is common in northern Europe. The nature of the precipitate could have been altered either by an increase in the acidity of precipitation or by a local increase in acidity, for example by the areal use of artificial fertilisers. The likelihood of leaching is influenced by groundwater and air quality in East Yorkshire and therefore the data accessible online was reviewed and is discussed below.

The Nitrates Directive is legislation initiated in order to protect watercourses against the nitrate pollution which largely arises from agricultural by-products. Following the original classification in 2002, and then reclassification in 2006, approximately 70% of England is a Nitrate Vulnerable Zone (NVZ). Virtually the entire Yorkshire Wolds region is a NVZ and has been designated as such by identifying the groundwater, surface water and standing water bodies that could, without preventative measures, contain 50 mg of nitrate per litre of water or be subject to eutrophication processes (DEFRA 2008). This scheme ensures that water quality is continually monitored in vulnerable areas and action taken as necessary to prevent nitrate increases. Incentives for farmers to reduce nitrate usage are made via the Environmental Stewardship Scheme but are dependent on uptake by individual farmers.

The air quality of the country is continuously monitored by DEFRA and the data is available via the UK National Air Quality Archive (2009). The report on Air Pollution in the UK for 2007, which records the levels of pollutants remotely in 139 automatic stations, and manually in other locations, finds that the levels of nitrogen dioxide on the Yorkshire Wolds are low at below 10 μgm^{-3} (the lowest category) compared with greater than 60 μgm^{-3} in London. However, the measure for particulate matter pollution in East Yorkshire is 12.5–15 $\mu g/m^3$, which is a moderate result. This small particle and droplet pollution arises from a range of processes including elemental and organic carbon release arising for example from the mechanical generation of particles during quarrying or building work. The 2007 report by DEFRA and the Centre for Ecology and Hydrology 'UK Acid Deposition Monitoring Network' looks specifically at particulate pollution related to precipitation and concludes that, for example, particulate sulphate concentrations have shown a downward trend since the 1980s (Lawrence *et al.* 2007). The graphs produced relating acid deposition to levels of precipitation show the Yorkshire Wolds in a favourable condition compared with the levels first recorded when monitoring began, however the east of England, with its proximity to the continental landmass, and high agricultural intensity has higher levels of acid deposition than many other parts of the country (Figure 131).

A similar mechanism may be responsible for the preservation of some pollen in calcareous sediments. At Kilham Long Barrow the pH values of the samples used to retrieve the pollen for analysis were all alkaline at between 7.5- 8.0. This discrepancy in pollen preservation is accounted for by a process involving the percolation of calcium carbonate from the overlying barrow mound, which was constructed of chalk gravel. The survival of the pollen indicates that at the time of burial the soil was acidic (Evans and Dimbleby 1976). The evidence for widespread decalcification comes from West Heslerton and includes decalcified sediment from within Neolithic tree hollows. It is suggested that decalcification during the Neolithic period resulted in extremely poor land snail preservation with modern burrowers the main snail component. Additionally pollen preservation here was poor and therefore, the site contains limited environmental sources of evidence (Macphail 1998). The evidence from the Overton Down earthwork experiment found that molluscs were poorly preserved with apices faring particularly badly, but the proteinaceous coat was much better preserved than had been expected (Johnson 1996, 140). A series of gaps were identified in the land snail sequence. These appeared to be related to unfavourable conditions for both the preservation of snails and for mollusc life, with little free calcium in the sediments (*ibid*).

The analysis of modern land snail samples taken from the chalk grassland ramparts of Maiden Castle found that the main species diversity was related to habitat factors, including lime content and warmth, and that this has sharply defined boundaries (Rouse and Evans 1994, 315). Within a single habitat type there is scope for distinct molluscan faunas and associations, which occur in relation to micro-habitat change (*ibid* 326). These associations can be grouped into species communities, which vary considerably. The analysis of molluscs should therefore always be undertaken by considering diversity, total abundance and species associations with the role of modern analogues being of limited value (*ibid* 327). This research emphasises the contrasts over short distances related to vegetation cover and the available calcium and proposes that the mollusc diagrams, which arise from palaeosol analysis, do not generally represent a continuous sequence of snails but rather discrete episodes of colonisation and of preservation. As the evidence from Fairy Dale and Wharram Grange Crossroads shows at a microhabitat level the land snails are informative. The best snail deposits tend to occur in rapidly accumulating ditch fills such as those found at Wharram Grange Crossroads, related to humidity and shade on a micro level. They are a subset of what inhabits the local area but are affected by unstable deposits and the effects of slope processes.

Although Carter (1990) felt that the potential for improving the accuracy of the ecological interpretations of land snail communities from buried soils was extremely limited, there are a number of studies which have made significant use of such assemblages. Carter argues that snails within buried soils do not provide any time depth, unlike for example pollen, and may represent a few decades. This may be unimportant if we accept that the snail assemblages are a sub-sample that has been subject to a wide range of taphonomic processes but still represent a wider community which may be significantly different from current communities. It does seem likely however that detailed interpretations based on land snails assemblages involving, for example, clear interspersed phases of woodland and grassland habitat may be insecure. Since researching the potential of land snail analysis it seems that using assemblages from an off-site location in deep valley deposits had limited potential. The assemblages generated were only even going to be able to be used as a subset of what was in the local area rather than being able to answer questions about large-scale landscape change and past environmental conditions.

8.5 SUMMARY: METHODS

The method of identifying prospective sites, or deeper areas of deposition, within the valleys relies on the combination of an initial assessment of geomorphological potential, and is then assessed by auger survey. The flatness of the valley floor in relation to the steep sided slopes was taken as indicative of valley filling and potentially deeper deposition. However, this was not always the case as, particularly at the valley heads and in the Burdale main valley, where the depth of deposit onto angular chalk gravel was shallow. The morphology of the base of valleys is frequently related to chalk rubble/periglacial solifluction infilling rather than sedimentary accumulations and is therefore a potentially faulty way of selecting sites. Another means of predicting deep deposits by the use of ground penetrating radar was tested in 2006 but the results in the main Burdale valley were poor and were not reflective of the auger records for the same area. The problem of modelling the sub-surface means that there can be difficulty locating any significant deposits in addition to the problem of identifying hotspots of human activity. If we accept that the dry valleys are not a closed system, and that sealed cultural deposits may have been washed out of the system, then identifying areas of human activity becomes increasingly problematic.

Auger survey is an effective and minimally destructive way of assessing sediments over a large area but on chalk lithology with high volumes of gravel this can be problematic. As the pilot study demonstrated the standard Dutch auger was not accurate due to the density of chalk gravel and even with the more specialised German steel auger, which was hammered through lenses of gravel, there were difficulties with using the auger. The first of these related to health and safety concerns and meant that a special magnetometer, which can be used to some considerable depth, had to be used in conjunction with the auger to check for any buried utilities (Figure 132). The second and more pressing problem of using the auger in 2005 was the issue of ground conditions, which resulted in relatively few auger points being recorded. One of the key aims of the 2005 season of fieldwork had been to carry out a more intensive auger survey based on the results of the pilot study (Neal 2004). However, the very dry preceding winter made this virtually impossible. November 2004 to July 2006 was the driest equivalent period since 1932–34 with 17 out of the 21 months having below average rainfall (Met Office 2007). Based on the rainfall patterns recorded from 1961 to 1990 the nationwide anomaly for 2004–2006 was 80% but in northern England, the anomaly was particularly pronounced at 96%. This led to fewer auger points being recorded than anticipated and limited the number of records that informed the test pit location and the identification of different sedimentary units.

The descriptions of sediments made in the field sometimes varied from those made in the laboratory especially in relation to stoniness and colour. It seems that this can be explained by considering the effects of relative description to adjacent layers in the field, so that those layers described as 'not stony' are actually quite stony when quantified randomly in the laboratory by absolute measures. When compared to extremely stony layers visually they were perceived as having few stones. This is an important distinction and typifies the way that decisions are made in field interpretations which rely heavily on the inspection of adjacent layers and colours, and, to some extent, the level of past experience. Some field descriptions of colour specified that they were 'orangey' but when the Munsell chart was used to record colour, and the description was used from the numeric code, then the orange colours were usually classified as yellowish. Any elements of loess-based deposits seen were reworked and appeared to contribute the yellowish colouration to many of the silt rich layers recorded.

The scale of investigation, especially when excavating small hand dug test pits, makes accurate depiction and recording variable and is dependent on the weather conditions, and the amount of shade in addition to the photographic expertise of the fieldworker. The section photographs in this research make this point, being of variable quality and this makes cross-referencing with the drawn record difficult.

The recovery levels for artefactual and ecofactual material was one of the my main concerns when comparing the results for the test pits at Whay Dale 2005 and the section cut in the same location in 2006. In 2005, although working in 1 m^3 test pits, a range of artefacts were recovered that represented a long time-scale. When then progressing on to an 11 m section in 2006 the assumption was that the artefact recovery should be greater than the previous year or at least the same, however the reverse was true. Four artefacts were found *in situ* during the excavation in 2006. The majority of personnel working in both seasons were undergraduate students who were unfamiliar with the site and had limited excavation experience but they were supported in both years by a group of more experienced postgraduate students. The weather conditions were much worse during 2006 with rain everyday, waterlogging of the trench and the collapse of some parts of the section due to water. That said, the recovery of three charred barley seeds, two flints and some small charcoal fragments in these poor conditions led me to believe that it was not the recovery process that was faulty but that in was likely that less material was present. With regard to the low numbers of snails recovered there may be an issue with sample size for although we took large samples for many of these the volume of chalk gravel was great. With the gravel component removed from the sample the actual sample weight ratio to the recovery of snail shells is altered considerably. In addition, the sample sizes recorded in the tables of sedimentary results show a wide variation. A number of factors influenced this as the sample weight recorded is a dry weight, and when the samples were taken they were wet/ damp and held different volumes of moisture depending on the sediment type. The ease of taking samples and the depth of the sampled layers also affected sample size. The most significant factor affecting sample size was the individual fieldworkers perception of the weight of the sediment.

The results for increased loss on ignition could be related to the method used. Some researchers have found that during heating to the higher temperature the calcium carbonate can be broken down which leads to an increased loss on ignition unrelated to the organic content (Dean 1974). Additionally, the removal of interstitial water from structural clay during heating to high temperatures leads to higher loss on ignition results (*ibid*). This process could be responsible for the increased loss on ignition that we have seen in the gravel rich sample D22 at Whay Dale 2006, but if this were the case then you could expect the effect to occur across the board. It is possible, however, that the level of degradation of the chalk component before heating and the volume of ground up calcium carbonate incorporated within the heated fine fraction might account for the increase in some samples but not in others.

As discussed previously Hotston dug three test pits in Fairy Dale and took between 14 and 19 samples from each pit. The nature of the pits was substantially different however to the current research as two of the pits Hotston excavated were more than 2 m deep, and the third was close to 2 m deep, with an area 1.5 m^2 open on the surface. Today these dimensions would be considered unsafe, as any pit that was deeper than 1 m^3 would need to have the surface area extended to make a safe working area with an escape route, consisting of either a battered ramp or steps. Alternatively, shoring could be used to provide additional safety for the excavators but this can make the recording of sections difficult. The current research project adhered to the guidelines set out by the Health and Safety Executive to ensure safe working practices. These consider that any sedimentary surface exposed and subject to weathering will become unstable, it is just a matter of time. The exact size for safe working depth is not given and must be assessed individually as part of the project's risk assessment, but some investigators suggest that after 80 cm depth a test pit can become unstable and so all the test pits forming part of this research were 1 m^3 maximum and the deeper section at Whay Dale 2006 was stepped, with an escape route.

The use of a pilot study is widely recognised as a way of assessing the efficacy of the methods and the research design prior to undertaking a larger study and committing additional resources. In this case, the specific sedimentary results of the pilot study were rather more productive than the results of the main study, with the discovery of a buried soil and the identification of a primary loess deposit. In this sense, the pilot study is a general guide and indicates the complex sedimentary and depositional regime within one valley.

My primary aim when undertaking the micromorphological sampling and analysis was to identify any potential elements from a buried land surface. However, there are other features that we could have looked for in our analysis of the slides including evidence for formation processes. A more comprehensive analysis of the micromorphological slides might have shown newly formed carbonate elements (Stephen Carter pers. comm.) indicating that the sediment was initially decalcified when it formed, and then became calcified later in its development and modification This would have enhanced our understanding of the land snail evidence and the pedogenic processes.

8.6 ARCHAEOLOGICAL THEMES

8.6.1 Settlement patterns and visibility

Many scholars believe that most areas of the Wolds were continuously settled throughout the past (Allison 1976, 53; Harris 1961; Jennings 2000). It is entirely possible that the focus of activity might shift or the mode of settlement might alter but that in one form or another, the settlement of the area is likely to continue from one chronological period to another. Early archaeological interpretations of settlement patterns in Yorkshire saw the Wolds as a focus for settlement due to the highly visible surviving aspects and there was a belief that the lowlands, including the Vale of York and Holderness, contained little evidence for prehistoric settlement of any description (Allison 1976, 30). We now know that this is incorrect but this example illustrates the way that our current preconceptions and assumptions frequently affect our explanation of the intensity of settlement and the distribution of sites.

As Harris (1961, 2) suggested the bottom of valleys provide an excellent settlement location with shelter from the wind and the elements, and access to water via springs and shallower wells than would be possible at the top of the slopes, however during heavy rain the effects of flooding might be felt more strongly here. Many small villages and hamlets are strung out along the valley floor, especially in the High Wolds, but this type of settlement from the past is more difficult to identify due to the nature of methods such as aerial photography which are dependent on the depth of buried features, land-use and favour eroded sites. Archaeological patterning is dependent predominantly on sites revealing themselves, through processes of denudation, or by methods which rely on shallow deposits for their success. Occasionally a site in the valley bottom is revealed, as was the case at Burdale. This site is in a broad valley that has been used for arable crops for a considerable number of years and has therefore been theoretically amenable to aerial photography. Many aerial photographs from previous years had revealed limited cropmark evidence, but not a settlement site, in this field. Since the discovery of the Anglian site at Burdale and the investigation of the archaeology there, illicit metal detectorists have turned their attention to other portions of this valley, towards Thixendale, indicating the possibility of settlement sites strung out along the modern routeway. In a landscape such as the deeply incised dales of the Yorkshire Wolds it is likely that past settlement is concentrated in precisely the locations that are most difficult to 'see' and to investigate. The settlement record, when discussing for example the concentration of occupation along a spring line, is fundamentally flawed and uses partial records that are reflective of the method, and the limitations that arise from assessing different areas in a representative way.

In addition to the chance discovery during reconnaissance of settlement sites at Burdale, or the burials discovered by Mortimer at Vessey Pasture/Backdale, there are also opportunities arising from commercial investigations that contribute to our understanding of past settlement on the Wolds and as noted previously this constitutes the majority of the archaeology undertaken in Britain today. However as also discussed the opportunities from commercial archaeology on the Yorkshire Wolds are necessarily limited due to the sparse settlement and low population. Most of the commercial projects reviewed during this research therefore have been related to industrial (generally quarrying) or infrastructure projects (pipelines). The Easington to Morecambe Bay pipeline route across the north of England demonstrates the opportunities for discovering new and previously undetected sites are high especially where they are sealed beneath a protective and substantial layer of sediment. This also means that they are difficult to detect or avoid during construction and are at risk of removal without proper recording or, if necessary, protection.

A specialist mitigation strategy was developed for colluvium and buried soils in Wiltshire, which aimed to reduce the impact of a bypass on the Holocene sedimentary sequence (Wessex Archaeology 2007). The evidence from the excavation at Heslington East, York demonstrates that the role of geoarchaeology is often only realised towards the end of a commercial project in northern England when difficulties with site formation and interpretation have come to the fore and necessitate a geoarchaeological approach.

The ALSF has provided a great deal of funding for archaeology since it began in 2002 as a means of addressing a range of problems in the areas affected by the extraction of aggregates but this opportunity has not been seized for archaeology on the Yorkshire Wolds. Some of the recent research projects discussed in this thesis have been funded through this scheme (Whyman and Howard 2005; Powlesland *et al.* 2006) however there have been no projects on the chalk itself. An ALSF funded project in East Yorkshire provided a desk-based assessment of the vulnerability of the heritage resource in this area in relation to aggregate abstraction (Brigham *et al.* 2008). The study found that minerals had been extracted in East Yorkshire for centuries and included chalk (at some times in the past principally for building purposes), limestone, gravel, and clay however, the recent extraction of chalk was for mainly industrial purposes. The study selected five areas for detailed analysis and this included an area of Wolds scarp in Area 5b Hayton but not any areas substantially or wholly on the chalk; this decision appears related to the requirement to primarily consider areas that contained economically exploitable minerals but is not explicitly stated (*ibid*). Whether this is because the chalk aggregate market is weak and economically less productive than other aggregates or whether it is because of tighter planning controls on aggregate extraction on the Wolds is unclear. What is clear from the review however is that there are still a number of productive quarries on this chalk landscape and that the extraction process on the Yorkshire Wolds has identified and, to some extent, damaged archaeological sites in the past.

As commercial development is vital in order for archaeological research to take place it is important to investigate what the limitations of this approach to archaeology might be in the Yorkshire Wolds. The use of commercial development and grey literature to enhance the understanding of the archaeology of a region can be further explored by utilising the Archaeological Investigation Project, based at the University of Bournemouth. This project consists of a database of all grey literature arising from either commercial or research projects since 1990 up until 2007 currently (http://csweb.bournemouth.ac.uk/aip/aipintro.htm). The database can be searched in a variety of ways including by the period of archaeological feature or by date of intervention. For the current research purposes a search was undertaken for the number of reports for East and North Yorkshire. The Wolds lie predominantly in the East Riding of Yorkshire but a smaller proportion lies in North Yorkshire, in the Ryedale District Council area of North Yorkshire County Council. This revealed a total of 1041 records for East Riding of Yorkshire since 1999 and 3453 records for North Yorkshire. When this search was combined with a search for work on chalk geology there were 55 records for East Yorkshire and 58 for North Yorkshire. Of the 55 records for East Yorkshire since 1999, 10 were desk-based assessments, 22 were watching briefs or post determination events and 23 were field evaluations of some description. If we then compare these results with those for the county of Wiltshire, there were a total of 1971 records for Wiltshire and 849 records on chalk geology however these records began in 1986. If we look at the records from 1999 only on the Wiltshire chalk there are 469 items of grey literature, which is more than eight times the number of records for East Yorkshire chalk in the same period.

Allied to the regional difference in the levels of archaeological research and investigation, there is also the issue of protection for the chalk landscape and the evidence contained therein. Of the chalk landscapes across the country, many have legal protection via the Area of Outstanding Natural Beauty (AONB) designation scheme. Of the 40 AONBs in England and Wales those with chalk downland as a major component include; Chilterns, Isle of Wight, Surrey Hills, Sussex Downs, Cranborne Chase and West Wiltshire Downs, North Wessex Downs, High Weald, Dorset, Kent Downs, East Hampshire, Surrey Hills, Dedham Vale and Stour Valley, and the Lincolnshire Wolds AONB. The Yorkshire Wolds are the most northerly chalk downland and rise significantly higher than the Lincolnshire Wolds. The reason for the Yorkshire Wolds omission from this type of protection is not known and may be to do with the lack of development pressure/visitors (although the same could be said of the Lincolnshire Wolds) although the commercial pressure arising from agriculture is potentially significant. There is also the possibility that the lack of inclusion in the scheme relates to political pressures connected with land ownership and the large land holding estates that dominate the Yorkshire Wolds. There is some protection from agriculture for archaeology on the Yorkshire Wolds outside of the usual scheduling arrangements and within the DEFRA scheme for environmental stewardship. The key targets of the environmental stewardship scheme which gives subsidies to farmers include creating chalk grassland, managing and restoring historic dewponds, managing and restoring native woodland, conserving scheduled monuments and conserving archaeological features (DEFRA 2005). It is not true to say that because they are not intensively settled that the Yorkshire Wolds are somehow protected from development pressures. It is accepted that as restrictions on mineral abstraction begin to increase within the National Parks and AONBs, the effects could well be felt within the unregulated Yorkshire Wolds area (Countryside Commission 1998, 52).

Fenton Thomas regards a chronological approach to the landscape and settlement of the Yorkshire Wolds as problematic because it emphasises the breaks between periods and artificial changes. Fenton Thomas' (2003, 134) research is a well written narrative but is undermined by on the one hand refuting period based analyses, and then using the very same time periods to describe phases of change or continuity in a way that would be familiar to any archaeologist. Although the approach to understanding the Wolds on a landscape scale is to be commended the arguments for the changing intensity, or for absence of, settlement seem to depend almost entirely on the role of undated, long distance trackways (*ibid* 131). The presence of trackways, the reuse of burial monuments and the existence of pasture land does not convey a clear indication of the continuity and change in settlement patterns on the Wolds. The Iron Age and the Anglian period are times when Fenton Thomas (2005, 55) feels that the Wolds is 'the landscape of the dead'. In light of this his explanation for the discovery of the Iron Age settlement adjacent to the Iron Age cemetery at Garton and Wetwang Slack is that this site is close to the spring line on the Wold edge and so is not typical of his 'landscape of the dead' pattern. Evidence for proven Anglian settlement at Cowlam and Cottam and probable extensive evidence from dry valley floors on aerial photographs detailed by Stoertz (1997, 59) has been overlooked by Fenton Thomas (2003, 133) who claims that 'Anglian presence on the Wolds appears only in the form of burials…'. Added to this is now the evidence from Burdale which not only shows the value from repeated aerial photography but also contains evidence for Roman and Anglian settlement at the same location, something which Fenton Thomas cites specifically as lacking (*ibid* 133). Eagles (1979, 42) finds that there is evidence for Anglian settlement at eight locations on the Wolds (at that time before the discovery of Cowlam and Burdale) and that most of these sites have evidence for Romano-British activity at the same site. Although there is no *proven* continuity between the periods, this can be a difficult relationship to identify with certainty, because of the nature of chronological divisions and the nature of the evidence itself. As there seems to be a clear correlation between the location of Romano-British and Anglian sites it seems likely that there was continuity of some sort from one period to another. Another issue with continuity concerns the territorial range of past communities and the way that we assume continuity in current villages on an ancient site when it is not proven (Dent 1988, 96).

As Stoertz has suggested the wealth of high quality aerial photography for the Yorkshire Wolds may have left the impression that the picture is virtually complete but this misapprehension is clearly addressed by the recent aerial photography from Burdale which has highlighted a substantial multi-period settlement in the valley floor. Although elements of the buried features have been picked up previously the extent of the settlement features was unexpected and unpredicted.

8.6.2 Environmental history

The efforts made in the 1960s to understand the ancient Yorkshire Wolds landscape by analysing the land snails below a single long barrow are not sufficient to make decisive statements about the environment especially as there are a number of problems with the methodology, processing, snail numbers and ecological groupings. The results from the Willerby Wold Long Barrow are inadequate and it is regrettable that, along with the problematic pollen results from Kilham Long Barrow and Willow Garth, they are still being used today without caveats to support to the timing, nature and extent of Mesolithic and Neolithic landscape clearance (Manby 1988; Stoertz 1997, 3; Flenley 1990, 50). The attempt of this research project to add to the corpus of environmental data for the region has not been fully recognised due mainly to the critical issues of preservation and dating. Implicit within this failure is an acknowledgement and acceptance of the difficulties in modelling environmental change in calcareous landscapes. The problems with the earlier research into the Yorkshire Wolds environment relate in part to the theoretical context in which they were undertaken and partly to the early application of methods, before the limitations and intricacies of the methods were fully appreciated. With a well-devised and executed analysis of the land snails from the buried soils beneath a selection of barrows, and off-site locations it might be possible to begin reconstructing the local Yorkshire Wolds landscape as has been recently undertaken by French *et al.* 2007 in the Allen valley.

The opportunity to interrogate the land snail data from Willow Garth would have been welcomed but the molluscan data from the site is available in a publication but does not include species counts and the data is presented graphically (Bush 1988b). The possibility of further investigations at Willow Garth in order to collect coleopteran assemblages has been considered by other scholars but the chance of securing undisturbed samples was thought to be slim (Wagner 1992, 75). More recently, issues of the water table height have become critical. Willow Garth is a SSSI designated as a rare chalkland fen, marsh and swamp and its general condition is described as favourable, although low water levels have recently led to the installation of a sluice as part of the management programme (English Nature 2006). The safe long-term storage of environmental data and materials from the Yorkshire Wolds is needed.

As discussed in Chapters 2 and 3 the analysis of land snails from ditch fills beneath long barrows has been widely used. The analysis of ditch fills from long barrows in Wiltshire has resulted in molluscan assemblages that suggest that there was a general trend from open country towards woodland or scrub in the later Neolithic (Davies and Wolski 2001, 311). The spatial scale of such implied clearances has recently been questioned, and they have been defined as relatively small-scale and localised events. If the molluscs from a buried soil beneath a long barrow suggest construction in open, or recently cleared, country this could represent an area that was predominantly open or alternatively it could represent a large clearing in a predominantly wooded area; open country fauna are often minor constituents of woodland faunas (*ibid*). The best way to analyse this issue is to look at contemporaneous sites and compare assemblages (*ibid*) but as we know the widespread and coordinated analysis of land snail assemblages from beneath long barrows has not been undertaken.

As the evidence discovered at Langtoft church has demonstrated there is not a closed sedimentary system on the Wolds, as some have suggested, but rather a highly dynamic landscape with significant episodes of erosion sometimes related to short-term, intensive flood events which deposit material some distance from its source. The possibility of sediment loss from the area challenges another archaeological assumption regarding the loss of sediment into the valley bottoms, which is usually called the 'inversion of the productive landscape'. This idea supposes that as the slope top sediments become thinner the thicker sediments will accumulate in the valley bottoms and will begin to be exploited for agricultural purposes. As this research has identified, the slopes are highly variable in terms of original soil development, stability and there is evidence for net movement of sediment out of system. The inversion of the productive landscape is a simple explanation for valley bottom ploughing but is not a conclusive explanation.

Human relationships with the natural environment are based on feelings, experiences and skills and another way of expressing this is intuition (Ingold 2000, 25). Intuition is something that used to be considered as inferior knowledge or skills. Intuition is something that we all have and intuitive knowledge results from perceptional skills which have been developed in a particular environment but whether the choices made are natural/pre-ordained or 'passed on' in an inherited sense remains unclear (*ibid* 32).

Cultural landscapes, which have been modified by people, are often described in relation to an antithesis, the natural landscape but this distinction is problematic (Head 2000, 3). The pristine natural environment is something which never existed and researchers today accept that even hunter-gatherers have a subtle impact on the landscape (*ibid* 4). From an archaeological perspective cultural landscapes are difficult to study as not all aspects of landscape find material expression, and their meaning can be interpreted differently by various groups, individuals and communities (*ibid* 4). Environmental management and conservation is fixed within a western scientific tradition which serves to emphasis the split between culture/nature, mind/body and humanities /science (*ibid* 5). This dualism is often expressed as 'either /or' forms of explanation. Contingency is a way of explaining the historical peculiarity of local circumstances and has been increasingly invoked by palaeoecology, ecology and the humanities to form more nuanced explanations (*ibid* 7). It is still relatively common within archaeology to see the relationships between people and the natural environment expressed as an operation of 'explicit logic' (Edmonds 1999, 485). This type of approach sees the relationship between the environment and social change reduced to a simplified stimulus/response process. Implicit within this view is the environment seen as 'impact' and this does not provide a satisfactory basis for understanding how people lived in their place (*ibid*).

8.6.3 Water sources and marginality

The field work undertaken has identified the presence of some surface streams on the High Wolds which are no longer extant, and the evidence from written nineteenth century sources which discusses chalk streams implies that they were once more common than they are today. Archaeological evidence for artificial water channels and tanks has been described, albeit infrequently.

There is evidence for severe flood events from historic sources and from the material evidence at Langtoft church and Cowlam Well Dale. This correlates with the findings of Giles (2000) who contrasts the life giving and affirming nature of the water of the Gypsey Race with its fierce appearance at times of high water, when it bubbled forth and was linked with 'trouble ahead' in local folklore. Although surface water sources were not numerous the sudden deluge of water from severe flooding has caused death and destruction on the Wolds landscape and is responsible for the erosion of sediment both downslope and down valley.

Two pieces of research have examined rainfall, one for the UK and one for northern England specifically. The research from northern England looked at rainfall trends from the Scottish borders down to the boundaries with Cheshire and the southern Yorkshire boundary from 1900 to 1959 (Barret 1966). Barret found differing trends depending on upland or lowland locations but for the North Pennines and the area east of the Vale of York (including the North Yorkshire Moors and Yorkshire Wolds) the rainfall could only be inferred due to a lack of weather stations (*ibid*). A study of twentieth century extreme rainfall events identified four factors that affect the development of serious flooding; the intensity of precipitation, the duration of precipitation, the wetness of the ground and the response of the rainfall catchment area (Hand *et al.* 2004). The findings were that the average annual rainfall occurs over mountainous areas with the most extreme rainfall, in terms of range, falling over the lowlands. The usual patterning was no extreme rainfall in February, March and April partly because of lower sea temperatures which reduce available moisture (*ibid* 18) and extreme events connected to convective weather systems in June, July and August especially clustered in the south-east of the country, East Anglia and Lincolnshire (*ibid* 19). Of the 60 severe events none were from the Yorkshire Wolds, perhaps linked to the previously discussed lack of weather stations, and whilst it appears there is a cluster around London, East Anglia and Lincolnshire, the mechanism for the recording of such events must surely play a part in any patterning, especially with a sample of this size? The evidence for high levels of precipitation on the Yorkshire Wolds, from the Environment Agency, correlates with these findings in terms of the likely months of heavier precipitation.

The assessment of data from the Environment Agency indicates the cyclical and fluctuating nature of the aquifer levels over the last century but may be indicative of variations in normal cycles of weather rather than any broader climatic change, this could only be assessed by using longer term data than is currently available.

The lack of current water sources on the Wolds forms a central theme in much archaeological research and current perceptions of marginality and risk are widely invoked in archaeological explanations. Fenton Thomas states that the hydrological system on the Wolds is poorly understood and that it is possible that some dry valleys contained watercourses in the past, but then goes on to cite the lack of surface water as an explanation for changing settlement pattern, with Iron Age settlement sited to take advantage of springs on the Wolds edge. The evidence from the archaeological interpretations on the Yorkshire Wolds commonly sees the environment as an impact, as suggested by Edmonds (1999). Marginality is a complex condition of disadvantage linked to inequitable environmental, cultural, social, political or economic factors (Mehretu *et al.* 2003, 89). A typology of marginality determines two principle forms; contingent and systemic. Systemic marginality is the result of a socially constructed inequitable relationship based on class, gender or ethnicity, relating to control over another group and commonly seen in colonial situations and relations (*ibid* 92). Contingent marginality on the other hand arises from competitive inequalities due to the dynamics of a free market economy. An example of self inflicted contingent marginality is the lifestyle of the Amish or the actions of disaffected youths who fail to take free market opportunities for education or advancement (*ibid* 91). Environmental conditions including poor soils, low precipitation or poor location can intensify contingent marginality (*ibid* 91) and this appears to explain some of the marginality felt and expressed on the Yorkshire Wolds. The low density of population and the concomitant effect on services, thin but productive soils and poor transport routes/hubs all serve to create current contingent marginality for this region. Current evidence of marginality and the nature of the chalk landscape as 'other', compared with the rest of Yorkshire or the north, reinforces a view of the Wolds as a marginal landscape in the past.

Current concerns over drought in some areas, and also the way that precipitation falls for just a few months of the year in some regions, has led campaign groups and overseas charities to promote rainwater harvesting as a method for the collection and storage of rainwater for later use. The ability of people to undertake such activities and modifications to the resources available to them appears to have been over looked in many archaeological writings when even in arid locations precipitation collection and storage will provide the necessary potable water supply for communities. The only necessity for harvesting is that there must be rain. There are historical and ethnographic sources for rainwater harvesting for example the Palace of Knossos in Minoan Crete and in ancient Mexico slopewash was trapped on contour terraces by the placement of rows of stone, this also reduced erosion (Aswathanarayana 2001, 137). Whilst I am not suggesting that rainwater harvesting on the Wolds was as complex or developed as the systems mentioned above it does provide a simple mechanism by which people, if not animals, can survive without running water and can augment the ancient standing water sources found in meres, streams and ponds.

The Yorkshire Wolds has been described as the Wessex of the North but should it be perceived as different to southern Britain? By establishing it as the 'other' creates and reinforces Wessex as the dominant site of British prehistory and denies the significant and enduring regional differences (Bevan 1999, 123). The most apparent differences in archaeological terms are the presence of square barrows from the Iron Age period in Yorkshire and the absence of hill forts, however the differences can also be seen in a general pattern of settlement, the deposition of artefacts and the role of enclosures (*ibid*).

The issue of comparison with the southern chalk has been long considered:

Nor do we welcome the companionship of those other critics who, misled by similar geological features, insist at every turn upon comparing this chalk range with the Sussex Downs

Dickens 1954, 26

and cites the importance of local people in modifying the landscape:

the personality of our Wolds has developed in stimulating companionship with man

Dickens 1954, 27

8.7 APPROACHES TO THE YORKSHIRE WOLDS LANDSCAPE

As the previous sections have indicated there are many complicating issues in understanding the archaeology, landscape and environment of the Yorkshire Wolds. These include the lack of geoarchaeological study, the paucity of development opportunities, the lack of any ASLF funded projects, the lack of any statutory protection (as many other chalk landscapes have through the AONB scheme) and a lack of basic meteorological and environmental monitoring until the latter part of the twentieth century. If these limiting factors are then linked to the history of the region and especially to the prevalent theoretical paradigms then the problem of environmental archaeology on the Yorkshire Wolds is more complex. Since the 1970s environmental archaeology has been seen as a sub-discipline of New Archaeology and as such has been criticised for a preoccupation with methodology and little interest in social and cultural issues (Roskams and Saunders 2001, 61). The main critique of environmental archaeology has come from post-processualists who see it as an approach flawed by empiricism however the fault does not all lie with environmental archaeology as the post–processual idealist theory may not allow the integration of archaeological data with theory and particularly social archaeology. Post–processualism, as part of postmodern theory, has been successfully criticised for viewing archaeological science as caricature and for conflating empiricism with the Establishment and a dominant ideology (*ibid)*. Different analytical approaches can be applied to environmental archaeological data and, in the case of a Marxist approach to faunal and floral evidence from the city of York, can offer a relevant and vibrant interpretation of the evidence (*ibid* 73). Post-processual archaeologists have also criticised the traditional landscape archaeologist as being over-empirical (Fleming 2006, 267). Since the 1990s a branch of landscape archaeology has focussed on a post-processual approach which asserts that as prehistory and history is written in the present it can only exist in the present and any aspirations to objectivity or scientific enquiry are pointless (*ibid* 268). The result of the approach can be seen in elements of performance and/or cultural production which not only go 'beyond the evidence', but have no control beyond the imagination. In terms of understanding and allowing for local diversity of response, this approach could be beneficial to landscape archaeology but it is open to any number of interpretations. The recording of elements such as aerial photographs, distribution maps, GIS and satellite images are associated within the post-processual paradigm as surveillance and the control of the past (*ibid* 269) and such Cartesian approaches do not consider otherness, or go 'beyond the evidence'. One way of expressing ideas within a post-processualist landscape archaeological approach has been described as a 'hyper-interpretive writing style' and this style seeks to distance itself from the evidence or data, and focuses on rhetoric and the uncritical acceptance of the imagination (i*bid* 275). This type of approach is utilised in the most currently accessible landscape history of the Yorkshire Wolds (Fenton Thomas 2005) and the desire to generalise about the entire region and the evocation of an imagined landscape leads to a narrative style with little recourse to archaeological data.

The approach taken to 'landscape' in this research has been akin to the traditional focus on Cartesian space and the recording of empirical data. This type of approach has heuristic potential, and can form an argument by building on the accretion of patterns and knowledge (Fleming 2006, 279). Operating from a Cartesian and empirical basis, I have nevertheless sought to incorporate the social, economic and political impacts on the landscape. Changing settlement, farming methods and archaeological research on the Yorkshire Wolds has been considered in terms of the transformation of social, political and economic relationships.

The chalk landscape of the Yorkshire Wolds is different materially from the chalk landscapes of the south of England due to the absence of watercourses, the differing geology, climate and land-use. It is of note however that the methodologies employed on the Wolds, the intensity of the investigation of dry valleys and the theoretical frameworks underpinning research appear to be the greatest factors influencing our understanding of past environment, settlement and land-use. The role of farming in relation to archaeology is of particular importance on the Yorkshire Wolds where the predominantly arable landscape is subject to increasing demands by large farming businesses that are increasingly unrelated to family farming by local people.

This research has failed to find evidence to date and link phases of increased erosion to an increasing intensity of human activity or agricultural intensification. It has however revealed the complex phases of sedimentary erosion and deposition even within a single transect of a single valley. The problems of dating in calcareous landscapes have been discussed by most researchers working in these environments and on this occasion relative dating by artefact distribution has not been possible. The preservation of land snails, as proxy indicators of environmental change has also been surprisingly variable, and this is thought to be related to the leaching of mildly acidic rainwater which does not substantially alter the soil pH. Areas with shallow soils on the Wolds tops appear to preserve land snail shells more successfully in shallow or deep ditch fills related to anthropogenic activity, as at Wharram Grange Crossroads and Thwing. These assemblages contrast with the poorly preserved quantities of land snails found within dry valley deposits generally. This appears to relate to the mode of incorporation into the sediment, with colluvium an unstable deposit for colonising activity by land snail communities, and to the nature of the sediment, with widespread decalcification during the development of early soils and possible subsequent phases of decalcification.

8.8 NEW APPROACHES

The numerical modelling of deposits, and specifically colluvium, has been undertaken increasingly and doctoral research which models colluvium on the Yorkshire Wolds is about to be released in 2009 by John Pouncett from Oxford University. The modelling applied arises from a model originally developed and tested in the South Cadbury Environs Project (Lock and Pouncett 2008). The application of algorithms produces a morphometric surface which aims to identify the areas of possible enhanced accumulation of colluvium. At South Cadbury this was tested in six localities within an 8 km^2 area (centred on the hillfort) by excavating 300 test pits. Of these pits 170 contained hillwash deposits. Seven specific colluvial deposits were assigned to period based episodes by the analysis of in situ artefacts. By using the spatial data from the test pits along with presence or absence data for colluvium the morphometric surface was characterised and identified key topographic zones (*ibid*). This model was applied to Toisland Dale, around Toisland farm, to the immediate north of Vessey Pasture Dale and incorporates fieldwalking data from the area around Vessey Ponds and up to the summit of the northern slope of Vessey Pasture Dale. The study relates the fieldwalked data to a numerically modelled colluvial surface and may therefore be able to predict areas of increased erosion and deposition. This study reveals that 194 artefacts were recovered from fieldwalking in the field to the north of, and above my study area, Vessey Pasture Dale. If we accept that the effects of erosion and Wolds top ploughing should deposit some of this surficial material downslope (as at Fairy Dale and Whay Dale) then the lack of artefacts in the valley base compared with the field walking data from the plateau supports our finding that the Vessey Pasture Dale slopes represent relatively stable sedimentary systems.

Archaeologists are familiar with assessing the geological and sedimentary influences to the sites on which they work, but this is often undertaken at a superficial level especially when working on chalk, which is perceived as relatively well understood. Geomorphology is considered when it is perceived to have had a significant impact on the archaeological site, and this is particularly relevant in some parts of the world. The results of this research indicate that geomorphic processes can be more complex and nuanced than they are often considered to be. The significance of Pleistocene and early Holocene palaeochannels, rills and gullies have not been explored and so their relationship to archaeology cannot be assessed but it may be that they are of some considerable influence especially in relation to early land boundaries and land-use. Understanding something of relict land surfaces and site formation processes should be a precursor to archaeology. The mechanisms of erosion and deposition are strongly influenced by geomorphic, climatic and cultural processes and so it is vital that all these related elements are fully explored. Any spatial analysis, which archaeology relies upon, is strongly determined by geomorphology and geomorphological processes impinge on commonly made geological interpretations (Twidale 1996). Although there ought to be clear links between erosional and depositional records these correlations are often absent and should involve the analysis of volume of sediment, sediment type, landscape character and relief and the 'erosional style' for example uplift or wasting (*ibid* 367). The paradox of differing geomorphological regimes where some areas are essentially stable for millions of years and others relatively unstable poses important intellectual questions that affect many other research spheres (*ibid*). What constitutes stability and how reliably we can anticipate rapid change, spatially and temporally, are examples of this type of enquiry, which is as fundamental to archaeology as geology, proper. Geomorphology is therefore something to be questioned, understood, analysed and perspectives on landscape shape developed, it is not something that is merely described.

The scope of the work in the Allen valley can be considered a new approach as it involved a number of well-established, professional researchers, working in a well-defined geographical area. A series of related studies were funded by different bodies which allowed a composite picture to be developed and resulted in exceptional levels of recording including 880 boreholes (French and Lewis 2007b, 19). By using the results of several strands of evidence, from different landscape types and in an integrated manner has provided a complex and comprehensive assessment of land-use change during the prehistoric period for a chalkland (French *et al.* 2007). In addition to the analysis of ditch fill sequences and buried soils from eleven monuments, which resulted in 154 samples for molluscan analysis (and 62,000 identified land snails), the overall synthesis has involved the interrogation of database evidence from a total of 450 samples and 180,000 identified land snails by a variety of statistical and analytical methods (Allen 2007). Although some shade preferring species were indicative of leaf litter or vegetation cover within ditches the overall picture was of dry chalk grassland conditions before the barrow construction (*ibid* 158). However the analysis of samples from the Dorset Cursus found substantial variations in mollusc sequences over short geographic distances representing the action of the cursus as an ecological corridor and exhibiting rapid ditch infilling at some times (*ibid* 161). No ancient woodland was identified at Cranborne Chase (the most well-studied area in northern Europe) and the question then became whether this was typical or atypical (*ibid* 186). At Wyke Down there is no evidence for thicker brown forest soils. There was evidence for thicker, clay rich and organic soils in the past, but they existed in places where they still exist today and have not been subject to erosion or truncation (Lewis 2007a, 195). In the same way that we can ask about what constitutes a stable landscape we can also ask what is soil fertility or soil degradation, these concepts that we use as archaeological scientists as not objective and need to be considered and defined as part of the research process (Lewis 2007b, 217). The proposition that a pastoral economy dominated the Neolithic period in the Allen valley was tested by the development of a GIS simulation model

(Samarasundera 2007, 197). Scenarios were developed and tested using the palaeoecological data from the Allen valley. This resulted in the finding that livestock numbers were very influential on the model outcomes in a way that the introduction of arable farming is not. The early introduction of livestock appears necessary as part of a rapid increase in pastoral farming, to form an open landscape in the late Neolithic (*ibid* 206). The application and interpretation of the scenarios within the model are complex and must be undertaken with great care for the appropriate outcomes to be proposed (*ibid* 206).

Palynological evidence suggests valley bottoms and downland slopes remained open through most of the Mesolithic and substantial woodland cover is found only at Wimborne Minster, at around 7000 BP (French 2007, 209). Some of the southern study area contains woodland and tree dominated mosaics into the Bronze Age (*ibid*). The effective combination of molluscan, palynological, micromorphological and geoarchaeological evidence allows a detailed landscape history to be developed for part of Cranborne Chase (*ibid* 213). The findings challenged traditional models and found that woodland development had been slower and more patchy than expected in the early Holocene (*ibid*). The success of the project lies not just in the integration of different datasets and the tight geographical focus but in the experience of the investigators and the ability to draw on a body of past palaeoenvironmental data. In the north of England we have neither the archaeologists with chalkland geoarchaeological experience nor the datasets.

However, the possibility of a long term, inter-institutional landscape scale project on the Yorkshire Wolds has been considered and has led to the formulation of a research agenda between Giles, Roskams, Atha and Pouncett of the University of Manchester, University of York and Oxford University (Steve Roskams pers.comm.). The necessity for landowners to undertake Farm Environment Plans, in advance of submission to DEFRA for Higher Level Stewardship agreements, led the Birdsall Estate to discuss a programme of archaeological work that would feed into their plans. The research would consider the High Wolds landscape belonging to the Birdsall Estate from the early prehistoric settlement through to the current day by analysing different landscape zones; from Wharram Grange Crossroads ladder complex to Wharram Percy and north to Grimston Brow, from Wharram Grange

Crossroads to the west across Birdsall Brow and Toisland Wold, and from Vessey Pasture west towards Aldro. Some of the zones would investigate continuous landscape features including ladder settlements and linears, some of the zones would look at landscape scale fieldwalking and reconnaissance transects which would consider different ecotones and the location of possible palaeoenvironmental data. The research will focus on the large-scale social transformation associated with the colonisation of the landscape by people after the last glaciation, the Neolithic/ Bronze Age transition evidenced by settlement and funery evidence, the later prehistoric period and access to resources and the Late Iron Age/Romano-British transition.

A strong regional and local identity and the activities of antiquarians and land owners, situated within a strongly culture-historical paradigm, has dominated Yorkshire Wolds archaeological research during the twentieth century. This approach has generally played down issues of class, local diversity, the variability of local response and the environmental milieu. The current environmental conditions we encounter have provided an interesting backdrop to the archaeology but have not formed a vital part of most archaeological fieldwork or interpretations. The theoretical stance taken means that important geomorphic and landform processes have not been fully recognised, with a concentration on the ubiquitous chalk geology. Some landscape scale projects on the Wolds edge (see Powlesland 2003 and Halkon 2003) have emphasised the interconnectedness of the Wolds with the surrounding land blocks. This is important in terms of understanding marginality as the Wolds may have been used as part of a system of integrated micro-regions exploitation and this gives a more comprehensive approach to the evidence. Some projects have taken a chronological approach to the interpretation of the archaeological evidence, that both emphasises people and maintains accuracy (see Giles 2000, 2006, 2007). These types of projects offer future archaeological research on the Yorkshire Wolds direction and would allow the integration of environmental and geoarchaeological data within mainstream archaeology. The need for a geoarchaeological approach to this calcareous landscape is evident from not only its relative absence but also its potential, as represented in the dry valley studies in the south of England. The potential of geoarchaeology to add to site-based, and particularly monument-based, studies on the Yorkshire Wolds is significant and would allow the problematic environmental approach taken to buried barrow soils in the 1960s to be conducted in a more detailed and accurate manner.

9.0 CONCLUSION

It is possible, as I have learned again and again, to be in one's place, in such company, wild or domestic, and with such pleasure, that one cannot think of another place that one would prefer to be, or of another place at all

Berry 2008

I have considered deposits close to earthworks, multiperiod settlement sites, and areas defined as 'preferred settlement locations' in order to locate colluvial deposits. My research has revealed complex phases of erosion and deposition on a local scale and which appear to be in part influenced by the steepness and morphology of the slope and possibly by the valley axis, but this can vary considerably within a short valley reach. Whilst some phases of increased erosion may be related to intensive agricultural activity on the interfluve plateaux above the valleys there is evidence for an absence of sediment deposition at the bottom of some slopes. This could mean that the sediments have washed out of the system as I have shown that the valleys are not a closed system, despite being dry, but it is also possible that widespread deep Brown Forest Soils did not develop on all areas of the Wolds, as assumed by past researchers. The Yorkshire Wolds, with its relatively waterless environment, has not seen significant fluvial activity responsible for eroding and redepositing material, at least within the Holocene, however the alluvial and colluvial mechanisms of erosion and deposition have been significant for the area and have resulted in a skewed and distorted understanding of the region.

The sediments encountered owed part of their composition to the aeolian loess deposition that occurred during the Devensian glacial advance around 18,000 years ago, and whilst this process was widespread, there is evidence that it was not uniform so part of the variation in sedimentary depths may be due to this variation in silt particle deposition. The lack of deep colluvial sequences in all locations makes the archaeological explanation of land use patterns that concentrate on the 'inversion of the productive landscape' flawed. This research has concentrated on 'off-site' locations and has emphasised the relationship between sediments and geomorphology as an under utilised approach to the Yorkshire Wolds landscape. The main limitation of my findings is the lack of dating evidence, which would allow us to postulate a chronological model for increases in erosion and colluvial deposition.

In my review of the evidence for settlement sites on the Yorkshire Wolds I have facilitated research at the hitherto unrecognised Anglian site at Burdale, and moreover I have found widespread evidence for multi-period settlement across the Wolds discovered during commercial activity, such as quarrying and pipeline construction. When this is considered alongside my discussion of the history of archaeological theory and practice in the region, with a concentration on funerary monuments and culture historical modes of enquiry, it is clear that the key issue for an accurate analysis of past settlement patterns on the Wolds is archaeological research and visibility rather than any other factor, including past hiatuses in habitation. Archaeological visibility is a complex and important aspect of research. The assessment of settlement distribution should always take account of the partial nature of the features we see and recognise that even in areas which are, for example, very responsive to aerial photography this can never provide a complete or uniformly applied model of past land-use. Where the period of study and the intensity of archaeological research have been sufficiently concentrated, archaeologists have found that past settlement was of a similar intensity to current population density in rural North Yorkshire (Powlesland *et al.* 2006).

Many environmental assumptions are made about the Yorkshire Wolds some of which are based on the scanty palaeoenvironmental data. An assessment of the environmental evidence on which the past landscape history of the region has been based has found it limited. The evidence is frequently scanty and suffers from significant stratigraphic breaks and gaps, and it is sometimes a partial record of the totality of the evidence that was found during the research. The main criticism of this palaeoenvironmental research is not that it suffers from these problems in the collection and interpretation of the results as they are unavoidable, but that the limitations of the work are seldom identified when later cited and discussed. As this evidence is repeatedly used in subsequent and newer publications it creates a false impression of the accuracy of the palaeoenvironmental history of the Yorkshire Wolds. An attempt to locate, and assess, the quality of work not published found little and this points to the paucity of the palaeoenvironmental record for this area. The work of Wagner, undertaken whilst based at Sheffield University (1992), has not been published and remains an important and critical body of palaeoenvironmental data for the region that should be brought to full publication.

The review of water source evidence finds that the hydrology of the region has fluctuated and that the water table is now likely to be lower than in the past. A number of possible prehistoric water sources can be identified and include dolines, ponds and springs. Some enigmatic archaeological features have given the implication that water management may have been practiced here in the past and this is something that has not been fully considered. This may be because the current perceptual status of the Wolds as a marginal and waterless environment is used to propose how people may have lived here in the past, or indeed how they could not. The mechanisms by which communities can live without running water can be broadened to include the use of kettle holes, meres, hollows and the collection of rainwater which is especially relevant in an area with increased precipitation compared to the surrounding land blocks.

A review of the regional development of the Yorkshire chalk resource and its current use, research and protection indicated that it has not been subject to the same intellectual analysis, statutory protection or systematic analysis as the southern chalk. There is a problem with applying methods used in the south to Yorkshire Wolds relating to preservation and intensity of evidence and this needs to be carefully targeted. The use of data from different agencies gives a more coherent overview. Notions of marginality relating to the north, Yorkshire and to the Wolds themselves are intensified due to the geographical location, the history of research and the lack of development and knowledge of the place. The preconceptions of researchers about landscape and marginality are inevitable but need to be discussed, contextualised and at times challenged. The key issues identified for the environmental and land use history of the Yorkshire Wolds are not methodological, although the methods are a substantial challenge, but are the conceptual and theoretical frameworks within which we all work. This arises in part from the historical background of research in the region, the research interests of the individuals in the area, the skills and expectations of different modes of enquiry and the ability to exploit development and commercial opportunities, such as the ALSF project. It appears that most archaeological researchers consider an appreciation of past land use and environment as critical elements of archaeological enquiry. For environmental archaeology, and geoarchaeology, to be able to provide an accurate picture of this for future archaeological research on the Yorkshire Wolds it needs to be at the forefront and heart of project designs and funding bids, and not included during the latter stages.

The general model of geoarcheological processes that I have proposed here can be tested in the future, with an emphasis on geomorphology which could exploit the work of earlier researchers, such as Lewin, with twenty first century technology, including Lidar, IFSAR and numeric deposit modelling. Pouncett's study of proposed colluviation, based on the south Cadbury model, may prove to be a useful method of identifying and testing areas that preserve traces of earlier settlement or past land surfaces.

Geomorphology is an integral part of earth history providing perspectives on processes, space and time (Twidale 1996, 375). These processes are not a backdrop but are an active part of the archaeological formation process. The opportunity to investigate the buried palaeosurfaces of the Yorkshire Wolds is one that should be taken, especially as the importance of such data sources is currently highlighted by a range of fully funded archaeological research projects. Taking a lead from the multi-dimensional projects to the north, west and south of the Wolds a more ambitious landscape assessment could be made which would potentially take advantage of the opportunities afforded by commercial companies/ schemes under PPG 16. Adjacent areas to the Yorkshire Wolds have recently benefited from the application of research agendas that consider the visibility of the archaeological record as pivotal to understanding settlement and land-use in the area, and to the curation of our archaeological heritage (Powlesland 2003; Howard *et al.* 2008).

Research such as the recently published study in the Allen valley (French *et al.* 2007) has utilised new GIS approaches alongside more traditional approaches, and has benefited from using on-site and off-site analysis, including the buried soils beneath monuments. This type of mixed method approach is a possibility for the proposed inter-institutional research on the Birdsall Estate and could be used as a template to formulate a research design which would comprehensively investigate the landscape and the scope for understanding past land use and environment. This would require a body of researchers to work collaboratively for a sustained period and to take advantage of multidisciplinary involvement that could include the British Geological Survey and the Environment Agency, both of whom have contributed to this project and are undertaking research in the area. This type of project, situated on the edge of the north-western Wolds at Birdsall Brow would also allow research on the relationships and the differences between landscapes types and ecotones in the past; a way of understanding the joined up landscape as it was used in the past rather than the dissected and isolated agricultural landscape as we see it today.

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