



TERRESTRIAL MINERAL RESOURCE, CUMBRIA

Assessment Report



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SUMMARY

An assessment of the terrestrial mineral resources in Cumbria (excluding the two National Parks and Areas of Outstanding National Beauty) has been undertaken on behalf of English Heritage (now Historic England; Project 6490), in partnership with Cumbria County Council. This was designed to assess the character, significance and range of sites of archaeological significance within areas that may potentially be affected by future aggregate extraction. A project design was submitted in 2012 by Oxford Archaeology North (OA North), to undertake a programme that identified areas of potential future aggregate extraction and then obtain a more detailed information base for the heritage resource within these areas. OA North was commissioned to undertake the project, with work commencing in April 2012.

The first stage of the programme assessed the commercial potential for soft and hard aggregate resources across the county and defined areas with the greatest potential for future extraction. Eleven areas were selected for further study in the second stage, all centred on existing quarries, as it was demonstrated that it was highly unlikely that completely new quarries would gain planning consent. These areas were subject to more intensive investigation, examining the current state of knowledge relating to heritage assets, and establishing the potential for further heritage resources within these areas. This was achieved by examining existing datasets, aerial photography and Lidar data, analysis of historical mapping, and a review of previous archaeological investigations. In the third stage of the project, a process of analysis was undertaken to examine the heritage potential within the areas at greatest threat from future extraction. The fourth stage entailed the compilation of this report.

This study of the mineral resource of Cumbria has identified those areas across the county where there is the greatest potential for expansion of quarries up until 2028. By means of GIS analysis of the identified resource, it has been possible to highlight those zones within the study areas that have the greatest density of significant archaeological monuments, and the assessment has highlighted areas where there will be a need for ongoing archaeological investigation to inform the mineral planning process. [This assessment of the resource, however, demonstrates that some areas have benefited from greater levels of archaeological investigation than others, and this will almost certainly have resulted in some bias in the results.](#)

The process has highlighted which of the 11 areas, centred on existing quarries, have the greatest potential for buried archaeological remains and where future quarry expansion may have an impact on a significant heritage resource. The quarry areas of lowest heritage potential were those in the Brampton Kame Belt, and at Cardew Mires, Roan Edge, Ghyll Scaur and Peel Place. The quarry areas with a medium potential were Moota, and Eskett and Rowrah, whilst those with the highest potential were at Tendley, Low Plains, Roosecote, and on the Abbeytown Ridge. In order to preserve the heritage resource in these areas, a series of recommendations has been proposed.

It is considered most important that a dialogue with the quarry operators and minerals planners should be established at an early stage of the planning process. To initiate this process, it is proposed that articles should be submitted to the main trade journals, which would introduce the issues of potential archaeological remains within areas of extraction, and the importance of preserving that resource.

There is a need for integrated landscape investigation at those quarry sites that have the greatest heritage potential. This would entail the use of mainly non-destructive techniques to provide a better understanding of the below-ground archaeological resource within those areas of immediate and longer-term threat, with a view to developing quarry extensions that have a minimal impact upon the archaeological remains. The potential for establishing an integrated, GIS-driven, landscape project has been demonstrated by the Thornborough Henges (Nosterfield) project in North Yorkshire, which established a process that was able to provide sufficient information to obtain permissions for extraction, despite the proximity of a nationally important prehistoric landscape.

As far as possible, remote-sensing investigative techniques should be used, which would provide a rapid and cost-effective means of exploring the subject areas. These include aerial photography, Lidar, low-altitude photogrammetry, palaeoenvironmental assessment, and geophysical survey techniques. Depending upon whether the land has been ploughed or not, it may be possible to undertake surface artefact surveys to identify ceramics or lithics in the topsoil, but if the land is under pasture, shovel test-pitting is an alternative method, which has proven to be successful. Following on from the programme of survey, there may be a need for larger-scale targeted evaluation trenching to test the character of the identified resource and to enhance the landscape model. The resultant model can provide the basis for a continued dialogue with the mineral planners and quarry operators to develop an extraction strategy that minimises the impact of the extraction process on the archaeological remains.

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OA North would like to thank English Heritage (now Historic England) for commissioning the project, and staff of Cumbria County Council, who were partners with OA North in implementing the project. Particular thanks are extended to the members of the Steering Group for their support, both in the Steering Group meetings and during the life of the project. These were principally, for Cumbria County Council, Mark Brennand (Senior Historic Environment Officer), Sue Brett (Senior Minerals and Waste Policy Officer) and Jeremy Parsons (Historic Environment Officer); for English Heritage, Jon Humble (Inspector of Ancient Monuments and Senior National Minerals and Environmental Adviser), Andrew Davison (Inspector of Ancient Monuments, North West Region), Helen Keeley (Project Assurance Officer), and Sue Stallibrass (Archaeological Science Adviser for North West England). Rachel Newman (Project Executive) and Jamie Quartermaine (Senior Project Manager) from OA North, and Alan Thompson (Cuesta Consulting) were also members of the Steering Group.

All the relevant Ordnance Survey (OS) first edition 6" to one mile maps were consulted: these were the 1851-73 *Lancashire and Furness*, 1862 *Westmorland* and 1867-8 *Cumberland* editions. Several other OS maps were also examined, to define areas of current and historical quarrying. These included: 1893-5 *Lancashire and Furness*, 1900-1 *Cumberland* and 1899 *Westmorland*, Second edition 6" to one mile maps; 1938-52 *Pre-WWII Cumberland*, 1956-7 *Post-WWII Cumberland* and 1971-4 *Post-WWII Westmorland* editions, at 6" to one mile; 1972 *Post-WWII Cumberland* maps, at 1:2,500; 1973-93 *Post-WWII Cumberland*, 1975-93 *Post-WWII Cumberland*, 1979-82 *Post-WWII Cumberland*, and 1987-8 *Post-WWII Cumberland* editions, at 1:10,000. All base mapping for the GIS was provided by Cumbria County Council.

Several British Geological Survey maps were consulted during the geological assessment, and these were used to create the relevant figures. The maps shown within the figures were reproduced from the following map sheets: Sheet 18 (*Brampton*), published in 1980; Sheet 22 (*Maryport*), published in 1995; Sheet 23 (*Cockermouth*), published in 1997; Sheet 24 (*Penrith*), published in 1974; Sheet 28 (*Whitehaven*), published in 2004; Sheet 37 (*Gosforth*), published in 1999; Sheet 39 (*Kendal*), published 2008 and Sheet 48 (*Ulverston*), published 1997, all originally at 1:50,000 scale. They were reproduced by the permission of the British Geological Survey, ©NERC. All rights reserved.

The primary acquisition of baseline archaeological and historical data (mapping, national databases *etc*) and the consolidation of this data within a GIS format were undertaken by Anna Hodgkinson. The geological assessment was undertaken by Alan Thompson from Cuesta Consulting, whilst the National Monuments Programme (NMP) analyses of aerial photographs and Lidar data were undertaken by Alison Deegan, and the study of previous archaeological investigations was undertaken by Helen Quartermaine. The culmination of the project was the analysis of historical mapping, the refinement and rationalisation of the datasets, the scoring of the area sub-divisions, and the impact assessment, undertaken by Hannah Leighton, with Alastair Vannan, who also co-wrote the report. The illustrations were produced by Hannah Leighton, Alastair Vannan and Anne Stewardson. The project was managed by Jamie Quartermaine, who also edited the report. The report was quality-assured by Rachel Newman.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF THE PROJECT

- 1.1.1 The assessment of the Terrestrial Mineral Resources in Cumbria was undertaken on behalf of English Heritage (now Historic England; Project 6490), in partnership with Cumbria County Council, and was instigated to assess the character, significance and range of sites of archaeological significance within areas that may potentially be affected by future aggregate extraction. A key project aim was to inform and facilitate the improved curation of the archaeological resource in relation to future mineral extraction in Cumbria. The study excluded the designated landscapes of the Lake District National Park, the Yorkshire Dales National Park and the North Pennines, Solway Coast and Arnsdale/Silverdale Areas of Outstanding Natural Beauty (AONBs; Fig 1), as it was established that quarries within these areas would not be granted permission for future expansion.
- 1.1.2 In December 2011, a proposal was submitted by Oxford Archaeology North (OA North), in partnership with Cumbria County Council, for a project to identify areas of potential future mineral extraction and threats to the heritage resource (OA North 2011a). Following submission, marking the project's start-up stage, as defined in English Heritage's *Management of Research Projects in the Historic Environment* (MoRPHE; English Heritage 2006a, 12), OA North was commissioned to produce a costed project design. This was submitted in February 2012, and a revised version, which addressed comments received from English Heritage, was submitted in March of that year (OA North 2012). Following English Heritage's approval of the revised project design, which marked the project's Initiation Stage (English Heritage 2006a, 12), OA North was commissioned to undertake the project, with work commencing in April 2012.
- 1.1.3 The project design provided for a programme that identified areas of potential future aggregate extraction and then obtained a more detailed information base for the heritage resource within these areas. The methodological process is outlined in *Section 3*, but the project could be divided into four principal stages.
- 1.1.4 The first stage assessed the commercial potential for soft and hard aggregate sources across the county (excluding the National Parks and AONBs) and defined areas with the greatest potential for future extraction (Fig 1). These would be focused on in the second phase of the project, and 11 areas for further study were agreed at a Steering Group meeting on 22nd August 2012.
- 1.1.5 In the second stage of the project, the 11 areas selected for further study, which were all centred on existing quarries, were subject to more intensive investigation, examining the current state of knowledge relating to heritage assets, and the potential for these heritage resources within the areas. This was achieved by examining existing datasets, aerial photography and Lidar data, analysis of historical mapping, and a review of previous archaeological investigations. The degree of impact from historical and twenty-first-century extraction, and the potential for impacts as a result of future extraction, was then assessed. This entailed the creation of an Access database, compatible with the

County Historic Environment Record (HER), of all available evidence of archaeological sites within the individual study areas, and of a GIS model for sites that may be within the area of potential extractions (*Section 3.2*).

- 1.1.6 In the third stage of the project, once the compilation of all geological and archaeological information had been completed, an assessment was undertaken of each of the selected areas to narrow down the areas of investigation further, to those with the greatest potential for expanded extraction. A process of analysis was undertaken to examine the heritage potential within these refined areas of greatest potential threat from future extraction.
- 1.1.7 In the fourth stage of the project, the analytical results were compiled into this report, which outlines areas of threat, heritage potential and makes recommendations for the future curation of that resource.
- 1.1.8 **Outcomes:** the outcomes of the project are intended to offer an initial source of reference to inform the various stakeholders involved in decision making on mineral extraction, who include archaeological curators, minerals planners, Historic England, and the quarry operators; it is intended that this should facilitate the curation and preservation of the archaeological resource in the course of the mineral planning process. It was envisaged that one of the most significant outcomes would be to raise awareness amongst stakeholders of the character, extent, and importance of the heritage resource within areas of potential aggregate extraction in Cumbria. It was also intended to enhance the provision of planning advice aimed at the management and preservation of this finite and potentially significant heritage resource. As such, it will entail the incorporation of GIS shapefiles and the database as an over-arching layer within the HER, facilitating the provision of advice on the likely impact of future extraction proposals on the buried archaeological remains in these areas. It was clear that the data gathered could also serve as an important research tool.

1.2 BUSINESS CASE

- 1.2.1 Glacio-fluvial gravels are major sources of soft aggregates in England, as they occupy large uninterrupted swathes along valley sides as terraces, and under floodplains. The gravels are generally worked dry, and have considerable potential for the preservation and recording of archaeological sites. Sub-alluvial river gravels are found in the lower reaches of river valleys and are either Late Devensian (Late Palaeolithic) or Holocene (Mesolithic to modern) in origin. River terraces also have rich archaeology above the gravels, often illustrated by the large quantities of cropmarks which are visible on the plains. Palaeochannels, palaeosols and organic ditch fills also provide environmental evidence (Brown 2004a); sub-alluvial gravels preserve waterlogged remains associated with pits, ditches and soils. The hydrogeological effects of aggregate extraction on palaeoenvironmental archaeology are currently being considered (Brown 2004b).
- 1.2.2 Aggregate extraction sites can cause major disruption to the landscape, and if there is any archaeological resource within the extent of a proposed development it will be destroyed. Aggregate quarries that most affect the hydrological environment and nature conservation are typically those extracting from valley floors, concentrating on low terrace and sub-alluvial sand and gravels. The quarries penetrate the water-table and cause drainage of the surrounding deposits.

The hydraulic conductivity of gravels or sand and gravel with low clay or silt content is extremely high, falling as the content of silts and clays increases. A substantial reduction of the water-table is typically caused upstream of a quarry, with a less marked reduction downstream (Brown 2004b).

- 1.2.3 Although it is possible to undertake mitigative recording of any resource in advance of the development in response to the planning process, it is by far the preferred option that the extraction facility is designed so as to afford preservation *in-situ* to the archaeological resource. Within the existing planning process, this is rarely achievable because the design of the facility is too far advanced to be able to accommodate radical change at the time that an archaeological evaluation is usually implemented, but the archaeological sensitivities for aggregate-rich areas can be defined, and guidance can be provided, at an early stage of design.
- 1.2.4 The project addresses the priority need identified to assess the impact of future extraction on the historic environment (Minerals and Historic Environment Forum 2008 (MHEF)), and represents the first major assessment of the historic environment in relation to areas of anticipated aggregate extraction within the county of Cumbria. It provides the recommended evidence-based approach to allow archaeological curators to give appropriate guidance for aggregate extraction companies at the outset of site design, and can also inform a mitigative process if disturbance of the archaeological resource is unavoidable (MHEF 2008).
- 1.2.5 With reference to Historic England's own agendas and research priorities, the *National Heritage Protection Plan Activity Plan* (English Heritage 2011a) established the principle that all projects implemented or commissioned must meet at least one of the organisation's corporate aims and objectives. This project achieves the following Protection Results for Threat Assessment (*ibid*):
- 2D4.1 - Better information for assessing risk of extraction on the historic environment;
 - 2D4.2 - Better protection of historic mining and extraction assets;
 - 2D4.3 - Reduction of negative impacts to (and enhancement of public benefit from) the historic environment as a result of commercial exploitation of minerals.
- 1.2.6 The programme accords with the aims to recognise and identify the heritage resource in those areas of the lowlands of Cumbria that have previously not seen intensive exploration and for which our existing knowledge is limited. The project achieves the following protection results for recognition of the resource:
- 3A4.1: Identification of unknown assets from aerial reconnaissance;
 - 3A4.2: Identification and contextual understanding from aerial photograph/Lidar mapping to provide base-level protection.
- 1.2.7 ***The North West Archaeological Research Framework***: the *North West Archaeological Research Framework* (Brennand 2006; 2007) identified the need for landscape analyses for all chronological periods, and also to utilise existing datasets to assess both environmental sensitivity, and enhance the knowledge database, for research and curatorial purposes (Brennand 2007). These were

embedded within the *Research Framework Action Plan* (Brennand *et al* 2007, 194-7).

- 1.2.8 **Regional Guidance:** the *Regional Spatial Strategy* (Government Office for the North West 2008) places sound environmental management at the heart of its vision, to ensure that the region's heritage assets are protected and enhanced. The region's Development Principles seek to enhance the quality of life, and not damage or destroy irreplaceable assets without suitable mitigation delivered through the planning system. Policy EM1 states that 'plans, strategies, proposals and schemes should deliver an integrated approach to conserving and enhancing the landscape, natural environment, historic environment and woodlands of the region' and that 'these will be founded on a sound understanding of the diversity, distinctiveness, significance and sensitivity of the region's environmental assets' (*op cit*, 91). This embodies the principle of preservation *in-situ*, rather than by record, which is a fundamental aim of this project.
- 1.2.9 Regional planning guidance similarly emphasises the need for sustainable development, and that the 'the Region's economic, social and environmental interests must be advanced together and support each other' (ODPM 2003, 4). The protection of the historic environment in particular will be delivered through the proactive management of cultural assets.
- 1.2.10 **Minerals and Waste Development Framework:** core Strategy Policy 4 of the draft *Cumbria Minerals and Waste Development Framework* aimed to protect, conserve and enhance the historic environment (Cumbria County Council 2008, 20). This assessment of the archaeological potential within the areas most likely to be targeted for future aggregate extraction directly addresses the need for 'a thorough understanding of the historic environment and a robust baseline so that significant adverse impacts can be avoided or reduced, and potential benefits maximised' (Cumbria County Council 2009a, 17). This document again embodied the principle of preservation *in-situ* and required that an appropriate level of archaeological knowledge is available at the time of the outline design of the extraction site.

1.3 GEOLOGICAL AND ARCHAEOLOGICAL CONTEXT

- 1.3.1 **Current Aggregate Knowledge and Exploitation:** the main source of information on the aggregate reserves in Cumbria is the British Geological Survey (BGS) *Mineral Resources Technical Report* (BGS 2001), a desk-based survey utilising the current BGS Quaternary Geology GIS. These assessments are constrained by the scale, nature, and age of the primary mapping. For certain parts of Cumbria, the BGS has undertaken more detailed mapping, for example around Brampton. However, four of the Cumbria sheets are still at the imperial scale of 1:63,360, and are therefore somewhat dated. This is reflected in the level of detail depicted, but these include prime aggregate areas. Comparison of academic research on the glacial deposits of the region (Huddart 1977; 1991; 1994; Huddart and Glasser 2002; Thomas 1999; Nirex 1997) and the precision of the Quaternary geology shown on BGS sheets shows that there is considerable scope for improvement in understanding the location, nature, quality and quantity of sand and gravel reserves in Cumbria.

- 1.3.2 ***Current Sand and Gravel Mineral Extraction:*** sand and gravel extraction in Cumbria exploits three main mineral sources: riverine; glacial; and beach. In the case of the former two, the currently available mapping at best represents a start at producing an inventory of the aggregate reserve. Extraction is currently focused on glacial deposits in the Brampton area (Fig 2) and from Maryport to Abbeytown Ridge, and the higher river terraces flanking the River Eden and its tributaries. Further extraction has targeted the low terrain fronting the western edge of the Lake District, between St Bees Head and the River Irt, which drains Wast Water. There has also been local extraction of glacial sand and gravel around Barrow-in-Furness, and marine-won aggregates are landed in limited quantities at Barrow. Applications for new permissions in the past few years have focused on the Brampton area and Maryport to the Abbeytown Ridge (Fig 2).
- 1.3.3 Crushed-rock aggregates are constrained to particular bedrock geologies, particularly the Carboniferous limestones fringing the Lake District National Park (Fig 3). Igneous rocks, particularly granites and andesites, have long been extracted from around Shap. Cumbria has three extraction sites for High-Specification Aggregate (HSA) in the south of the county, targeting the Waberthwaite Tuff and the Kirkby Moor Flag Formations (*Section 18.1.2*). Recent planning applications for new permissions for crushed rock have focused on an identified landbank concentrated in the environs of existing HSA extraction sites, namely the Tendley, Roan Edge and Snowhill Quarries.
- 1.3.4 ***Areas of Potential for Aggregate Extraction:*** the pattern of aggregate extraction has focused upon glacial deposits in a lowland belt, extending along the west coast northwards and across lowland Cumbria (Huddart 1977; 1991; 1994; Huddart and Glasser 2002; Thomas 1999; Nirex 1997; Fig 2). These deposits were laid down during deglaciation from the late glacial maximum of the last Ice Age, the Devensian, and reflect the pattern of decoupling of an active ice margin between Scottish ice and Lake District ice, together with locally passive ice wastage during the latter stages of deglaciation (Thomas 1999). As such, this belt provides a coherent region for assessing the deglacial geomorphology, geology, palaeoenvironments, and chronology, which will help to improve an understanding of both the glacial heritage and aggregate potential. This area incorporates the Brampton Kame Belt area and that from Maryport to the Abbeytown Ridge, which may be key sites for extraction, but which also have considerable archaeological potential. The fluvial deposits of the drainage basins for the Rivers Eden, Kent, and Ellen, and the Cumbrian stretch of the River Lune, also form coherent areas for assessment of aggregate potential, containing a significant resource for the study of geomorphology, geology, and environmental history. The assessment of the resource of crushed-rock aggregate is much more focused (Fig 3), and addresses the currently used lithologies, in particular those yielding HSA, where investigation has assessed the surface exposure of those rock types and the degree of burial by Quaternary geology.
- 1.3.5 The Cumbria County Council *Minerals and Waste Development Framework* (MWDF; Cumbria County Council 2009a) defines the policy for future mineral permissions for the county up to 2020. This provides for extensions to existing extraction sites, and only where the needs of specific major markets demand more local supplies will there be an allowance for new sites. This puts the

emphasis of the present study upon areas with present-day or historical extraction.

- 1.3.6 ***Landscape Heritage Potential:*** in recent years, rapid mapping programmes for the geomorphology associated with the last glacial maximum (late Devensian) have complemented earlier work to produce a reasonably comprehensive understanding of the relative order of events. However, the timing of landscape changes across this timeframe remains poorly resolved (Huddart 1991). Conversely, the rivers of the region have received relatively little attention, and, with the exception of limited work on the River Irthing (Eden system; Cotton 2001), and detailed investigation of the upland reaches of the River Lune in the Howgill Fells (Cundill 1976), an understanding of the fluvial geomorphological history is poor.
- 1.3.7 ***Archaeological Potential:*** the areas that seemingly have the greatest potential for aggregate, the north-western coastal plain and the Eden Valley, also have a considerable potential for archaeological remains. The North Cumbrian coastal plain has been settled since at least the Mesolithic period, and settlements such as Ewanrigg and Plasketlands (Bewley 1994), initially identified from aerial photography, have been found to have a long development through the later prehistoric period. The Hadrian's Wall defensive system extends along the Solway coast to at least Maryport, and there is considerable Roman infrastructure associated with the frontier zone (Shotter 2004).
- 1.3.8 The Eden Valley contains some of the more significant prehistoric monuments in Cumbria, such as the stone circle known as Long Meg and Her Daughters, and the King Arthur's Round Table and Mayburgh henge monuments (Hodgson and Brennand 2006, 38-9). Some of the highest-grade agricultural land in Cumbria is in the Eden Valley and, as such, the valley bottom has been extensively farmed, obscuring and degrading the remains of earlier activity (Countryside Commission 1998; OA North 2010a). Significantly, most of the visible surviving prehistoric remains are on marginal lands just above the valley bottom, but it is highly likely that the archaeological resource within the valley is at least as rich, but is now mostly obscured by later activity. Extensive fieldwalking surveys have been undertaken in the Penrith area as part of the community-based *Living Amongst the Monuments* project, which have demonstrated considerable activity from the Neolithic Period and the Bronze Age (Clarke *et al* 2008).
- 1.3.9 The valley was also traversed by the major arterial Roman road linking Carlisle and York, which utilised one of the few natural crossings of the Pennines at Stainmore (Margary 1973). As such, this area has attracted settlement since the early prehistoric period, and a considerable military infrastructure developed during the Roman period to protect this important route (Vyner 2001). There was considerable activity in the area during the early-medieval period, as evidenced by a number of sites, such as the monastic establishment at Dacre (RM Newman 2006) and the Viking-age cemetery at Cumwhitton (Paterson *et al* 2014). The Eden Valley was within the disputed Anglo-Scottish border region for much of the medieval period, and there is a major defensive line that extends down the valley and its tributaries, from the castle at Bewcastle, in the north, through those at Naworth, Appleby, Brougham, Brough, Hartley, and Pendragon

(C Newman 2006). Given the considerable activity within the valley throughout history, the area has a correspondingly high archaeological potential.

- 1.3.10 The Lune Valley similarly has been a vital strategic route since at least the Roman period, when there was a line of forts from Lancaster, through Burrow-in-Lonsdale and Low Borrowbridge, to Brougham (Shotter 2004). It also served briefly as a frontier in the late eleventh century, and again contains a defensive line of motte and bailey fortifications (C Newman 2006).
- 1.3.11 Despite this considerable potential, there is a dearth of exploratory work in these areas. Extensive survey of the archaeological resource of the Cumbrian uplands has been undertaken (Quartermaine and Leech 2012), but there has been less work within the lowlands, where the exploitable Quaternary aggregates are found. Nevertheless, survey work has highlighted the significant post-glacial and later prehistoric archaeological resource on the western coastal plain (Cherry and Cherry 1987), in the lowland wetlands (Hodgkinson *et al* 2000), at Eskmeals (Bonsall *et al* 1994), and most recently on Walney Island (D Coward *pers comm*), but these studies have not examined the areas of greatest potential for aggregate extraction. A major programme of excavation was undertaken at Stainton West on the northern flood plain of the Eden (OA North 2011b; Brown *et al* in prep), in advance of the construction of the Carlisle Northern Development Route, which identified a complex succession of settlements from the Mesolithic period to the Bronze Age and, because it was waterlogged, is providing a remarkable insight into early activity in the estuarine environment. Aerial photography has also revealed further evidence of potential later prehistoric and Romano-British settlements and field systems in the area (Bewley 1994; Webster and Newman 2007; Small 2008). It is thus evident that there is considerable potential for significant surviving data on the historic environment in the landscapes underlain by lowland Quaternary aggregates. This has been highlighted by the *Archaeological Research Framework for North West England* (Brennand 2006; 2007), which clearly indicates a need for more palaeoenvironmental and (especially) geoarchaeological research throughout the region.

2. AIMS AND OBJECTIVES

2.1 INTRODUCTION

2.1.1 The aims and objectives set out in the project design (OA North 2012) have been used to measure the success of the project, and are presented again here. The principal aim was to identify the heritage resource that may be affected by future aggregate extraction in the county, which would aid planners and curators in making decisions that would have an impact on the heritage of the county.

2.2 RESEARCH AIM 1

2.2.1 *To establish the character, scale and geographical distribution of potential future aggregate reserves that will be assessed in the context of the historic environment, with an emphasis upon existing and historical extraction sites.*

2.2.2 *Objective 1.1:* to compile a record of existing and past mineral extraction workings from Ordnance Survey (OS) mapping, the National Mapping Programme, and the Mineral Planning Authority, including pre-1947 workings.

2.2.3 *Objective 1.2:* to compile a record, and evaluate existing sources, of geological information (such as BGS maps, mineral assessment reports, and appropriate academic literature), in order to characterise the geological resource.

2.2.4 *Objective 1.3:* to identify and obtain aggregate data that are relevant to understanding the aggregate and geoarchaeological potential of the deposits.

2.3 RESEARCH AIM 2

2.3.1 *To identify and quantify the archaeological resource within aggregate-rich areas, and produce data that help planners, curators, the archaeological community at large, and the minerals industry to manage the historic environment within the mineral extraction areas of the county.*

2.3.2 *Objective 2.1:* to identify the archaeological resource within areas of potential aggregate extraction using existing historic environment datasets, aerial photography, Lidar and historical mapping.

2.4 RESEARCH AIM 3

2.4.1 *To define the impact of past and present aggregate extraction across the county.*

2.4.2 *Objective 3.1:* to produce digital mapping (GIS) of the existing and past aggregate resource, together with the known historic environment.

2.5 RESEARCH AIM 4

2.5.1 *To identify the possible impacts of future aggregate extraction upon the historic environment, and to assess the extent and character of the historic environment in these areas.*

2.5.2 *Objective 4.1:* to produce digital mapping (GIS) of areas of potential future aggregate extraction, relative to the known historic environment.

2.6 RESEARCH AIM 5

2.6.1 *To assess the impact of future extraction and provide a mechanism to inform future aggregate-related planning guidance.*

2.6.2 *Objective 5.1:* to produce baseline data for both strategic and case-based mineral planning decisions through the definition of actual and potential areas of sand and gravel extraction and by collating and improving the archaeological data available for those areas.

2.6.3 *Objective 5.2:* to provide recommendations for mitigation strategies.

2.7 RESEARCH AIM 6

2.7.1 *To enable a better understanding of the archaeological resource amongst stakeholders.*

2.7.2 *Objective 6.1:* to work with stakeholders to establish the needs of quarry operators, planners and the archaeological community.

2.7.3 *Objective 6.2:* to use an improved understanding of the mineral resource, to enable discussions with quarry operators to understand better the potential for future aggregate extraction.

2.7.4 *Objective 6.3:* to compile a pair of short articles for appropriate trade journals, which would present the issues relating to quarrying and heritage; this is a recommendation of the Steering Group (rather than a leaflet, as suggested in the project design (OA North 2012)).

2.8 RESEARCH AIM 7

2.8.1 *To develop the management of the archaeological landscapes and monuments within areas of potential aggregate extraction.*

2.8.2 *Objective 7.1:* to develop research questions and strategies for further investigation.

2.8.3 *Objective 7.2:* to develop mitigation strategies that are pertinent to the heritage resource and the nature of the aggregate extraction.

3. METHODOLOGY

3.1 INTRODUCTION

- 3.1.1 In accordance with Historic England guidelines (MoRPHE; English Heritage 2006a, 14), the fulfilment of the project's aims and objectives (*Section 2*) entailed the completion of a series of tasks, which resulted in the creation of a number of products. The tasks required to achieve the Terrestrial Mineral Resource project were presented in the project design's Method Statement (OA North 2012, 10-17), and in the Task List (*op cit*, 23-4).
- 3.1.2 The project was divided into six elements, as defined in the project design (Table 1). All the work was undertaken in accordance with the models set out in the second edition of Historic England's *Management of Archaeological Projects* (English Heritage 1991), and in *MoRPHE* (English Heritage 2006a).

1	Preparation - design of GIS and database
2	Identification of areas of potential for future extraction
3	Desk-based research for geology and archaeology
4	Analysis of the impact of past and future extraction upon the heritage
5	Reporting
6	System documentation and closure

Table 1: Summary of principal project elements

- 3.1.3 The outcomes for the project, as defined within the project design (OA North 2012), are presented within the present report in *Sections 3.6-3.8*; however, some anticipated outcomes proved unfeasible as the project developed. It had been proposed in the project design that an assessment of the context of the extraction sites should be provided, compared with comparable river valleys elsewhere within the North West that have been exploited for aggregate extraction. However, in the event, it was established that almost all of the extraction areas under investigation utilised glacial rather than fluvial aggregate sources. The only extraction site utilising fluvial sands and gravels was Cardew Mires and this is on a minor tributary to the River Caldew, which itself is a tributary of the Eden and does not provide an effective comparator with other fluvial extraction rivers, such as the River Ribble (OA North and University of Liverpool 2007). Because of the lack of directly comparable working areas, this element was therefore omitted from the overall assessment.
- 3.1.4 It had also been proposed that an assessment should be undertaken to establish the potential of using remote-sensing techniques to assess the geomorphology of the area. In the event, the Lidar data were found to be too inconsistent in extent and type to be able to provide reliable comparisons, and this element was accordingly omitted from the overall assessment.

3.2 DESIGN OF GIS AND DATABASE

- 3.2.1 ***Construction and Maintenance of Compatible GIS:*** a GIS (geographic information system) was designed, established, and maintained to facilitate input and analysis of the disparate data types. It was tailored to allow interaction between datasets developed as part of the project and also comparison with extant datasets, such as those generated by the Historic Landscape Characterisation Project (Newman 2009). This enabled an analysis of the archaeological and geological resource within the study area.
- 3.2.2 The GIS platform used was ArcGIS. This allows the display of data of many types, both raster and vector, with precise control over display order, visibility and other characteristics, and enables the presentation, modelling, interrogation, and interpretation of layers of information, including modern and historical mapping, HER data, and other archaeological data, aggregate extraction data, and contour mapping. The clear graphic representation of information allows rapid comparisons of a disparate range of data, which has allowed, for example, spatial analysis between historic environment data and drift geology or aggregate permissions data as a means of identifying areas of historical significance under potential threat from future extraction.
- 3.2.3 ***Current Cartographic Sources and Datasets:*** the project required the collation of a wide range of contemporary mapping data for the study area. The base mapping for the GIS was the OS Mastermap coverage, which was surveyed at a level of accuracy appropriate for reproduction at scales of 1:2500, or 1:1250; and 1:25,000 and larger-scale raster mapping was used for the purposes of location mapping. The datasets were provided under licence by Cumbria County Council; it is a requirement of the OS licence that these data are deleted or returned at the completion of the project and that they are not used on any other project. Several maps sourced from old-maps.co.uk were also consulted in order to assess the extent of quarrying that has taken place within the nineteenth, twentieth and twenty-first centuries.
- 3.2.4 Other sources of information crucial to the project included details of statutory designations and other areas of interest, such as boundaries of AONBs, National Parks (Fig 1), Sites of Special Scientific Interest (SSSIs), Scheduled Monuments, Listed Buildings, Registered Parks and Gardens, in addition to Parish, Township, and District boundaries, which were incorporated into the GIS. Historic Landscape Characterisation (HLC) mapping (Newman 2009) was also incorporated within the GIS.

3.3 IDENTIFICATION OF AREAS OF POTENTIAL FOR FUTURE EXTRACTION

- 3.3.1 One of the main aims of the project was an assessment of which areas of Cumbria are under the greatest potential threat of future extraction, as these would serve as the focus for future archaeological investigations. The principal criterion in selecting the study areas was to identify locations, outside the National Parks and the AONBs, where areas of archaeological potential were most likely to be under threat from future mineral extraction within the short- to medium-term future (through to 2028 (Cumbria County Council 2008)).

3.3.2 The first stage of this assessment was to capture datasets pertinent to the project and incorporate them into the GIS; these included:

- BGS records, digital resource maps and Industrial Mineral Assessment Unit (IMAU) reports;
- The Minerals Planners' database, information held by the Mineral Planning Authority on current and historical mineral permissions;
- The Cumbria County Council *Minerals and Waste Local Plan* (Cumbria County Council 2013);
- BGS Britpits database of mines and quarries.

3.3.3 Using these datasets, the assessment focused on three factors:

- **The distribution of geological resources** - specifically primary, land-based aggregate minerals, comprising both natural sand and gravel and crushed rock;
- **Minerals planning criteria** - including the general and site-specific approaches to future aggregate extraction being adopted by the Minerals Planning Authority (Cumbria County Council) over the period up to 2028 (Cumbria County Council 2009a);
- **Demand criteria** - specifically the broad pattern of existing and likely future demand for land-based aggregate extraction within Cumbria, over the next 20 to 30 years.

3.3.4 On this basis, 11 areas were selected, which were centred on existing quarries that have permissions up to the year 2028, with the greatest potential for extraction, and included both sand and gravel and also hard-rock aggregate sources. These proposed areas were discussed with the Steering Group on 22nd August 2012, and in the light of the discussions were refined and then formally adopted as the basis for Stage 2 of the programme.

3.4 DESK-BASED RESEARCH

3.4.1 Several sources of data relating to the historic environment were used in order to ensure a comprehensive understanding of each study area. These various sources of data comprised the main data types that are appropriate when undertaking a desk-based study of such an extensive area, to ensure that the maximum number of sites of archaeological interest has been identified for each study area, and that these have been considered within the impact assessment. The sources comprised historical mapping, data from the Cumbria HER and the National Record of the Historic Environment (NRHE), analysis of aerial photography and Lidar data (*Appendices 1 and 2*), and a review of previous archaeological investigations (*Appendix 3*). These data were combined to create a single dataset that represents the current state of knowledge with regard to the location and number of sites of archaeological interest within each study area. The dataset was refined to remove duplications and, therefore, to ensure that any sites that were recorded within multiple datasets were represented in the GIS by a single entry that would not skew the perceived density of sites within any of the study areas.

- 3.4.2 **Historical Mapping:** the OS First edition maps at a scale of 1:10,560 (6" to 1 mile; published 1844-52) were the primary source of historical mapping used to inform the project. The first edition OS mapping at 1:2500 scale (25" to 1 mile; 1860-95) was also inspected in order to augment the information provided by the earlier mapping, and to help clarify areas where the detail was lacking from the earlier mapping, or where the quality of reproduction was poor. The analysis of historical mapping enabled previously unidentified sites of archaeological interest to be recorded and also provided information relating to the spatial extent of historical quarrying within each study area.
- 3.4.3 **HER and NRHE Data Capture:** Cumbria County Council maintains the HER for the study areas, and also includes data generated by the Portable Antiquities Scheme; the NRHE was maintained by English Heritage. Spatial data relating to each site within these databases were obtained as shapefiles, which is the format that is compatible with GIS. The shapefiles consisted of point, line, and polygon data and the use of each of these expressions of spatial information varied between individual sites, geographical areas, and datasets. The detailed textual information relating to each site recorded by the HER and NRHE was made available in database form.
- 3.4.4 **Previous Archaeological Investigations:** a review of published and unpublished (grey) literature, particularly the results of fieldwork undertaken within the last 20 years, was undertaken in order to produce a bibliography of previous archaeological investigations undertaken within the study areas. This also entailed consultation with organisations and individuals that have undertaken investigations within the study areas. Any additional sites of archaeological interest identified during this review were added to the GIS layer as point data. In addition to enhancing the data relating to known sites of archaeological interest across the study areas, this study aided the examination of the potential for sub-surface remains of archaeological interest.
- 3.4.5 **Analysis of Aerial Photographs and Lidar Data:** the analysis of aerial photographs and Lidar data broadly followed the National Mapping Programme (NMP) standards and methodology (English Heritage 2006b; see *Appendix 1*, and Deegan 2013 for the full report).
- 3.4.6 The recording strategy for this analysis aimed to create new, or enhance existing, entries in the National Record of the Historic Environment (NRHE) in formats compatible with English Heritage's Archive and Monuments Information England (AMIE) database. The areas for the NMP study (Fig 4) were defined (OA North 2013) so as to include all of the wider areas of potential quarry expansion, but were also substantially increased so as to fulfil the secondary requirement of the study, which was for general HER and NHRE enhancement. This overall entailed the examination of 102 square kilometres.
- 3.4.7 The entries in this database record the location, the monument types present and their dating, the latest condition, a free-text description of the monument or monument group, the source of record information (*ie* photograph and any bibliographic or cartographic references) and administrative details such as concordance with HER records, record authorship, and links to NRHE event records and archives. The recording strategy was also designed to assist in the management and querying of the map data in GIS or Autodesk Map®

environments and select monument data were, therefore, attached to each individually mapped feature.

3.4.8 *Aerial Photographs*: aerial photographs from the following collections were accessed (*Appendix 2*):

- English Heritage Archive (EHA; formerly NMR): specialist, military, oblique and vertical collections;
- Cambridge University Committee for Aerial Photography (CUCAP): oblique and vertical air photographs;
- Cumbria HER: oblique and vertical air photographs;
- Pan-Governmental Agreement (PGA): digital photographs produced by GeoPerspectives were made available through the PGA;
- Online digital air photographs: digital photographs delivered by Google Earth were consulted, and photographs from Bing were also consulted when information from all other sources proved ambiguous.

3.4.9 All of the available air photographs were examined, under magnification, and stereoscopically where possible. Appropriate photographs were selected for transcription (rectification and mapping). Permission to scan the photographs was sought from the copyright holders at the outset of the project.

3.4.10 The selected photographs (or acetate overlays) were scanned at a suitable resolution, normally 300 dpi, and output as uncompressed TIFF format images (.TIF). These images were rectified using AERIAL5.33 and control information was mostly derived from the OS LandLine™ 1:2500-scale vector maps, which were also used as a base for mapping. Accuracy for the OS raster 1:2500 maps is in the range of $\pm 2\text{m}$ and acceptable tolerance for rectification of photographs is generally $\pm 2.5\text{m}$ (English Heritage 2006b). Rectified images were output from AERIAL in uncompressed TIFF format at a minimum resolution of 300 dpi and a scale of 1:2500.

3.4.11 *Lidar Acquisition and Processing*: Environment Agency Lidar data were available for approximately 55% of the overall project areas. This was initially limited to low-resolution, georeferenced, colour raster images (jpps) with fixed parameters (*eg* lighting, azimuth and vertical exaggeration). However, during the course of the project, 1m- and 2m-resolution ASCII data became available and were used in preference to the raster images for the remaining survey areas (Fig 5). The ASCII data were processed either as 16-direction hill-shade models or as a series of single-lit views, depending on the resources available. Digital surface models were examined in preference to digital terrain models, except in areas of extensive tree cover.

3.4.12 *Mapping*: the rectified images were imported into a MapInfo Professional 11.5 (MI) table in their correct geographical position. The required information was then traced from the rectified images (air photographic and Lidar). All features of archaeological interest were then digitised from the images, observing the NMP standards (English Heritage 2006b).

3.5 ANALYSIS OF THE IMPACT OF PAST AND FUTURE EXTRACTION UPON THE HERITAGE

3.5.1 In order to assess the historical, twenty-first-century, and future impacts of quarrying on the historic environment, it was necessary to characterise each area according to the significance, type, period, and density of sites of archaeological interest. A scoring system was utilised in order to ensure that the sites of highest significance were visible within the dataset and that large numbers of less significant sites did not obscure rarer sites and skew the impression of the distribution of sites of archaeological interest (Table 2). For example, sites of post-medieval date are the most common and their presence would dominate the dataset if a system of weighting and scoring were not utilised.

Period	Score
Modern	0
World War I or II	1
Unknown	1
Industrial	1
Post-medieval	1
Medieval / Post-medieval	2
Medieval	3
Roman	3
Early medieval	4
Iron Age / Bronze Age	4
Mesolithic / Neolithic	4
Designation	Score
Listed Buildings	4
Parks and Gardens	4
Battlefields	4
Scheduled Monuments	5
World Heritage Sites	5

Table 2: Weighting given to individual periods and designations

3.5.2 This process was intended to highlight the densities of those heritage assets across the study areas that are from the prehistoric, Roman or early medieval periods, and those which have statutory designations, and that are, therefore, generally considered to be of greater archaeological significance and rarity. It is, however, recognised that undesignated later sites of schedulable quality may also be present and that this broad approach would not differentiate such sites. The process did, however, still highlight areas that have significant numbers of post-medieval monuments.

3.5.3 The total of the scores for period and designation for each site were then used to calculate the overall scores for areas within each study area. These sub-divisions were based on the polygons that were defined for the Historic Landscape Characterisation (HLC) for Cumbria (Newman 2009) and the scores reflected the density of sites within each area; however, the polygons did not retain any HLC data and there was no attempt to provide HLC characterisation for the study areas.

3.5.4 **HLC Polygon Rationalisation:** the HLC polygons were selected as an appropriate means to sub-divide spatially each of the study areas into smaller units that reflected broad, recognised characteristics of the historic environment. This would also enable the area sub-divisions to be more closely compared with

the HLC than arbitrary sub-units. A process of rationalisation of the HLC dataset was undertaken in order to make it suitable for this purpose, for which it had not been originally conceived. Greater uniformity was required within the HLC dataset and, therefore, points and lines were excluded, leaving only the polygon data. The polygons varied considerably in size and, therefore, polygons smaller than 10ha were merged into adjacent polygons, which, as far as possible, shared the same attributes of historic character. This merging process reduced the granularity of the area sub-divisions (Fig 6).

- 3.5.5 **HLC Polygon Scoring:** following the rationalisation of the HLC polygons, the total scores for each polygon were calculated, and these reflected not only the numbers of sites within each HLC polygon, but also their period and status. Although the polygons had been rationalised, they were not of a uniform size and it was, therefore, necessary to calculate the total scores in terms of 'densities', *ie* scores per unit area, for each polygon, rather than simply assigning scores based on the total number of sites within each polygon. This was achieved by dividing the combined total score by the area of the HLC polygon to produce a density of combined score per km².
- 3.5.6 The density scores were colour-coded for ease of display (Fig 7), with the areas of lowest density of sites being dark green and those of highest density being dark red, with graduating colours in between. The density values were initially divided into five sub-groupings to which this colour coding would be applied, with the groupings being generated automatically, based on a statistical classification of the density data by quantiles. However, this apparently logical approach treated the density scores purely as quantifiable numbers and did not enable professional archaeological judgement and experience to be exercised. Professional judgement was important in the consideration of the assigning of relative levels of site density to such colour-coded classifications, as these should reflect, at a very general level, the current understanding of the archaeological significance of each polygon. It was, therefore, necessary to set manually the levels of density that would define each colour-coded category, based on an informed consideration, which constituted a high, medium, or low density of sites, within the current dataset.
- 3.5.7 **Limitations of the Scoring System:** as some sites of archaeological interest are represented within the datasets by representative points that do not reflect the spatial extent of the sites, it was not possible to include the spatial extent of sites within the calculation of density. This means, for example, that a polygon of 10ha containing three small post-medieval sites (such as limekilns) will produce the same density score as a 10ha polygon containing three very extensive post-medieval sites (such as fields of ridge and furrow).
- 3.5.8 The density scores represent only the current state of understanding of the archaeological record within each of the study areas. These scores do not reflect what is present within each polygon, but what has been previously identified. The number of sites identified will, therefore, be affected by the quantity and nature of previous archaeological investigations that have taken place within each area. If an area has never been examined archaeologically, then it follows that no sites of archaeological interest will have been identified in that area. Similarly, where intrusive works, such as mineral extraction, have been undertaken, sub-surface remains of archaeological interest may have been

identified that would otherwise have remained undetected and, conversely, areas that have been under pasture during the modern period are not likely to have been subject to this type of intrusive examination. The presentation of this dataset should, therefore, be understood to be a representation of the current state of knowledge and not a predictive model that demonstrates definitively where sites of archaeological interest will be present or absent. As such, this data should be consulted and considered with guidance from professional archaeologists or heritage curators, who are able to consider all factors that will inform an understanding of the potential for previously unrecognised heritage assets.

- 3.5.9 This data should be considered for use at a strategic level and to be the first stage in understanding the potential for impacts upon heritage assets within each area. More intensive archaeological assessments would be required in advance of any development proposals relating to specific parts within these study areas.
- 3.5.10 **Correlating the HLCs with the Study Areas:** in addition to the calculation of scores for each HLC sub-division within each study area, the overall score for each was calculated in order to provide the capacity to make broad comparisons between these areas (Fig 8). However, due to the large size of the areas, this process provided only a very generalised indication of the heritage resource within each, and the HLC scores and the location of individual sites should be consulted for more detailed indications of the character of each area.

3.6 REPORT PREPARATION AND ASSOCIATED GIS MAPPING

- 3.6.1 One output of the project is this report, which provides details of the methodology, results, and conclusions of the study. In accordance with the project design (OA North 2012), the report is accompanied by maps indicating the densities of sites within each of the areas selected for more intensive study. It is also supported by layers of GIS data, detailing geology, historical mapping, and the characterisation model for each area (*Section 3.5*), and the report is cross-referenced with the GIS database, which provides the primary digital archive of the archaeological resource. The report also provides an assessment of anticipated extraction threats to the historic resource and guidance for its future management (*Section 7*).

3.7 SYSTEM DOCUMENTATION

- 3.7.1 Full documentation on the use of the database and GIS had been compiled and will be provided, along with copies of the GIS and database, to the HER. In accordance with the *Archaeological Data Services Guide to Good Practice for GIS* (Gillings and Wise 1998), this includes full documentation on the derivation and accuracy of the different aspects of the database and GIS. A basic guide to the use of the database has been compiled, which includes how to find particular records, how to query the database, and how to generate printed reports from it. Instructions on how to add new data generated by future interventions in any of the study areas have also been included, thus allowing the ongoing production of a coherent and user-friendly product. Finally, instructions have been provided on importing the GIS data into common formats for use in other GIS software

packages, in order to ensure maximum accessibility across the anticipated varied user groups.

3.8 DISSEMINATION OF RESULTS

- 3.8.1 The results of the project are being disseminated to as wide an audience as possible, including specialist and non-specialist users. The digital archive for the project includes a GIS, comprising a full index of archaeological features identified in the course of the project. The GIS has been designed to be compatible with the Cumbria HER and a dialogue has been maintained with the HER in the course of the project to ensure this; the database and GIS data will be transferred to the HER for long-term curation.
- 3.8.2 It is proposed that the results of the project be disseminated to a target audience of quarry managers and planners, who may benefit from an understanding of the heritage issues and may be able to affect the implementation of future extraction plans. A fundamental part of this process is to enable a dialogue with the quarrying community. It was originally proposed (OA North 2012) that this should be achieved by means of a leaflet and through a web site. However, at the Steering Group meeting in June 2014, it was agreed that a more effective approach would be through the production of two articles, which will introduce the issues relating to the potential for archaeological remains within areas of extraction, and the importance of preserving this resource. It is proposed that these articles should be submitted to *Quarry Management* and *Minerals Planning*, both of which are journals that are used by different elements of the minerals extraction community. These articles will be tailored to fit the requirements of the respective journals and will be targeted at audiences involved with quarry management and planning.

4. PLANNING GUIDANCE AND LEGISLATION

4.1 SUMMARY

- 4.1.1 The following section provides a summary of planning policies relevant to quarrying and the consideration of the historic environment within Cumbria.
- 4.1.2 **National Planning Policy Framework (NPPF):** national planning policies on the conservation of the historic environment are set out in the National Planning Policy Framework (NPPF), which was published by the Department of Communities and Local Government (DCLG) in March 2012. Sites of archaeological or cultural heritage significance that are valued components of the historic environment and merit consideration in planning decisions are grouped as ‘heritage assets’; ‘heritage assets are an irreplaceable resource’, the conservation of which can bring ‘wider social, cultural, economic and environmental benefits...’ (DCLG 2012, section 12.126). The policy framework states that the ‘significance of any heritage assets affected, including any contribution made by their setting’, should be understood in order to assess the potential impact (*op cit*, section 12.128). In addition to standing remains, heritage assets of archaeological interest can comprise sub-surface remains and, therefore, assessments should be undertaken for a site that ‘includes or has the potential to include heritage assets with archaeological interest’ (*ibid*).
- 4.1.3 The NPPF draws a distinction between designated heritage assets and other remains considered to be of lesser significance; ‘great weight should be given to the asset’s conservation. The more important the asset, the greater the weight should be; substantial harm to or loss of a grade II listed building, park or garden should be exceptional. Substantial harm to or loss of designated heritage assets of the highest significance, including scheduled monuments, protected wreck sites, battlefields, grade I and II* listed buildings and grade I and II* registered parks and gardens and World Heritage Sites, should be wholly exceptional’ (DCLG 2012, section 12.132). Therefore, preservation *in-situ* is the preferred course in relation to such sites unless exceptional circumstances exist.
- 4.1.4 It is normally accepted that sites that are not designated will be preserved by record, in accordance with their significance and the magnitude of the harm to or loss of the site as a result of the proposals, to ‘avoid or minimise conflict between the heritage asset’s conservation and any aspect of the proposals’ (DCLG 2012, section 12.129). Undesignated heritage assets of archaeological interest will also be subject to the policies reserved for designated heritage assets, if they are of equivalent significance to scheduled monuments (*op cit*, section 12.132).
- 4.1.5 **Cumbria Minerals and Waste Development Framework (MWDF):** Cumbria’s framework to deal with minerals and waste disposal was in preparation at the start of this project. It includes a *Core Strategy* and a set of *Generic Development Control Policies*, both of which were adopted in April 2009 (Cumbria County Council 2009b; 2009a). The MWDF core strategy provides a spatial vision and strategic objectives for the area, including a spatial strategy, core policies and a monitoring and implementation framework. Policy 17 of the

Core Strategy (Cumbria County Council 2009b), which remains valid to 2020, relates to extraction for building stone:

‘Planning permission will be granted for proposals that would help to provide the full range of local building stones that are needed to maintain Cumbria’s local distinctiveness and that have acceptable environmental impacts.’

4.1.6 The MWDF *Generic Development Control Policies* document (Cumbria County Council 2009a) sets out the broad, non-site-specific policies which will be used to guide Development Control decisions on individual applications for the extraction of minerals.

4.1.7 ***Draft Cumbria Minerals and Waste Local Plan 2013 to 2028***: proposed site allocations and minerals safeguarding areas were initially developed under the MWDF, but have now been carried forward, with some amendments, as part of the emerging *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013), which will run to 2028. This relates to Policy DC14 of the draft Plan, deriving from Policy 17 of the *Core Strategy* (*Section 4.1.5*), and which provides additional detail relating to developments that adversely affect the historic environment:

‘Proposals for mineral developments that would adversely affect an internationally or nationally important archaeological site, monument or historic asset, whether scheduled or not, or its setting, will not be permitted unless there is an over-riding reason of national importance for the development to proceed, or the site and setting can be preserved *in situ*.’

The draft plan states that proposals will not be permitted that:

- fail to preserve or enhance the character or appearance of Conservation Areas; or
- damage, obscure, or remove important archaeological sites or other historic features; or
- are detrimental to the character or setting of a listed building.

4.1.8 Such developments will only be permitted if it is demonstrated that the need for, and benefits of, a development decisively outweigh these interests. The Local Plan also states that development proposals should be accompanied by an assessment of any impacts on the historic environment. A list of specific issues that should be considered when assessing the significance of impacts on the historic environment is provided in the Plan (Cumbria County Council 2013, section 17):

- the rarity of the historic asset and any trends;
- the fact that the historic environment is an irreplaceable and finite resource, and hence impacts are unlikely to be reversible;
- the critical importance of a thorough understanding of the historic environment and a robust baseline, so that significant adverse impacts can be avoided or reduced and potential benefits maximised;
- the inextricable link between the historic and natural environment and the character of the landscape.

- 4.1.9 *The Potential for Cumulative Impacts*: when considering impacts on the historic environment, care must be taken before concluding that impacts on individual heritage assets are not significant.
- 4.1.10 ***Cumbria and Lake District Joint Structure Plan (adopted April 2006)***: policies were developed from the Cumbria and Lake District Joint Structure Plan (Cumbria County Council and the Lake District National Park Authority 2006), which were included within the Regional Spatial Strategy (RSS; Government Office for the North West 2008). This Regional Spatial Strategy for the North West was adopted on 30th September 2008.
- 4.1.11 *Policy E38: Historic environment in Cumbria and the Lake District*, states that measures will be taken to identify, record, protect, conserve or enhance areas, sites, buildings, and settings of archaeological, historical and architectural importance (Cumbria County Council and the Lake District National Park Authority 2006). Proposals which fail to preserve or enhance the character or appearance of Conservation Areas, or which damage, obscure, or remove important archaeological sites or other historic features, or are detrimental to the character or setting of a listed building will not be permitted unless the harm caused to their importance and intrinsic interest is clearly outweighed by the need for the development. Development and land-use change should be compatible with the distinctive characteristics and features of Cumbria's Historic Landscape Characterisation Programme (Newman 2009).
- 4.1.12 *Policy R48: Mineral extraction in the Lake District National Park and AONBs*, states that proposals for mineral extraction within the Lake District National Park and AONBs will only be permitted in the following circumstances:
- to provide building stone, which in the Lake District National Park will be limited to small-scale extensions to existing workings or small-scale re-opening of previously worked quarries; or
 - the small-scale re-opening of previously worked slate quarries; or
 - the extension of existing slate quarries, where there is no other reasonable alternative source of supply.
- 4.1.13 In all circumstances, it must be demonstrated that the scale and nature of the proposed works are such that harm would not be caused to interests of acknowledged importance, or that any such harm is outweighed by the need to maintain a supply of local building material, to sustain local diversity of employment, or by other local economic considerations. Proposals must include strategies to minimise the production of mineral waste, to ensure the acceptable reclamation and after-use of land and to encourage the transport of materials by the most sustainable mode of transport.

5. STAGE 1: SAND AND GRAVEL RESOURCES: THE SELECTION OF STUDY AREAS

5.1 INTRODUCTION

5.1.1 At the outset, an assessment was undertaken of areas that are at greatest risk from future extraction in Cumbria (Stage 1; OA North 2012), which would serve as the basis of the archaeological elements of the project. The principal criterion in selecting the study areas was to identify those locations, outside the National Parks and the AONBs, where there was greatest threat from future mineral extraction within the short- to medium-term future, corresponding to the timescale of the emerging *Minerals and Waste Local Plan* (through to 2028) (*Section 4.1.7*). This assessment did not prejudge the significance of the heritage resource within the areas, as that, in many cases, was either unknown or only partially known prior to the commencement of this study. Attention was therefore initially focused primarily on the following three factors: the distribution of geological resources; minerals planning criteria; and demand criteria (*Section 3.3.3*).

5.2 THE DISTRIBUTION OF GEOLOGICAL RESOURCES

5.2.1 Construction aggregates are obtained from a range of sources, including secondary and recycled materials, marine-dredged natural aggregates, aggregates imported by land or by sea from other areas, and land-based extraction of aggregates within Cumbria itself. This project focuses only on the last of these categories, but includes both natural sand and gravel (sediments laid down by glaciers, glacial meltwater streams and post-glacial rivers during the most recent ('Quaternary') period of Earth's history); and crushed rock, which uses much older, 'hard-rock' resources, which are extracted by blasting and are then crushed to produce angular rock fragments in various size classes. In both cases, the distribution of resources is taken directly from the BGS digital maps produced in connection with the report on *Mineral Resource Information for Development Plans - Cumbria and the Lake District* (Young *et al* 2001).

5.2.2 ***Natural Sand and Gravel Resources:*** sand and gravel deposits comprise just part of the wide range of sediment types laid down by natural processes during and since the various ice ages of the Quaternary period. They include both glacio-fluvial deposits, associated with deposition by meltwater streams and rivers during former glaciations; and river terrace and sub-alluvial deposits, laid down by post-glacial streams and rivers.

5.2.3 ***Glacio-fluvial sands and gravels:*** in Cumbria, most of these sediments date from the most recent, 'Devensian' glaciation, when Cumbria was covered by ice from the Lake District ice cap and, in some areas, by ice flowing south from the Southern Uplands of Scotland or westwards from the north Pennines. Research has shown that, even during the Devensian, there were several different episodes of glaciation, with differences in the directions of ice flow being reflected in the complex patterns of streamlined drumlins and other landforms of glacial deposition (Livingstone 2010). It was during the final stages of glaciation,

however, when the majority of glacio-fluvial sands and gravels, that are currently exposed at the surface, were deposited by meltwater streams and rivers, in a wide range of depositional environments: in front of retreating glaciers; amidst stagnating ice; and as deltas building out into glacial lakes and tidewater glacier margins. In some areas, earlier episodes of deposition produced similar sediments, which were subsequently buried by glacial tills ('boulder clays'), and/or by glacio-lacustrine clays or marine sediments during periods of high sea level, as the ice-sheets melted. Whilst some of the 'concealed' sands and gravels might be capable of being commercially exploited (*ibid*), in most areas insufficient information is available for these to be mapped, and the BGS resource maps prepared for mineral planning purposes are thus primarily focused on sand and gravel deposits which are exposed at the surface. The main exceptions to this are the deposits of the 'Brampton Kame Belt' (*ibid*), where the former Institute of Geological Sciences (now the BGS) carried out an extensive sand and gravel mineral assessment during the late 1970s (Jackson 1979). The resource maps in that area thus include areas of both exposed and concealed sand and gravel. Detailed sub-surface information is also available for the deposits around and to the south of Sellafield (Merrit and Auton 2000; Michie *et al* 2010), although in that area, whilst concealed deposits occur beneath glacial tills, especially offshore, the main land-based sand and gravel deposits (the 'Peel Place Member') occur at the surface.

5.2.4 The exposed glacio-fluvial deposits occur sporadically throughout the lowlands of Cumbria, primarily within the Eden Valley, the Solway lowlands and along the western and south-western coastal plain (Fig 2). The main concentrations of relatively thick deposits, which are not sterilised by existing built developments, occur within:

- the **Brampton Kame Belt**;
- the **Holme-St Cuthbert** area (Abbeytown Ridge), to the south-west of Abbeytown);
- the **Peel Place** area, near Seascale; and
- the **Roosecote** area, to the south-east of Barrow-in-Furness.

5.2.5 Active sand and gravel quarries operate in all four of these areas and also at Low Plains, close to the M6 between Carlisle and Penrith (Fig 1). This is the only one of the many smaller areas of glacio-fluvial sediments within Cumbria that is currently being worked.

5.2.6 Study areas were selected, and then refined, within all five of these localities, based on a combination of geological, planning and economic demand criteria (Section 5.7; Fig 2).

5.2.7 **River Terrace and Sub-alluvial Sands and Gravels:** river terraces, representing the surfaces of former river floodplains which have subsequently been incised into by the post-glacial downcutting of the streams and rivers during the Holocene, frequently contain high-quality sand and gravel resources (Macklin and Lewin 1993). These are extensively worked as such in many parts of England. This is not the case in Cumbria, however, where very few terrace deposits are mapped as sand and gravel resources by the BGS.

- 5.2.8 Far more extensive are the sub-alluvial gravels, which occur beneath the modern floodplains (Fig 2). As with terrace deposits, the sub-alluvial gravels tend to be better sorted and ‘cleaner’ than glacio-fluvial sediments, as they have been reworked to a greater extent by streams and rivers, a process which has progressively winnowed out the finer sediments (silts and clays) (*ibid*). The deposits are, however, typically overlain by varying thicknesses of modern alluvium, which is generally dominated by silts and clays, forming a layer of ‘overburden’ above the mineral. The mineral itself is frequently below the water-table, necessitating either dewatering (artificial lowering of the water-table by pumping, to enable the deposits to be worked dry), or ‘wet-working’, in which the deposits are dredged from within an area of open water (*ibid*).
- 5.2.9 In Cumbria, there is only one currently active site working sub-alluvial gravels, at Cardew Mires to the south-west of Carlisle. Accordingly, this locality was put forward as a sixth study area (Fig 2).

5.3 HARD-ROCK AGGREGATE RESOURCES

- 5.3.1 Hard-rock resources that are currently exploited for use as crushed-rock aggregates in Cumbria comprise:
- **Carboniferous Limestone**, which is widely quarried throughout its outcrop encircling the Lake District National Park;
 - **Silurian sandstones**, which are quarried in two locations near Kendal for use as high-specification aggregates (HSA) for skid-resistant road-surfacing materials;
 - Ordovician rocks of the **Borrowdale Volcanic Group**, which are quarried at Ghyll Scaur, near Millom, as a source of even higher-specification road aggregates; and
 - the **metamorphic rocks** at Shap Blue Quarry, which are formed by localised thermal alteration of the rocks adjacent to the Shap Granite, and are exploited as a more general-purpose hard, durable aggregate.
- 5.3.2 The distribution of these rock types outside the National Parks and the AONBs, together with the associated currently active quarries, has been mapped (Fig 3). This led to the selection of study areas for hard-rock aggregate, following the consideration of additional planning and economic criteria (*Section 5.7*). These include examples within the Carboniferous Limestone, Silurian Sandstone and Ordovician volcanic rocks, but do not include the metamorphic rock at Shap Blue, as planning and economic considerations do not favour further expansion there.
- 5.3.3 Most other bedrock formations outside the National Parks comprise younger sandstones (of both Carboniferous and Triassic ages), which are too weak to be used as crushed-rock aggregates, but are commonly worked for natural building stone. In several places, the Carboniferous Limestone is also worked for building stone, and the Silurian slates are worked for roofing materials (Young *et al* 2001); however, neither building stone nor roofing slates are within the scope of this project.

5.4 MINERALS PLANNING CRITERIA

- 5.4.1 Cumbria County Council, as the Mineral Planning Authority (MPA) for the area, is responsible for planning the future provision of aggregate minerals within the county, in accordance with the guidance issued by the Aggregates Working Party (AWP) for North West England (NWAWP 2014), which issues guidance on behalf of central Government. This forms part of its more general obligation to plan for all types of minerals provision in the county, in accordance with the National Planning Policy Framework (NPPF) (DCLG 2012; *Section 4.1.2*), balancing these requirements against the need for environmental protection and economic growth.
- 5.4.2 Cumbria's Minerals and Waste Development Framework (MWDF) *Core Strategy* (Cumbria County Council 2009b) indicates what minerals (and waste) developments are likely to be needed, and provides broad (rather than site-specific) locations where they are likely to take place. Core Strategy Policy 7, which relates to Strategic Areas for New Development, specifically identifies that land adjacent to Ghyll Scaur Quarry is important for further supplies of nationally important, very high-specification, roadstone. With respect to other types of crushed rock and all future supplies of sand and gravel, this policy refers only to the details contained within the Site Allocations Policies Development Plan Document and Proposals Map (Cumbria County Council 2012). Core Strategy Policies 13 and 14 (Cumbria County Council 2009b) relate, respectively, to future minerals supply and the safeguarding of mineral resources. Policy 13 confirms that provision will be made in accordance with the County's apportionment but also that account will be taken of differences in type of aggregate and of the County's dispersed settlement pattern, with a consequential need to maintain supplies in close proximity to areas of demand.
- 5.4.3 Policy DC6 of the *Generic Development Control Policies* (Cumbria County Council 2009a) sets out the criteria for non-energy minerals development in Cumbria, and highlights a strong preference for new permissions within 'Preferred Areas' that are identified within the Site Allocations Policies (Cumbria County Council 2012). It also notes, however, that favourable consideration may be given to proposals that can be more sustainable than any available alternative, including (*inter alia*) 'areas already subject to minerals extraction where the additional working will enable comprehensive exploitation of the reserves, or where the proposal achieves a more sustainable after use or a better restoration of the area' (Cumbria County Council 2009a, 10). In the absence of any Preferred Areas being identified elsewhere, this effectively suggests that future extraction is more likely to be permitted as extensions to existing quarries than as completely new 'greenfield' sites.
- 5.4.4 A third set of documents, comprising the proposed *Site Allocations Policies and Proposals Map*, was issued for consideration by The Secretary of State, in January 2012 (Cumbria County Council 2012), following consultation in 2009. These maps, which have now been carried forward as part of the emerging *Minerals and Waste Local Plan* (which is replacing the MWDF; Cumbria County Council 2013), identify site-specific proposals for future mineral working and are thus a very important indication of the areas where archaeological resources might be under the most immediate threat from future

extraction. Of particular relevance to this project, proposed allocations for future aggregates extraction are identified within these documents.

- 5.4.5 ***Sand and Gravel Extraction:*** the Allocations document (Cumbria County Council 2012) notes that the current landbank of permitted reserves for sand and gravel in Cumbria is around 20 years and is not considered likely to fall below the minimum of seven years required by the NPPF (DCLG 2012) within the plan period. Whilst this suggests that Preferred Areas or Areas of Search no longer need to be identified to be in accordance with the Policy, the document notes that the landbank is disproportionately located within the north of the county and provision for the west and south, where Peel Place and Roosecote (Fig 2) are the only sand quarries, needs to be considered in accordance with Core Strategy Policy 13 (Cumbria County Council 2009b). It also notes that some of the current planning permissions will expire within the plan period. Taking these various factors into account, a single Preferred Area and four Areas of Search are identified, in Site Allocations Policy 7 (Cumbria County Council 2012). These comprise (Fig 1):

Preferred Area:

- (M 27) Roosecote sand quarry, Barrow-in-Furness (Preferred Area);

Areas of Search:

- (M 6) land between Overby and High House sand and gravel quarries, near Abbeytown;
- (M 8) land adjacent to Cardew Mires sand and gravel quarry, near Dalston;
- (M 12) Roosecote sand and gravel quarry extension, Barrow-in-Furness;
- (M 15) land adjacent to Peel Place sand and gravel quarry, near Gosforth.

- 5.4.6 ***Crushed-Rock Extraction:*** as noted within the *Core Strategy* (Cumbria County Council 2009b), no further provision for the release of general crushed-rock aggregate can be justified within the plan period, because of the overall size of the existing crushed-rock landbank. However, one Area of Search for limestone extraction is identified in Policy 7, with a specific view to securing environmental improvements in that area. In addition, separate consideration is given (in accordance with NPPF; DCLG 2012) to the requirement for high-specification aggregate resources, and two further Areas of Search are thus identified in Policy 7 for this purpose. The three current Areas of Search thus comprise (Fig 3):

- (M 10) land adjacent to Silvertop limestone quarry, near Brampton;
- (M 17) land adjacent to Ghyll Scaur, which is a very high-specification roadstone quarry, near Millom;
- (M 30) land adjacent to Roan Edge, which is a high-specification roadstone quarry, near New Hutton.

- 5.4.7 These allocations, though yet to be finally confirmed, are in line with the *Core Strategy* and *Generic Development Control Policies* (Cumbria County Council

2009b; 2009a). They also confirm that the focus of future mineral development is likely to be in close proximity to existing active permitted workings within these areas.

- 5.4.8 All of the proposed allocations correspond to areas that have provisionally been selected for investigation on the basis of geological information, but they do not include all of those areas. In order to finalise the recommendations, consideration was also given to economic demand criteria.

5.5 DEMAND CRITERIA

- 5.5.1 The Minerals *Core Strategy* (Cumbria County Council 2009b) makes specific reference to the dispersed settlement pattern of Cumbria, with a consequential need to maintain supplies in close proximity to areas of demand, thereby reducing the ‘mineral miles’ involved, and avoiding or minimising the need for transportation through the Lake District National Park. Geographical areas of demand broadly equate to the main centres of population and industrial development, but also to major infrastructure projects, such as the Sellafield nuclear power station and its possible future replacement; the Low Level Waste Repository (LLWR) at Drigg, near Sellafield; and various windfarm proposals.

- 5.5.2 Once the Sellafield factors, in particular, are taken into account, this reinforces the need for attention to be given to the resources of both crushed rock and natural sand and gravel aggregates in West Cumbria. Sand and gravel sites have already been suggested (Cumbria County Council 2009b), on the basis of their associated allocations for future working, but these additional demand criteria suggest that one or more of the limestone quarries in West Cumbria (Eskett, Tendley and Moota; Fig 3) should also be considered.

- 5.5.3 Elsewhere, the proximity of the Brampton Kame Belt area to Carlisle (Fig 2), and the good communications from the northern edge of this area, at least, via the A69 and M6 motorway, suggests that this area is also worthy of investigation. This is despite the fact that there are, at present, no specific allocations in that area. Similarly, the existing sand and gravel operation at Low Plains, which has good access onto the A6 and the M6 motorway further south, could well experience more demand for its products than many other existing operations.

5.6 RECOMMENDED STUDY AREAS

- 5.6.1 By combining the geological, planning and economic demand criteria, six areas of sand and gravel extraction (Fig 2) and six areas of hard-rock aggregates extraction (Fig 3) were identified for further study:

Natural Sand and Gravel:

- *Study Area 1:* the northern part of the glacio-fluvial deposits within the *Brampton Kame Belt*;
- *Study Area 2:* the glacio-fluvial deposits within the *Holme St Cuthbert* (Abbeytown Ridge) area;

- *Study Area 3*: the glacio-fluvial deposits surrounding the existing sand pit at *Peel Place* (but excluding resources within the Lake District National Park);
- *Study Area 4*: the north-eastern part of the glacio-fluvial deposits adjacent to the existing *Roosecote* sand pit;
- *Study Area 5*: the areas of glacio-fluvial sand and gravel adjacent to the existing *Low Plains* sand pit;
- *Study Area 6*: the areas of sub-alluvial sand and gravel immediately adjacent to the existing *Cardew Mires* gravel pit.

Crushed-rock Aggregates:

- *Study Area 7*: *Silvertop* Carboniferous Limestone quarry;
- *Study Area 8*: *Ghyll Scaur* - volcanic rock quarry, comprising very high-specification aggregates;
- *Study Area 9*: *Roan Edge* - Silurian sandstone quarry, comprising high-specification aggregate;
- *Study Area 10*: *Moota* Carboniferous Limestone quarry;
- *Study Area 11*: *Tendley* Carboniferous Limestone quarry;
- *Study Area 12*: *Eskett and Rowrah* Carboniferous Limestone quarries.

It should be noted that Study Areas 1 and 7 are in the same general location, to the south of Brampton, and form the single refined study area known as the Brampton Kame Belt.

- 5.6.2 The last study area does not currently have allocations for future working. The two quarries there were nevertheless suggested for inclusion by the project Steering Group, not least because of their proximity to potential large-scale construction projects at Sellafield and Drigg.
- 5.6.3 Together, the study areas are thought to represent those where any archaeological resources that may exist are most likely to be under threat from mineral extraction within the short- to medium-term future. Since the areas were selected, additional Areas of Search have been identified by Cumbria County Council (2012) at two other sites (*Holmescales*, high-specification aggregate quarry; and *Kirkby Slate* quarry), but not in time for these to be considered in the selection of study areas.

5.7 REFINEMENT OF STUDY AREAS

- 5.7.1 The specific outlines for each of the agreed study areas were defined initially on the basis of the local geological outcrop, modified (in some cases) by proximity to access routes, and were put forward for discussion at the first Project Steering Group meeting in August 2012, at the end of Stage 1. Following discussion, and taking account of budgets (since that has a direct influence on the total surface area which could be covered), the proposals were modified slightly and revised outlines were defined. These are defined as the '*original study areas*' and are the areas within which the initial archaeological searches were focused. These

allowed a 1km 'buffer zone' around each study area, but these were subject to reconnaissance-level investigations only.

- 5.7.2 The study areas were then refined (*'refined study areas'*), to allow the most detailed investigations to be focused on those areas most likely to be affected by extraction in the short- to medium-term future. The refinement was an iterative process, carried out in Stage 3 of the project, drawing on more detailed information on geology, quarrying activity, minerals planning boundaries and preliminary archaeological findings. The refinements were agreed at the Steering Group meeting in June 2014.
- 5.7.3 Given that hard-rock quarrying is a much slower process, in terms of the annual rate of surface area land-take, than is generally the case for sand and gravel extraction, the areas likely to be 'at risk' over a 20-30-year period are likely to be much smaller for hard-rock quarries than for sand and gravel sites. This is reflected in the size of the refined study areas, which are deliberately intended to focus on those areas in greatest need of investigation.

6. STAGE 2 RESULTS: DATA CAPTURE AND REFINEMENT

6.1 INTRODUCTION

6.1.1 Several different sources of data were examined, in accordance with the methods described in *Sections 2.2-3*, and these were used to explore the initial larger search areas centred on the quarry sites that were defined by the Steering Group (*Section 5.6*). These comprised historical mapping, HER and NRHE (National Record of the Historic Environment) data, analysis of aerial photographs and Lidar data, and a review of previous archaeological investigations. For the most part, this entailed the examination of a previously documented heritage resource; however, the National Mapping Programme (NMP) element led to the identification of new sites using aerial photography and Lidar (the NMP report is presented in *Appendices 1 and 2*). The data from all the sources were integrated within a GIS and refined to produce a consistent and rational dataset according to the specific requirements of the project (*Section 2.4*).

6.2 INVENTORY OF BELOW-GROUND ARCHAEOLOGICAL INVESTIGATIONS

6.2.1 An inventory of below-ground archaeological investigations in the areas of the quarry study areas was compiled; the results were incorporated within the GIS and a summary of the results is presented in *Appendix 3*. These excluded studies such as desk-based assessments and topographical surveys, which examined either existing data or only surface features. Within the 11 quarry areas, a total of 52 investigations was recorded, of which the most intensively examined area was the Abbeytown Ridge, which had 16 investigations (*Appendix 3.4*); Cardew Mires (*Appendix 3.3*) and Eskett and Rowrah (*Appendix 3.7*), by contrast, had never been investigated by formal archaeological excavation. The numbers of investigations, for the most part, reflect the number of modern quarry expansions, rather than the amount of archaeological sites in each area, hence the most investigated quarry, after Abbeytown Ridge, was Peel Place (*Appendix 3.8*), with eight below-ground investigations, although these had not revealed a significant resource.

6.3 NATIONAL MAPPING PROGRAMME - LIDAR AND AERIAL PHOTOGRAPHIC SURVEY

6.3.1 An important part of Stage 2 of the project was a National Mapping Programme (NMP) survey of the areas selected, which provided information that had not previously been incorporated within the HER or other sources (*Appendix 1*). This survey covered areas that were largely centred upon the 11 study areas, although the coverage fitted into earlier NMP programmes (Hadrian's Wall Project and the North-West RCZA project; Small 2008; Bacilieri *et al* 2009). The overall coverage was also substantially more extensive than the project's study areas, as it was also designed to provide wider HER and National Record of the Historic Environment (NRHE) enhancement. The total area of new NMP coverage was 102 square kilometres, extending across whole kilometre squares,

rather than the tightly constrained boundaries of the project's areas (Fig 4). The survey identified significant numbers of sites, many of which are new (Table 3). The site numbers allocated were NRHE numbers, so that they are compatible with the other NMP projects in Cumbria; the digital archive will be transferred to Cumbria County Council for incorporation into the HER.

Survey Area	Area Covered (km ²)	New records	NRHE	Enhanced NRHE records	Density records / km ²
Brampton Kame Belt	13	75		5	6.1
Low Plains	11	43		16	5.3
Cardew Mires	10	35		3	3.8
Abbeytown Ridge	3	7		1	2.6
Moota	7	49		1	7.1
Tendley	10	48		0	4.8
Eskett and Rowrah	13	83		0	6.3
Peel Place	14	50		1	3.6
Ghyll Scour	9	47		1	5.3
Roosecote	4	24		1	6.2
Roan Edge	8	39		3	5.8
Totals	102	500		32	5.2

Table 3: Sites recorded by the NMP survey

6.4 DATA REFINEMENT

- 6.4.1 Following the capture of the archaeological data, the datasets were clipped to the extent of the refined study areas (Areas of Maximum Potential Resource Extraction), which were based upon the area that might be subject to extraction over a 20-year period (Fig 9). Any data that lay beyond the boundaries of these refined study areas were excluded from further analysis and refinement.
- 6.4.2 Once all the data, including the NMP data, had been collated in the GIS, it was apparent that there was considerable overlap between the sources and that many of the sites recorded were included within multiple datasets. For example, if subject to intensive survey, a single site, such as field systems recorded by the NMP survey, might be represented by numerous entries with the same site number, which related to individual elements of the overall site, such as walls and portions of buildings. As this project aimed to characterise areas according to the density and period of sites of archaeological interest, this created a highly skewed impression of the number of individual sites within certain areas and, therefore, multiple points relating to individual database entries were merged and these were considered as single entries.
- 6.4.3 The presence of such duplicate entries presented the likelihood of considerable inaccuracy in calculations of the density of sites (monument characterisation)

within each area and so a process of refinement was undertaken to remove duplications. To ensure that the most accurate spatial representation for each site was retained, polygon data were selected as the preferential type for representing each site. Therefore, where sites were represented by polygon, line, and point data, the polygon data only were retained; line data were second in order of preference and point data were used only where no other data were available. Where there was duplication between datasets, the Cumbria HER polygon data were used in preference to that of the other data sources.

- 6.4.4 Within the NMP data, merging first took place between those sites that had the same HER number, and then features sharing the same monument (NRHE) number and site type were merged together. Finally, these two separate datasets were merged together. After this exercise had been completed, it was noted that some of the groups that had been merged included a large number of features, which could cause an under-representation when the scoring process was undertaken. To rectify this, features that had been merged based upon monument number and site type were split into separate records according to location. It also became apparent that some of the features had components made up of both polygons and polylines, which meant that they could not be merged. In these cases, care had to be taken to ensure that only one of the scores was added to the total for that particular polygon.
- 6.4.5 This refinement process had a considerable impact upon the site numbers within the datasets (Table 4). The primary dataset can thus be shown to have contained considerable amounts of duplication.

Refined Study Areas	Number of Sites Before Refinement	Number of Sites After Refinement
Brampton Kame Belt	252	92
Low Plains	96	40
Cardew Mires	72	36
Abbeytown Ridge	310	105
Moota	31	23
Tendley	397	65
Eskett and Rowrah	1659	98
Peel Place	32	27
Ghyll Scour	29	19
Roosecote	86	37
Roan Edge	16	9
Totals	2980	551

Table 4: The impact of refinement on the site numbers within the datasets

7. STAGE 3 RESULTS: IMPACT ASSESSMENT

7.1 INTRODUCTION

- 7.1.1 All of the earlier phases of the project provided the detailed preparatory work that was necessary to enable the informed assessment of historical, twenty-first-century, and potential future impacts on the historic environment as a result of aggregate extraction (Stage 3 of the project). For the purposes of this assessment, historical impacts refer to any quarrying during, or earlier than, the twentieth century. In some cases, quarrying occurred during the later years of the twentieth century and the early years of the twenty-first century, and available information from mapping and aerial photographs does not necessarily enable the precise definition of a cut-off point between the two. In these cases, the extents of historical and twenty-first-century quarrying were estimated, based on the available information. Within this impact assessment, ‘twenty-first-century’ quarries do not necessarily correspond to ‘active’ quarries, as described within the geological assessment (*Section 5*), as active quarries relate to sites that were subject to permissions for quarrying works at the time of the assessment.
- 7.1.2 An enormous quantity of data was produced during Stages 1 and 2 of the project and its incorporation within a GIS enabled a comprehensive assessment to be undertaken. It has also allowed a large and complex dataset to be analysed and interrogated effectively. An impact assessment has been compiled for each of the 11 refined study areas selected (*Sections 8-18*; Fig 9), and they are discussed in geographical order, following an anti-clockwise arc from north-east to south-east. Brief summaries of the archaeological and historical context are given at the beginning of each assessment, which focus specifically on the periods for which there is the greatest likelihood of unidentified sub-surface remains of archaeological significance that could be affected by future quarrying. These typically comprise any material from the prehistoric period to medieval activity, and for the most part do not cover the later periods, which are generally better represented in the documented archaeological record.

7.2 IMPACT ASSESSMENT

- 7.2.1 For each quarry site, the study areas have been reduced so as to reflect the areas that are most likely to be at risk from mineral extraction within the short- to medium-term future (*Section 5.7*). It is these refined areas that have been the focus of more detailed archaeological study and GIS analysis (*Sections 8-18*).
- 7.2.2 These sections present a process that culminates with an assessment of what potential heritage is likely to be affected in the short- to medium-term future. The descriptions start with an assessment of the geological character of each of the refined areas, and outline the geological potential of the landbank for future extraction. The process then examines the history of extraction within each of the refined study areas, and, drawing upon cartographic evidence, highlights the extent to which the area has already been disturbed by past extraction.
- 7.2.3 The third stage of the process examines the evidence of current extraction, looking at the extent of present-day quarries and the outline of the present areas

where extraction is permitted. In most instances, these quarries have been subject to previous archaeological investigations, be they evaluations, excavations, or watching briefs, and the project has thus examined the character of the below-ground archaeological remains within each of the areas, as indicated by these investigations (see also *Appendix 3*).

- 7.2.4 The fourth stage of the process examines the potential impact of extraction in the short- to medium-term future (up to 2028) on the basis of existing permissions, areas of search and defined areas of landbank. In some instances, existing areas of permission provide sufficient landbank for the future and can be defined with some degree of confidence, but in other instances the prediction of areas for future quarry extensions inevitably has a lower degree of confidence. Within these parameters, an attempt has been made to provide some indication of the significance and character of the heritage resource that may potentially be affected by the anticipated future extraction. This is based upon a scoring system which incorporates the evidence from HER monuments, sites identified from the NMP study and the examination of the findings of below-ground investigations (*Section 3.5*). The system weights the sites according to the archaeological importance, including designated status, of each monument (*Section 3.5*, Table 2) and then the density of these weighted sites within HLC-defined polygons was used (*Section 3.5.3*) to provide a score for the archaeological potential of an area, where the highest score is given to the polygon-defined area that has a large number of significant monuments, and a low score is given to an area containing a small number of less-significant monuments. Although, for convenience, the scoring system has used area polygons defined initially for the Cumbria HLC, the polygons do not retain HLC data and do not provide characterisation for the areas (*Section 3.5.4*). This scoring system for the most part is based on known monuments, and does not allow for monuments that are yet to be discovered, but areas defined as having a high potential are also likely to have an association with other comparable or directly related sites that are presently unknown. As such, there is a potential that high scores may also reflect areas with below-ground potential.
- 7.2.5 The scoring is presented graphically on maps that outline the extent of existing planning permissions and the known sites. The colours reflect scoring density, extending between 0 and 103, where the darker red indicates high potential. A separate colour scheme on the figures presents the broad date range of the known monuments.

8. THE BRAMPTON KAME BELT

8.1 GEOLOGICAL CHARACTER

- 8.1.1 ***The Brampton Kame Belt:*** the area around, and to the south of, Brampton is one of the classic areas of glacio-fluvial ‘kame’ deposition and associated topography to be found within England, and it is also one of the largest (Livingstone 2010). ‘Kame’ is a generalised term referring to irregular mounds of sand, gravel and other deposits, resulting from deposition by glacial meltwater within, on, or in, the immediate proximity of former glaciers (*ibid*). In the Brampton area, the deposits are believed to have been formed at the inland margins of an ice sheet which originated in Scotland, during the late stages of deglaciation in the last ‘Devensian’ ice age, approximately 18,000 years ago (Jackson 1979).
- 8.1.2 Following the melting of the glaciers, the deposits, which were originally supported by, or contained in, hollows or tunnels within the ice, have become positive (upstanding) topographical features within the post-glacial landscape. They range from isolated mounds to sinuous ridges (‘eskers’), and from valley-side features (‘kame-terraces’) to various flat-topped, steep-sided landforms, often enclosing ‘kettle holes’, subsidence features formed during the melting of blocks of ice (Huddart 1994). The deposits and adjoining hillsides are also characterised by numerous erosional features that were originally formed as glacio-fluvial meltwater channels.
- 8.1.3 Some of the kame depositional features within the Brampton area have been exploited as sources of natural sand and gravel aggregate (Fig 10). The Minerals Assessment Report on this area, published by the former Institute of Geological Sciences (now the BGS; Jackson 1979), indicates that the resources are generally dominated by red sand, with relatively little gravel, except in localised areas, and particularly within esker deposits. Recent and, in some cases, ongoing extraction has taken place mostly within the northern part of the kame belt, primarily because that area has closer access to main roads than the otherwise similar, but more rural, areas further south, and thus offers greater commercial potential. The scale of operation has generally been limited, not least because of the high ratio of sand to gravel, which restricts the proportion of output that can be utilised in concrete production.
- 8.1.4 The general topography of the area, together with the original and revised study areas (*Sections 5.6-7*), the resource outcrops mapped by the BGS, areas of current and previous surface mineral extraction and current minerals planning permission boundaries, have been collated (Fig 10). The basic geology of the area is taken from the latest available BGS 1:50,000-scale mapping (1980; Fig 11).
- 8.1.5 ***Silvertop Limestone Quarry:*** a relatively limited limestone quarry is also present within this study area, but it is one that is uniquely located in the north-east of Cumbria, some distance away from all other active, crushed-rock quarries in the county, which are found on the western, eastern and southern sides of the Lake District National Park (Fig 3). The site is located to the east of Brampton, and was investigated in conjunction with the various sand and gravel

sites in that area (Study Area 1). There is a single active minerals permission (Silvertop Quarry), which extends considerably beyond the actual resource outcrop to the north and north-east of the current workings, and there is a single allocation of land for future working, to the west of the workings. The current planning permission runs to 2042 (Cumbria County Council 2013).

- 8.1.6 The general topography of this area, together with the limestone resource outcrops as mapped by the BGS, areas of current and previous surface mineral extraction, current planning permission boundaries and the adjoining allocation for future working, have been collated (Fig 12). The basic geology of the area is taken from the latest available BGS 1:50,000-scale mapping (1980; Fig 13).
- 8.1.7 The mineral is Carboniferous Limestone, which occurs as a series of individual beds. These include the '4 Fathom' Limestone, which is one of the thickest beds, and is currently being worked at Silvertop Quarry, together with the 'Three Yard Limestone', the 'Five Yard Limestone', and the 'Scar Limestone', which occur at successively lower levels within the sequence and crop out to the north of the quarry (Young *et al* 2001). Of these, only the '4 Fathom' and Scar Limestone beds are recognised as worthwhile resources on the BGS resource maps, and only the '4 Fathom' Limestone is currently worked. To the south of the quarry, this bed continues beneath an overburden of other, inferior, limestones, shales and sandstones, as well as beneath the succeeding Great Limestone. None of these has been identified as a mineral resource by the BGS, although the Great Limestone was formerly quarried for lime at the Clowsgill quarries and limeworks, to the south-east of Hallbankgate (Fig 12).
- 8.1.8 The Carboniferous rocks are, in turn, largely concealed beneath superficial drift deposits comprising glacial till and/or glacio-fluvial sand and gravel, with some areas of more recent (post-glacial) alluvium. In this area, the sand and gravel deposits are not currently exploited as a source of aggregate (not least because several other sand pits are located within similar deposits further west (closer to the markets of Brampton and Carlisle; Fig 10)).
- 8.1.9 Within the north-westernmost parts of the initial study area, the Carboniferous Limestone sequence is intruded by a Quartz Dolerite sill. Elsewhere, such rock is frequently exploited as a source of aggregate (for instance within the Whin Sill in the vicinity of Hadrian's Wall, and in the Midland Valley of Scotland; Young *et al* 2001), but is not quarried in this area (presumably because the intrusion is of very limited thickness and of limited outcrop, making it uneconomic to work).

8.2 ARCHAEOLOGICAL ASSESSMENT

- 8.2.1 All of the archaeological data for both the Silvertop Limestone Quarry (Fig 14) and the sand and gravel quarries to the south-west (Fig 15) were collated within the GIS (see [Section 8.5 for details of sites](#)). This was then refined to remove duplicates, and the sites were scored according to period. A site-density score was subsequently assigned to each HLC polygon ([Section 3.5.5](#)).

8.3 HISTORICAL IMPACTS FROM QUARRYING

- 8.3.1 The refined study area comprises four distinct units situated to the south and east of Brampton (Fig 10). The following impact assessments treat each of these areas successively, from east to west.
- 8.3.2 **Silvertop Refined Study Area:** it is clear that there were numerous small areas of extraction within the easternmost study area prior to the twentieth century, with two larger sites having been quarried in the centre of the area (Fig 16). The total area of this extraction measured 0.069km². The majority of sites of archaeological interest that have been identified within the largest polygon, and on which historical quarrying has been demonstrated to have had an impact, are field boundaries (eg PN 187; Fig 17) and ridge and furrow of post-medieval date (eg PN 418 and PN 427). However, Roman remains have been identified within the two remaining polygon areas: an altar was found in the south-western area (PN 113) and a temporary camp reported in the north-western area (PN 123). It is therefore possible that sites of archaeological interest may have been present within this largest polygon, and have been affected by quarrying, but were not recorded in the process.
- 8.3.3 **Kirkhouse Study Area:** a single limited area, measuring only 1030m², has been subject to an assessment of the potential impacts on the historic environment (Fig 16). This is situated within the north-eastern HLC area, and has a high score for archaeological density. However, this high score is primarily the result of the presence of Lord Carlisle's Brampton to Midgeholme railway (Fig 18), which is a Scheduled Monument (PN 133; Fig 17). No sites of archaeological interest are known to have been disturbed by historical quarrying.
- 8.3.4 **Low Gelt Study Area:** part of the historical quarrying in this area was undertaken at the eastern side and consisted of several irregular, curvilinear cuttings with a combined area of 0.02km² (Fig 19). A larger quarry lies in the north of the study area and measures 0.041km². No sites of archaeological interest are known to have been affected as a result of the northernmost quarrying. The most conspicuous heritage asset within the southernmost area of historical quarrying is the Written Rock of Gelt (PN 148; Fig 20), which is a group of nine inscriptions cut into sandstone in an area used by the Roman army as a quarry, where stone to repair Hadrian's Wall was extracted during the early third century AD (Philpott 2006, 85). Post-medieval trackways and banks within the woodland have also been recorded within this area (eg PN 199 and PN 198), and these are the only sites that are known to have been affected by historical quarrying, although further sites may have been impacted upon but have not been recorded. These include Roman quarry sites that may have been expanded during later periods.
- 8.3.5 **Faugh Study Area:** the historical quarrying within this area comprises a relatively small area in its south-western quarter, which measures 0.021km² (Fig 19). No heritage assets have been identified within this quarried area.

8.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 8.4.1 Currently active, or intermittently active, sand and gravel permissions within the area comprise Kirkhouse, Low Gelt and Faugh No 1; there is also a dormant permission at Low Gelt Bridge Farm (Fig 10). Immediately outside the study

area, to the south-west, but within the original 'buffer zone', is a further current permission: Faugh No 2.

- 8.4.2 **Silvertop Study Area:** there is a single active minerals permission, Silvertop Quarry, which extends considerably beyond the actual resource outcrop to the north and north-east of the current workings (Fig 12). A single allocation of land exists for future working, to the west of the current workings. The current planning permission runs to 2042.
- 8.4.3 Quarrying during the twenty-first century has been restricted to a single consolidated area within the centre of the easternmost refined study area, which measures 0.134km². As with the historical quarrying within this area, the only sites of archaeological interest that can be demonstrated to have been affected by twenty-first-century quarrying are post-medieval field systems and ridge and furrow cultivation (eg PNs 187-8, PNs 428-9 and PN 418; Fig 17). However, due to the proximity of recorded remains of Roman date, it is possible that unrecorded sites of archaeological interest may have been present within this area and have been subject to disturbance from quarrying, but were not recorded.
- 8.4.4 **Kirkhouse Study Area:** at Kirkhouse, the oldest workings, as shown on the OS second edition map (1901a), comprise a small sand pit, which appears to have developed from a cutting on the north side of the former Brampton to Midgeholme railway line. More recent workings, now largely worked out but still with valid planning permission (which expires in July 2023), occur over a larger area between the old sand pit and the A689 to the north (Fig 10). This area is shown on the 1:25,000-scale OS map (1982a) as a sand and gravel pit. More recent workings have taken place within a separate area, under the same planning permission, to the south of the (now dismantled) railway, within an area that is largely screened by woodland. Unworked reserves remain within this permitted area and further potential exists (in terms of mapped, unworked resources) for future extensions on all sides of the existing workings (though, in practice, these would be limited by landscaping and highways constraints, amongst others).
- 8.4.5 Within the Kirkhouse refined study area are two areas of twenty-first-century quarrying within the central and north-eastern parts, with a combined area of 0.14km² (Fig 16). No known sites of archaeological interest were identified within the areas quarried prior to or during the groundworks. However, once more, it is possible that sites of archaeological interest may have been present within this area but were destroyed without record.
- 8.4.6 **Low Gelt Study Area:** at Low Gelt, glacio-fluvial deposits are worked within an area of undulating land immediately to the south-west of the River Gelt (Fig 11). The current OS 1:25,000-scale map (1982b) identifies this area as a sand quarry, rather than as a sand and gravel pit. No historical workings are shown within these deposits on the first (1868a; Fig 21) or second edition (1901b) OS maps, although former building-stone quarries (the 'Brampton Quarries') are shown along the sides of the deeply incised river valley a short distance to the east, where the river has cut down into the underlying St Bees Sandstone. Current planning permission at Low Gelt expires in December 2019, and significant permitted reserves, as yet unworked, still remain to the west of the current area of extraction (Fig 11). Again, further potential exists (in terms of mapped,

unworked resources) for future extensions to the west and south of the current permission boundary.

- 8.4.7 A separate, currently dormant, planning permission (Low Gelt Bridge Farm) exists to the north of the River Gelt, on land surrounding Capontree Hill (Fig 10). No historical workings are shown in this area on either old (1868b; 1901c) or modern OS mapping (1982b), although the Lidar image suggests that there may be an area of shallow former workings on the top of the low hill (*Appendix I*), which is confirmed by the Mineral Assessment Report (Jackson 1979), as this shows the extent of worked-out resources, coinciding with the gap in the mapped extent of sand and gravel resources on the latest BGS resource maps. The dormant permission does not expire until 2042; however, further working could *theoretically* take place on the sides of the hill, subject to a ROMP (Reviewing Old Mineral Permissions) application and environmental assessment. This, however, is considered to be unlikely.
- 8.4.8 An area of twenty-first-century quarrying lies within the centre of the refined study area, measuring 0.069km² (Fig 19). The only heritage asset to have been demonstrably affected as a result of this quarrying is part of a group of embankments enclosing and sub-dividing areas of woodland.
- 8.4.9 **Faugh Study Area:** Faugh No 1 Quarry is a currently inactive permission, shown on the modern OS 1:25,000-scale map (1982b) as ‘Whinhill Quarry (sand)’. The most recent OS 1:10,000-scale maps (1982c; 1982d) show the whole of the currently permitted area as a quarry, and recent aerial photographs (Google Earth) reveal that workings extend across most of that area (*Appendix I*), obliterating any evidence of former activity (although no historical workings are shown on the OS First (1868c) edition maps; Fig 21). Permitted reserves are still likely to remain within the permission boundary, and the current permission has recently been extended until 30th June 2024. Unworked resources are shown on the BGS maps to be present on all sides of the existing permission, offering potential scope for future lateral extensions. To the south of this sand pit, and falling just outside the study area boundary, but within the buffer zone, is Faugh No 2 Quarry (Fig 10). Again, this is shown on the OS 1:25,000-scale map (1982b) as a sand quarry and, again, much of the currently permitted area has already been worked, particularly on the areas of higher ground, where the deposits are likely to have been thickest. The existing permission, which is currently active, expires in 2022, giving scope for continued extraction within the existing boundary. Although further sand and gravel resources are shown to exist on all sides of the existing permission on the BGS maps, the scope for extending the quarry into those areas is hampered by watercourses, roads, buildings and woodland. The only evidence of historical workings in this area is a very small sand pit shown on the OS second edition map (1901c), located between Faugh No 1 and Faugh No 2 quarries, and a larger pit at Moss Nook, straddling the outer edge of the buffer zone to the south-west of Faugh No 2, which is indicated on the modern OS map (1982b) and is shown as a worked-out site on the Mineral Assessment Report map (Jackson 1979). It now coincides with a gap in the mapped distribution of resources.
- 8.4.10 The twenty-first-century quarrying within this refined study area measured 0.09km² (Fig 19). There are no indications that any heritage assets were affected as a result of these works.

8.4.11 **Other Quarrying:** elsewhere within the study area, historical workings, as shown on OS First (1868a; 1868b; 1868c; 1868d) and second edition maps (1901a; 1901b; 1901c; 1901d; 1901e), are almost entirely former hard-rock quarries, working either the Triassic St Bees Sandstone (as building stone) in the western part of the area, or the older Carboniferous Limestone (possibly as a local source of aggregate) in the east. The main exceptions to this are the two former sand quarries ('Brampton Quarry' and 'Hardbank Pit') located on either side of the railway line at How Mill, between Low Gelt and Faugh No 1 (Fig 21). Both of these are shown on the modern OS maps (1:25,000 (1982b) and 1:10,000 (1982c) scale), but only a small part of Brampton Quarry is noted on the OS second edition map (1901d); neither of these benefits from current planning permission. Although further resources exist on all sides of each quarry, further extraction would be hindered by existing roads, railway and buildings, except to the south and west of Hardbank Pit.

8.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 8.5.1 The area around the Brampton Kame Belt is extremely rich in sites of historical and archaeological significance. The quarry sites lie to the south of Brampton and numerous sites of archaeological significance from many periods have been identified in the surrounding area. The quarries are in the vicinity of the Rivers Gelt and Irthing, which are tributaries of the River Eden, and within a strategically important part of the borderlands, as attested by defensive sites from numerous phases of the Roman and medieval periods (Breeze 2006; C Newman 2006).
- 8.5.2 Enclosures and field systems of possible prehistoric date have been identified from aerial photography (*eg* PN 552; Fig 20; and PNs 554-6; Fig 17) and burials and a cairn of possible Bronze-Age date are known from the wider area (PNs 558-9; Fig 20). There have also been finds of prehistoric date, such as urns (PN 560; Fig 20) and axes (PN 561), from the wider area.
- 8.5.3 Activity in the area during the Roman period is extremely well attested and provides one of the most conspicuous indicators of the strategic importance of this area. The Stanegate and Hadrian's Wall both lie to the north of the study areas, with portions of the Stanegate having been identified in Naworth Park and to the north-west of Brampton, at Crooked Holme, where it would have crossed the River Irthing, and a branch road led southwards to the Roman fort at Old Church (Margary 1973, 447). Hadrian's Wall lies to the north of the Stanegate, with the nearest forts to the study areas being Castlesteads and Birdoswald (Breeze 2006).
- 8.5.4 There is evidence that elements of the Wall system, particularly some forts and even milecastles, remained in occupation following the end of the Roman administration (Wilmott 1997). Many soldiers would by that time have been local to the area, and would have established families (*op cit*, 224-5; Breeze and Dobson 2000, 246). Excavations at Birdoswald have revealed a substantial timber hall erected over a granary, with another hall being built over it (Wilmott 1997), indicating continued, presumably military, activity there well into the fifth century AD, if not longer. The abandonment of Hadrian's Wall as a military system may have had little immediate impact on people living in the local area, and roundhouses in small undefended hamlets may have represented

the local settlement character in the border region for some time (Frodsham 2004, 64). There is also evidence for activity during the later part of the early medieval period in the wider landscape, with a Viking-age cemetery having been discovered at Cumwhitton (RM Newman 2006; Paterson *et al* 2014).

- 8.5.5 The medieval period is well attested in the local landscape, and military sites are conspicuous, with mottes at Hayton, Irthington, and Brampton. A fortified medieval hilltop enclosure, or ringwork, known as Tower Tye or Tortie, may be of medieval date (SM 1013969; Perriam and Robinson 1998), to the south-east of the medieval Naworth Castle. Several bastles are present within the local area (Ramm *et al* 1970), in addition to medieval moated sites, such as that at Denton Hall; a pele tower was built at Denton Foot, and a medieval tower house (PN 562; Fig 20) is at Hayton. In addition to fortified sites, Lanercost Priory was an Augustinian house founded in 1169 (Summerson and Harrison 2000), and the Church of St Thomas (PNs 556-7; Fig 17) at Farlam was also established during the medieval period. A deserted medieval village (HER 17684, NGR 355000 561150) has also been recorded at Cumcatch, and numerous examples of ridge and furrow of possible medieval date are known from the area. The field boundaries around Hayton preserve the shape of numerous curving strip fields (Fig 21) that are indicative of medieval agriculture.
- 8.5.6 Although defended and ecclesiastical sites tend to be conspicuous within the landscape, due to their scale, status, curation, and consequent likelihood of survival, other associated or contemporary rural settlements are under-represented in the archaeological record. Such sites are likely to have been present in the local area during the Roman, early medieval, and medieval periods and may now survive as unidentified sub-surface remains.
- 8.5.7 **Silvertop Study Area:** future limestone extraction in this area is likely to be focused within the southern part of the existing planning permission and the small allocated Area of Search (Fig 12). The northern part of the existing permission appears to extend well beyond the resource outcrop (*ie* into areas which contain only thinner or inferior beds of limestone), and is thus less likely to be worked.
- 8.5.8 The most conspicuous areas of potential archaeological significance that may be affected by future extraction are the south-western polygon, where two Roman sculptures, perhaps associated with an altar (PN 124; Fig 17), were found, and where the site of a bastle was recorded, and also the north-western area, where a putative Roman camp lies (PN 123). In addition to physical impacts upon these specific, recorded sites, they provide indicators of activity during the Roman and later medieval periods. Such activity may have extended into areas where remains have not been previously identified, including the central polygon, which has a low archaeological density score. The rich historical landscape in the environs of Naworth Castle and Park (Perriam and Robinson 1998), within 1.5km to the north-west, also provides an indication of the high degree of historical activity in the local area and the potential for previously unidentified remains of archaeological interest within this refined study area.
- 8.5.9 **Kirkhouse Study Area:** the potential for future impacts from quarrying at Kirkhouse has been mapped (Fig 12). The north-eastern polygon has a high density score as a result of Lord Carlisle's Brampton to Midgeholme railway, which is a Scheduled Monument (PN 133; Fig 17). This site has also increased

the density scoring of the central polygon. Although a significant site, it is likely to be relatively well-defined and does not represent widespread archaeological sensitivity across the whole of these polygon areas. There are few other identified heritage assets within this refined study area. In the north-eastern part, several industrial sites have been identified, including a wagonway (PN 125), a tramway, a railway shed, brick and tile works (PN 28), coke ovens, and limekilns (PN 27). Post-medieval trackways have been identified from aerial photographs in the western HLC area (eg PN 347; *Appendix 1*), and examples of post-medieval ridge and furrow occur across the study area (eg PN 350). A spring named ‘Glazier Spring’ (PN 87) might indicate glass working in this area. Although there are relatively few identified heritage assets within the refined study area, the general proximity of the area to Cumcatch, Brampton, and Naworth Park suggests that the potential exists for previously unidentified remains dating to the Roman and medieval periods (*Sections 8.5.5 and 8.5.8*), as well as the potential for early medieval remains.

- 8.5.10 ***Low Gelt Study Area:*** several types of heritage asset have been identified within the refined study area that could be vulnerable to future quarrying. The potential for future impact from quarrying has been mapped (Fig 10). A cropmark that might represent an enclosure and barrow of Bronze-Age date is present on the western side of a hill to the north of the River Gelt (PN 29; Fig 20). The scheduled Written Rock of Gelt (PN 148) comprises a set of Roman inscriptions associated with quarrying within the gorge in the centre of the refined study area and there is a further example of Roman inscriptions to the south (PN 563).
- 8.5.11 The eastern defined extent of Hayton medieval village extends into the western side of the refined study area and the potential exists for the survival of associated features that have not previously been identified. Ridge and furrow cultivation earthworks, of possible medieval or post-medieval date, have also been identified on the western side of the study area (eg PN 446 and PN 444). Numerous field boundaries and woodland boundaries, of probable post-medieval date, have also been identified within the study area (eg PN 189, PNs 193-4, PNs 198-9, PNs 191-2 and PN 448). The Watch Hill place-name (PN 90), immediately to the south of the quarry, may record the presence of a former watch tower or beacon on the hill.
- 8.5.12 In addition to these identified sites, the potential exists for further heritage assets dating to the Bronze Age, Roman, and medieval periods that have not been previously identified. The general location of the area means that the potential for previously unrecognised remains of early medieval date should also be considered.
- 8.5.13 ***Faugh Study Area:*** this area provides the least direct evidence for the presence of heritage assets within the Brampton Kame Belt refined study areas. The potential for future impacts from quarrying at Faugh No 1 has been mapped (Fig 19). One well has been identified (PN 525; Fig 20), in addition to three examples of ridge and furrow of medieval or post-medieval date (eg PNs 440-2). However, the study area lies between Castle Carrock, Hayton, and Cumwhitton, with medieval remains known from the former two villages and the site of excavated Viking-age burials being present at the latter (Paterson *et al* 2014). Therefore, some potential exists for the presence of previously unidentified heritage assets within this area, although, given the current state of knowledge,

the potential does not appear to be as high in this study area as it is within the other three areas within the Brampton Kame Belt.

9. LOW PLAINS

9.1 GEOLOGICAL CHARACTER

- 9.1.1 This study area occupies a broad, Y-shaped area of relatively low ground, between the hills of Blaze Fell and Castlerigg, on the western flank of the Eden Valley (Fig 22). The mineral, which occupies the lower ground, comprises glacio-fluvial sand and gravel, deposited in the form of eskers (*ie* originally from within sub-glacial meltwater channels beneath the former ice sheet; Young *et al* 2001). The deposits are composed of irregularly bedded coarse, medium and fine sands, with silt lenses and bands. Gravel, in a wide range of sizes, is found throughout the deposit within the sands, and as thin, gravelly horizons. The sand and gravel is generally flanked, and partially overlain, by relatively thin deposits of glacial till (boulder clay; *ibid*). Locally, it is overlain by narrow tracts of post-glacial alluvium. Outcrops of the underlying bedrock (Penrith Sandstone) occur on Blaze Fell and other areas of higher ground, and along much of the eastern edge of the study area (Fig 23).
- 9.1.2 The general topography of the area, together with the resource outcrops mapped by the BGS, areas of current or previous surface mineral extraction and the current planning permission boundaries, has been collated (Fig 22). The basic geology of the area, taken from the latest available BGS 1:50,000-scale mapping (1974; Fig 23), has also been mapped.

9.2 ARCHAEOLOGICAL ASSESSMENT

- 9.2.1 All of the archaeological data were collated within the GIS (Fig 24). It was then refined to remove duplicates and the sites were scored according to period ([see Section 9.5 for details of sites](#)). A site-density score was subsequently assigned to each HLC polygon (Fig 25).

9.3 HISTORICAL IMPACTS FROM QUARRYING

- 9.3.1 Prior to the late nineteenth century, there had been very little quarrying within the Low Plains study area. A small area of quarrying, which measured 459m², was depicted on the first edition OS map (1867a; Fig 26) and an area of quarrying measuring 2035m² was depicted on the second edition OS map (1901f). The quarry increased considerably after this date and the total area of quarried land in this area prior to the twenty-first century was 0.169km². The impact from historical quarrying at Low Plains have been mapped (Fig 25).
- 9.3.2 The central polygon area has a demonstrably high density of sites of archaeological interest, including numerous sites of possible prehistoric origin, ranging in date from the Neolithic period to the Iron Age, with some sites of possible Roman date. The prehistoric sites within this area include some with large spatial extents, such as field systems that are represented by cropmarks (*eg* PN 258, PN 269, PNs 264-6 and PN 373; Fig 27), in addition to smaller, discrete features, such as Bronze-Age cremation burials (PN 101) and an example of cup-and-ring rock art (PN 106). Features of Roman date include a ditch that may

have been adjacent to a metalworking site, which lay to the east of the historical quarry (PN 129 and PN 261). The Wragmire Roman road (PN 61) ran to the west of one of the small areas of historical quarrying. Historical quarrying in this central HLC area has affected field boundaries of possible Iron Age or Roman date (PN 259). It is also likely, particularly in relation to nineteenth-century quarrying, that sites of archaeological interest may have been destroyed without being identified or recorded.

- 9.3.3 A second area of historical quarrying (measuring 0.128km²) lies within a polygon area on the eastern side of the study area. A very small portion of an area of cropmarks likely to represent an Iron Age or Romano-British field system (PN 12) extends into the western part of this polygon area and two discrete boundaries of possible similar date (PN 258) lie just outside the area. Given the known presence of features relating to field systems in this area and the high density of heritage assets in the neighbouring HLC area to the west, it could be assumed that large quantities of features of archaeological interest are likely to be present within this area. However, the large areas of identified quarrying do not appear to have generated archaeological data. This suggests that either there were no sites of archaeological interest present, or that sites were present and were not identified during, or prior to, extractive groundworks. Unless this area has been subject to past disturbance that destroyed earlier remains, it seems unlikely that no sites would have been present in this area. It is likely that quarrying undertaken during the 1970s at Low Plains Quarry was undertaken in the absence of archaeological investigations or watching brief, which explains the lack of data from this area.

9.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 9.4.1 There is a single extant planning permission for Low Plains Quarry, which expired in 2011. This permission covers a large part of the available resources within the study area and, at present, there are no allocations of additional land for future working (Fig 22). An application to extend the period of working was refused by Cumbria County Council in January 2013, largely because of the limited evidence for ongoing demand and the adequacy of the existing landbank. However, planning officers noted that this decision would not sterilise the reserves, which could be exploited in the future if the need arose (*ie* if demand were to increase). The decision has since been appealed by the site's operator and mineral extraction has continued, pending the appeal hearing, which is scheduled to commence in February 2015.
- 9.4.2 The impact of twenty-first century quarrying on sites of archaeological interest within the study area has been mapped (Fig 25) and is somewhat easier to define than that of historical quarrying. This is due to the fact that archaeological investigations preceded some of the current works in this area (Fig 28; *Appendix 3*). Three areas of modern quarrying, with a combined area of 0.128km², are present within the refined study area, all of which lie within the central HLC area. This quarrying has been undertaken in the immediate vicinity of numerous sites of possible prehistoric and Roman date. Several sites of archaeological interest lay wholly or partially within the quarried area and were physically affected, or destroyed, as a result of groundworks. These include several boundaries forming part of a prehistoric field system that had been identified as

cropmarks (PN 94; Fig 27), boundaries associated with field systems of possible Iron Age or Roman date (*eg* PN 258 and PN 261; NPA 2009a), a findspot of flint of possible Neolithic date (PN 177; OA North 2005a), a series of Bronze-Age cremation burials (PN 101), five pits of possible prehistoric date, and a ditch of possible Roman date associated with metalworking remains (PN 129; NPA 2009a).

9.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 9.5.1 Within the short- to medium-term future, sand and gravel extraction in this area (subject to the current appeal decision and any future applications) seems most likely to be focused within the extensive areas of currently unworked permitted reserves. Additional resources exist beyond these areas but no allocations are currently identified within the *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013). The potential for future impacts from quarrying at Low Plains has been mapped (Fig 27).
- 9.5.2 The Low Plains study area lies within a landscape that is archaeologically very rich. It is situated on the western side of the Eden Valley, which features high-grade agricultural land and has been the focus of conspicuous human activity since the prehistoric period. Neolithic and Bronze-Age monuments, such as Mayburgh henge and the stone circle named Long Meg and Her Daughters, lie further south along the Eden Valley and considerable activity from these periods has been identified by fieldwalking (Clarke *et al* 2008). As a result of the impact of later farming, prehistoric sites on the marginal lands above the valley bottom have survived better than those on lower-lying land, in the area of Low Plains, which is at *c* 140m (aOD). The major Roman road between Carlisle and York runs through the study area and there is evidence for settlement or industrial activity from this period within the area. A settlement of supposed Iron Age or Roman date lies to the north of the area at Blaze Fell, approximately 500m beyond the study area (PN 905).
- 9.5.3 The area lies approximately midway between the early medieval site at Dacre (RM Newman 2006), apparently that referred to as a monastery by the Venerable Bede (Colgrave and Mynors 1969), and the Viking-age cemetery at Cumwhitton (Paterson *et al* 2014). Given the presence of remains of Roman date, and the generally good farming land of the area, it must be considered that rural settlement continued into the early medieval period in this area and that such remains might be present within the study area. The continuity, or reuse, of Romano-British rural sites into the early medieval period may not be represented by conspicuous material remains, due to the collapse of Roman bulk trade in cultural goods and, therefore, the later occupation of such sites may only be identifiable by radiocarbon dating (RM Newman 2006, 91).
- 9.5.4 Areas occupied by substantial quantities of known heritage assets are present within the study area. This is particularly conspicuous in the central and western parts, where several sites relating to prehistoric or Romano-British field systems have been identified (*eg* PN 259, PN 94 and PN 371), and where a Bronze-Age cremation cemetery (PN 101; OA North 2005a) and an example of rock art (PN 106) have been found. These sites do not represent the total surviving remains of archaeological interest in the area but are the detectable indicators of activity that is likely to have produced a larger body of surviving remains. For example,

prehistoric and Romano-British field systems will have been associated with settlements, including domestic structures, which have not previously been recorded, yet may lie within the study area. Although the easternmost HLC area has a low density of previously recorded sites, this has almost certainly been severely skewed, since large areas have been disturbed, apparently without accompanying archaeological investigations. There is, therefore, a considerable likelihood of high densities of heritage assets of prehistoric and Roman date within those parts of this eastern area that have not been quarried. The density of sites in these areas is likely to be comparable to that of the central and eastern portions of the study area.

- 9.5.5 There is considerable potential for significant remains of archaeological interest to be affected by future quarrying. These include known sites of Bronze-Age and Iron Age/Roman date, in addition to the potential for previously unidentified sites from these periods, and possibly also remains of early medieval date.

10. CARDEW MIRES

10.1 GEOLOGICAL CHARACTER

- 10.1.1 Cardew Mires is an area of sub-alluvial sand and gravel resources (Fig 2). As with all sub-alluvial deposits, the mineral is concealed beneath post-glacial alluvium (silts and clays) but lies within an oversized valley (compared to the very small present-day streams seen there) and is therefore likely to have been laid down by a more powerful meltwater river during the last (Devensian) glaciation (Huddart 1991). The mineral lies almost entirely beneath the modern water-table and, following the removal of overburden, is extracted primarily by wet-working (*ie* by dredging from beneath the water surface). Some dewatering is carried out, however, to enable the uppermost parts of the mineral to be excavated dry. Excavation results in the formation of a lake occupying the full width of the former meltwater channel.
- 10.1.2 The general topography of the area, together with the resource outcrops referenced by the BGS, areas of current and previous surface mineral extraction, current planning permission and the current allocation for future working, have been plotted (Fig 29). The more general BGS 1:50,000-scale mapping of this area is currently out of print.

10.2 ARCHAEOLOGICAL ASSESSMENT

- 10.2.1 All of the archaeological data was collated within the GIS (Fig 30). It was then refined to remove duplicates and the sites were scored according to period ([see Section 10.5 for details of sites](#)). A site-density score was subsequently assigned to each HLC polygon (Fig 31).

10.3 HISTORICAL IMPACTS FROM QUARRYING

- 10.3.1 No historical quarrying was recorded at Cardew Mires prior to 1901 (second edition OS map; 1901g; 1901h). However, during the late twentieth century, a large area adjacent to the River Wampool appears to have been quarried. As quarrying has occurred relatively consistently from the late twentieth century until the present day, it is difficult to define precisely the extents of extraction prior to and after the year 2000 from available mapping and aerial photographs. It appears that up to approximately 0.14km² of land may have been quarried by the end of the twentieth century. The impact from historical quarrying at Cardew Mires has been plotted (Fig 31).
- 10.3.2 Prior to the aerial photographic analysis, undertaken as part of the current assessment (*Section 6.3*), no features of archaeological interest had been identified within the northern polygon, within which the historical quarrying was undertaken. The analysis of aerial photographs identified two areas of ridge and furrow cultivation of medieval date (*Appendix 1*; PNs 292-3; Fig 32) and several post-medieval examples (*eg* PNs 300-6), and a ditch of medieval or post-medieval date, but no other site types within this polygon. However, the field systems to the north of the railway line appear to represent the remains of strip

fields (Fig 33) that might have been associated with agricultural practices dating from as early as the medieval period.

- 10.3.3 The lack of available archaeological data could indicate that either few remains of archaeological interest survive within the area or, alternatively, this could be the result of a lack of archaeological investigations. No previous archaeological investigations were identified within this area during the research phase of the current project.
- 10.3.4 The quarrying of large areas did not generate any recorded archaeological data and, once more, this suggests that either there were no sites of archaeological interest present, or that sites were present but had not been identified during, or prior to, extractive groundworks. The lack of available archaeological data for this area may have been an influential factor when planning conditions associated with the quarrying were being considered, and may have precluded any perceived necessity for archaeological investigations in advance of groundworks. A lack of available archaeological data may, therefore, have restricted the possibility of archaeological investigations being undertaken. This may thus have prolonged an absence of data which would on the surface seem to confirm the presumption of an absence of remains of archaeological interest, but thus perpetuates a self-fulfilling prophecy.

10.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 10.4.1 The mineral is currently worked at a single extraction site (Cardew Mires; Fig 29), for which planning permission currently extends until the end of 2025. An Area of Search is identified in the emerging *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013) to enable extraction to continue further east, on the southern side of the railway, towards Dalston. This is, however, subject to future planning permissions that are being obtained.
- 10.4.2 Extraction during the twentieth century has been undertaken primarily to the north and west of the earlier quarrying and affects an area measuring 0.25km². The impact from twenty-first-century quarrying has been plotted (Fig 31). As with historical impacts, the impact of this quarrying on the local historic environment is difficult to ascertain, due to the lack of archaeological data for this area and the absence of investigations that might have tested the likelihood of the presence of sub-surface remains. No record of impacts on the historic environment is present.

10.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 10.5.1 In terms of future sand and gravel extraction in this area, the short- to medium-term focus will inevitably be within the existing permitted reserves and in the Area of Search identified within the emerging *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013), on the opposite side of the railway from the current extraction. That area is understood to contain approximately 20 years' worth of additional reserves. Beyond that, there may be scope for the workings to be extended further east, towards an oil-storage depot at the western edge of Dalston. Further resources also exist to the south-west of the existing permission, and these might eventually be considered for exploitation, but not

within the medium-term future. The potential for future impacts from quarrying at Cardew Mires has been mapped (Fig 32).

- 10.5.2 The Solway Plain has long been recognised as an area that was occupied during the prehistoric and Roman periods (Bewley 1994). Neolithic stone axes have been found in a widely dispersed pattern across the area, including in the corridor of the River Caldew (*op cit*, 55), which lies immediately to the east of the Cardew Mires study area. Such axes are often found on low rises above areas of peat/moss or rivers (*op cit*, 56) and, although there are no conspicuous eminences within the study area, the edges of the area do gently rise from the slight basin within which quarrying has been undertaken. Bronze-Age artefacts have not been found as widely as Neolithic axes, although flint findspots are known from the nearby Caldew Valley (*op cit*, 60). Recent excavations to the north-west of Carlisle, at Stainton West, have produced significant evidence for activity dating to the Mesolithic and Neolithic periods, and the Bronze Age (OA North 2011b; Brown *et al* in prep).
- 10.5.3 Field boundaries (PN 375; Fig 32) and a pit alignment (PN 376) of unknown date were identified as cropmarks on the western side of the study area (*Appendix 1*), but these do not appear to be consistent with the orientation of surviving field boundaries. An enclosure (HER 9739) of unknown date, that is visible as a cropmark, lies to the north of the study area, at Cardewlees, and it is possible that this is indicative of early settlement and land-use. Once again, the enclosure does not appear to conform with the morphology of the surrounding field- or localised road systems. These cropmarks suggest that there is a potential for sub-surface remains that are not represented at surface-level and are likely to pre-date the visible pattern of landscape organisation, which might have begun to be established by the medieval period. Therefore, remains of prehistoric, Roman, or early medieval date might be present within the study area, as well as the locale. The main road to the north-west (A595) follows the course of part of the Roman road between Egremont and Carlisle (PN 565).
- 10.5.4 Few discrete heritage assets were identified within the study area from historical mapping, although the somewhat *ad hoc* character of the sub-divided field systems in this area (Fig 33) suggests that they pre-date the geometric field systems typical of nineteenth-century parliamentary enclosure that lie to the north-east (Whyte 2003). The field systems within the study area to the north of the railway line, and also to the west of Dalston, appear to preserve the curving form of strip fields associated with cultivation by oxen and are likely to have been enclosed at a relatively early date (perhaps as early as the medieval period; *see* Eyre 1955). The fields are particularly conspicuous on historical mapping but are also discernible on modern mapping. These fields may have been established within former open fields associated with medieval settlement in the vicinity of Nealhouse and Cardewlees, and may have lain within the manor of Cardew, which clearly existed by the reign of Edward I (1272-1307) (Lysons and Lysons 1816, 89-100). Given the likelihood of agriculture and associated settlement from as early as the medieval period in the immediate vicinity of the study area, the potential exists for surviving remains of medieval and post-medieval date within this area. This might include ridge and furrow, although the analysis of aerial photographs and Lidar data suggests that indications of many such earthworks may have been eradicated or concealed by later cultivation (*Appendix 1*). Only three examples of possible medieval ridge and

furrow were identified during the current analysis, two lying towards the centre of the study area (PNs 292-3; Fig 32) and one to the north of the Roman road near Linden Farm (PN 566). Bishop's Dyke (PN 880) provides further evidence of medieval activity close to mineral extraction at Cardew Mires. It is possible that this defensive earthwork, built to defend the manor of Dalston during the Scottish wars, extended into the study area; however, this cannot be said with certainty, as conflicting data make it difficult to determine the exact extent of the feature.

- 10.5.5 Findspots and structural evidence might also survive as sub-surface remains. A cluster of structures identified from aerial photographs to the south of the railway line and on the eastern side of the study area (PNs 295-9) relate to a construction camp that appears to have been associated with the construction of the Maryport and Carlisle railway (Joy 1983).
- 10.5.6 There is therefore potential for remains of archaeological interest to be affected by future quarrying. The sites include field systems and associated features connected with medieval or post-medieval agriculture. There is also the potential for the existence of previously unidentified sites of prehistoric, Roman, early medieval, and medieval date. The lack of detailed archaeological investigation in this area means that the potential of the archaeological resource is difficult to define.

11. ABBEYTOWN RIDGE

11.1 GEOLOGICAL CHARACTER

- 11.1.1 **Geological Character:** this is an area of glacio-fluvial sand and gravel deposits, laid down during the late stages of deglaciation at the southern margin of an ice sheet originating in Scotland (Livingstone 2010). The general topography of the area, together with the study area boundaries, the resource outcrops mapped by the BGS, areas of current and previous surface mineral extraction, current minerals planning permissions and the single allocation for future working, have been collated (Fig 34). The basic geology of the area, taken from the latest available BGS 1:50,000-scale mapping (1995; 1997a), has also been plotted (Fig 35).
- 11.1.2 Geomorphological and sedimentological evidence (Livingstone 2010) has demonstrated that, during this closing stage of the last glaciation, ice flowed from the Southern uplands of Scotland across the Solway Firth, impinging onto rising ground at the northern edge of the Lake District. In doing so, the ice blocked westward drainage in the area and impounded a temporary ice-marginal lake along this part of the north Cumbrian coast. Locally, in the Holme St Cuthbert area, sediments were discharged into this lake from the ice sheet to form a complex deltaic sequence. This was superimposed upon an older pattern of drumlins (streamlined mounds of glacial ‘till’ (boulder clay) deposited during an earlier stage of the last glaciation by rapidly flowing ice, moving from east to west (*ibid*).
- 11.1.3 The flat-topped ridge which extends from around Overby in the south-west towards Aldoth in the north-east represents the uppermost surface of the Holme St Cuthbert delta, from which the deposits slope down towards the south-east. This ridge, which reaches up to 50m in elevation and has a width of approximately 500m, is likely to contain the thickest sequence of glacio-fluvial deposits, and has been (and continues to be) the primary focus for sand and gravel extraction in the area. This is clearly evident in the distribution of current planning permissions, areas of previous working, and the allocation for future extraction (Fig 34), though these areas also extend onto lower ground between Overby and New Cowper in the south-west and onto a separate spur of high ground at Aldoth in the north-east.
- 11.1.4 To the north-west of the main ridge, the glacio-fluvial deposits were laid down on the surface of the stagnating ice front, rather than within the ice-marginal lake, and now form an area of generally lower, and irregular ‘kame and kettle’ topography, resulting from the melting of previously buried ice. This area has a steep (north-west-facing) slope against the main flat-topped ridge, interpreted by Livingstone (*ibid*) as an ice-contact slope, and the deposits are likely to be much thinner than those in the main deltaic sequence. Low eskers, representing the sinuous courses of former drainage channels within or beneath the ice, have been identified in the far north-western part of this area, and these might contain thicker and relatively coarse-grained sediments, though there has been no recent extraction in these areas and no clear evidence of historical extraction.

11.2 ARCHAEOLOGICAL ASSESSMENT OF THE SOLWAY PLAIN AND NORTHERN CUMBRIA COAST

- 11.2.1 **Summary:** the following provides some background relating to the archaeological context of the Solway Plain and is generally relevant to considerations of all study areas in the north-west of Cumbria (Abbeytown Ridge, Moota (*Section 12*), and Tendley (*Section 13*)). This is not intended as a comprehensive synthesis of archaeological and historical information relating to the area, but is merely an indication of its general archaeological potential.
- 11.2.2 Although palaeoenvironmental evidence might allow the tentative suggestion of human management of the landscape in the northern Cumbrian coastal plain during the Mesolithic period, the archaeological evidence is limited to findspots of Mesolithic and early Neolithic worked flint (Hodgkinson *et al* 2000, 110). An understanding of Neolithic settlement has been largely derived from the distribution of polished stone axes, with over 100 having been found on the Solway Plain (*op cit*, 111). Many axes were found in association with mires, including an example from Pelutho, to the north of the Abbeytown Ridge (*ibid*), and a significant group of lithic material of Neolithic date was found on the southern slopes of the Abbeytown Ridge, above Common Moss (*ibid*). A ditched enclosure, with origins in the early Neolithic period, was partially excavated at Plasketlands, near Mawbray (Bewley 1993), and a cemetery at Ewanrigg, to the south of Maryport, contained urned cremations dating to the transition between the Neolithic and the Bronze Age (Bewley 1992).
- 11.2.3 Numerous lithic scatters of Bronze-Age date have been found along the Abbeytown Ridge and many sites have been identified by aerial reconnaissance that have not been tested by excavation; these include the potential for 21 burial sites (Hodgkinson *et al* 2000, 113). Bronze-Age metalwork has been found within wetlands on the Solway Plain, such as the Salta Moss rapier, from Edderside (*ibid*).
- 11.2.4 Enclosures have been identified in numerous places across the Solway Plain through aerial photography (Bewley 1994, 63) and many of these may date to the Iron Age or Roman period (Hodgkinson *et al* 2000, 183). Indeed, evidence from some excavated examples suggests the reuse of prehistoric enclosures during the Roman period, including enclosures at Ewanrigg and Edderside. The most conspicuous activity during the Roman period in this part of Cumbria was associated with the western extension of the Stanegate road system, which may have terminated at Kirkbride, to the north-east of Abbeytown, and the coastal system of forts, milecastles, and towers that extended the Hadrian's Wall frontier system (Shotton 2004, 88-90). A Roman road, which is reused in several places by the A595, also ran between Carlisle and Maryport (Margary 1973).
- 11.2.5 Although the archaeological evidence for early medieval activity in Cumbria is generally sparse, there is a greater level of activity on the west side of the county. Palaeoenvironmental analyses suggest that low-level agricultural activity continued on the Solway Plain (Hodgkinson *et al* 2000, 120) and the remains of several cattle from Solway Moss suggest the purposeful deposition of animals during this period (*op cit*, 129). It is also possible that sites presumed to be of Iron Age or Roman date might have been reused, or continued in use, during the early medieval period (RM Newman 2006, 97). Examples of stone sculpture

with Scandinavian motifs are relatively densely distributed in an arc from Bromfield, south of Abbeytown Ridge, to Workington (Hodgkinson *et al* 2000, 137), with strong Scandinavian influence being evident on carvings at Aspatria (Bailey and Cramp 1988).

- 11.2.6 There is a large collection of documentary material relating to the Abbeytown Ridge during the late medieval and post-medieval periods as a result of the ownership of many of the local mosses by the Lonsdale estate and, before that, by the monks of Holm Cultram Abbey, as well as from the records relating to use and enclosure of the mosses (Hodgkinson *et al* 2000, 137). These include records of boundary banks and ditches from the twelfth century, and the establishment of grange farms and saltworks was also recorded (*op cit*, 137-8). Peat extraction and pasture were recorded, although the mosses were largely kept intact, rather than being subject to substantial reclamation (*op cit*, 138).
- 11.2.7 The archaeological data relating to Abbeytown Ridge was collated within the GIS (Fig 36). It was then refined to remove duplicates and the sites were scored according to period. A site-density score was subsequently assigned to each HLC polygon (Fig 37).

11.3 HISTORICAL IMPACTS FROM QUARRYING

- 11.3.1 The total area of historical quarrying within the Abbeytown Ridge study area is 0.179km² and consisted of numerous irregular areas of extraction spread primarily across the southern part of the area (Fig 37). Surprisingly, given the wide overall area that the quarries occupied, few sites of archaeological interest are known to have been affected by quarrying. The identified extents of the New Cowper field system and settlement (PN 18; Fig 38), which could date to the prehistoric or Roman period, lay just at the northern edge of one of the areas of historical quarrying at the southern end of the study area. A small area of quarrying to the north-west of this lay within a field where a boundary ditch of possible Iron Age or Roman date was identified (PN 158). An area of narrow ridge and furrow of post-medieval date was also affected by quarrying near Overby (PN 464).
- 11.3.2 Although few sites have been demonstrated to have been affected by historical quarrying (Fig 39), much of this extraction was undertaken in the immediate vicinity of areas of considerable archaeological interest. This includes the extensive areas of settlement and field systems at New Cowper Quarry (PN 15 and PN 156; Fig 38; *Appendix 1*), which are of uncertain date and were identified by the examination of cropmarks. This area lies between Cockley and Hangingshaw Moss, at the southern end of the study area. Numerous other ditches and boundaries of possible Iron Age or Roman date have been identified in this southern area (PN 158), in addition to the discovery of Mesolithic material (PN 174), the remains of Neolithic pottery, worked flint, a polished stone axe (PN 175), pits, an Early Bronze-Age funerary cairn (PN 176), a possible Bronze-Age palisade (PN 175), and a pit containing Iron Age pottery (PN 178). It, therefore, appears highly likely that large areas of historical extraction, such as that to the west of Cockley Moss, have resulted in remains of archaeological interest being affected by quarrying but that these were not recorded prior to, or during, extractive works.

- 11.3.3 This pattern repeats across the whole of the southern half of the study area, with Neolithic material (PN 179) and a considerable Bronze-Age cremation cemetery (PN 181) having been found at Overby Quarry. Undated field systems (*eg* PNs 78-9) and numerous boundaries of possible Iron Age or Roman date (*eg* PN 204, PN 210 and PN 449) have been identified in the vicinity of Overby No 2 Quarry. Both of these quarries are situated in the central part of the study area.
- 11.3.4 The historical quarries in the northernmost part of the study area are relatively small, but lie in the vicinity of at least three Bronze-Age barrows (PN 93, PN 200 and PN 471), a Bronze-Age cremation cemetery (PN 162), an enclosure and field system of possible Iron Age or Roman date (PNs 205-6), field systems and a roundhouse of uncertain date (PN 20), a signal tower of possible Roman date and an earthwork of unknown date (PN 19), and undated and unclassified cropmarks at Raise How (PN 5) and Watch Hill (PN 16). The impact of historical quarrying is, therefore, unknown, but is likely to be considerably greater than the number of sites identified within each quarried area. This lack of correlation is likely to result from the fact that the local archaeological data have been compiled only after some of the historical quarrying had already taken place and that there was a lack of archaeological monitoring during some of this quarrying.

11.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 11.4.1 Currently or recently active permissions within the study area comprise New Cowper, Overby, High House and Aldoth quarries (Fig 34).
- 11.4.2 ***New Cowper and Aikshaw:*** at the south-western end of the main flat-topped ridge, the New Cowper and Aikshaw planning permission (for which permission for extraction expired at the end of 2012) occupies three separate blocks of land, with completed workings (as indicated on ‘Google Earth’ imagery) in all three areas. Some small areas of as yet unworked, previously permitted, reserves appear to remain within the northernmost and southernmost blocks, but these would require new planning permissions in order to be worked. The site is currently used only to host processing plant. There may also be some limited adjoining areas where resources have yet to be worked but these are mostly either in close proximity to the two villages (New Cowper and Aikshaw) and/or towards the edge of the resource outcrop, where the deposits are likely to be relatively thin. A separate, dormant planning permission (Aikshaw No 1) lies to the north-east of Aikshaw. This permission does not expire until 2042 but appears to be largely worked out and is shown as ‘disused workings’ on the modern 1:25,000 (1987a) and 1:10,000-scale (1987b) OS maps.
- 11.4.3 ***Overby No 2:*** directly north of the dormant Aikshaw site is the active sand and gravel permission known as Overby No 2. This occupies the full width of the main, flat-topped ridge and, although much of the land is either currently, or has previously been, worked, a significant area of unworked reserves appears to remain at the north-eastern end of the permission, together with a smaller portion at the south-western end. The current planning permission runs until 2026. Further resources are indicated on the BGS maps on either side of the main ridge (*ie* to the north-west and south-east of the Overby permission; Fig 34), and these could be potential targets for future extraction, although in both cases the deposits are likely to be thinner than beneath the main part of the ridge

(Section 11.1.3). A small area of disused workings ('Overby No 1') is shown, directly to the south of Overby House, on the modern OS edition (1987a), and coincides with a gap in the BGS resource distribution maps.

- 11.4.4 **High House Quarry (Highfield):** further north, but still occupying the main part of the ridge, is the active High House Quarry (Highfield) sand pit, which has planning permission until the end of 2021. Two separate parts of this site are currently being worked, but at least half of the permitted area does not yet appear to have been worked. Additional unworked resources remain on all sides of the quarry and the land directly to the south-west (occupying the full width of the main ridge between High House and Overby) has been identified as an allocation for future working (the *Overby and High House Quarries Area of Search for Extension*) in the emerging *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013).
- 11.4.5 **Aldoth Quarry and Dixon Hill:** to the east of High House, and occupying a separate spur of land, detached from the main ridge, is the Aldoth Quarry and Dixon Hill planning permission, which runs until the end of March 2022. Current workings occupy the whole of the western part of this area, whilst the eastern portion ('Round Hill') has already been worked and restored. Unworked resources are shown on the BGS maps both to the north and the east of the current site, though these are closer to existing buildings and/or on lower ground, where the deposits are likely to be thinner (Section 11.1.3).
- 11.4.6 **Impact:** the degree of impact of twenty-first-century quarrying on sites of archaeological interest is easier to define than for historical impacts, since the archaeological significance of the area has now been recognised and archaeological investigations have been undertaken in advance of quarry expansion (Appendix 3; Fig 40). Twenty-first-century quarrying has, therefore, both increased our understanding of the character and extent of sites of archaeological interest but has also been responsible for the destruction of significant heritage assets. Twenty-first-century quarrying is spread fairly evenly across the study area and occupies a combined area of 0.73km². The impact from present-day quarrying at Abbeytown Ridge has been plotted (Fig 37).
- 11.4.7 The study area is associated with numerous identified sites of archaeological interest of prehistoric and possible Roman date and, therefore, there is a considerable likelihood that twenty-first-century quarrying will have had a major impact on heritage assets. Works at Aldoth Quarry, in the vicinity of Round Hill, have removed the findspot of a prehistoric spearhead (PN 74; Fig 38) an alleged Iron Age or Roman enclosure (PN 140) and a series of unclassified cropmarks (PN 7). Neolithic (PN 179) material and a considerable Bronze-Age cremation cemetery (PN 181) lay within an area where extraction took place at Overby Quarry (NPA 2010; Appendix 3). Extraction at High House Quarry, situated in distinct areas at Raise How and Cobble Hall, included areas where a Bronze-Age field system (PN 26) and field boundaries of possible Iron Age or Roman date (PN 210) were present (NPA 2008a; Appendix 3). Numerous sites of archaeological interest were present within quarried areas at New Cowper Quarry, including an undated settlement and field system (PN 15 and PN 18), numerous ditches and boundaries of possible Iron Age or Roman date (PN 158; Appendix 3), Mesolithic material (PN 174; NPA 2006a), the remains of Neolithic pottery, worked flint, a polished stone axe (PN 175; NPA 2006b), pits,

an Early Bronze-Age funerary cairn (PN 176; NPA 2007), a possible Bronze-Age palisade (PN 175), and a pit containing Iron-Age pottery (PN 178; Headland Archaeology 2004).

11.4.8 It can, therefore, be established with certainty that considerable numbers of known prehistoric sites of archaeological significance, and sites of potential Roman date, have been affected by quarrying at Abbeytown Ridge during the twenty-first century. It is also likely that further sites were affected, but were not recognised prior to, or during, extractive works.

11.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

11.5.1 In terms of future sand and gravel extraction in this area, the main focus is likely to be within the unworked portions of the existing permissions at Overby, High House and Aldoth, and within the Area of Search that has been allocated between Overby and High House quarries (Fig 34). Beyond that, there may be scope for extending both of those quarries in other directions, into previously unworked resources. It is thought unlikely that new extraction sites would be developed in other parts of the resource, within the short- to medium-term future.

11.5.2 **Archaeological Potential:** there are numerous undated field systems, enclosures, settlements, and roundhouses within this study area (eg PN 2, PN 17-18, PN 20; Fig 38), in addition to Neolithic flint and axe findspots (eg PN 175), pottery and pits (PN 178), and Bronze-Age urns (PN 93), funerary barrows (PN 200, PN 471), and cremations (PN 180-1). Some examples of field systems, enclosures, and roundhouses have been assigned Iron Age or Roman dates (eg PNs 201-2, PN 204, PN 206, PN 145), although some of these are based on morphology, and excavation would be required to establish closer dating. It is possible that some of these settlements may have continued in use during multiple periods and that early medieval phases of occupation might be represented in some areas.

11.5.3 The density scores for some of the HLC areas reflect the large numbers of heritage assets in the study area. The south-western area has a high score, and HLC areas in the centre of the study area and at the northern edge also have high-density scores. However, these scores represent the current state of knowledge of the number of identified heritage assets, rather than the total number of sites that might actually be present. Therefore, the actual density of sites is likely to be considerably higher than the recorded density, and certain areas may appear to have low densities of sites as a result of fewer archaeological investigations having taken place within those areas, and less quarrying groundworks being monitored that may otherwise have revealed the presence of sites, or differences in the vegetation, topography or geology, that might have affected the visibility of sites. Indeed, an examination of the locations of recorded archaeological investigations within the Abbeytown Ridge study area demonstrates a clear correlation between areas of investigation and HLC areas with high-density scores. Conversely, none of the HLC areas with very low-density scores (shown in green) have been the subject of archaeological investigations (Fig 40).

- 11.5.4 Differences in the way in which some site types have been recorded also affect the apparent density of sites within each polygon area. One of the most conspicuous examples of this is in the north-western area, where extensive field systems and possible settlement enclosures are situated (PNs 201-3, PNs 208-9, PN 450, PNs 472-3). Such sites, identified by aerial photographic analysis (*Appendix 1*), were grouped by monument number so that they would constitute a single heritage asset. This was undertaken in order to prevent each individual element of a single field boundary, for example, being scored as an independent site, which would dramatically skew the density scoring within a polygon area. This also brought the data in line with the methodologies often employed in the cataloguing of HER and NMR data, whereby the overall field system or settlement would be recorded as a 'site', rather than each component (English Heritage 2006b). The consequence of this, however, is that the scale and extent of such large sites could not be reflected by the scoring system. Therefore, this polygon area is clearly one of extremely high archaeological significance and contains a high density of heritage assets, but receives only a mid-range density score.
- 11.5.5 These considerations mean that although the HLC scores within the Abbeytown Ridge study area reflect the density of previously identified heritage assets, every part of this area should be considered to have high potential for the presence of remains of archaeological interest. The potential for future impacts as a result of quarrying in this area is extremely high and it is likely that, if future quarrying is undertaken in association with archaeological investigations, the number of identified sites within this area will grow incrementally.

12. MOOTA

12.1 GEOLOGICAL CHARACTER

- 12.1.1 The mineral resource in this area comprises a succession of limestone beds (LM2 to LM7) of the Carboniferous ‘Chief Limestone Group’. There are also beds of sandstone, primarily between LM3 and LM4, but, unlike the limestones, these are not identified by the BGS as mineral resources (Young *et al* 2001). The Carboniferous rocks are partly concealed beneath relatively thin superficial deposits, primarily glacial till but also more recent alluvium, in the far south of the study area.
- 12.1.2 The general topography of the area, together with the resource outcrops mapped by the BGS (which include areas of limestone beneath superficial drift deposits), areas of current and previous surface mineral extraction, current planning permission boundaries and a small allocation for future working, have been mapped (Fig 41). The basic geology of the area, taken from the latest available BGS 1:50,000-scale mapping (1997a), has also been plotted (Fig 42).

12.2 ARCHAEOLOGICAL ASSESSMENT

- 12.2.1 [A general background to the archaeological context of the Solway Plain and northern Cumbrian coast has been compiled, which is relevant to the Abbeytown Ridge \(Section 11\), Moota, and Tendley study areas \(Section 13\). This is therefore presented under the archaeological assessment of the Abbeytown Ridge \(Section 11.2\), since this is the first to be described.](#)
- 12.2.2 The archaeological data relating to Moota was collated within the GIS (Fig 43), and was then refined to remove duplicates. The sites were scored according to period, and a site-density score was subsequently assigned to each HLC polygon (Fig 44).

12.3 HISTORICAL IMPACTS FROM QUARRYING

- 12.3.1 There are several recorded instances of historical quarrying within this study area, with very small pits scattered around the northern and southern edges, and two large areas in the southern part. The overall area occupied by the quarrying is 0.106km² (Fig 44).
- 12.3.2 At least four limekilns formerly lay within the easternmost area of quarrying (Fig 45; PN 117 and PN 517; Fig 46). Two of these have been destroyed by the quarrying and a third has been replaced by a modern kiln. Limekilns associated with quarrying at the northern end of the study area, and with Moota Hill Quarry at the southern end of the area, may also have been destroyed (PN 117).

12.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 12.4.1 The only active mineral permission in this area at present is Moota Quarry, which primarily extracts aggregate from the 4th Limestone (LM4; Fig 41). This

currently has planning permission until the end of 2016. A further dormant permission, High Close Quarry, exists just to the north of the refined study area boundary, within the LM5 outcrop, and a local operator is understood to be interested in reopening this site. The dormant permission there is valid until 2042 and, subject to a successful application for an initial ROMPs (Reviewing Old Mineral Permissions) review and Environmental Assessment, the site could potentially be reactivated at any time. Both there and at other sites to the west of High Close, there is evidence of previous historical quarrying activity. A further dormant permission exists to the north-east of Moota, at Wharrels Hill. Again, this permission is valid until 2042 but the site falls outside the study area's 'buffer zone', so is not considered further.

- 12.4.2 A very small Area of Search directly adjacent to Moota Quarry is identified within the emerging *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013), though this has now been incorporated within a recent physical extension of the permission boundary. Previously, the quarry operator (CEMEX UK) had identified the need for a wider area of search around the whole of the existing permission. This also noted the Company's intention to submit a planning application to the County Council once initial drilling and environmental appraisals had been completed.
- 12.4.3 Twenty-first-century quarrying has been focused on one large area towards the centre and south-eastern end of the refined study area. The area affected measures 0.207km² and appears to be an extension of the work carried out at the end of the twentieth century. The impact from present-day (twenty-first-century) quarrying there has been mapped (Fig 44). Despite the size of the quarry, few recorded sites of archaeological interest have been affected. Those that have been impacted upon include the location of a medieval beacon, situated on Moota hill (PN 107; Fig 46), and a small portion of a field system of post-medieval ridge and furrow (PN 275), which was identified during the NMP survey (*Appendix 1*) and lies on the eastern edge of the study area. It is possible, however, that further unrecorded sites have been affected, or destroyed, by this phase of quarrying, as no recorded archaeological works took place prior to extraction.

12.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 12.5.1 Within the short- to medium-term future, further limestone extraction in this area will inevitably be focused within the existing planning permission boundary (recently expanded slightly to include the small area of search; *Section 12.4.2*). However, additional unworked resources surround the quarry on all sides, offering the potential for further extension of the workings in the longer term. Relatively small lateral extensions would enable the quarry to be deepened further, and this is considered far more likely than the prospect of developing a new quarry elsewhere within the resource. There is, however, also a prospect of reactivating High Close Quarry, directly to the north of the identified study area, which should also be taken into account.
- 12.5.2 Future quarrying within the Moota study area has the potential to impact on archaeological remains dating from a number of periods. Whilst there have been several archaeological investigations in the area of the quarry, no significant features have been recorded to date. Although few prehistoric

remains have been recorded within the study area, two Neolithic axes have been found close by, at Wart Hole (HER 862, NGR 313000 538000) and Battery Hill (HER 864, NGR 319000 537000). Finds of Neolithic or Bronze-Age date from within the wider landscape suggest that the possibility of finding surviving buried remains within the boundaries of the study area should not be ruled out.

- 12.5.3 Within the area itself, very close to the twenty-first-century quarrying, lies a prehistoric scooped settlement (PN 112) and an unclassified cropmark, which is possibly prehistoric, or perhaps dating to the Roman period (PN 272). These two sites are in direct danger of being affected by future quarrying. There are also other sites of the same date close to the study area. Settlements of possible Iron-Age or Roman date lie to the north of the study area at Ewe Close (HER 851, NGR 314100 538000) and Wardhall (HER 41104, NGR 314168 538000).
- 12.5.4 The Roman road within the study area (PN 51) leads to the fort at Blennerhasset (HER 1620), which is less than 5km north-west of the study area. Slightly further afield are the sites of Caermote Roman fort, to the east (HER 9904), and Allerby Romano-British settlement (HER 779) to the north-west. All of this evidence demonstrates that there is potential for Roman remains within this study area.
- 12.5.5 At least some of the parish churches in the area surrounding the study area seem to have had early medieval origins (Bailey and Cramp 1988). Fragments of an early medieval cross, with Scandinavian affinities, have been found at St Mary's church in Gilcrux (HER 861, NGR 311720 538170). A cross of similar type was found at the site of St Bridget's church in Bridekirk (HER 869, NGR 311640 533690), to the south-west of the study area, along with a font (HER 869, NGR 311640 533690) from the same period. Hogback stones, which are an early type of grave marker that has been described as the archetypal Viking colonial monument (Lang 1984), have been found in the vicinity of the study area at St Cuthbert's church in Arkleby (HER 860, NGR 314150 539220), and slightly further afield at St John's Church, Crosscannonby (HER 799, NGR 306910 539000). These finds are significant, considering the relative lack of early medieval remains in this area (*Section 11.2.5*).
- 12.5.6 Medieval ridge and furrow (PN 476) at risk from future extraction can be seen in the north of the study area. In addition to this, the southern part of the study area lies within the eastern edge of strip-field systems that are likely to be indicative of medieval agriculture associated with the settlement at Blindcrake (PN 568 and PNs 572-7). This type of field system can also be seen at Gilcrux, beyond the study area, to the north. No other activity dating to this period has been recorded within this study area, but the possibility of unrecorded medieval sites remains high, as several sites dating to this period are present within the surrounding area. As with early medieval evidence, this often comes from churches, such as St Mary's church in Gilcrux (HER 861, NGR 311720 538170), which has medieval architectural elements and possible medieval earthworks within the graveyard. St Cuthbert's church in Arkleby (HER 860, NGR 314150 539220) also has medieval masonry, as does St Bridget's church at Bridekirk (HER 869, NGR 311640 533690), which is also the location of a suspected medieval shrunken village (HER 853, NGR 311800 533700). Other medieval remains in the area include the pele tower at Tallentire Hall (HER

5645, NGR 310400 535200), the house at Warthole Hall/ Ward Hall (HER 856) and the bastle house at Croft View (HER 16953, NGR 315627 539269) at Threapland.

- 12.5.7 Although it seems that the number of sites of significant archaeological interest within the Moota refined study area is low, activity within the local area suggests that it is probable that unrecorded remains do lie within the area under threat from the impact of future quarrying and this should be considered before further quarrying occurs within this area.

13. TENDLEY

13.1 GEOLOGICAL CHARACTER

- 13.1.1 The mineral resources exploited in this area are Carboniferous Limestones of the Great Scar Limestone Group. These comprise a cyclical succession of thickly bedded limestones with interbedded sandstones and mudstones (Young *et al* 2001). Within and beyond the western edge of the study area, the limestones are overlain by the mudstones, siltstones, sandstones and impure limestones of the Hensingham Formation, though these are not identified by the BGS as mineral resources. Within the study area, and elsewhere, the bedrock resources are partly concealed beneath superficial glacial till deposits, which, in places, are overlain by post-glacial alluvium or peat (*ibid*).
- 13.1.2 The general topography of the area, together with the limestone resource outcrops, as mapped by the BGS, areas of current and previous surface mineral extraction and current minerals planning permissions, have been collated (Fig 47). The basic geology of the area, taken from the latest available BGS 1:50,000-scale mapping (2004), has also been plotted (Fig 48).

13.2 ARCHAEOLOGICAL ASSESSMENT

- 13.2.1 A general background to the archaeological context of the Solway Plain and northern Cumbrian coast has been compiled, which is relevant to the Abbeytown Ridge (Section 11), Moota (Section 12) and Tendley study areas. This is therefore presented under the archaeological assessment of the Abbeytown Ridge (Section 11.2), since this is the first to be described.
- 13.2.2 The archaeological data relating to Tendley was collated within the GIS (Fig 49), and was then refined to remove duplicates. The sites were scored according to period, and a site-density score was subsequently assigned to each HLC polygon (Fig 50).

13.3 HISTORICAL IMPACTS FROM QUARRYING

- 13.3.1 Historical quarrying in the Tendley refined study area comprises a large extraction site within the central-western HLC polygon, in addition to smaller quarries both to the south, towards Eaglesfield, and the north, towards Ellerbeck (Fig 50). The total area of historical extraction amounts to 0.279km², a large portion of which falls within high-scoring HLC polygons. Historical extraction in this area has had an impact on several previously recorded sites. Four of these are of particular interest and lie within the area that has been subject to the most extensive quarrying. One of these sites is at Eaglesfield (PN 108; Fig 51), where the remains of a skeleton of early medieval date were found, along with an iron sword, iron 'halberd' (probably a spear), and a pennanular brooch of clear Scandinavian derivation (Cowen 1948). Less than 200m to the east, the Endlaw Field early medieval cemetery was identified (PN 114; Cowen 1967). Two Roman roads have been affected by historical quarrying: the Papcastle to

Lamplugh road (PN 135); and the road running from Egremont to Carlisle (PN 569; Margary 1973). These pass through the full length of the study area, the Papcastle to Lamplugh road extending from south-south-east to north-north-west and the Egremont to Carlisle road on a south-south-west to north-north-east alignment. The two burial sites lie on either side of the putative crossroads. A large section of the Papcastle to Egremont route, approximately 600m long, has been negatively affected by quarrying during the nineteenth and twentieth centuries (OS First edition (1867b); OS 1:10,000 (1970)).

- 13.3.2 In other parts of the Tendley study area, elements of historical quarrying have also had a negative impact on remains of archaeological interest. To the north, part of the Ellerbeck water cornmill (PN 64), including the dam and mill pond (PN 411), has been subjected to twentieth-century quarrying, along with an area of medieval ridge and furrow (PN 321). Two similar-sized portions of ridge and furrow in the centre of the same polygon, dating from the medieval and post-medieval periods, have also been affected (PNs 339-40). However, it is possible that the areas of ridge and furrow have only been subjected to limited disruption, as the quarrying just clips the edge of the sites in all three instances. Additionally, the southern end of a small stretch of banking, making up a twentieth-century road (PN 326), has probably been destroyed by historical quarrying.
- 13.3.3 The HLC area within which the largest amount of historical quarrying has taken place has a site-density score that falls within the top range (Fig 50). Many of the sites within this area are significant. Given the close proximity of archaeological sites to historical quarrying, particularly in the centre of the study area, it is likely that quarrying in this area has negatively impacted on additional archaeological sites, which were not recognised at the time that the extraction occurred.

13.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 13.4.1 A single, active minerals planning permission, Tendley Quarry, exists within the study area and is valid until the end of 2029. There are no other dormant or inactive permissions within the area, and no current allocations for future working. There are, however, numerous areas of former limestone extraction, both within and just to the east of the current permission boundary, and further north, notably within and around Brigham Hill, where historical (first edition (1867b; Fig 52) and second edition OS mapping (1900a; 1900b; 1900c; 1900d) identifies both quarrying activity and limekilns.
- 13.4.2 Twenty-first-century quarrying at Tendley has taken place in the western part of the study area, in one large area measuring 0.218km² (Fig 50). Archaeological investigations, prompted by the presence of known archaeology in the area, particularly the early medieval inhumations (PN 108 and PN 114; Fig 51), took place prior to quarry extensions. This has involved a desk-based assessment and walkover survey carried out in 2001 (Headland Archaeology 2001a; PN 183), and a series of trial trenches undertaken in 2003 (Headland Archaeology 2003a), which built on the results of the 2001 work and a previous geophysical survey. The walkover survey did not identify any new sites, although it did note that a medieval axehead had been found in an earlier soil strip (PN 120). Some 248 artefacts were identified in the trial trenches, many of which were ferrous and

from the post-medieval period (PN 184). The trenches also identified areas of either medieval or post-medieval ridge and furrow (PN 184). In 2008, a geophysical survey and the excavation of four evaluation trenches were undertaken prior to a proposed quarry extension (PN 185; *Appendix 3*; OA North 2008a). Although the results of the geophysical survey indicated the possible presence of ridge and furrow and the remains of earlier quarrying activities, the evaluation found only limited archaeological remains. In Trench 1, a possible posthole was found and in Trench 3 a lens of burnt or decomposed dark material was recorded (*ibid*).

- 13.4.3 In addition to the sites identified through archaeological investigations, quarrying in the twenty-first century has affected two sites previously identified within the HER. The first of these is a findspot of a medieval axe (PN 120) and the second, the routes of the Roman roads (PN 135 and PN 569; *Section 13.5.2*), although much less impact has occurred on these than that caused by nineteenth- and twentieth-century quarrying.
- 13.4.4 A large portion of the area quarried during the twenty-first century falls within two high-scoring polygons. The majority of the sites of significant archaeological interest within this area had, however, been previously affected by historical quarrying. Although the possible Roman roads were affected by twenty-first-century quarrying, the fact that the below-ground archaeological investigations have yielded few results suggests that the impact of twenty-first-century quarrying on the archaeological resource within the study area has so far been relatively low. It is possible, though, that any work carried out prior to the beginning of the archaeological work in 2001 may have destroyed other sites that were not recorded.

13.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 13.5.1 Within the short- to medium-term future, further limestone extraction in this area is likely to take place within the current planning permission boundary. No allocations for future working beyond that boundary have been identified within the *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013). Additional unworked resources surround the quarry to the south and east (Fig 47), with those to the east having been partially worked in the past. Further development of those resources might be considered eventually, but probably not for some considerable time.
- 13.5.2 The Tendley study area contains a number of high-scoring HLC polygons, reflecting a high density of sites of archaeological interest (Fig 50). The largest and highest-scoring HLC polygon lies directly adjacent to the area of twenty-first-century quarrying. Sites of archaeological interest within this polygon are dominated by the remnants of medieval and post-medieval agricultural practices, including multiple areas of medieval (*eg* PNs 320-1 and PN 323; Fig 51) and post-medieval ridge and furrow (*eg* PNs 336-8 and PNs 402-5), field boundaries (*eg* PN 322 and PN 397) and medieval headlands (PN 324). Other sites within this high-scoring area include the findspots of two unpolished Neolithic stone axes (PN 151), a Middle Bronze-Age armlet (PN 149), and stretches of the Roman roads (*Section 13.2.1*) that have not been previously affected. Those parts of the Ellerbeck water cornmill unaffected by historical quarrying, and the site of an unnamed building identified from the first edition OS map (1867b; Fig

- 52; PN 508), are within this area, as well as a well (PN 515) and a guidepost (PN 516) identified from the same source.
- 13.5.3 Three other polygons showing high-density scores also lie within this study area; however, in two of them, the majority of the sites of archaeological interest have been badly affected by historical and twenty-first-century quarrying (*Section 13.3*). This raises the importance of surviving sites within these areas.
- 13.5.4 Polygons with a relatively high-density score occur in the Tendley area, in the north and south of the study area. The Roman roads (PN 135 and PN 569) run through both of these polygons, which have contributed to the higher-density scores. Besides these sites, areas of medieval and post-medieval ridge and furrow (*eg* PNs 394-6) are present, particularly in the north of the study area, and activity relating to historical quarrying can be seen primarily in the southern polygon (PN 341, PNs 406-7). The scoring arising from historical quarrying may be somewhat contradictory, as this activity may have resulted in the loss of archaeological remains. However, these sites are now part of the historical record in their own right, but the probable destruction of sites increases the importance of archaeological investigations prior to future quarrying, to ensure that any other possible remains are recorded properly.
- 13.5.5 Lower-scoring areas can be seen to the east and north of the twenty-first-century quarrying, the only recorded remains in these being a small area of post-medieval ridge and furrow (PN 412). However, this does not automatically mean that there is a lack of archaeological remains, and there may be further potential for such a presence that is at present unknown.
- 13.5.6 Looking within a more general context, there is prehistoric activity in the wider landscape (*Sections 11.2.1-4*). This has been demonstrated by the Neolithic axes (PN 151) and the Bronze-Age armlet (PN 149) within the study area, and the presence of further prehistoric activity remains a possibility. This is supported by the recovery of numerous prehistoric finds from the wider area, including Neolithic axes at Eaglesfield (PN 570) and Brigham Hill (PN 571).
- 13.5.7 There is also the potential for additional Roman and Romano-British remains, firstly because of the roads within the area (PN 135 and PN 569), and secondly, because there are important Roman sites in the neighbourhood. These include Fitz Wood Romano-British farmstead (HER 871, NGR 310870 530450), to the east of the area, and the Roman fort and extramural settlement at Papcastle (HER 872, NGR 310960 531490).
- 13.5.8 There is also a case for remains from more modern periods, as numerous medieval and post-medieval sites have been recorded within the locality. Aerial photography has identified further areas of medieval and post-medieval ridge and furrow lying just outside the study area, suggesting extensive agricultural activity (*Appendix 1*; PNs 578-665). Evidence for settlement comes from nearby towns, such as Cockermouth (HER 5553, NGR 312100 530700). Other smaller settlements, since deserted, are known at Broughton (HER 3696, NGR 312100 530700) and Ribton (HER 821, NGR 306100 530500). There is also evidence for a shrunken medieval village at Brigham (HER 819, NGR 308600 530900). Churches within the surrounding area are the product of many hundreds of years of building and rebuilding, some with early medieval origins. St Bridget's church in nearby Brigham is the site of a possible tenth-century burial, as well as a Northumbrian cross (Bailey and Cramp 1988; Paterson *et al* 2014). This

church also has medieval and post-medieval architecture (HER 809, NGR 3080 5300).

13.5.9 There is therefore a considerable potential for a number of remains of archaeological value to be affected as a result of future quarrying. The high density of sites seen within some of the polygons in this study area demonstrates that the known risk to archaeological remains is high. However, there is also potential for previously unidentified sites of prehistoric, Roman, early medieval, medieval and post-medieval date. This may mean that further sites may be present in areas of known high-density scores and it may also mean that areas currently showing lower density scores have the potential to yield sites of archaeological interest.

14. ESKETT AND ROWRAH

14.1 GEOLOGICAL CHARACTER

- 14.1.1 The mineral resources in this area are once again the Carboniferous Limestones of the Great Scar Limestone Group. In places, the limestones are overlain by the mudstones, siltstones, sandstones and impure limestones of the Hensingham Formation (Fig 53). Those, in turn, are overlain, to the west, by Coal Measures, and the Whitehaven Sandstone Formation (Young *et al* 2001). However, none of those extends into the study area itself, where the subsequent breccias of the Permian Brockram Formation directly overlie the Hensingham Formation, with a major unconformity in between. None of the strata which overlie the Carboniferous Limestone represent aggregate resources, but the coal measures to the west of the study area have previously been extensively worked for coal.
- 14.1.2 Within the study area, and elsewhere, the bedrock is partly concealed beneath superficial glacial till deposits and/or glacio-fluvial sand and gravel. In places the till is overlain by more recent alluvium or peat (*ibid*).
- 14.1.3 The general topography of the area, together with the resource outcrops mapped by the BGS, areas of current and previous surface mineral extraction and current mineral planning permissions, have been mapped (Fig 54). The basic geology of the area, taken from the latest available BGS 1:50,000-scale mapping (2004), has also been plotted (Fig 53).

14.2 ARCHAEOLOGICAL ASSESSMENT OF THE WEST CUMBRIAN COASTAL PLAIN

- 14.2.1 **Summary:** the following provides some background relating to the archaeological context of the West Cumbrian Coastal Plain and is generally relevant to considerations of Eskett and Rowrah, Peel Place (*Section 15*), and Ghyll Scaur (*Section 16*). Extensive archaeological investigations have been undertaken in the West Cumbrian Coastal Plain since the mid-twentieth century and these have demonstrated that the region was a focus of late Mesolithic and early Neolithic activity (Hodgkinson *et al* 2000, 61). Evidence for Mesolithic settlement in this area is, however, associated almost exclusively with the raised beaches of former coastlines, with some sites on the cliffs north of St Bees (*op cit*, 68). Estuaries and fenlands may have provided additional resources to supplement coastal exploitation and there is a concentration of settlement in the Esk estuary (*op cit*, 69-70). Some of the sites in this area may have been associated with activity continuing into the Bronze Age (*op cit*, 71).
- 14.2.2 Large numbers of finds of Neolithic date were recovered from Ehenside Tarn, south of Egremont, during drainage works in 1868 and by excavations in 1871 (Darbishire 1874). These included stone axes (one with a wooden haft), polissoirs, animal bones, and wooden paddles, 'clubs', possible wooden fish spears, pottery, a stone quern, and a bowl (Hodgson and Brennand 2006, 33; Hodgkinson *et al* 2000, 71). Late Neolithic and Bronze Age activity is more visible in this area than that of earlier periods, with large ritual monuments, such as stone circles, being present (Hodgkinson *et al* 2000, 75). Considerable

field survey has been undertaken in Cumbria, the Cherry family having been responsible for producing considerable amounts of data relating to worked lithics (Cherry and Cherry 1983; Hodgson and Brennand 2006, 31-2; Hodgkinson *et al* 2000, 75-7). Evidence for Bronze-Age settlement in Western Cumbria relies almost entirely on lithic assemblages (Hodgkinson *et al* 2000, 76). However, the distribution of work is not even (Hodgson and Brennand 2006, 31) and, therefore, the distribution of identified flint scatters will reflect, to a degree, the spatial extent of archaeological surveys. The large quantities of lithic material and the limited palaeoecological data suggest that much of the western lowlands were settled by the Bronze Age (Hodgkinson *et al* 2000, 76) and several burnt mounds have been identified in the western lowlands, for instance, at Drigg (Brown 2014) and Nether Wasdale, that are likely to be of Bronze-Age date (OA North forthcoming).

- 14.2.3 There is very little evidence for Iron Age activity in the North West, although palaeoecological evidence from Ehenside Tarn suggests that a relatively stable regime of continuous agriculture was undertaken throughout the Iron-Age and Roman period (Hodgkinson *et al* 2000, 77). A body was found preserved in peat deposits in Seascale Moss in the early part of the nineteenth century, near to Peel Place, and, although undated, similar examples have been demonstrated to date to the Iron-Age or Roman period (*op cit*, 77-8). At Whicham, near Ghyll Scaur, a double-ditched enclosure has been identified from aerial photographs that has been interpreted as a bivallate hillfort (*ibid*).
- 14.2.4 The character and distribution of Iron Age activity in this part of Cumbria are relatively poorly understood. The character of rural settlement during the Roman period is similarly uncertain, although Roman military activity is represented by the fort at Ravenglass (Potter 1979, 78). This fort seems to have been preceded by a fortlet, perhaps constructed as part of a larger scheme to provide an east/west overland route between the coast and Ambleside, via the Roman road over Hardknott (Potter 1979; Bidwell *et al* 1999). Scattered Roman finds have been identified at Drigg and Eskmeals, where there may have been small encampments within the sand hills, and there is evidence for a local iron-manufacturing industry at Eskmeals (Hodgkinson *et al* 2000, 78). Stray coins have also been found, including one from Hallsenna (*ibid*). An enclosed settlement (NRHE 37411), with a phase of activity dating to the Roman period, has been identified at Barnscar, on rising ground to the east of Ravenglass (Quartermaine and Leech 2012).
- 14.2.5 The early medieval period is under-represented on the West Cumbrian coastal plain, although it contains a greater amount of evidence, largely in the form of stone sculpture, than elsewhere in the county (Bailey and Cramp 1988). There are, however, no known settlement sites of this date, although the stone sculpture attests to the presence of early churches and a local population during this period. Some of the sculpture is of extremely high quality, with examples of national and European importance from Irton and Gosforth (*ibid*; RM Newman 2006, 102). Examples of sculpture with Northumbrian affinities demonstrate activity during the eighth and ninth centuries at Irton and Waberthwaite (Bailey and Cramp 1988), and an even larger number of sites provide evidence of sculpture with Scandinavian affinities dating to the tenth and eleventh centuries, including the exceptional cross at Gosforth (*ibid*; Hodgkinson *et al* 2000, 78; RM Newman 2006, 102-4). A single apparently

early Christian grave from Ravenglass may indicate settlement of fifth- or sixth-century date, and the seventh to ninth centuries are represented by a scatter of place-names of early English origin (National Trust 2000, 22). Place-names of Scandinavian origin are also evident in the local landscape, and the element 'scale', for example, relates to the Scandinavian word for a shieling (Armstrong *et al* 1950).

- 14.2.6 The Cumbrian coastal mosses were exploited by large monastic houses, such as Furness Abbey, with documentary evidence existing from the twelfth century (Hodgkinson *et al* 2000, 78). Documentary evidence records fish ponds, turbary (turf cutting), pasture, salt production and small-scale control and division of the mosses, but without large-scale drainage initiatives (*op cit*, 79; Brownbill 1916).
- 14.2.7 Medieval settlements are known from this area, including Hallsenna, adjacent to Peel Place, which was first recorded in the Chartulary of St Bees in *c* 1225 and the Assize Rolls of 1278 as 'Sevenhoues' (Armstrong *et al* 1950, 394). Peel Place was first named in a deed of 1365 as 'Pyel' (*ibid*). This might suggest the presence of a medieval defended house in the area, although there is no other evidence for the presence of such a site.
- 14.2.8 The archaeological data relating to Eskett and Rowrah was collated within the GIS (Fig 55). It was then refined to remove duplicates and the sites were scored according to period. A site-density score was subsequently assigned to each HLC polygon (Fig 56).

14.3 HISTORICAL IMPACTS FROM QUARRYING

- 14.3.1 Historical quarrying in the Eskett and Rowrah study area covers 0.357km² and is divided into two large areas, one to the north and one to south-west, in addition to several small extraction areas around the periphery. The impact from historical quarrying has been mapped (Fig 56). The largest expanse of historical extraction, to the north, started as a scattering of small quarries during the mid-nineteenth century (Fig 57). Some had adjacent limekilns, which have since been destroyed as a result of later quarrying activity. This extraction site straddles an area of medieval ridge and furrow (PN 364 and PN 367; Fig 58), a small portion of which directly coincides with the quarrying. It can be assumed that this site has been severely affected, along with other ridge and furrow that probably once existed there but has since been lost to the quarry. There was once a mineral railway in operation when the quarry was active (*eg* PNs 131-2) and the remains of this have mostly survived, despite a series of expansions during the nineteenth and twentieth centuries.
- 14.3.2 The second large area of extraction, in the south-west of the study area, started in a similar way, as small quarries accompanied by limekilns (*eg* PNs 494-5). Other than the destruction of the limekilns within later phases of extraction, and the remains of railways associated with quarrying complexes (PN 132), this expanse of historical quarrying does not impact on any recorded archaeology. The extraction site does, however, lie close to the former position of Postlethwaite's Eskett iron ore mine (PN 41) and the polygon representing this site overlaps with the area of quarrying. On closer inspection, though, it seems that the polygon encompasses both the mine and the historical quarry. It

seems unlikely that extraction had any severe impact on the mine, as the sites were in operation at the same time and the two seem to have remained separate entities.

- 14.3.3 The smaller expanse of historical quarrying at the southern end of the southernmost HLC polygon lies close to a patch of medieval ridge and furrow (PN 239), and it is possible that additional ridge and furrow may have existed in the area that has now been quarried away. In several places, ironstone mining and quarrying have taken place in close proximity (*eg* PN 42, PN 501, PNs 229-30) and, in some cases, historical quarrying has taken over the mining sites. The notable extant example of this is mineshaft PN 550, which is recorded as being on the north-eastern edge of the present quarry. However, the relationship between the two types of extraction and the chronology of the site are unclear in a number of instances. It is therefore not possible to ascertain the impact of historical quarrying in these cases.

14.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 14.4.1 A single minerals planning permission, covering Eskett, Salter Hall and Rowrah quarries, exists within the study area, and runs until the end of September 2034. The site is divided into two sections, known as Eskett and Rowrah quarries, respectively (Fig 54). Of these, only Eskett Quarry is active, whilst Rowrah Quarry (which includes Salter Hall) is dormant.
- 14.4.2 Rowrah and Salter Hall quarries, which were formerly worked for industrial limestone for the iron and steel industry, up until the 1970s, are currently flooded, and the workings are expected to remain dormant until the reserves at Eskett, which are now almost worked-out, are exhausted (*Minerals and Waste Local Plan* (MWLP); Cumbria County Council 2013). However, unworked reserves still remain within the dormant areas and are intended to be worked for aggregates in future years, subject to dewatering to remove and manage the future inflow of groundwater (as currently undertaken at Eskett Quarry).
- 14.4.3 There are no other dormant or inactive permissions within the area, and no current allocations for future working. There are, however, numerous areas of former limestone extraction, both within and surrounding the current permission boundary, as indicated on historical (first (1867c; Fig 57) and second edition (1900e)) OS mapping. These include fairly large disused quarries at Stockhow Hall and High Leys, to the east of Salter Hall and Rowrah, respectively, and Yeat House Quarry, near Frizington.
- 14.4.4 The large area of historical quarrying in the south-west of the Eskett and Rowrah study area has continued to be active, and an area covering 0.36km² has been extracted in the twenty-first century (Fig 56). A large number of the archaeological sites affected by this work relate to mining and, unlike the situation with historical quarrying, it is very clear that the more recent extraction has destroyed several of these sites. Postlethwaite's Eskett iron ore mine (PN 41; Fig 58), for example, has been completely consumed. This is also the case for part of Margaret mine (PN 42), spoil heaps (*eg* PN 223), buildings (PN 234), chimneys (PN 227) and small sections of road (PN 213), that once formed part of mining complexes. The Rowrah and Kelton Fell Railway (PN 131), and the Winder Branch Railway (PN 132), both established during the

Victorian period (Powell 2008), had sections of track running to and from the quarries. Expansion during the twenty-first century has resulted in the destruction of small sections of both railway lines.

- 14.4.5 Several areas of ridge and furrow, post-medieval in date, have been affected by quarrying within the twenty-first century. For instance, two fields that existed in the south of the quarried area have been destroyed (PN 240 and PN 242). It is likely that further features have been affected, as there are four fields containing ridge and furrow bordering the area, two to the north of the quarry (PN 244 and PN 251) and two to the south (PN 239 and PN 241). It is possible that further fields containing ridge and furrow fell between these two clusters and were destroyed by the quarrying before they could be recorded. This may also have happened to a number of unrecorded sites, as it seems that no archaeological work was undertaken before any phases of quarry expansion.
- 14.4.6 A group of buildings identified on historical maps as 'Eskett' (eg OS First edition map (1867c; Fig 57)) once stood in the centre of the quarried area (PN 510; Fig 58). These have now been destroyed, but it is uncertain whether this was the result of work undertaken in the twenty-first century or earlier. The various maps (OS First edition (1867c; Fig 57) and OS second edition (1900e)) show that historical quarrying increasingly encroached on the buildings, but from these maps it is not clear exactly when the buildings disappeared. It is certain, though, that quarrying activity has had a negative impact on the site.

14.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 14.5.1 Within the short- to medium-term future, further limestone extraction in this area is likely to take place within the existing planning permission boundary (Fig 54). This could include further expansion and deepening of Eskett and/or Rowrah quarries. No allocations for future working outside the current permission boundaries have been identified within the *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013). However, additional unworked resources surround the quarry on almost all sides, offering the potential for further extension of the workings in the longer term. Relatively small lateral extensions would enable the quarries to be deepened further, and this is considered to be more likely than the prospect of developing a new quarry or re-opening and extending one of the disused quarries elsewhere within the resource.
- 14.5.2 The Eskett and Rowrah study area is dominated by high-scoring HLC polygons. Only one, in the east of the area, has produced a score that does not fall within the highest bracket (Fig 56). Much of the recorded archaeological evidence at risk of being affected by future quarrying relates to industrial activity in the form of historical quarrying and iron mining (eg PN 497, PN 499, PN 354, and PN 505; Fig 58), and agriculture, where both farm buildings (PN 46 and PN 48) and medieval or post-medieval ridge and furrow (eg PN 253, PN 255, PN 365 and PN 362) are known. Medieval remains at risk of being affected can be seen at the site of Salter, a deserted medieval settlement (PN 109). The earliest recorded remains at risk from future quarrying within this study area are sections of the Roman road from Egremont to Carlisle (PN 569), which passes through the north of the study area.

- 14.5.3 Many of the sites of archaeological interest within this area seem to be relatively recent. This lack of earlier evidence may be the result of the absence of any archaeological investigations within this study area, especially prior to quarrying work, which may have resulted in unrecognised evidence from earlier periods being destroyed without being recorded.
- 14.5.4 In addition, activity in the vicinity suggests that there is a possibility that additional remains from a number of periods could be present within the boundaries of the study area. Prehistoric finds within the locality include an axe hammer discovered in Frizington (HER 1204, NGR 304000 518000), a Bronze-Age cremation urn from Tutehill (HER 1041, NGR 302990 520700), and a stone hammer found in Kidburngill (HER 1047, NGR 306000 521000). Much closer to the study area is the site of a destroyed Bronze-Age stone circle, with a possible associated burial (PN 666). This lies less than 200m from the edge of the study area and thus increases the potential for prehistoric remains within. The polygon that received the lowest site-density score, on the eastern edge of the area, lies closest to this site. This could mean that, although it may seem the lowest area of risk according to known sites, it is very possible that important undiscovered archaeological remains exist within its boundaries and could be affected by any future quarrying.
- 14.5.5 Iron Age and Roman or Romano-British remains do seem to be scarce within this particular area, but there are several undated earthworks and enclosures within the area surrounding the refined study area and it is possible that they could be of this date; however, without any archaeological investigation, no further conclusions can be drawn. There is therefore a perception that there is little potential for Iron Age and Roman remains to be discovered within the study area that could be affected by future quarrying activity.
- 14.5.6 While early medieval remains are generally scarce in Cumbria, indeed in most of the North West, there are potential remains of the period within the environs of the refined study area. To the north-north-west is a possible early medieval enclosed settlement at Gatra (HER 1026, NGR 307000 520750). Other evidence from the area is largely in the form of stone sculpture associated with churches; the remains of an early medieval cross have been found at St Michael's church near Arlecdon (Bailey and Cramp 1988), which also has medieval architectural components. Aerial photography has identified an extensive area of medieval and post-medieval ridge and furrow and field boundaries within the land surrounding this study area (PNs 667-745). It is likely that this activity extended inside its boundaries, but the nature of more recent activity may have obscured its presence (*Section 14.4.5*). Further evidence of activity from this time within the local area comes from sites such as the deserted medieval village of Arlecdon (HER 1207, NGR 305200 519910), the medieval cross at Lacon (HER 1208, NGR 302460 516660) and the medieval deer park at Lamplugh (HER 43696, NGR 308000 521001).
- 14.5.7 The level of activity within the local environment suggests that there could be further remains that have not yet been discovered within the study area. These may well be at risk from the impact of future quarrying.

15. PEEL PLACE

15.1 GEOLOGICAL CHARACTER

- 15.1.1 The area around Peel Place also comprises glacio-fluvial sand and gravel deposits, laid down during the late stages of deglaciation at the southern margin of an ice sheet originating in Scotland (Livingstone 2010). The deposits form part of a very complex sequence of Quaternary drift deposits, as revealed by an intensive programme of site investigations carried out between 2007 and 2009 in connection with the proposed Low Level Waste Repository (LLWR) site between Drigg and Seascale (Michie *et al* 2010).
- 15.1.2 The general topography of the area, together with the original and refined study area boundaries, the sand and gravel resource outcrops as mapped by the BGS, areas of current and previous surface mineral extraction, the current minerals permission boundaries and the adjoining allocation for future working, have been plotted (Fig 59). The basic geology of the area, taken from the latest available BGS 1:50,000-scale mapping (1999), has also been plotted (Fig 60).

15.2 ARCHAEOLOGICAL ASSESSMENT

- 15.2.1 A general background to the archaeological context of the West Cumbrian Coastal Plain has been compiled, which is relevant to the Eskett and Rowrah (Section 14), Peel Place, and Ghyll Scaur (Section 16) study areas. This is therefore presented under the archaeological assessment of Eskett and Rowrah (Section 14.2), since this is the first to be described.
- 15.2.2 The archaeological data relating to Peel Place was collated within the GIS (Fig 61). It was then refined to remove duplicates and the sites were scored according to period. A site-density score was subsequently assigned to each HLC polygon (Fig 62).

15.3 HISTORICAL IMPACTS FROM QUARRYING

- 15.3.1 The impact on archaeological remains within the Peel Place study area is very minimal. Quarrying is only present in one area, measuring 562.18m², and did not coincide with any known archaeology. This lack of impact from historical quarrying at Peel Place can be demonstrated visually (Fig 62).

15.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 15.4.1 Glacio-fluvial deposits, identified as the ‘Peel Place Sand and Gravel Member’ (Michie *et al* 2010), are currently worked at Peel Place Quarry and occur at or very close to the surface over most of the refined study area. This is reflected in the latest available BGS mapping (Fig 60). Locally, the BGS map reveals that these deposits are concealed beneath post-glacial alluvium or peat and, in places, the sand and gravel unit is absent, with glacial till being exposed at the surface. Detailed borehole evidence demonstrates that lenses of further glacio-fluvial sand and gravel (identified by Michie *et al* 2010 as the Drigg Holme

and Kirkland Wood Sand and Gravel Members, respectively) are present at greater depth within the till, though these are considered most unlikely to be economically workable within the study area because of the thickness of overburden involved. Overall, the thickness of superficial drift deposits ranges from about 30m to 60m, and no exposures of the underlying bedrock occur anywhere within the area.

- 15.4.2 Peel Place Quarry, operated by Tendley Quarries, currently has planning permission until April 2015, although the operator is understood to be likely to request a time extension to complete the extraction of currently unworked permitted reserves. An Area of Search for future working beyond that (subject to future planning applications) has been identified in the emerging *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013) to the north of the existing permission (Fig 59).
- 15.4.3 Twenty-first-century quarrying within the Peel Place refined study area covers 0.162km² and is contained within one polygon (Fig 62). The site of the quarry lies close to the medieval village of Hallsenna (Fig 63) and, as a consequence, it has impacted on archaeological features from the same period. These include the route of a medieval hollow-way identified within the HER (PN 128; Fig 64). The proximity to Hallsenna has also been a factor in prompting archaeological work prior to quarry expansions. Such work took place between 2003 and 2010 in four phases (OA North 2003a; 2004a; 2005b; 2008b; 2010b). Investigations uncovered the remains of medieval and post-medieval ridge and furrow, ditches, gullies, field boundaries and a rutted trackway (PN 173), along with an iron pipe (PN 170). Finds were for the most part post-medieval in date, and generally from within the topsoil. It is thought that these artefacts resulted from the spreading of manure and midden on the fields. Two possible waste flint chunks were found, although it was not possible to date these artefacts closely. Other archaeological assets that have existed within the area of extraction include Greaston Cottage (PN 97), on the south-east edge of the quarried area, and a corner of post-medieval ridge and furrow to the north-east (PN 276).

15.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 15.5.1 Within the short- to medium-term future, sand and gravel extraction in this area is likely to be focused largely, if not entirely, within the identified Area of Search (Fig 59). Beyond that, the most likely prospects would probably fall within the unworked resources directly to the north of the Area of Search, utilising the existing or new access directly onto the A595 trunk road. Consideration might also be given to the resources directly east of the existing permission. It is thought very unlikely that new extraction sites would be developed in other parts of the resource within the foreseeable future, because of their more patchy distribution and poorer access.
- 15.5.2 The Peel Place study area comprises two HLC polygons, both of which have relatively low site-density scores (Fig 62). The largest HLC polygon, which contains all the areas of previous quarrying, has the higher score out of the two. Within this, sites of archaeological interest under threat from future quarrying include a possible prehistoric trackway, following the current line of Stubhead Lane (PN 134; Fig 64), field boundaries associated with Hallsenna medieval

village (PN 127), the findspot of a Roman coin (PN 75), and an undated enclosure close to Blackbeck Bridge (PN 11). Post-medieval remains include areas of ridge and furrow (eg PN 276, PN 278 and PNs 281-4) and the sites of two dwellings, Benfold House (PN 98) in the northernmost corner of this polygon, and an eighteenth-century house and barn at Hallsenna (PNs 143-4). The second polygon also contains prehistoric trackway PN 134, which forms the very edge of area, in addition to a small patch of post-medieval ridge and furrow to the south-west (PN 284).

- 15.5.3 At first, it may seem that any future quarrying within this study area will have little impact upon archaeological remains. However, it is important to look within the wider area. Indeed, the potential for prehistoric remains within the area is very high. Very large numbers of flint scatters and finds have been recorded within the immediate vicinity (PNs 746-53), generally in the area to the west, towards the sea. Further finds include three Neolithic axes from close to the study area at Burntmoor (PN 754), the medieval village of Hallsenna (PN 755) and Holmrook Hall (PN 756), and a middle Bronze-Age cremation (PN 757), found close to Greengarth Hall. Aerial survey has identified a later prehistoric curvilinear enclosure and field to the south of the study area (UID 1579049, NGR 306749 499454).
- 15.5.4 The Roman road from Ravenglass to Moresby (PN 758) passes just over 200m from the study area (Margary 1973), and the site where a bog body of possibly Iron Age or Roman date was found (PN 759; *Section 14.2.3*) lies just beyond the Roman road, to the west. Given the position of these sites in relation to the study area, it may be that further Iron Age / Romano-British sites exist within its boundaries.
- 15.5.5 The close proximity to the medieval village of Hallsenna, where a medieval cross fragment was also found (PN 760), along with the areas of ridge and furrow (eg PNs 280-4), identified through the examination of aerial imagery, and field boundaries (PN 127), shows that this was an area of settlement and agricultural activity during the medieval period. This continued through into the post-medieval period.
- 15.5.6 The several phases of excavation prior to quarry extensions at Peel Place have yielded little archaeological material of any significance (*Section 15.4.3*). However, this does not mean that the entire area is barren of archaeological remains, since the evaluation trenches have only sampled a portion of the area of proposed extraction. This study area therefore still has considerable potential for undiscovered sites of archaeological interest, particularly of prehistoric and medieval origin. These potential sites may well be at risk from the impact of any future quarrying.

16. GHYLL SCAUR QUARRY

16.1 GEOLOGICAL CHARACTER

- 16.1.1 The Ghyll Scaur area is underlain by a complex sequence of igneous rocks known as the Millom Park Formation (Fig 65). This forms part of the Ordovician ‘Borrowdale Volcanics’ Group and comprises mostly volcanic rocks, massively-bedded dacitic and andesitic lapilli tuffs. The formation also includes sills and irregular intrusions of basalt, andesite and basaltic andesite (Young *et al* 2001). The far western edge of the study area encompasses part of the slightly older, but very similar, Po House Tuff Formation (still part of the Borrowdale Volcanics Group), which comprises mainly planar-bedded andesitic lapilli tuffs with similar intrusions.
- 16.1.2 The general topography of the area, together with the resource outcrops mapped by the BGS (1997b), areas of current and previous surface mineral extraction and the current allocation for future workings, have been plotted (Fig 66).

16.2 ARCHAEOLOGICAL ASSESSMENT

- 16.2.1 A general background to the archaeological context of the West Cumbrian Coastal Plain has been collated, which is relevant to the Eskett and Rowrah (Section 14), Peel Place (Section 15), and Ghyll Scaur study areas. This is therefore presented under the archaeological assessment of Eskett and Rowrah (Section 14.2), since this is the first area to be described.
- 16.2.2 The archaeological data relating to Ghyll Scaur was collated within the GIS (Fig 67). It was then refined to remove duplicates and the sites were scored according to period. A site-density score was subsequently assigned to each HLC polygon (Fig 68).

16.3 HISTORICAL IMPACTS FROM QUARRYING

- 16.3.1 Historical quarrying within the Ghyll Scaur study area is characterised by small areas of extraction towards its west and east edges, with an absence of activity in the centre and to the north and south (Fig 68). It is unclear from an examination of the available sources precisely which areas of extraction were active at the end of the twentieth century, and which may have been worked during the early twenty-first century. For the purposes of this assessment, an estimated cut-off point between these episodes of quarrying has been established. The total area of known quarrying within the nineteenth and twentieth centuries comes to 0.119km². Much of the study area lies within the medieval and post-medieval boundaries of Millom Castle deer park (Fig 69; PN 67 and PN 69; Fig 70), and this is the only heritage asset to be affected by historical extraction (Fig 68).

16.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 16.4.1 A single mineral operation, Ghyll Scaur Quarry, exists within the study area, which, in 2009, was granted a time extension to work existing permitted reserves until the end of 2021. Beyond that date, and subject to further planning permissions, an allocation of land for future extraction has been identified within the emerging *Minerals and Waste Local Plan* (MWLP; Cumbria County Council 2013), adjoining the existing workings (Fig 66).
- 16.4.2 The volcanic ‘tuffs’ at Ghyll Scaur (which are the products of accumulated hot volcanic ash and pyroclastic flows) possess physical characteristics which enable them to be used as skid-resistant road-surfacing aggregates (Young *et al* 2001). Whilst this also applies to some of the sedimentary rocks within Cumbria (for instance, those quarried at Roan Edge (*Section 18*) and Holmescales (*ibid*)), the aggregates produced at Ghyll Scaur have the highest Polished Stone Values (PSVs) of any source within England, and are thus able to provide the highest levels of skid-resistance. As such, they are recognised as being of national importance.
- 16.4.3 More generally, all of the rocks within the sequence are likely to be suitable for use as high-quality roadstone, of varying PSV, and are therefore identified as resources on the BGS resource maps. However, the basalt is likely to have a lower PSV than the other rocks and, with the possible exception of minor intrusions (not shown on the published geological map), has not yet been worked. The main basalt outcrop is unlikely to be worked while it is still possible for the quarry to access higher PSV resources within the tuffs and andesites. The main area of basalt (shaded green on Figure 65) falls within the refined study area, but outside both the current permission and the allocation for future working.
- 16.4.4 Locally, within the study area (and more extensively within the surrounding area), the igneous rocks are mantled by generally thin superficial deposits of glacial till. This includes much of the area which has been allocated as an Area of Search for future working (Fig 66). However, the overburden of till in that area would be insignificant compared with the thickness (and economic value) of the mineral beneath.
- 16.4.5 Twenty-first-century quarrying at Ghyll Scaur covers 0.124 km² (Fig 68). The site that has received the largest negative impact from twenty-first-century quarrying within the Ghyll Scaur study area is the Millom Castle deer park (PN 67 and PN 69; Fig 70). The disturbance is much more extensive than the effect of historical quarrying, since the size of the extraction area has increased greatly. In addition to the deer park, the site of a post-medieval farmhouse, Park House Farm (PN 45), has also been negatively affected; the house no longer exists, as the land it once stood on is now part of the quarry.
- 16.4.6 Two archaeological investigations have taken place within the study area: firstly, an archaeological assessment, evaluation and watching brief undertaken in 1995 (LUAU 1995); and a watching brief was later carried out (Headland Archaeology 2005; *Appendix 3*). Neither investigation identified any significant archaeological features.

16.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 16.5.1 Within the short- to medium-term future, hard-rock quarrying within this area is likely to be focused on the existing permitted reserves and on the adjoining Area of Search (Fig 66). Beyond that, similar resources continue to the west and south-west of both of these areas, both within and beyond the boundary of the refined study area, and these represent potential targets for longer-term quarry development. By comparison, the basalt deposits to the north of the existing workings are less likely to be developed.
- 16.5.2 The polygons that make up the Ghyll Scaur study area fall within the lower brackets of site-density score and, given the size of the area, relatively few sites of archaeological interest have been identified (Fig 70). From the sites that have been recorded, those of particular interest include an apparently prehistoric roundhouse settlement (PN 111) in Millom Park, in the south of the area, and a flint flake found near Underwood (PN 119), in addition to a medieval bloomery (PN 116) and the medieval deer park (PN 67 and PN 69). A square enclosure of unknown date can also be seen in the north of the study area (PN 122). Post-medieval remains include a bloomsmithy (PN 121), the Millom Park iron mine (PN 115), and sites of agricultural activity, such as narrow ridge and furrow (PN 353), a sheep fold (PN 491) and field boundaries (PN 221), identified from aerial photographs (*Appendix 1*) and OS First edition mapping (1867d; Fig 69).
- 16.5.3 Although only a few significant sites of archaeological interest have been identified within this study area, there is the potential for further surviving remains that could be affected by future quarrying. This can be deduced from the known sites in the vicinity of Ghyll Scaur.
- 16.5.4 The Ghyll Scaur study area lies close to significant prehistoric activity. Prehistoric finds within the local area include a Neolithic stone axe found at Waterblean (PN 761), a polished axe from Lowscapes (HER 18975, NGR 315000 481000), flints from Kirksanton Haws (HER 18912, NGR 312900 479500) and a Bronze-Age urn found at Beck Farm in Millom (HER 4008, NGR 316000 480000). Two important prehistoric sites lie close to the study area. The first is the Giant's Grave standing stones at Kirksanton (HER 1472, NGR 313610 481100), which includes a cup-and-ring-marked stone and a barrow. Not far from this are the Bronze-Age stone circles and avenue at Lacra (HER 1472, NGR 313610 481100; Burl 1976, 62), one of which contained a cist and a cremation. There is thus considerable potential that further significant sites exist close by, and it is possible that some of these may lie within the boundaries of the study area.
- 16.5.5 As for much of the West Cumbrian Coastal Plain, evidence from later prehistory and the Roman period is scarce. However, two sites have been identified close to the study area from aerial imagery. The first is a bivallate hillfort at Whicham (*Section 14.2.3*), and the second, a possible Iron Age or Romano-British circular enclosure and field boundaries just to the south-east of the study area, towards the Duddon estuary (*Appendix 1*; PN 763).
- 16.5.6 Medieval activity within the area surrounding the study area is extensive. A short distance away to the south-east is Millom Castle, a medieval fortified house with a moat (PN 764). Holy Trinity church, which has medieval architectural components (PN 765), is adjacent to Millom Castle, and this has

led to the suggestion of a deserted medieval village there (PN 762), just to the east. Agricultural activity from this period can be seen in the remains of ridge and furrow ploughing and headland banks identified through the NMP survey (*Appendix 1*; PNs 766-872).

- 16.5.7 Although the archaeological investigations undertaken to date in the study area have produced little evidence (*Section 16.4.6*) of archaeological features, if activity within the local area is taken into account, then there is potential for undiscovered sites of archaeological interest. Any such sites within the study area, already identified, are potentially at risk from future extraction.

17. ROOSECOTE

17.1 GEOLOGICAL CHARACTER

- 17.1.1 In this area, glacio-fluvial sand and gravel deposits occur on gently undulating terrain to the south of the more pronounced topography of the drumlin field which lies immediately to the east of Barrow-in-Furness (Young *et al* 2001). The general topography of the area, together with the resource outcrops mapped by the BGS, areas of current and previous surface mineral extraction and the current allocation for future working, have been plotted (Fig 71). The more general BGS 1:50,000-scale mapping of this area is currently out of print, although the drumlins are very clearly seen on the available Lidar imagery.
- 17.1.2 The glacio-fluvial deposits extend from the edge of the main drumlin field towards the coast, but in places are seen to wrap around other isolated drumlins. Whereas the drumlins, composed largely of glacial till, were deposited beneath, and moulded by, the flow of ice from the Lake District ice cap, the glacio-fluvial sediments would have been laid down by meltwaters during the later stages of deglaciation (Livingstone 2010). It is likely, though it cannot be confirmed, that glacial till underlies the sand and gravel. Within the areas of lowest ground, to the north, east and west of the refined study area, the glacio-fluvial deposits are overlain by more recent (post-glacial) alluvium.

17.2 ARCHAEOLOGICAL ASSESSMENT

- 17.2.1 The archaeological data relating to Roosecote was collated within the GIS (Fig 72). It was then refined to remove duplicates and the sites were scored according to period ([see Section 17.5 for details of sites](#)). A site-density score was subsequently assigned to each HLC polygon (Fig 73).

17.3 HISTORICAL IMPACTS FROM QUARRYING

- 17.3.1 Historical quarrying at Roosecote is restricted to one area measuring 0.153km² in the south-west of the study area (Fig 73). This was active during the twentieth century, although extraction took place just outside the boundary of the refined area during the nineteenth century (Fig 74). Extraction has affected two sites of archaeological importance, a small area of post-medieval ridge and furrow (PN 480; Fig 75) to the north of the quarried area, and a significant early Neolithic occupation site (Headland Archaeology 2001b; PN 161). This site comprised a hearth, containing pottery and two leaf-shaped arrowheads. It is possible that other unrecorded Neolithic remains were once present within the quarried area. It could also be that further areas of post-medieval ridge and furrow and perhaps other types of activity have been destroyed by this phase of historical extraction.

17.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 17.4.1 The glacio-fluvial deposits are worked at Roosecote Sand Pit, which currently has planning permission until May 2029 (following a recent time extension). Older workings, to the north-west of the existing quarry, have now been restored. An Area of Search has been identified within the emerging *Minerals and Waste Local Plan* (MWLP), to the north-east of the existing permission, on the opposite (eastern) side of the A5087 Rampside Road (Fig 71), and further unworked resources are shown to exist to the north, east and south-east of that area on the BGS resource maps.
- 17.4.2 Quarrying in the twenty-first-century at Roosecote expanded from the works undertaken in the twentieth century; the present sand quarry covers 0.316km², overlapping with the area of historical quarrying, which is still retained as an extant, albeit disturbed area.
- 17.4.3 Like the historical extraction, the expansion of the twenty-first-century quarrying has affected the Neolithic occupation site (PN 161; Headland Archaeology 2001b). A further evaluation just outside the area of quarrying, to the north-east, took place in 2014, prior to a further proposed expansion (OA North 2014a). This investigation found a small number of archaeological features, most of which were modern (PN 168), although there were three possible prehistoric pits that contained large unworked pebbles, which have been interpreted as possible pot boilers. This demonstrates that archaeology is present within the surrounding area and, although it is being recorded, it is also being negatively affected by the process of sand extraction.

17.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 17.5.1 Future sand and gravel extraction in this area is likely to be focused largely within the identified Area of Search (Fig 71), though there would seem to be scope (in terms of unworked resources) for that area to be extended in all directions on the northern side of the A5087. Whilst several other parts of the resource might also be exploited, the progressive development of the Area of Search would seem to be a more logical expectation, within the foreseeable future.
- 17.5.2 The Roosecote study area lies close to Barrow-in-Furness on the Furness Peninsula, an area rich in archaeological remains. Significant prehistoric activity has been recorded within this area, with finds dating to the earliest occupation of the region in the later Palaeolithic period (Hodgson and Brennan 2006, 26). Evidence comes from sites such as Bart's Shelter, which yielded a great number of finds, including 80 lithic implements and a late Upper Palaeolithic shouldered point (*op cit*, 25). Walney Island, to the south-west of the study area, has produced a great deal of evidence relating to Mesolithic activity, mainly in the form of flint scatters (Hodgkinson *et al* 2000, 35). Excavations there also suggest that Walney was occupied during the Neolithic period and Early Bronze Age (Hodgson and Brennan 2006, 33), and there is the possibility that there were one or more Neolithic axe-polishing sites in the Furness Peninsula. Examples of both polished and unpolished axes have been found at nearby Stone Close, Stainforth (Davis and Quartermaine 2007), suggesting that the site was involved in the secondary stage of axe

manufacture, and similarly polished and unpolished axes, along with polishing stones (polissoirs), have been found around Leece and Roose, suggesting the presence of a further finishing site near Stank and Roosecote Mosses (Robinson 1985, 36). Examples recovered from within the study area include a stone axe from Stank Moss (PN 85; Fig 75), a celt and perforated stone from Moor Head (PN 84) and flint finds from fieldwalking (PN 96).

- 17.5.3 Previous archaeological work at Roose Quarry, carried out in 2001 (Headland Archaeology 2001b), recovered evidence for prehistoric activity in the form of two finds of polished-stone axeheads, and several cut features, one of which contained two leaf-shaped flint arrowheads and fragments of an early Neolithic pottery vessel (*ibid*). This has been interpreted as an Early Neolithic occupation site (PN 161), the extent of which partially falls within the boundaries of the refined study area. Further evidence for prehistoric activity on the Furness Peninsula has been found during excavations at Sandscale. There, a small posthole structure was associated with a lithic assemblage of later Neolithic/early Bronze-Age date (Hodgson and Brennand 2006, 33). A Neolithic or Early Bronze-Age ring ditch and round barrow have been identified from aerial photography, in the centre of the study area (*Appendix 1*; PNs 316-17). A Bronze-Age spearhead (PN 163) was also recovered on the southern edge of the study area. Numerous other prehistoric finds have been made in the area close by, including further Neolithic axe finds (*eg* PNs 873-4).
- 17.5.4 Evidence of later Bronze-Age and Iron-Age activity within the area is sparser. A large part of the evidence comes from sites in and around the village of Urswick to the north-east of the study area, where a Bronze-Age hoard (HER 2314, NGR 326000 474000) and a knife (HER 2312, NGR 326000 474000) have been found. A rich cist burial, containing a razor, was identified at nearby Stainton (HER 2379, NGR 324120 472500) and a hoard of six late Bronze-Age socketed axes came from Skelmore Heads (HER 2226, NGR 327000 475000; Hodgkinson *et al* 2000, 45). Skelmore Heads is thought to be a multi-phase Iron-Age hillfort (Powell 1963), the presence of which suggests that the Furness area could have held significance within the region, showing a high level of social, economic and political sophistication in the presence of a stratified society (Shotter 1995, 73).
- 17.5.5 On first examination, Roman activity within Furness seems to be minimal, especially compared to other parts of Cumbria, where further activity is well-known (Breeze 2006). The Furness peninsula has a particularly low density of Romano-British sites (Philpott 2006, 64). Although it is possible that some earthwork remains that once stood in the churchyard in Dalton represented the site of a fort (Elsworth 2007, 32-3), there is no firm evidence for this type-site or associated Romanised settlement in the area, and evidence for farmsteads is rare (Shotter 1995, 73).
- 17.5.6 However, numerous Roman artefacts, particularly pottery fragments, have been recovered, suggesting a steady level of activity (Elsworth 2007, 43). It is probable that the Romans exploited the natural resources within this area, particularly the rich supply of iron ore (Shotter 1995, 74). The Barrow area has also produced a considerable number of Roman coins, particularly from around Furness Abbey, although it is possible that this may be the result of collection by the monks (*op cit*, 75). However, it is also possible that these finds indicate

the presence of substantial Roman activity around the Abbey (Elsworth 2007, 43). A re-examination of evidence has also strengthened the argument for the existence of a Roman road across the peninsula (*ibid*).

- 17.5.7 Despite varying levels of evidence, the Roosecote study area does not contain potential Iron-Age or Roman remains. A rectilinear enclosure has, however, been identified in the north-north-west of the study area (PN 875). Further possible remains dating to this time in the vicinity include Iron-Age or Romano-British field boundaries, and a pit alignment at Catty Crook Lane, identified by the NMP survey (PN 881; *Appendix 1*).
- 17.5.8 Place-name evidence on the Furness Peninsula suggests Anglo-Saxon and Scandinavian settlement in the area. This is supported by finds, such as possible early Christian burials reported close to the study area at Roosebeck (HER 2614, NGR 326000 468000), which could suggest the presence of a long-cist cemetery somewhere in the area (O'Sullivan 1985, 23), and a ninth-century sword from the graveyard at Rampside church (Gaythorpe 1910; Paterson *et al* 2014, 173). In addition, in 2011, a Viking hoard of silver coins with some other artefacts was discovered in the vicinity of Dalton by a metal detectorist (www.dockmuseum.org.uk).
- 17.5.9 Roose is recorded in Domesday Book (1086) as one of the largest villas in Furness, comprising six carucates, amounting to *c* 600 acres (Faull and Stinson 1986; Wardell Armstrong 2000, 3). In 1127, the Furness area came under the control of Furness Abbey, which was granted the land by the future King Stephen of England (Hodgkinson *et al* 2000, 57). Agricultural activity increased on the peninsula in this period, as a result of the establishment of monastic granges (Rollinson 1963, 14). By 1292, the monks had established 11 granges on the peninsula, one of which was at Roose (Hodgkinson *et al* 2000, 57). This grange was particularly associated with sheep and wool (Rollinson 1963, 22). Other activity besides major agriculture at this time included iron working, salt extraction and fishing, with extensive trading links as far as Ireland. The monks also invested in defence, building and maintaining a castle on Piel Island, close to Barrow (Newman 1996). Furness Abbey was the first of the major monasteries to be dissolved in England in 1537 (C Newman 2006, 130).
- 17.5.10 There is some evidence for a deserted medieval village, known as Fordbodele (PN 152), within the study area at Roosecote, and the findspot of a medieval strap-end (PN 105) and ridge and furrow (PN 389) are also within the area to the north of the A5087. The site of a deserted medieval village, known as Crivelton or Neuton, is thought to be to the south-east of the area, towards the coast (PN 876). The presence of these sites adds to the evidence that this area saw a high level of activity during the medieval period.
- 17.5.11 The agricultural character of the area persisted for some time after the dissolution of the abbey in 1537. Evidence of this can be seen in the presence of post-medieval ridge and furrow in and around the boundaries of the study area (*eg* PNs 479-80). However, during the nineteenth century, the area became more industrial in character, along with much of the area around the rapidly expanding iron and port town of Barrow-in-Furness. Extensive haematite extraction and iron working took place and, as a result, the population of the area dramatically increased (Wardell Armstrong 2000, 4).

Sites linked to this phase of activity include the Stank Iron Mine (HER 5585, NGR 323200 470700), which was to the north of the study area.

- 17.5.12 This level of activity demonstrates that the Furness peninsula saw considerable activity, particularly in the prehistoric, medieval and post-medieval periods. Sites representing all of these are known both within and around the boundaries of the refined study area, indicating that the potential for further phases of quarrying to affect sites of archaeological interest is high.

18. ROAN EDGE

18.1 GEOLOGICAL CHARACTER

- 18.1.1 Roan Edge is a relatively new quarry for hard-rock aggregates, developed initially in the early 1990s in response to the growing need for high-specification, skid-resistant road-surfacing aggregate. Although somewhat lower in PSV than the volcanic rocks at Ghyll Scaur Quarry (*Section 16*), the strata at Roan Edge are directly comparable, in this respect, with those found at only one other active quarry in Cumbria, at Holmescales, near Kendal, and c 6km to the south-west of Roan Edge, and also at three quarries within the Yorkshire Dales National Park. In the north of England, they are therefore still of considerable strategic importance.
- 18.1.2 In this case, the mineral comprises a sequence of hard, Silurian siltstones and sandstones, formerly known as the ‘Kirkby Moor Flags’, and now classified as part of the ‘Kendal Group’ on the latest geological map (BGS 2008; Young *et al* 2001; Fig 76). Within most of the study area, the Silurian rocks are exposed at the surface. Around the edges of the outcrop, and in much of the surrounding areas, they are concealed beneath relatively thin superficial deposits of glacial till.
- 18.1.3 The general topography of the area, together with the extensive resource outcrops mapped by the BGS (which includes areas concealed beneath thin superficial overburden), areas of current and previous surface mineral extraction, the current permission boundaries and allocation for future working, have been collated (Fig 77). The basic geology of the area, taken from the latest available BGS 1:50,000-scale mapping (BGS 2008), has been plotted (Fig 76).

18.2 ARCHAEOLOGICAL ASSESSMENT

- 18.2.1 The archaeological data relating to Roan Edge was collated within the GIS (Fig 78). It was then refined to remove duplicates and the sites were scored according to period (*see Section 18.5 for details of sites*). A site-density score was subsequently assigned to each HLC polygon (Fig 79).

18.3 HISTORICAL IMPACTS FROM QUARRYING

- 18.3.1 Historical quarrying has been noted on maps from both the nineteenth and twentieth centuries (OS First edition 6" to 1 mile maps (1862a; 1862b; Fig 80); OS 6" to 1 mile map (1899a; 1899b; 1899c; 1899d)). This comprises four small areas of quarrying with a total area of extraction of 6.418km² (Fig 79). None of these areas have any impact on any recorded heritage assets.

18.4 PRESENT-DAY IMPACTS FROM QUARRYING

- 18.4.1 A single minerals planning permission, Roan Edge Quarry, exists in this area (Fig 77), with a current expiry date of 2038. Directly adjacent to this, to the east and south-east of the existing permission, an Area of Search for future extraction has been identified within the emerging *Minerals Waste Local Plan* (MWLP; Cumbria County Council 2013).
- 18.4.2 Twenty-first-century quarrying within the Roan Edge study area covers 0.299km² and is much greater than the historical activity (Fig 79). The area is made up of one polygon with a low density of archaeological sites, which are clustered towards the west of the area, including small sections of a possible later prehistoric or medieval curvilinear enclosure (PN 312; Fig 81), a small area within the medieval and post-medieval New Hutton deer park (PN 70), and a small area of ridge and furrow (PN 311). The quarry only impacts upon one feature, a post-medieval trackway (PN 308). The relative absence of recorded archaeology within certain areas of this study area may be a true representation of the evidence; however, it is just as likely that it results from the lack of archaeological interventions in the area, and therefore, any sites that were affected by the quarrying may have been removed without record.
- 18.4.3 Only limited amounts of archaeological investigation have been undertaken in advance of quarry works. A programme of palaeoenvironmental sampling was undertaken in 2006 to assess the survival and extent of the peat deposits, and this found only two small pockets of peat, one of which, at NGR 358400 492500 and 1.54m in depth, had a well-preserved environmental record of mid- to late Holocene vegetation (OA North 2006a). In 2010, on the same site, two boreholes were drilled to a depth of 1.30m and sub-samples were taken at NGR 358200 492600, which were used for palynological and plant macrofossil analysis (Cotswold Archaeology 2010).

18.5 POTENTIAL FOR FUTURE IMPACTS FROM QUARRYING

- 18.5.1 In the short- to medium-term, future sandstone quarrying in this area is likely to be focused on the existing permitted reserves and the identified Area of Search (Fig 77). Beyond that, the resources continue in all directions but, given the constraints imposed by the adjacent road and the M6 Motorway, future proposals are perhaps most likely to seek to extend the workings southwards, following the crest of the hill.
- 18.5.2 Only a few known sites are at risk from future extraction within the Roan Edge study area, mainly in the northern part of the area (Fig 81). The majority of known sites are medieval or post-medieval in date, including New Hutton deer park (PN 70) and areas of medieval and post-medieval ridge and furrow. It also contains the site of Goody Cross Stones (PN 110), where three stones, thought to date to the medieval period, mark the point at which Firbank, Lambrick and Hutton lordships meet. Post-medieval and twentieth-century quarries and trackways have also been identified through aerial photography (PN 44, PN 310 and PN 308; *Appendix 1*). The only possible prehistoric site, a curvilinear enclosure, which may also have medieval activity, straddles the western edge of the study area (PN 312). The low level of sites with a high period score has meant that the density score for the site as a whole is low. However, there may

be other unidentified sites lying within the boundaries of the study area that could also be potentially at risk from future quarrying.

- 18.5.3 Activity in the wider landscape suggests that there could be unidentified prehistoric sites within the study area. The examination of aerial images has revealed a possible later prehistoric roundhouse (*Appendix 1*; PN 879) to the north-east, and a later prehistoric hut platform associated with areas of prehistoric ridge and furrow, known as a cord rig (*Appendix 1*; PNs 877-8). The amount of prehistoric activity is not as extensive as elsewhere in the county, such as on the Furness Peninsula and West Cumbria Coastal Plain (*Sections 17 and 14*). However, a scattering of prehistoric sites has been identified in the surrounding area, including a possible long cairn at Black Essett Plantation (HER 13767, NGR 358600 488700) and possible prehistoric clearance cairns at Craggstones, near Sedbergh (HER 18570, NGR 364450 493660). Bronze-Age activity is known in the form of a circular platform at Middleton Hall (HER 5753, NGR 362800 487400), and a flanged axe has been found at Tarney Bank Tarn (HER 16726, NGR 358000 488000).
- 18.5.4 Several sites within the locality have been assigned a later prehistoric or Roman date within the HER, for example, a possible settlement at Brichfield (HER 4713, NGR 360990 496000), enclosures at Lakethwaite (HER 18592, NGR 360340 495700), and roundhouses at Craggstones (HER 18569, NGR 364290 493520), close to Sedbergh. It has also been suggested that Castlesteads hillfort (SM 43089), near Oxenholme, has probable Iron Age origins (Collingwood 1908; English Heritage 2014).
- 18.5.5 There is no direct evidence relating to Roman-period archaeological remains within the study area, but there was clearly a presence within the locality. The site is close to the main arterial Roman road linking the forts at Watercrock (near Kendal) and Low Borrowbridge, which passes close to Sedbergh (Margary 1973). The fort at Low Borrowbridge lies some 16km north of the study area, in the Lune Valley, and is believed to be an early Flavian foundation (Shotter 2004, 62). That at Watercrock was established in *c* AD 80 and was occupied until at least the later years of the fourth century (Birley 1957, 14; Potter 1979). Several sites are associated with the road, including a Romano-British settlement at Birks Farm (HER 2088, NGR 356600 493300), and a Roman strap fitting (HER 42895, NGR 358000 489000) and pendant (HER 42896, NGR 358000 489000) were found close to Old Hutton.
- 18.5.6 Like many parts of Cumbria, evidence for activity in the early medieval period is rare. Evidence of activity can, however, be seen in the place-names. Anglo-Saxon influence can be identified in place-names ending in *-ham* and *-tun* (Rollinson 1967, 58), such as Hutton, which is situated very close to the study area, and means ‘farmstead on the hill’. ‘Hutton’ is one of the few entries in Domesday Book for the old county of Westmorland, within the manor of Whittington (Faull and Stinson 1986). This is now divided into Old and New Hutton, the latter being the result of farmers in Old Hutton seeking new land in the middle of the thirteenth century (Millward and Robinson 1974, 140; Smith 1967). Other names in the area originate from Scandinavian dialects. The nearby town of Kendal was known historically as Kirkby-Kendal. ‘Kirkby’ is of Scandinavian derivation, meaning ‘settlement with a church’ (*op cit*, 143).

- 18.5.7 The area surrounding Roan Edge seems to have seen a substantial amount of activity in the medieval period. The study area is situated partially within and close to several medieval deer parks. As well as the New Hutton deer park (PN 70), Killington Old Park (HER 14640, NGR 360500 489500), Lambrigg Park (HER 6808, NGR 359000 494000) and Middleton deer park (HER 4028, NGR 362000 487000) were near by. In addition, a shrunken medieval village is thought to exist at New Hutton (HER 3632, NGR 356200 491300), just to the south of the boundary of the study area.
- 18.5.8 All of this evidence of archaeological activity suggests that this area has the potential to yield further archaeological evidence from multiple time periods. Although the number of known sites of archaeological significance potentially at risk from future quarrying is relatively small, evidence from the surrounding area supports the theory that there could be further unidentified sites at risk from extraction, particularly dating from the medieval period.

19. DISCUSSION

19.1 INTRODUCTION

- 19.1.1 This study of the mineral resource of Cumbria has identified those areas across the county, excluding National Parks and AONBs, where there is the greatest potential for expansion of quarries up until 2028, based upon extant permissions, the *Cumbria Minerals and Waste Local Plan* (2013 to 2028; Cumbria County Council 2013), and an understanding of the available mineral resource. While the greatest potential for expansion is within quarries that have existing permissions, there is also limited potential for expansion beyond the permissions within the timeframe up to 2028. Although it is possible to attempt some prediction as to which direction quarry expansion is likely to occur beyond the existing permissions, this cannot be confidently defined without the benefit of superior geological information; however, it can be more confidently asserted that expansion will not extend beyond the boundaries of the refined study areas. In the light of this, it has been possible to examine the identified archaeological resource, based on existing documentation and new survey, that will potentially be affected by quarry expansion.
- 19.1.2 By means of GIS analysis of the identified resource, it has been possible to highlight those zones within the study areas that have the greatest density of significant archaeological monuments (*Sections 8-18*). This GIS-based scoring system entailed counting the numbers of archaeological monuments within polygons and applying a scored weight according to their individual significance, which was defined on the basis of their date and their designated status. Hence a polygon with a high score indicates that it contains a substantial number of generally older and more significant monuments. While this scoring is based on known monuments, those polygon areas of significant archaeological resource also have a greater potential for further, as yet undiscovered, remains; thus the GIS analysis can provide an initial indication of areas that need particular investigation in advance of quarry works. However, in terms of future planning applications, the use of the data should be subject to guidance from professional archaeologists or heritage curators, who would be able to consider all factors in assessing the potential for previously unrecognised sites. In particular, it should be emphasised that a low heritage score for an area, based on existing data, is not a guarantee that it does not contain a significant buried resource.
- 19.1.3 While the scoring strategy imposed on the resource is a valuable indicator of archaeological significance, and archaeological potential, there needs to be a caveat in relation to its application. While every attempt has been made to produce meaningful results from this approach, it is based upon extant knowledge of the archaeological resource, and that in turn is based upon an extended history of archaeological exploration. Those quarry sites which have benefited from more investigation invariably have a greater documented resource, and consequently have a higher resource score. Nevertheless, the assessment has highlighted areas where there is clearly a need for ongoing archaeological investigation to inform the mineral planning process.

19.1.4 **Assessment of Potential:** the process has demonstrated that there is considerable variation in the identified resource and the scoring for the different areas of extant permissions. It has also highlighted those areas where there is the greatest potential for sites being affected by future extraction. The potential for a significant heritage resource to be affected by extraction can be divided into areas where there is little potential damage, to those where the damage is likely to be significant.

19.2 AREAS OF APPARENTLY LITTLE POTENTIAL

19.2.1 **Brampton Kame Belt:** the areas with extant permissions in the Brampton Kame Belt, for both sand and gravel and hard-rock quarries, for the most part have little in the way of identified/recorded archaeological resource, and thus the scoring for all the quarry sites is low. This is particularly the case for Silvertop (*Section 8.5.7*; Fig 16), Low Gelt (*Section 8.5.10*; Fig 19) and Faugh No 1 quarries. Kirkhouse Quarry has a high score for the north-eastern part of the study area (*Section 8.5.9*; Fig 16), but this is a result of Lord Carlisle's Brampton to Midgeholme railway (*Section 8.3.3*; Webb and Gordon 1978), which is a Scheduled Monument (SM 32895) and thus has a significant impact upon the scoring. The monument is, though, well defined and, by virtue of its designation, would be protected within any future extraction programme. It is not, however, an indication of a wider archaeological sensitivity in the rest of the study area with permission to extract, which is generally minimal.

19.2.2 **Cardew Mires:** Cardew Mires similarly has a limited density of archaeological sites (*Section 10.5*; Fig 32), and thus has a low score. The present Area of Permission is within the flood plain of the River Wampool, which is a type of terrain that traditionally has not provided many known archaeological sites, particularly as surface expressions. This is because the landscape would most often have been used as water meadow, although it is possible that there might have been water-powered or water-management features within these areas. It is, perhaps, not very surprising that the score for this area is very low. However, this should be treated with some caution, as it is within this sort of context that very significant prehistoric remains were recovered during the construction of Preston Dock in the 1880s (OA North and University of Liverpool 2007; Dickson 1887), when workmen discovered dozens of skulls of red deer and aurochs, as well as 24 human skulls, a flint arrowhead, and two dug-out boats. While the radiocarbon dates subsequently obtained indicated activity over an extended time, the majority of the dates were from the Neolithic period (Sidell and Haughey 2007). Significantly, the finds were recovered from a considerable depth (reported as 4.5m below the bed of the River Ribble), and beneath substantial deposits of aggregate, which had been deposited by the river subsequent to the prehistoric period (OA North and University of Liverpool 2007). Similarly, very significant waterlogged prehistoric remains have been found at Stainton West, near Carlisle, within the fluvial deposits of the lower Eden Valley, which reflect extensive occupation between the Mesolithic period and Bronze Age (Brown *et al* in prep). This highlights that, within such river valley contexts, significant archaeological remains, and also palaeoenvironmental records, can survive beneath (and within, in the case of the palaeoenvironmental evidence) what would typically

be perceived as natural deposits. It is normally very difficult to evaluate the archaeological resource effectively at such depths, and therefore, particular methodologies need to be established.

- 19.2.3 **Roan Edge and Ghyll Scaur:** both Roan Edge (*Section 18.5*; Fig 81) and Ghyll Scaur (*Section 16.5*; Fig 66) quarries have seemingly little heritage potential, as the majority of the identified resource is post-medieval quarrying. Each does, however, lie close to areas with potential for archaeological remains, the main Roman and medieval route northwards in the case of Roan Edge, and a medieval deer park in the case of Ghyll Scaur. The extensive historical extractions have, however, mostly sterilised the site of earlier activity within the extent of the extant permissions, but the extraction itself has become an archaeological site, albeit of relatively little significance.
- 19.2.4 **Peel Place:** Peel Place similarly has little heritage potential and a generally low score (*Section 15.5*; Fig 62). Much of the existing Area of Permission has already been worked, and the area that is most likely to be affected by future extraction is to the north of the Area of Search. The identified resource for the most part comprises post-medieval farming features and twentieth-century quarrying. The only site of note is an area of apparently medieval strip fields (PN 173; *Section 15.4.3*; Fig 64), but this has in part been removed by the existing extraction. The site has been subject to a number of archaeological evaluations in advance of each phase of extraction (*Appendix 3*), which have to date revealed no significant archaeological features. Despite this apparently limited resource within the study area, the wider locale within the coastal plain has a rich prehistoric resource (Cherry and Cherry 1983; 1987), reflecting the fact that the area has been intensively occupied since the Neolithic period. The apparent dearth of identified sites, may belie that there is in reality a more significant buried resource in the vicinity.

19.3 AREAS OF MEDIUM POTENTIAL

- 19.3.1 **Moota:** Moota Quarry has an extensive Area of Permission, of which only part is presently worked; within the short- to medium-term future, development will be concentrated within the present Area of Permission (*Section 12.4.1*). Much of the identified heritage resource relates to the limestone geology and its historical extraction; there are five sites of limekilns and associated quarries within the area (PNs 117-18 and PNs 517-19; Fig 46). The most notable site within the Area of Permission is a medieval beacon (PN 107), and if it has survived the existing landscaping, this would warrant further investigation. Generally, the northern part of the Area of Permission has a low score, whereas the southern part has a medium to high score, in part reflecting the beacon site, but also the numbers of historical extractive sites (*Section 12.5*).
- 19.3.2 The Papcastle / Old Carlisle Roman road is situated just on the boundary of the Area of Permission, and it is likely that contemporary settlements would have been placed in the environs of this main communication route (*Section 12.5.4*). Indeed, a scooped settlement (PN 112) is situated about 500m away from the line of the Roman road, and this is particularly relevant to the present study, as it is only 120m from the edge of the existing Area of Permission. Scooped settlements are typically of late prehistoric or Roman date (Quartermaine and Leech 2012); given its proximity to the road, this example is perhaps more

likely to have been later in this sequence. The presence of the scooped settlement in the vicinity of the area of potential extraction could be an indication that there are other, as yet undiscovered, remains within the environs of the settlement site, and indeed, there is the potential for further settlements associated with the road. However, the part of the existing Area of Permission that is closest to the road has already been quarried, and will no longer have any surviving archaeological remains, either on the surface or buried.

- 19.3.3 ***Eskett and Rowrah:*** Eskett and Rowrah are two closely associated quarries, with an Area of Permission extending between the two (*Section 14.4.1*). Eskett Quarry is nearly exhausted, and future extraction is likely to concentrate around Rowrah Quarry (presently dormant) to the north (Fig 54). The study has identified a substantial heritage resource in this area, which is, for the most part, within the Area of Permission; as a consequence, the scoring for this area is relatively high (*Section 14.5*). However, the sites are largely post-medieval in date, and include a number of iron-ore extraction sites (eg PN 236, PN 500, PN 502 and PN 504; Fig 58), and limestone quarries (eg PN 233), as well as nineteenth-century mineral railways (PN 131, PN 132 and PN 226), which transported the ore ultimately to the line running along the Cumbrian coast. In addition to this, there are also several areas of post-medieval ridge and furrow.
- 19.3.4 The identified sites reflect an archaeological resource that is either documented on nineteenth-century mapping or is visible as a series of surface features within the current landscape. While there is always the possibility that there are significant buried sites within the extent of the Area of Permission, there is nothing evident from the range of identified sites that would suggest this. For the most part, the high score reflects large numbers of post-medieval sites of lesser significance, and, in the event of the expansion of the quarry in the future, it is likely that the identified resource can, for the most part, be mitigated by landscape survey techniques.

19.4 AREAS OF HIGH POTENTIAL

- 19.4.1 There are four areas of quarrying that have the highest potential of having an impact upon a significant archaeological resource.
- 19.4.2 ***Tendley:*** Tendley Quarry will, within the short- to medium-term future, be working within its existing permission, which extends to the north and south of the present quarry (*Section 13.4.1*; Fig 47); that to the east of the Brigham / Eaglesfield road is less likely to be worked. The key sites within the area are two Roman roads (PN 135 and PN 569; Fig 51), which must have crossed somewhere at or near the south-eastern part of the present quarry. Given that settlements are likely to have been situated in the environs of such roads, and particularly close to crossroads (Shotter 2004), there exists the very real possibility that early archaeological remains survive in the area to the south of the existing Area of Permission (*Section 13.5*; Fig 50).
- 19.4.3 Early medieval inhumations had been reported in the nineteenth century on Tendley Hill, and the early medieval date for at least one nearby burial is confirmed by a Viking type of sword (Cowen 1948; 1967). Further inhumations were reported as having been found to the east of the Brigham / Eaglesfield road, at NGR 3091 5287 (Wilson 1978), although this location is

not necessarily reliable. An archaeological evaluation was undertaken in the southern part of the extraction area to investigate the possibility of early medieval inhumations (Headland Archaeology 2003a), but none were revealed; the identified resource was instead mainly of post-medieval date, including substantial amounts of ferrous material.

- 19.4.4 Although the exact locations and date of most of the inhumations cannot be reliably confirmed, the presence of early medieval material is not surprising, given the proximity of the Roman roads, which would have continued to be prominent landscape features after the end of the Roman period. The settlement of Eaglesfield, immediately to the south of the quarry, is perhaps significant, as its name is believed to have derived from the British word *eccles*, meaning church (Wilson 1978, 50), which would suggest the presence of an early religious institution. Given the presence of the Roman roads and the early medieval activity, the area to the south of the quarry, within the existing Area of Permission, has a considerable potential for as yet unidentified buried remains.
- 19.4.5 **Low Plains:** Low Plains is an active quarry, and has a sizable Area of Permission (*Section 9.4.1*; Fig 22). While there are existing applications in progress for additional areas, it is considered that, in the short- to medium-term future, extraction will be from within the existing Area of Permission. There is a broad range of significant archaeological sites, both within the Area of Permission and its environs, the rich diversity of remains in part resulting from the presence of the Wragmire Roman road (PN 61; *Section 9.5*; Fig 27). This would have attracted settlement in the Roman period, as represented by a Romano-British ditch, probably a boundary (PN 261; NPA 2009a), to the east of the road, which may be an indication of contemporary settlement. In subsequent periods, the crossroads would have also provided a focus for settlement, as the routes clearly continued to be used. However, the area had also been a focus for earlier activity, demonstrated by rich remains, including a cup-and-ring-marked stone (PN 106), a cropmark, which would appear to be of prehistoric date (PN 94), a Bronze-Age cremation cemetery (PN 101; OA North 2005a), and an unclassified cropmark. This level of activity reflects the position of the study area on a well-drained, north/south-orientated ridge, which would have been a natural line of communication. Given the substantial numbers of significant remains, the Area of Permission has a correspondingly high resource score.
- 19.4.6 Many of the most significant sites (PN 94, PN 101, PN 177 and PN 261) are within the Area of Permission, but have already been investigated in advance of extraction, since the site has been subject to considerable archaeological campaigns, both evaluatory and in mitigation for the loss of the resource (OA North 2000a; 2003b; 2005a; 2005c; NPA 2009a; *Appendix 3*). The sites recorded by the investigations had not been documented previously and thus they form an important indicator that future archaeological work is likely to reveal new sites. As such, the area of Low Plains has a very high potential for an, as yet undiscovered, heritage resource.
- 19.4.7 **Roosecote:** at Roosecote, the Area of Permission is largely worked, and there is potential for an expansion of the quarry in almost all directions, including north of the A5087 road (*Section 17.5.1*; Fig 71), within the short- to medium-term

future. Within the area of potential expansion, significant remains are documented, as well as the potential for the identification of as yet undiscovered remains (*Section 17.5*). The area therefore has a high resource score to the south of the A5087, and only a slightly lower score to the north of the road. Particularly significant is the suggested Neolithic settlement site (PN 161; Fig 75) to the south-east of the existing Area of Permission revealed by evaluation (Headland Archaeology 2001b), which identified a hearth and flint arrowheads. Neolithic settlements in the North West are extremely rare and potentially very important (Hodgson and Brennan 2006). Immediately adjacent to the Area of Permission are three possible prehistoric pits (PN 168) and, slightly further afield, and partly on the north side of the A5087, are the findspots of a stone axe (PN 85), a celt (PN 84) and flints (PN 96), which testify to further prehistoric activity. Further to the north-east is the cropmark of a rectilinear enclosure (PN 881), which has the potential to be of Iron Age or Roman date. While it is unlikely to be affected by any expansion of the quarry in the medium-term future, it is an indication that there is activity of that period in the area.

- 19.4.8 The range of significant prehistoric and Roman sites in the immediate vicinity of the quarry, not to mention early medieval material from Rampside Churchyard (Gaythorpe 1910), is an indication of a high level of activity throughout these periods, and any further expansion of the quarry has a considerable potential to impact on both known sites and those yet to be discovered. Medieval activity is also recorded in the vicinity. There is consequently a need to allow for further archaeological investigation to inform the planning process.
- 19.4.9 **Abbeytown Ridge:** the Abbeytown Ridge is in considerable demand for aggregates and there are presently four active quarries on it; however, it is considered that future extraction over the short- to medium-term will be concentrated on the three northernmost sites (Overby, High House and Aldoth Quarries) and within an Area of Search that has been allocated between Overby and High House quarries (*Section 11.4*; Fig 34). Within these areas, there are considerable numbers of documented archaeological sites, particularly around the High House quarry, and a correspondingly high resource score was achieved. These include field systems, Iron Age / Romano-British enclosures and settlements (eg PNs 201-2, PN 204; Fig 38), Bronze-Age round barrows (PN 200 and PN 207), and cremations (PNs 180-1), which highlight the fact that the ridge was once a rare area of well-drained land within a wider area of poorly drained land (Hodgkinson *et al* 2000). It has consequently been a favoured place for settlement and agricultural activity for many thousands of years. There are substantial numbers of known significant sites within the High House Area of Search and existing Area of Permission. Several of these have been identified using aerial photography, including Iron Age / Romano-British boundaries (PN 204, PN 210, PN 449 and PN 474) and enclosures (PN 145), and an undated, but potentially Iron Age / Romano-British, field system (PN 78). Evidence from archaeological investigations has been more firmly dated, and includes charred grain dating from the early-middle Bronze-Age (PN 179; NPA 2006c) and a Bronze-Age field system (PN 26; NPA 2008a).
- 19.4.10 What is particularly interesting, though, is that there is a close correlation between the identification of significant prehistoric / Romano-British sites and

archaeological interventions, of which there have been 14 to date in advance of quarry operations (*Appendix 3*). The implication is that significant archaeological remains have been identified during most of these evaluations, and that any future archaeological work in this area is very probably also going to find significant remains. The area is thus both in considerable demand for aggregate, and yet also has an exceptional potential for the discovery of significant archaeological sites. The present study has demonstrated that there is a very considerable need to undertake further archaeological investigations within the area of search at the earliest opportunity to ensure that full consideration can be made of the archaeological resource in the course of the overall planning process.

19.5 ASSESSMENT OF TECHNIQUES

- 19.5.1 The NMP survey provided a valuable opportunity to increase knowledge of the archaeological resource within the environs of each of the study areas, and was extremely effective, being able to identify 500 new sites and enhanced 32 previously documented sites (*Appendix 1*). The survey used a number of techniques to identify the resource, including aerial photography, ASCii Lidar data and Raster Lidar data, and, as such, provides a good opportunity to assess the value and effectiveness of the different techniques, so as to provide guidance for implementing future, comparable, surveys.
- 19.5.2 **Raster Lidar:** the NMP survey examined, in total, 102km², and, at the time of mapping, Lidar data were available for 57km². Initially, this was delivered as low-resolution, colour, raster images (.jpps), with set parameters (eg one-direction lighting, fixed azimuth, and no vertical exaggeration); at that stage, 33km² of data were delivered in this format.
- 19.5.3 **ASCii Lidar:** during the later stages of the NMP survey, 1m- and 2m-resolution ASCii gridded data became available and were used in preference to the raster images for the remaining survey areas. These data were processed either as 16-direction hill-shade models or as a series of single-lit views, depending on the resources available. Digital Surface Models (DSM) were examined in preference to Digital Terrain Models (DTM), except in areas of extensive tree cover, where DTM was used. With these data, the lighting, azimuth and vertical exaggeration parameters could be adjusted to optimise the appearance of even fairly low earthworks. Approximately 24km² of data were delivered in this format.
- 19.5.4 **Assessment:** although the raster files required no processing and could be examined in a relatively short time, the rewards from this raster Lidar data in terms of new finds were relatively low. The data were useful to verify the presence of upstanding earthworks, where their physical condition was ambiguous on the most recent conventional air photography. However, a lack of visible earthworks on the raster Lidar images was not considered to be a reliable indicator of monument condition, because of the static parameters and in particular because these images failed to reveal linear features that were parallel to the fixed direction of the defined lighting.
- 19.5.5 The relatively low resolution of the raster data, both in terms of the original gridded data from which they derived, which was mostly at 2m resolution, and

of the jpeg output, resulted in a low confidence in the recording of any apparent features that could not be verified from the aerial photographic imagery. This meant that even in areas of complex and well-preserved earthworks, such as the industrial landscapes of the Eskett and Rowrah study area, very little new information was gleaned specifically from this type of imagery.

- 19.5.6 Despite the fact that ASCii Lidar data were available for only a third of those areas examined by the project, it was very evident that this was a much more efficient method of mapping in areas where earthwork survival was generally good. This includes upland areas and those that have been under pasture for an extended period. In these areas, most features were mapped using the processed ASCii Lidar data and were then checked against the air photographs; as a consequence, this significantly reduced the amount of rectification that was required. Several significant monuments were uniquely identified by this technique, including an oval enclosure near Roan Edge Quarry. Where it was available, the ASCii Lidar data were also considered to be a good indicator of monument condition at the time that the information was collected. One of the greatest assets of the technique was that it provided accurate mapping data without the need for the processing of aerial photographic sources, and it improved the accuracy of output from remote sensing. The resolution of the 1m Lidar data was significantly better than the 2m Lidar data. Thus, although the 2m Lidar data can be used to record substantial earthworks, they were found to be, for the most part, inadequate for recording more subtle earthwork features.
- 19.5.7 It is clear that there is considerable potential for using Lidar to identify the surface heritage resource remotely. Although this technique is becoming a major tool within the remote-sensing arsenal, however, it should not replace conventional aerial photography, and should rather be seen as being an additional technique that is effective in augmenting the aerial photography, if used alongside it. Because it records the ground / air interface, its greatest strength is in recording earthwork features; however, if DSM data are used, it can also reveal cropmarks.
- 19.5.8 Perhaps the greatest advantage of the method is that, using DTM Lidar data, features beneath vegetation and, specifically, woodland canopies can be recorded. It thus provides a remarkable opportunity to record surface features in woodland, that previously could only have been recorded using laborious and expensive total-station survey.
- 19.5.9 **Recommendations:** as a result of this assessment, the following specific recommendations have arisen out of this NMP programme. These do not form part of the present project, but should, perhaps, be considered either as an element of follow-on NMP work, or in advance of specific development proposals at the sites highlighted.
- Consolidate the results of the NMP survey with the earlier NMP projects for each study area;
 - Target specialist aerial reconnaissance on cropmarked landscapes and features between the A6 and Blackrack Beck (Low Plains); near Dungeon Lane and Moor Head Cottage (Roosecote); the north side of Dalston

(Cardew Mires); Whicham Beck (Ghyll Scaur); and the eastern end of the Holme Abbey Ridge complex (Abbeytown Ridge);

- Undertake ground-truthing of several previously unidentified earthworks in the Roan Edge NMP survey area, around Eaglesfield (Tendley), and the Drigg hedged enclosures (Peel Place);
- Undertake detailed field survey of the Coalfell Beck landscapes (Brampton Kame Belt);
- Re-evaluate Schedule Monument status and descriptions of the cropmarked settlement on Cardew Hill (UID 10507/SM10077206, PN 914, Fig 32) (Cardew Mires), and enclosures on Lazonby Fell (UID 12466, NGR 350137 540329 and UID 12463, NGR 350676 540419, both SM1007195) (Low Plains);
- Devise protection strategies for the potentially regionally important Catty Crook Lane cropmarked complex (Roosecote; PN 881);
- Formalise archiving procedures for non-core data, *eg* photograph lists;
- Make provision for the archiving and dissemination of a version of the project mapping that contains all the original object data (*Appendix 2*).

19.5.10 **Refinement of site information:** in many instances, the work provided an opportunity to check and refine existing HER and NRHE sites, and the present survey allowed more detailed plotting of the known sites, which had invariably been represented by a single coordinate location. For the most part, the plotted positions of the previously defined HER and NRHE sites fell within the broad extent of the newly plotted landscape outlines; however, in a limited number of instances, there were more severe errors within the previously defined sites. There was also the issue of a number of duplicate records for some of the sites, reflecting the fact that the data are of mixed quality, having been compiled from a wide range of ancient and modern sources. There has, in the past, also been a tendency to retain all the site information within the record, rather than purging or combining the records. In the present study, the process has thus entailed the merging of multiple records, when conflicting site locations have been logged in the HER and NRHE databases.

19.6 RECOMMENDATIONS AND FUTURE RESEARCH AGENDA

19.6.1 **Research Agenda:** within any of the study areas, any further archaeological research should be undertaken in accordance with a focused research agenda that addresses the regional archaeological priorities. This should be in accordance with the Archaeological Research Framework for North West England (Brennand 2007). On this basis, a series of general research questions are proposed, although individual sites will have additional questions pertinent to themselves.

19.6.2 **General Themes:** general research questions fall into a number of different themes:

- How has the environment developed during the Holocene within the environs of each of the quarry sites (but particularly the Cardew Mire

quarry site), and to what extent has man had an impact on it (Hodgson and Brennand 2007, Initiative 2.15)?

- How important are areas where aggregate extraction is likely for an understanding of settlement patterns? To what extent do the well-drained sands and gravels and limestone areas result in more fertile and workable soils than the clayey till or acid upland areas, and to what extent has this caused an imbalance in patterns of settlement and the remains of human activity (Hodgson and Brennand 2007, Initiative 2.32; Philpott and Brennand 2007, Initiatives 3.28; Newman and Brennand 2007, Initiatives 4.18)?
- To what extent will aggregate extraction have an impact on a significant heritage resource? Have areas of aggregate extraction been understudied in the past, because the rural farming regimes have resulted in conservative land-use patterns and have not previously been under notable threat? Will aggregate extraction, as a result, have a markedly higher impact upon rural archaeological remains, by comparison with other areas?
- To what extent does the large-scale nature of aggregate extraction enable mitigative archaeological exploration at a landscape level rather than specifically at the more localised context of an individual site? Will this allow relationships between upland and adjacent lowland areas to be established?
- To what extent do limestone areas have an increased potential for enabling an understanding of human activities in these areas? Will the improved preservation of palaeoenvironmental data in the form of animal bones, human bone, snail shells, and charred plant remains (Brennand *et al* 2007, 183) provide significant potential for palaeoenvironmental analysis? To what extent can studies in such areas complement the wealth of environmental material recovered from lowland wetland environments (Hodgkinson *et al* 2000)?

19.6.3 **Specific Themes:** in addition, themes specific to individual quarries or landscape areas can be compiled:

- With respect to the areas around the Abbeytown Ridge, Moota, Tendley, Eskett and Rowrah, Peel Place, Low Plains, Cardew Mires and the Brampton Kame Belt quarries, to what extent is there demonstrable evidence of prehistoric activity within the Cumbrian coastal plain and the Eden Valley? How does this relate to the adjacent marginal lands (Hodgson and Brennand 2007, Initiatives 2.13, 2.29 and 2.43)?
- There is considerable potential for the identification and analysis of rural native settlement in association with Roman communication systems. In particular, to what extent did native rural settlements develop and expand to meet the requirements of the Roman army, or did much of the rural settlement have their origins in the Pre-Roman Iron Age (Philpott and Brennand 2007, Initiatives 3.8, 3.12, 3.27, 3.28 and 3.29)?
- What evidence for early medieval activity can be demonstrated in relation to Roman roads, and in particular can the junction of Roman

roads at Tendley be recognised as a focus for early medieval burial, religious and settlement activity (Newman and Brennan 2007, Initiatives 4.25, 4.31 and 4.36)?

- Can the development of quarrying and mining through the eighteenth to twentieth centuries be demonstrated at the quarry sites and can changes in social patterns be identified in relation to the expansion of mineral extraction? How did this impact upon the rural economy (Newman and McNeil 2007, Initiatives 7.17 and 7.40)?

19.6.4 **Recommendations for Conservation:** the study has identified the quarry sites and areas of potential extraction that are under the greatest threat in the short- to medium-term future (until 2028). It has also demonstrated the known resource that will be affected by any proposed quarry extensions and the areas around existing quarries that have the greatest heritage potential, based on a scoring system of the known resource. However, the scoring system cannot define the extent and character of the unknown buried resource but, at a very basic level, if there is known early activity in the environs, then there is potential for there to be more associated sites that are still to be identified. Abbeytown Ridge, for example, is an island of raised, well-drained, ground within a wider area that was poorly drained, which contained several raised bogs. It is perhaps not surprising, therefore, that investigations to date have demonstrated that it is a palimpsest of activity from the prehistoric period through to the present, and there is consequently a considerable likelihood that future extraction will identify more sites.

19.6.5 The other, potentially significant, factor is that some areas have benefited from greater levels of archaeological investigations in the past than others and this may have resulted in a bias in the results of these assessments. Abbeytown Ridge, for example, has seen substantial levels of archaeological investigations in advance of various episodes of quarry expansion, as well as other archaeological work (for instance, field survey as part of the North West Wetlands Survey (Hodgkinson *et al* 2000)), and this has both identified new archaeological sites and has also highlighted the potential for a significant buried resource. As such, this reinforces the perception that the area has a high archaeological potential. However, it is also noteworthy that Peel Place has also benefited from significant levels of pre-intervention archaeological investigations, but these have not resulted in a significant increase in the identified resource, and it is evident that the level of past investigations is only one factor in the assessment of the heritage potential.

19.6.6 Taking into consideration the potential for bias resulting from different levels of past investigations, the study has enabled a provisional assessment of prioritisation of areas and quarry sites, where there is the greatest need for future heritage management. However, this assessment of significance can only be provisional and, while it is important to prioritise attention to those areas which presently have the most significant resource potential, there is also a need for further investigations in those areas that presently have apparently less potential, as these may have a resource that is as yet unrealised.

19.6.7 The fact that areas apparently at greatest risk have been identified allows for the targeting of resources and management attention to minimise the impact of future extraction upon any significant heritage resource in these areas.

However, it is essential that the threat to the resource is actively anticipated, rather than waiting until the extraction proposals are active, otherwise the development plans will, by that stage, be too advanced to enable any significant modification. In this case, the only available option would be mitigation by record, which ultimately entails the destruction of the archaeological site and considerable expense to the developer. Undertaking sufficient early research to establish the character, extent, date, and significance of the heritage resource enables this information to be used during the early stages of quarry planning, and thus allows the possibility that the significant heritage assets can be preserved *in situ*.

- 19.6.8 ***Dialogue and Outreach:*** to highlight the presence of heritage assets at an early stage of planning will necessitate an ongoing dialogue with both the quarry operators and mineral planners. This needs to be undertaken at both a national level, so as to highlight the wider issues of archaeology at extraction sites, but also at a local level with individual quarry operators, to address the needs at each of the quarries. In terms of the dissemination of the issues to a wider audience, the project Steering Group has suggested that articles in the main trade journals would be the most effective way of informing the different elements of the minerals extraction community (quarry operators and minerals planners). These should introduce the issues of potential archaeological remains within areas of extraction, and the importance of preserving that resource. *Quarry Management* and *Minerals Planning* have been suggested as the best journals to target. At a local level, there is a need to create a dialogue between curators and all active quarry operators, but particularly targeting those where there is the greatest perceived threat to the heritage (*Section 19.4*).
- 19.6.9 By working in conjunction with both minerals planners and quarry operators, it should be possible to achieve a mutually acceptable compromise that enables the extraction to take place, but minimises the impact on the archaeological remains. This is a process that has been successfully achieved at the Thornborough Henges (Nosterfield), in North Yorkshire, where permissions were agreed for extraction, despite the proximity of a nationally important prehistoric landscape (Archaeoscope 2008). In this instance, the key issue was that the archaeological significance of the area around the Thornborough Henges had not been fully determined and it was not known to what extent extraction could be undertaken without affecting the archaeological resource. English Heritage and North Yorkshire County Council encouraged the quarry operator to develop a model to assist a better understanding of the detailed character and significance of this archaeological landscape (*ibid*). This entailed gathering together all existing archaeological knowledge and information, then analysing the form and development of the landscape. The information was compiled through the use of various non-intrusive investigatory techniques, including desk-based assessments, aerial photography, Lidar imagery and localised geophysical surveys; these datasets were mapped within a GIS. A landscape hypothesis was developed and then tested by carrying out trenching and coring in key areas. The results were then analysed to create guidance as to where little or no damage to archaeological remains would arise if extraction was to happen. Archaeological characterisation was carried out not only on the application site but also on the wider landscape; this ensured that future

applications for any quarry extensions could be planned to take into account archaeological considerations.

- 19.6.10 The work carried out at Nosterfield demonstrated that an integrated approach to determine the history of the environment and landscape change would work well, as this process has led to an improved understanding of the landscape (how it was formed; how it was and is currently used; what the landscape supports and what it holds within it to provide evidence of former use). As a result, the project has successfully characterised the archaeological resource, greatly assisting an assessment of the impact of future quarrying proposals. This is an approach endorsed by *Mineral Extraction and Archaeology: A Practice Guide* (MHEF 2008).
- 19.6.11 ***Integrated Investigations of Threatened Landscapes:*** it can be argued strongly that there is a need for such an integrated landscape investigation at those Cumbrian quarry sites that have the greatest heritage potential. Such investigations should use mainly non-destructive techniques to provide a better understanding of the below-ground archaeological resource within those areas of immediate and longer-term threat, with a view to developing quarry extensions that have a minimal impact upon the archaeological remains. The value of GIS-driven projects has been demonstrated by the Nosterfield project (*Section 19.6.4*), to allow the incorporation of the results of a range of techniques with geological and topographical data, so as to build up a model of the heritage resource alongside the mineral potential. As far as possible, remote-sensing investigative techniques should be used, which would provide a rapid and cost-effective means of exploring the areas. It is the nature of the soft, well-drained, aggregate deposits, that constitute the geology of these areas, that they are particularly amenable to the use of remote-sensing techniques. Aerial photography taken at the right time of the year (for instance in drought conditions), has been demonstrated to be very effective by the Vale of York Visibility Project, revealing a large density of cropmark sites on sands and gravels which dramatically contrasted with areas of glacial tills, where there were almost none (Howard *et al* 2008; Capita Symonds and OA North 2012). If Lidar is to be used to record sites, it is recommended that 1m (minimum) ASCii Lidar DTM and DSM data be used in future remote-sensing applications, as it can significantly improve the value of the output.
- 19.6.12 Similarly, low-altitude photogrammetry, using an Unmanned Aerial Vehicle (UAV), if undertaken in similar drought conditions, can be effective for the identification of cropmarks. In some instances, subtle earthwork features can also be identified that have not been seen by conventional aerial photographic techniques or on Lidar images. Geophysical survey techniques, particularly resistivity and magnetometry, have also been demonstrated to be effective at identifying below-ground archaeological features (Powlesland *et al* 2006). Depending upon whether the land has been ploughed or not, it may be possible to undertake surface artefact surveys to identify ceramics or lithics in the topsoil. If the land is under pasture, shovel test-pitting is an alternative method which, although a more time-consuming process, can be effective in identifying material in the topsoil. While these techniques are effective at identifying sites with a rich material culture, particularly those with lithics, and Roman, medieval and post-medieval sites with assemblages of ceramics, they

are less effective at identifying sites with a limited material culture, such as those from the Iron Age and early medieval period.

- 19.6.13 Some of the extraction sites have deposits of significant palaeoenvironmental potential that can inform the vegetational history of the locale as well as providing an indication of human impacts upon the natural environment. The notable example is Cardew Mires, which works a fluvial aggregate source, and has considerable waterlogged deposits, which could provide a valuable indication of the changing environment, both at the site and in the wider area. It is recommended that a programme of palaeoenvironmental coring and analysis should be undertaken on the deposits ahead of further extraction at this site. The value of the technique was demonstrated by a palaeoenvironmental programme on deposits from the Ribble Valley (OA North and University of Liverpool 2007), which established the developmental sequence of the river terraces across the lower Ribble, and highlighted the stratigraphic contexts where there was potential for archaeological sites, even in areas of deep deposits of sediment.
- 19.6.14 If the quarry is proposing expansion into a new area, it is hoped, with the support of the County Archaeological Service, that it would be possible to undertake collaborative prospection with the relevant quarry company, which could entail combined ventures to undertake geological and palaeoenvironmental coring across the area. Such work is often a necessity for the quarry company as geological data are sometimes very ‘broad brush’, and more detailed information is required to allow detailed quarrying plans to be proposed. Collaborative prospecting could either be under archaeological supervision or result in the taking of duplicate cores, so that the information can be analysed from a geological and a palaeoenvironmental and archaeological perspective. Such coring is particularly important at sites such as Cardew Mires, as it may prove possible to explore deeply buried, sub-alluvial, archaeological, deposits beneath later fluvial deposits of sand and gravels, which typically restrict the use of conventional archaeological prospection techniques, such as geophysics.
- 19.6.15 Following on from the programme of survey, there may be a need for larger-scale targeted evaluation trenching to test the character of the identified resource and to enhance the landscape model. The resultant model can provide the basis for a continued dialogue with the mineral planners and quarry operators to develop an extraction strategy that minimises the impact of the extraction process on the archaeological remains.
- 19.6.16 **Landscape Status:** at present, the most sensitive extraction area, the Abbeytown Ridge, has no designation that reflects the significance of the landscape or even the individual monuments, the implication being that the importance of the sites is not being given due consideration in long-term planning for the area. While it may potentially be possible to designate individual sites as Scheduled Monuments, this will not necessarily recognise the significance of the wider landscape and the potential for the discovery of as yet unidentified monuments. One possibility is that the wider area of the Abbeytown Ridge could be defined as a Site of National Importance. This designation would be made at local authority level. The National Importance Programme is presently being reviewed by English Heritage (eg OA North

2014b), but if the programme is developed further, then there may be potential to consider designating wider landscapes, such as the Abbeytown Ridge, as being nationally important, thus greatly increasing their standing within the planning process.

19.7 CONCLUSIONS

- 19.7.1 The project has identified the considerable archaeological potential within areas in Cumbria that may be subject to aggregate extraction in the foreseeable future, and has highlighted those areas where there is both the greatest heritage potential and also the greatest risk. On this basis, it has been possible to recommend future programmes of archaeological investigation that will concentrate on those areas with the greatest potential, and also suggest ways in which a better understanding of the buried resource can be gained with minimal recourse to expensive evaluation and excavation strategies.
- 19.7.2 One of the most important aspects of the project, however, is that it has highlighted the need for a closer dialogue between the heritage and planning communities and the extraction companies, so that true understanding of the needs of both can be gained. This will allow information as to the likely impact of future extraction to be shared (*Sections 19.6.8-15*) during the planning stages, which in turn will enable the development of strategies for the preservation of the heritage resource, rather than simply its preservation by record as it is identified immediately in advance of, or during, extraction. The first stage in establishing such a dialogue should be to produce articles highlighting the issues of heritage and aggregate extraction within appropriate trade journals (*Section 19.6.8*). As such, this represents the next stage of the ongoing programme of managing the heritage resource in quarry areas, and should form the culmination of the present project.

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APPENDIX 1: NATIONAL MAPPING PROGRAMME

A1.1 INTRODUCTION

A1.1.1 The NMP is generating a comprehensive record of the archaeology that is visible on air photographs for the whole of England. It is an ongoing programme and had covered over 46% of the country as of September 2013.

A1.2 BACKGROUND TO THE SURVEY AREAS

A1.2.1 Stage 1 of the *Terrestrial Mineral Resource, Cumbria*, project had defined 11 study areas where ‘the potential for the destruction of the archaeological resource was deemed to be greatest as a result of future aggregate extraction’ (OA North 2013, 7). The methodology and rationale for the selection of these 11 study areas was laid out in the project design (*op cit*, 17-18).

A1.2.2 To meet the requirements of the NMP, the study areas had to be extended to cover full kilometre squares (Fig 4). Parts of some of the extended areas had been dealt with by two earlier NMP-standard projects, namely the Hadrian’s Wall Project (NRHE Event UID 1360986; Small 2008) and the North-West RCZA (NRHE Event UID 1461811; Bacilieri *et al* 2009), and so these parts were excluded from this new work. As a consequence, the areas covered by the air photographic and Lidar mapping interpretation element are slightly different from those defined for the present project.

A1.2.3 The NMP survey areas studied covered a total of 102km². The aggregate potential provided the focus for the definition for each of the 11 NMP study areas, all of which lay outside the Lake District National Park, although some of the NMP survey areas did clip the Park boundary.

A1.3 ARCHAEOLOGICAL SCOPE

A1.3.1 ***Sphere of Interest:*** the scope of this project broadly mirrors the NMP Sphere of Interest (Winton 2012, section 5). The main aspects that are pertinent to this particular project and any divergence from it are summarised below:

- ***Cropmarks, Parchmarks, Soilmarks:*** all sub-surface archaeological remains are recorded when visible as cropmarks, parchmarks or soilmarks;
- ***Earthworks:*** all archaeological earthworks that are visible on aerial photographs or Lidar imagery are recorded. This includes features visible as earthworks on early photographs, but which have subsequently been levelled;
- ***Buildings and Structures:*** all foundations of buildings visible as cropmarks, soilmarks, parchmarks, earthworks or ruined stonework are recorded. Standing roofed or unroofed buildings are usually more appropriately recorded by other methods, so will not normally be mapped. The exceptions are in specific archaeological contexts (*eg* industrial and military complexes and country houses), or when associated with other

cropmark and earthwork features. Other unroofed structures, particularly twentieth-century military structures, sheepfolds and shooting butts, can be mapped if considered to be of archaeological significance to the project;

- **Ridge and Furrow:** all medieval and post-medieval ridge and furrow and prehistoric cord rig are recorded, regardless of preservation, according to NMP conventions;
- **Post-medieval Field Boundaries:** exclude post-medieval field boundaries, whether seen as cropmarks, earthworks, or still extant, with the exception of circumstances when they may be of particular archaeological significance (eg when field systems are not mapped by the OS);
- **Parkland, Landscape Parks, Gardens and Country Houses:** this was not particularly relevant to this project, but refer to Winton 2012;
- **Industrial Features and Extraction:** due to this project's focus on past and future aggregates and minerals, a more inclusive approach was taken to the recording of extraction sites in particular. Small local-use quarries were recorded and all quarries of all dates up to the most recent air photographs were depicted;
- **Transport:** the Sphere of Interest suggests that transport features, such as canals and railways, should not be recorded by the NMP if they are depicted on historical OS maps. The approach of this project was more inclusive, and disused mineral railways in particular were depicted where they were integral to the industrial landscape;
- **Urban areas:** this was not particularly relevant to this project, but refer to Winton 2012;
- **Twentieth-century Military Features:** all First and Second World War, as well as Cold War features, were recorded;
- **Natural Features:** all natural features which are geological or geomorphological in origin are excluded. If there is risk of confusion in contexts with other archaeological features, then the natural features should be mentioned in the text record but they should not be mapped.

A1.4 SOURCES CONSULTED

- A1.4.1 **Air Photographs:** three collections of air photographs were consulted for this project (Table 5). Contact details for these collections are provided in *Appendix 2*.

Collection Name	Quantity consulted	
	<i>oblique air photographs</i>	<i>vertical air photographs</i>
EHA	363 specialist + 5 military obliques	2482
CUCAP	35	21
Cumbria County Council	127	21
Total	803	2524

Table 5: Air photograph collections and summary of material consulted (includes duplicates between collections)

- A1.4.2 *English Heritage Archive (EHA) (formerly NMR)*: the vertical, specialist oblique and military oblique air photographs held by the EHA were made available to this project in a series of loans. The prompt and efficient servicing of photographic loans by the Archives team, and in particular Luke Griffin, ensured that this project was able to progress smoothly. A small proportion of photographs could not be loaned and laser copies were supplied *in lieu*. Some recent digital photography was supplied as electronic files because no physical prints have been produced. Unfortunately, there is, as yet, no mechanism for the stereoscopic examination of digital photographs for the NMP, which may have been useful in some cases. The EHA loan reference numbers are given in *Appendix 2*. These refer to the lists of the loaned photographs and as such are a record of the EHA images consulted for this project.
- A1.4.3 *Cambridge University Committee for Aerial Photography (CUCAP) collection*: this project was carried out in collaboration with CUCAP (briefly known as Cambridge University's Unit for Landscape Modelling), its contribution being the loan of air photographs to English Heritage's Aerial Survey and Investigation Team (York). Loans were limited to 100 photographs at a time.
- A1.4.4 *Cumbria County Council*: the county holds a collection of oblique and vertical air photographs at its offices in Kendal. The vertical air photographs were flown by the RAF, the OS, Fairey Surveys Ltd and Hunting Surveys Ltd. The vertical coverage is inconsistent and not complete, and many of the vertical photographs are duplicates of those held in the EHA. The oblique air photographs are attributed to a variety of organisations and individuals, including CUCAP, Manchester University, T Gates and RH Bewley.
- A1.4.5 To facilitate completion of each survey area in turn, the available air photographs in this collection were scanned in advance and the scanned copies were used for interpretation and mapping during the course of the project. Permission to scan the photographs of Tim Gates, solely for the purposes of mapping and interpretation, was sought and granted. Small-scale vertical photographs and those duplicated in the EHA were not scanned. Duplicates of CUCAP photographs were not scanned because these would become available via that collection (*Section A1.4.3*).
- A1.4.6 *Digital air photographs supplied through the pan-Governmental Agreement*: geo-referenced 0.25m-resolution colour digital air photographs produced by GeoPerspectives were made available to this project through the pan-

Governmental Agreement (PGA). These were supplied as 1km² tiles and were taken on various dates between May 2008 and September 2010. This imagery is a digital-only product (no prints), so it was viewed on screen during the course of mapping from the other photographs and again towards the end of the mapping process for each quarter sheet, to inform the assessment of monument condition.

- A1.4.7 *Online digital air photographs*: digital air photographs delivered online by Google Earth were examined and were captured and rectified where necessary. The imagery delivered by Bing was consulted on an *ad hoc* basis as and when information from all other sources was ambiguous.
- A1.4.8 *Light Detection and Ranging (Lidar)*: Environment Agency Lidar data were available for approximately 55% of the overall project areas. At the outset of this project, this was limited to low-resolution, georeferenced, colour raster images (jpegs) with fixed parameters (*eg* lighting, azimuth and vertical exaggeration). However, during the course of the project, 1m- and 2m-resolution ASCII data became available and were used in preference to the raster images for the remaining NMP survey areas. The ASCII data were processed either as 16-direction hill-shade models or as a series of single-lit views, depending on the resources available. Digital surface models were examined in preference to digital terrain models, except in areas of extensive tree cover. Figure 5 shows the relative coverage of raster and ASCII Lidar data as used by this project.
- A1.4.9 *Existing Site Records*: the textual and spatial monument and event records in the National Record of the Historic Environment (NRHE) were routinely consulted during the course of this project. Existing NRHE monument records were updated with new information from the air photographs and mapping. Where there was no existing monument record pertaining to the archaeological features mapped from the air photographs and/or Lidar imagery, then a new record was created.
- A1.4.10 The Cumbria HER supplied monument and events data for the NMP survey areas. This informed the mapping and recording, and the NRHE records that were created or enhanced by this project were concorded with the HER records.
- A1.4.11 *Historical Maps*: the historical OS maps delivered through English Heritage's WEBGIS were consulted in tandem with the air photographs and Lidar imagery. These informed interpretations and where appropriate were identified as a source in the NRHE monument record.

A1.5 METHODOLOGY AND RECORDING

- A1.5.1 *Mapping Methods*: all of the available air photographs from the specified sources were examined under magnification and stereoscopically where possible. Photographs selected for transcription (rectification and mapping) were then scanned at a suitable resolution; this was usually 300 dpi, and output as uncompressed TIFF format images (.TIF).
- A1.5.2 Scanned images were rectified using the specialist software AERIAL5.33. Control information was mostly derived from the OS Land-Line™ 1:2500-

scale vector maps, which were also used as a base for mapping. Accuracy for the OS raster 1:2500 maps is in the range of $\pm 2\text{m}$ and acceptable tolerance for rectification of photographs is generally $\pm 2.5\text{m}$.

- A1.5.3 Rectified images were output from AERIAL in uncompressed TIFF format at a minimum resolution of 300 dpi and a scale of 1:2500.
- A1.5.4 Individual digital maps for each survey area were created in MAPINFO Professional 11.5. The rectified images (air photographs and Lidar) were placed into the relevant map drawing and the archaeological features were then digitised from the images, observing the NMP standards (Winton 2012).
- A1.5.5 **Recording Strategy:** there are two strands to the NMP recording strategy and these were both employed for this project. The main strand is the creation of new, or the enhancement of existing, monument records in the NRHE. The NMP-generated entries or enhancements for each monument or monument group in this database record the location, the monument types present and their dating, the latest condition, a free-text description of the monument or monument group, the source of record information (*ie* photograph and any bibliographic or cartographic references) and administrative details such as concordance with SMR/HER records, record authorship, and links to NRHE event records and archives.
- A1.5.6 To assist in the management and querying of the map data in a GIS or in Autodesk Map® environment, selected monument data are attached to each individual mapped feature (Table 5). The content of this data table is listed *Appendix 2*.
- A1.5.7 **Quality Assurance:** during the lifetime of the project, the air photographs, mapping and recording for sample areas were examined and checked by English Heritage's own Aerial Investigators to ensure the product met the required standard for the NMP.

A1.6 BRAMPTON KAME BELT

- A1.6.1 The Brampton Kame Belt area is split into two by the Hadrian's Wall NMP Project (Small 2008; Fig 4). The two parts are quite distinct, with the northern being dominated by the moorland fringe, small pasture fields and wooded valleys, and the southern part being characterised by hummocky moraines and larger fields.
- A1.6.2 Considerable numbers of new monuments were recorded in this survey area (Table 6). No monuments of Neolithic or Bronze-Age date were identified, however. This agrees with the general paucity in the NRHE of finds or monuments from these periods in this area.

Survey Area	Brampton Kame Belt
Area covered (km ²)	13
Number of new NRHE monument records	75
Number of enhanced NRHE monument records	5
Number of records concorded with HER monuments	15

Table 6: Brampton Kame Belt: new and enhanced sites

- A1.6.3 Although most of the features recorded are earthworks of medieval or later date, the hummocky moraine to the south and east of Tarn Lodge Farm, Castle Carrock, has produced cropmarks that may be of earlier origin (UID 1029653, PN 553, Fig 20). Long ditches, 600m and more in length, cross east to west between the B6413 and the farm, with one long and several short sections extending north to south across these. An earlier assessment of recent aerial reconnaissance indicated that these linear features extended beyond the survey area and formed a fairly cohesive field system (Small 2008). A fragment of a possible contemporary enclosure is recorded a little to the north (UID 1573368, PN 8830), and another more substantial rectilinear enclosure lies to the west (UID 1573369; NGR 352860 554430). These features have been identified in the HER as being of possible Iron Age or Roman date, although the dating of the latter enclosure is more equivocal.
- A1.6.4 In the northern area, cropmarks near Williamgill Wood suggest the presence of two Iron Age or Roman rectilinear enclosures (UID 928546, PN 884, Fig 17). Cropmarks in this part of the Brampton Kame Belt survey area are otherwise very rare.
- A1.6.5 Cultivation ridges are fairly extensive in the northern area but appear to be absent in the southern strip, although this is likely to reflect differential preservation rather than the real extent of historical cultivation. Most of these features are in the form of narrow ridge and furrow and date to the post-medieval period. Some of the ridges are broader, but only those on the north bank of Coalfell Beck have been identified as being of medieval origin; most are attributed to the medieval and/or post-medieval periods because specific dating information is lacking.
- A1.6.6 The remains of several different post-medieval extractive industries are to be found in the northern part of this survey area. In the east, the landscape is dominated by Clowsgill Limeworks and its associated infrastructure (UID 12504, PN 885, Fig 17). The large quarry and internal features, including limekilns, an incline plane, the bed of a conveyor, and several structures, appear to be well preserved. The limeworks were served by the Tindale Fell Waggonway and the Blacksike Railway (shown as dismantled railway on Figure 17), and parts of these survive as earthworks (UID 1573284, UID 1573219 and UID 1573229, PN 886, PN 414 and PN 887).
- A1.6.7 To the east of Clowsgill Limeworks, on the slopes of Coalfell Beck, the earthwork remains of a complex history of coal extraction are present. These include clusters of small extraction pits (*eg* UID 1573193, PN 888), larger single shafts with substantial rings of spoil (*eg* UID 1573166, PN 889), adits (*eg* UID 1573180, PN 900), and the Howard Pit drift mine (UID 963436, PN 901). Intriguingly, amongst these, on the north side of the beck, there is a series of tofts and building platforms, and fields arranged around several well-defined hollow-ways (UID 1573191, PN 902). These may have been a post-medieval settlement and/or processing area associated with the coal extraction, but an earlier origin for these earthworks cannot be discounted on the present evidence. These remains were not previously recorded in the NRHE.
- A1.6.8 To the west of Clowsgill Limeworks, the features that were mapped comprise mainly the medieval and/or post-medieval cultivation ridges (PNs 937-47), small discrete quarries (*eg* UID 963430, NGR 356960 558597), some with

limekilns (eg UID 958433, NGR 356370 557986), and some incised trackways (eg UID 1573306, NGR 355697 558077) of likely post-medieval origin.

- A1.6.9 Of particular note is a small group of earthworks at Moss Pladdow. These comprise walled and ruined walled boundaries of likely post-medieval date (UID 1573309, NGR 355949 557822) but within them, a small group of mutilated earthworks was noted that appear to represent small embanked or walled enclosures (UID 1573311, NGR 355930 557765 and NGR 355943 557849). Whether these are the remains of stock enclosures or roundhouses, and their date, are not known.

A1.7 LOW PLAINS

- A1.7.1 Again, a relatively large number of sites was recorded in the Low Plains survey area (Table 7), and it is rich in prehistoric and Roman-period earthworks and cropmarks. Just below the ridge near Castlerigg Castle, there is a cropmark of a ring ditch that may indicate the remains of a Neolithic or Bronze-Age burial mound (UID 1573713, PN 903, Fig 27). The ring ditch is slightly oval in plan, which may suggest that this monument was more complex than a single-phase round barrow. On the opposite side of the valley, in the field to the north-east of Low Plains Farm, is a possible Iron Age palisaded enclosure (UID 1573681, PN 14). It is visible as a very narrow cropmark ditch or gully outlining a rectilinear enclosure with bowed sides. The enclosure appears to be cut by a field boundary of possible later Iron Age or Roman date (*Section 19.4.5*).

Survey Area	Low Plains
Area covered (km ²)	11
Number of new NRHE monument records	43
Number of enhanced NRHE monument records	16
Number of records concorded with HER monuments	25

Table 7: Low Plains: new and enhanced sites

- A1.7.2 Three hill-top enclosures of possible Iron Age or Roman date were recorded in this area. Two lie on local promontories and opposite one another on either side of a small valley (UID 1454250 and UID 1573704, PN 263 and PN 904) The third sits higher up, on the edge of Blaze Fell (UID 11356, PN 905). The two lower examples appear to be fairly simple ditch-defined enclosures, with only slight hints of internal or external features. The third example is defined by a more substantial ditch, with hints of an internal counterscarp and internal divisions. However, these differences may simply be the result of differential survival, since the latter is a substantial earthwork, whilst the two lower-lying enclosures have been truncated by modern ploughing.
- A1.7.3 In the low-lying fields between the A6 and Blackrack Beck, there are traces of three rectilinear enclosures which may also date to these periods (UID 1573644, UID 1573647 and UID 1573648, PN 906, PN 63 and PN 264).

Unfortunately, the cropmark evidence there is rather ambiguous and they thus warrant further specialist reconnaissance.

- A1.7.4 A significant feature in this survey area is the presence of numerous long linear boundaries. These have been recorded on Thiefside Hill and the lower southern slopes of Blaze Fell (*eg* UID 1573628 and UID 1473670, PN 907 and PN 259). Most of these features are single-ditched, but there is a group of them that converge towards the A6 on the south-east side of Thiefside Hill and which are double-ditched and may have been trackways (*ie* UID 1573629, UID 11364 and UID 1573638, PNs 908-10). Together, the boundaries and trackways appear to comprise a large and slightly irregular system of land division. This may have been associated with the Roman farmstead at Petterilgreen (UID 11351, PN 911) on the north-west side of Thiefside Hill, but may have had its origins in the Iron Age.
- A1.7.5 The Petterilgreen Roman farmstead is a substantial rectilinear enclosure defined by a broad rampart with inner and outer ditches (UID 11351, PN 911), surrounded by fields defined by ditches and trackways (UID 927416, PN 912 and PN 371). This farmstead was 700m to the west of the Roman road between Brougham and Carlisle (UID 1031541; PN 61). In this area, the A6 follows the course of this Roman road, except at Thiefside Hill, where the modern route briefly diverts to the east around the hillside, and the remains of the Roman road are visible as distinct parchmarks on the air photographs (UID 1573635, PN 270 and PN 913).
- A1.7.6 Three of the earthwork enclosures recorded on Lazonby Fell, near the southern edge of this study area, had been identified as being of medieval date within the NRHE record descriptions (UID 12466 and UID 12463). No new evidence arose from this work to contradict this. Two of the enclosures comprise low and indistinct earthworks (UID 12466, NGR 350137 540329), the larger being irregular in plan, and it apparently encircles a small knoll; the second appears to be cut by the north-eastern circuit of the larger, although a subsequent field inspection had concluded that these earthworks were indecipherable (UID 12466). The third enclosure sits slightly upslope and 540m to the east (UID 12463, NGR 350676 450419). In recent decades, it has been under woodland plantation and so has been obscured on most recent air photographs, but a site inspection concluded that a medieval origin was plausible (UID 12463).
- A1.7.7 There is very little earthwork or cropmark evidence of other post-medieval activity in this survey area. Ridge and furrow of any date is relatively sparse and the large-scale extractions at Low Plains (UID 1573671, PN 257) and near Abbots Moss Farm (UID 1573696, PN 374) did not start until the twentieth century.

A1.8 CARDEW MIRES

- A1.8.1 A relatively large number of new sites was recorded in the Cardew Mires survey area (Table 8). No monuments of Neolithic or Bronze Age date were identified, and this agrees with a general paucity in NRHE records of finds or monuments of these periods in this area.

Survey Area	Cardew Mires
Area covered (km ²)	10
Number of new NRHE monument records	35
Number of enhanced NRHE monument records	3
Number of records concorded with HER monuments	6

Table 8: Cardew Mires: new and enhanced sites

- A1.8.2 Three areas of possible Iron Age or Roman-period remains are in evidence on the air photographs. Near Cardew Hall, the cropmarked enclosures, trackways and fields that lie on the eastern side of Gill Beck have been scheduled as an undated settlement (UID 10507, SM1007206, PN 914, Fig 32). The visible remains are contained within a single modern field unit but are likely to extend further unseen. The scheduled area only encompasses the two enclosures and not the associated trackway or fields.
- A1.8.3 In the Cardewlees area, there is an extensive network of long single- and double-ditched linear features which appear to be the remains of a system of land division of possible Iron Age or Roman date (UID 10802 and UID 1574064, PNs 915-16). The evidence for settlement amongst these boundaries is equivocal. Two circular features north of Barras Brow that are defined by vigorous nettle growth have been interpreted as roundhouses (UID 10802, PN 915); a more circumspect interpretation of these features as pits has been made by this project, however. A small circular enclosure identified on the north side of Dalston has, though, been posited as a possible roundhouse (UID 1574064, PN 916). The latter feature was recorded from the PGA digital air photographs and it is clear that this area would benefit from further specialist reconnaissance.
- A1.8.4 Further west, on the banks of Nealhouse Beck near Wood Farm, there are cropmarks indicating a curvilinear enclosure, a trackway and fragments of field boundaries (UID 1574035, NGR 333411 550143 and UID 1574033, NGR 333113 550760). Again, these are likely to be of Iron Age and/or Roman date. These three groups of cropmarks are all on slowly permeable soils, which indicates that there is potential even where the conditions for cropmark formation appear unpromising.
- A1.8.5 Ridge and furrow is fairly widespread across this area but it is arranged in relatively small clusters of strip fields, some with broad ridges but others with later narrow ridge and furrow. Other post-medieval remains in this area are two possible construction camps sited alongside the Maryport and Carlisle railway (Fig 32; *Section 10.5.5*). They are of similar plan and comprised a large elongated rectilinear terrace or enclosure, and several building platforms or footings (UID 1574048, PNs 295-9, and UID 927357, PN 917).
- A1.8.6 The late post-medieval small-scale extractions that are common in many of the NMP survey areas are seemingly absent in this area. The large-scale extractions at Cardew Mires are of twentieth-century origin (UID 1574036, PN 291).

A1.9 ABBEYTOWN RIDGE

A1.9.1 The small Abbeytown Ridge NMP survey area lies to the east of, and is contiguous with, parts of the Hadrian's Wall NMP Project (Small 2008). This is a small area which yielded relatively few sites (Table 9), no earthworks, only a small number of cropmarked ditches and a twentieth-century structure.

Survey Area	Abbeytown Ridge
Area covered (km ²)	3
Number of new NRHE monument records	7
Number of enhanced NRHE monument records	1
Number of records concorded with HER monuments	0

Table 9: Abbeytown Ridge: new and enhanced sites

A1.9.2 No monuments of Neolithic or Bronze Age date were identified by this project in this study area. This agrees with a general paucity in the NRHE records of finds or monuments of these periods in this area.

A1.9.3 This NMP survey area covers the eastern extents of the extensive Holme Abbey Ridge cropmark complex (Higham and Jones 1975, fig 4). This complex comprises a landscape of Iron Age and/or Roman settlements, field boundaries and dyke systems. Within the NMP survey area, only a few possible field boundaries are visible (*eg* UID 1574197, PN 918, Fig 38). Most of the Holme Abbey Ridge cropmarks are located on freely draining sandy soils but they peter out in the NMP survey area, where the cropmarks are formed on slower permeable soils. Again, this indicates the potential for unpromising areas to produce evidence, and further reconnaissance may be warranted. One of a pair of twentieth-century direction finders is visible as a structure on Common Moss (UID 1473538 PN 919). The other (UID 1469228, PN 470) was recorded by the Hadrian's Wall NMP Project (Small 2008).

A1.10 MOOTA

A1.10.1 The Moota NMP survey area is contiguous with the Hadrian's Wall NMP Project (Small 2008) to the west. As perhaps might be expected, a relatively large number of sites was recorded (Table 10). No monuments of Neolithic or Bronze-Age date were identified by the project, however, and this in part reflects a general paucity of NRHE records of finds or monuments of these periods in this area.

Survey Area	Moota
Area covered (km ²)	7
Number of new NRHE monument records	49
Number of enhanced NRHE monument records	1
Number of records concorded with HER monuments	3

Table 10: Moota: new and enhanced sites

- A1.10.2 The Egremont to Carlisle Roman road (*Section 12.5.4*) is one of only two monuments previously recorded in this area in the NRHE. Although in the NMP survey area, this route is largely followed by the A595, but up to three possible sections of the Roman road are visible on the air photographs. In the fields south-west of Williamsgate, cropmarks and low earthworks reveal a section of road and possible roadside ditches along the projection of the Roman road, where the A595 takes a slightly more southerly route (UID 1325580, PN 51, Fig 46). North-east of Threaplands Gill, the A595 again takes a more southerly path and its Roman precursor can be seen as cropmarks running in a more northerly orientation in a neighbouring field (UID 1574426, NGR 316715 537991).
- A1.10.3 At Threaplands Gill itself, a hollowed way descends and ascends the banks of the gill on the alignment of the Roman road (UID 1574415, NGR 316263 537313). On the post-War air photographs, the modern road crossed the gill a little further south, but this diversion was straightened out in the late twentieth century. Part of the hollow-way is depicted on the OS map of 1867 (OS 1867e), where it ran through Threapland Wood (now removed). This was probably in use in the post-medieval period, but it may have been part of the original Roman route.
- A1.10.4 A significant element of this landscape is the pattern of long narrow fields that flank either side of the Roman road near Blindcrake (*Section 12.5.6*). Now fossilised by hedges and walls, these fields are relics of a medieval strip-farming system that relates to the adjacent village of Blindcrake. This project has identified the presence of medieval ridge and furrow within many of the strip fields and suggests that some ridges may still survive as earthworks. The village of Blindcrake and the fields south of the road are a Conservation Area (LDNPA 2011) and the character of the fields is cited as one of the points of special interest that justifies its status (*Ibid*; UID 1574382, NGR 314588 535027).
- A1.10.5 The second pre-existing monument record in this area was for a Prisoner of War (PoW) camp at Moota Hill (UID 1474045, PN 920). Camp 103 served as a PoW camp during the war and then as a Displaced Persons Camp in the immediate post-War period (Thomas 2003). The early vertical photographs show the layout of the camp, and more recent photography indicates that some of the buildings are still *in situ*.

A1.11 TENDLEY

A1.11.1 A relatively large number of sites was recorded in the Tendley survey area (Table 11). No monuments of prehistoric or Roman date were identified by this project, however, although a few Neolithic and Bronze-Age finds have been recorded there (eg UID 8851, UID 8871 and UID 9032, PN 149, PN 151 and PN 571; Fig 51). The remains of ridge and furrow are present in many of the fields within this area, particularly around the two villages of Brigham and Eaglesfield. Some strips of possible medieval ridge and furrow have been recorded (eg UID 1574731, PNs 582-4, and UID 1574824, PN 602, PNs 627-9 and PNs 654-6), although these are far more fragmentary and dispersed than in the landscape around Blindcrake, which lies a short distance to the north-east (see *Section A1.10*). In common with the other areas, dating for most of the ridge and furrow is ambiguous, it having neither the broad, S-bend character of medieval plough ridges nor the very straight and narrow form of post-medieval ploughing (Eyre 1955).

Survey Area	Tendley
Area covered (km ²)	10
Number of new NRHE monument records	48
Number of enhanced NRHE monument records	0
Number of records concorded with HER monuments	8

Table 11: Tendley: new and enhanced sites

A1.11.2 The air photographs did yield some evidence of possible abandoned settlement remains around Eaglesfield (UID 1574725, UID 1574721 and UID 1574718, PNs 921-3). These include parchmarks that appear to relate to a group of structures that are depicted on the OS map of 1881 (OS 1881), but the other features may be older.

A1.11.3 This NMP survey area is dominated by two main industrial complexes: the limeworks at Brigham; and the Tendley Hill Quarry. Nineteenth-century OS mapping (OS 1881) indicates that the complex at Brigham was large and included limekilns, trackways, tramways and a coal depot, as well as deep excavations. It is not clear whether the complex was still in use on the earliest air photographs (1946), but certainly the quarry floors had been colonised by shrubs and trees at that time. This complex is now largely obscured by vegetation and some parts have been landscaped, so it not clear which historical elements still survive.

A1.11.4 By contrast, the Tendley Hill Quarry has expanded in recent decades (UID 1574742, PN 328). In doing so, it has subsumed a number of quite small individual pits and limekilns that were depicted on the OS maps of 1864 (OS 1864a; 1864b; 1864c; 1864d) and were still extant on the earliest air photographs.

A1.12 ESKETT AND ROWRAH

A1.12.1 The Eskett and Rowrah area contains a large number of monuments (Table 12), and is one of the more industrialised landscapes covered by this project. Aside from the trace of a possible Roman road at Frizington Parks (UID 1576115, PN 924, Fig 58) and a fragment of possible medieval ridge and furrow near Rowrah Hall Farm (UID 1576443, PN 701), most of the features recorded in this area pertain to the post-medieval period or later.

Survey Area	Eskett and Rowrah
Area covered (km ²)	13
Number of new NRHE monument records	83
Number of enhanced NRHE monument records	0
Number of records concorded with HER monuments	25

Table 12: Eskett and Rowrah: new and enhanced sites

A1.12.2 Two main industries were active in this NMP survey area: ironstone mining and limestone quarrying. Most of the ironstone mines were active in the nineteenth century and are depicted in some detail on the OS maps of that time (*eg* 1867c). In many cases it has been possible to reconcile earthwork shafts, spoil heaps and some structures with individual mines that are named on the historical maps (*eg* UID 1576146, Eskett and Eskett Park Iron Ore Mines PN 212, PN 215, PN 217, PNs 355-6, and PNs 223-8). This project has also recorded some of the infrastructure that was associated with the mines, namely the tramways and mineral railways (*eg* UID 1576127, PN 354). Most of the ironstone workings appear to have been abandoned by the date of the earliest air photographs (1946).

A1.12.3 Limestone extraction is concentrated at five main locations: Yeathouse Quarry (UID 1576156, PN 925); Eskett Quarry (UID 1576183, PN 360); at Rowrah (UID 1576183, PN 360); Stockhow Hall Quarry (UID 1576234, PN 926); and Kelton (UID 1576251, PN 927). All of these quarries originate from small nineteenth-century workings. The Yeathouse and Stockhow Hall works had been abandoned by the 1940s but the others have expanded in recent decades. In between the modern workings and landscaping, some historical remnants of these industries do survive, particularly at Yeathouse and Stockhow Hall quarries, and at the north ends of the Rowrah and Kelton complexes.

A1.12.4 Regarding the air photograph coverage, unusually, there is a slight gap between early vertical sorties in the vicinity of kilometre square 305 516. Historical maps (OS 1867c) show that there were ironstone workings in this area. The problem is compounded because, by the 1960s, the date of the next available photographs, Eskett Quarry had already expanded and subsumed many of those workings. Fortunately, the OS historical maps (*eg* OS 1867c; 1900e) serve as a record of what has been lost.

A1.13 PEEL PLACE

A1.13.1 The Peel Place study area is contiguous with the NW RCZA project (Bacilieri *et al* 2009) to the west. The NMP study area produced a relatively large number of sites (Table 13), but, although the surrounding area is relatively rich in Neolithic and Bronze-Age finds, notably lithics, no monuments of Neolithic or Bronze-Age date were identified by this project.

Survey Area	Peel Place
Area covered (km ²)	14
Number of new NRHE monument records	50
Number of enhanced NRHE monument records	1
Number of records concorded with HER monuments	3

Table 13: Peel Place: new and enhanced sites

A1.13.2 There is, however, a pair of enclosures of speculative later prehistoric origin on the north side of Drigg (UID 1579049, NGR 366701 499423). These are in the form of two hedged fields, one oval in plan with an out-turned entrance, and the other of rather irregular shape. A small part of the hedging has been removed and has exposed a broad but seemingly shallow ditch. If not prehistoric, these features may have their origins in the medieval period.

A1.13.3 Most of the other monuments in this area are either ridge and furrow or quarries. A considerable proportion of the ridge and furrow is of the narrow form and of likely post-medieval date; the remainder may be of medieval and/or post-medieval origin.

A1.13.4 There are a few historical quarries in this area, including the excavations at Drigg Cross (UID 1579029, PN 928, Fig 64) and near Seascale Hall (UID 1579067, NGR 304222 502806). The larger workings, comprising the sand pit between Newton Wood and Fleming Hall (UID 1579003, NGR 305361 502772), and the quarries at Seven Acres (UID 1579013, PN 929) and near Peel Place (UID 1579019, PN 279), appear to have started in the mid-twentieth century or later.

A1.14 GHYLL SCAUR

A1.14.1 The Ghyll Scaur NMP survey area is contiguous with the NW RCZA project (Bacilieri *et al* 2009) to the east. Whilst identifying a relatively large number of sites (Table 14), this project did not identify any monuments of Neolithic or Bronze-Age date in this area, which agrees with a general paucity in the NRHE of any finds or monuments of any periods for this area.

Survey Area	Ghyll Scaur
Area covered (km ²)	9
Number of new NRHE monument records	47
Number of enhanced NRHE monument records	1
Number of records concorded with HER monuments	6

Table 14: Ghyll Scaur: new and enhanced sites

- A1.14.2 This area is generally devoid of any cropmarks, so the two locations at which cropmarks were observed have significance for their rarity. Both were located in the north-west, by the side of Whicham Beck. Near Topping Moss Plantation, a sub-circular embanked feature is visible as a slight earthwork on earlier air photographs and as a cropmark on later (UID 1577369, PN 930, Fig 70). Approximately 1km upstream, a group of linear cropmarks and soilmarks appears to suggest enclosures and boundaries (UID 1577372, NGR 315837 483980). However, it is far from certain that any of these features are of archaeological origin.
- A1.14.3 Cultivation ridges are fairly widespread in this area, except within the bounds of Millom Park. Although today the park is largely under plantation or has been taken by the Ghyll Scaur Quarry, most of the land surface was visible on air photographs up until at least 1972, and the absence of evidence for ridge and furrow appears to be an accurate reflection of its distribution. Beyond the park, very little of the ridge and furrow could be confidently identified as being medieval in origin. Of potential interest, though, are two low, broad banks (UID 1577435, NGR 318422 484964) near Arnaby that appear to be cut by medieval or post-medieval plough furrows (UID 1577433, NGR 318405 484880). These resemble plough headlands and may indicate an earlier phase of cultivation.
- A1.14.4 Interestingly, around Greenhills (UID 1577487, PNs 829-37) and Crosshouse Hill (UID 1577457, NGR 317759 484248), evidence for the medieval and/or post-medieval ploughing continues up to and between the rocky outcrops that characterise this landscape. This might indicate that there were considerable pressures to bring such difficult terrains into cultivation.
- A1.14.5 Some of the ridge and furrow is divided into fields by low, narrow banks or exposed walling. Many of these are depicted on historical OS mapping (OS 1867d) and so in general have not been duplicated for this survey, but where they have not they are recorded (*eg* UID 1577487, PNs 829-37). Of potential significance are the boundary remains found within the otherwise unenclosed north part of Millom Park (UID 1577405, PN 221).
- A1.14.6 Quarrying activity in this area is characterised by small post-medieval quarries (*eg* UID 1577402, PN 43, UID 1577422, NGR 317211 484884, and UID 1577411, NGR 316264 481245). Only one such quarry developed into a larger operation and this was the Ghyll Scaur granite quarry in Millom Park, which covered an area of approximately 21ha in 2010.

A1.15 ROOSECOTE

A1.15.1 The Roosecote NMP survey area is contiguous to the south with the NW RCZA Project (Bacilieri *at al* 2009). The NMP survey revealed relatively few monuments (Table 15), although it contains several intriguing features of possible to likely later prehistoric or Roman date. Perhaps the most significant of these is the spread of cropmarked features recorded in the Catty Crook Lane area (UID 1572108, PN 881, Fig 75). The dominant features are a large rectilinear enclosure, which appears to contain an avenue defined by large pits, and at least two circular enclosures, though this relationship may be coincidental. Beyond the enclosure, there is a third circular enclosure and a large rectilinear pit, which appears to be aligned with the pit avenue. The pit arrangement might suggest a monument of Neolithic or Bronze-Age ritual purpose and so the circular enclosure might be the remains of round barrows or related monuments. However, the enclosure itself may as readily be of Iron Age or Roman date as of earlier origin and, in this context, the circular enclosure could be the remains of roundhouses.

Survey Area	Roosecote
Area covered (km ²)	4
Number of new NRHE monument records	24
Number of enhanced NRHE monument records	1
Number of records concorded with HER monuments	5

Table 15: Roosecote: new and enhanced sites

A1.15.2 There are many ditches around the enclosure which appear to be from a system of land division, albeit rather fragmentary (UID 1579334 and UID 1579335, PNs 931-2, and UID 1579340, NGR 325338 468830). These features were identified by recent archaeological reconnaissance and were initially recorded by the English Heritage Aerial Reconnaissance (North): 2010-11 Programme (UID 1570057; English Heritage 2011b).

A1.15.3 By contrast, the two possible Neolithic or Bronze-Age round barrows identified just to the north of Moor Head Cottage are only recorded on vertical photographs (UID 1579508, PN 318, and UID 1579512, PN 316). Similarly, the faint cropmarks indicating a small Iron Age or Roman rectilinear enclosure with internal roundhouses, near Dungeon Lane (UID 1579320, PN 875), are only visible on recent imagery published on Google Earth. From a monument protection viewpoint, both sets of features would in the first instance benefit from specialist reconnaissance to establish their validity, or otherwise. Ridge and furrow is sparsely distributed in this area, and is of medieval and/or post-medieval origin.

A1.15.4 This area also contains two Second World War features associated with the protection of the strategically important ports and industrial complexes at

Barrow-in-Furness. They are a pillbox near the A5087 near Roose (UID 1429744, PN 933) and, on the opposite side of the road, the remains of a barrage balloon site (UID 1579305, PN 934).

A1.16 ROAN EDGE

A1.16.1 Prior to this mapping exercise, there were no monuments in this NMP survey area in the NRHE (Table 16). This work has revealed several possible sites of potential later prehistoric date, although, these are very cautious interpretations because of the nature of the remains and the available evidence.

Survey Area	Roan Edge
Area covered (km2)	8
Number of new NRHE monument records	39
Number of enhanced NRHE monument records	0
Number of records concorded with HER monuments	3

Table 16: Roan Edge: new and enhanced sites

A1.16.2 ASCII Lidar data for the Roan Edge area were available for manipulation and interrogation. These data appear to show the low earthworks of an embanked oval enclosure (UID 1576797, PN 312, Fig 81), a little to the west of the Roan Edge Quarry (UID 1576752, PN 309). It lies on high ground but in an inferior position, close to an area of issues and collects, and measures approximately 45 x 34m. It is not obviously visible on any of the vertical air photographs that cover this area and there is no specialist coverage. This feature is morphologically similar to others in the wider area that are thought to be of later prehistoric date (eg UID 1574607, NGR 364907 476350) but a medieval origin cannot be discounted, if the feature is indeed of archaeological origin.

A1.16.3 This area has produced the only identified examples of later prehistoric cord rig in the whole project. These characteristically narrow and uneven cultivation ridges are visible on the east side of the M6 on the western slopes of Drybeck Hill (UID 1576927, PN 882, and UID 1576929, PN 878). If they can be confirmed as cord rig, they might indicate that there was contemporary settlement in the area.

A1.16.4 There is a small earth disturbance by the side of the more northerly patch of cord rig, which resembles the remains of a scooped hut platform (UID 1576801, PN 877). However, the OS map of 1860 (OS 1860) also marks a triangulation station in the same area, which may explain the disturbance. A second possible roundhouse is visible further north, between Spanishaw Beck and the M6 (UID 1576800, PN 879). The oval enclosure, cord rig and two roundhouses all require ground-based investigation to validate their presence and these interpretations. Evidence of medieval or post-medieval ploughing is relatively sparse in this study area.

A1.16.5 One significant feature that was probably in use in the post-medieval period, but may have had earlier origins, is the long trackway across New Hutton Common, from Latterhowe Bridge towards Drybeck Hill (UID 1576749, PN 308, and UID 1576741, PN 935). Some sections have been destroyed by the Roan Edge Quarry (UID 1576752, PN 309) but, beyond this, it is defined by some deeply-incised hollow-ways.

A1.16.6 Until the 1980s, quarrying activity in this area was represented by a sparse distribution of small and abandoned post-medieval pits (*eg* UID 1576792, PN 310, and UID 1576934, PN 936). However, at the end of the decade, one of these pits, the Roan Edge Quarry (UID 1576752, PN 309), was reopened and extended, and now covers over 30ha.

A1.17 PROJECT REVIEW

A1.17.1 A review was undertaken of the aims defined in the project design (OA North 2013, 9-10):

- **Aim 1:** to contribute to English Heritage SHAPE sub-programme 32111.110 National Mapping Programme: recording and mapping archaeological landscapes using aerial photographs (English Heritage 2008). This project has contributed 102km² of mapping to the programme.
- **Aim 2:** to identify, characterise, and map, using a GIS, Cumbria's historic environment resource in relation to areas of past and potential future extraction of sand and gravel.

A1.17.2 Prior to this project, the NRHE recorded a total of 158 monuments within the 11 NMP survey areas. A substantial percentage of these were standing buildings or structures, and a smaller proportion were small finds; earthworks or cropmarked archaeological monuments were in the minority. This project has enhanced 29 of those existing monument record entries and generated records for 500 new monuments or monument groups.

A1.17.3 The HER had previously recorded 312 monuments within the NMP survey areas, with a higher representation of archaeological monuments than had been recorded in the NRHE. Ninety-nine of the new or enhanced NRHE records were concorded with existing HER records, suggesting that the mapping and textual information for a further 430 monuments will be new to the HER (see *Appendix 2* for a list of all the period terms and monument types identified by the project).

A1.18 DATA ARCHIVING AND DISSEMINATION

- A1.18.1 **Copyright:** the copyright of the air photograph mapping and associated records produced by this project lies with Historic England.
- A1.18.2 **Project Archive:** the results of this project's mapping and interpretation are contained within 11 ESRI shape files. These will be deposited with the Historic England Archive. Historic England's Aerial Survey and Investigation team shall also retain digital copies.
- A1.18.3 The records resulting from this project are contained within and are integral to the NRHE. They may also be accessed online via PastScape (www.pastscape.org.uk).
- A1.18.4 There are no formal arrangements for the archiving of other digital files created during the course of this project: scanned image files (.TIF); rectified image files (.TIF); World files (.TFW); AERIAL rectification files (.RDA); and lists of material consulted (.XLS). Copies of these will be deposited on the Historic England file server under Aerial Survey. For this project, decisions regarding the preservation of these files will be the responsibility of Historic England, but this is an area that needs consideration for future projects.

APPENDIX 2: AIR PHOTOGRAPH DETAILS

A2.1 COLLECTION DETAILS

- A2.1.1 **Historic England Archive (formally the National Monuments Record):** Historic England, National Monuments Record Centre, Great Western Village, Kemble Drive, Swindon SN2 2GZ.

Project blocks	EHA loan ref	Loaned verticals	Loaned obliques	Loaned military obliques
Block 1a	75178A	476	169	0
Block 1b	75178	691	113	1
Block 2	75446	1315	113	4
Total		2482	363	5

- A2.1.2 **Cumbria County Council:** Historic Environment Team, County Offices, Kendal, Cumbria, LA9 4RQ.
- A2.1.3 **CUCAP:** University of Cambridge, Air Photograph Library, Sir William Hardy Building, Tennis Court Road, Cambridge CB2 1QB.

A2.2 MONUMENT DATA TABLE

- A2.2.1 The Monument Data table consists of ten data fields. These are associated with, and specific to, each graphical element in a monument depiction.

Field name	Field content	Sample data
EHLAYER*	Name of NMP layer to which the object belongs	BANK, DITCH, EXTENT OF FEATURE, RF, MONUMENT POLYGON, STRUCTURE, T HACHURE
MONARCH	NRHE Unique Identifier (UID)	1460426
CHER*	Corresponding monument record in Cumbria HER (where appropriate)	12345
PERIOD	Date of features (EH Thesaurus)	LATER PREHISTORIC
TYPE	Monument type (EH Thesaurus)	RING DITCH/ROUNDHOUSE (DOMESTIC)
EVIDENCE	Form of remains, as recorded on the source photograph (EH Thesaurus)	CROPMARK
PHOTO1	NMR or other reference for the photograph from which the feature was plotted and its date of photography	HCC HAP 91/13/7 16-JUL-1991
LATEST CONDITION*	Condition of the monument as suggested by the latest available photographs or Lidar-derived images (this field may be blank if EVIDENCE was CROPMARK)	LEVELLED EARTHWORK
PHOTO2*	NMR or other reference for the most recent photograph from which LATEST CONDITION was deduced (this field may be blank if the EVIDENCE was cropmark or latest condition relied on the evidence of the Lidar-derived images)	EARTH.GOOGLE.COM 01-OCT-2009 ACCESSED 01-JUNE-2010
Lidar*	If the monument could be detected on the Lidar-derived images, the relevant tile reference is recorded here	Lidar SE2896 ENVIRONMENT AGENCY D0057155 20TH-JUL-2006

* these are not core NMP-standard data fields and they may not be retained in the files that are formally archived by the Historic England Archive and/or uploaded to the Historic England GIS. However, it is highly desirable that arrangements are made for the archive and dissemination of the full data versions, as this information cannot easily be recovered from the NRHE records alone.

A2.3 ENGLISH HERITAGE PERIOD TERMS INDEXED BY THE PROJECT

NEOLITHIC	SECOND WORLD WAR
BRONZE AGE	
IRON AGE	MID-TWENTIETH CENTURY
LATER PREHISTORIC	TWENTIETH CENTURY
ROMAN	LATE TWENTIETH CENTURY
MEDIEVAL	
POST-MEDIEVAL	TWENTY-FIRST CENTURY
EARLY TWENTIETH CENTURY	UNCERTAIN

A2.4 ENGLISH HERITAGE THESAURUS TERMS INDEXED BY THE PROJECT

ADIT	COAL WORKINGS	ENCLOSURE
BANK (EARTHWORK)	CONSTRUCTION CAMP	EXTRACTIVE PIT
BOUNDARY	CONVEYOR	FARMSTEAD
BOUNDARY BANK	CORD RIG	FIELD
BOUNDARY DITCH	CROFT	FIELD BOUNDARY
BRIDGE	CURVILINEAR ENCLOSURE	FIRING RANGE
BUILDING	DAM	GRANITE QUARRY
BUILDING PLATFORM	DIRECTION FINDER	GRAVEL PIT
CAMP	DITCH	HILLTOP ENCLOSURE
CAUSEWAY	DRAINAGE DITCH	HOLLOW
CHIMNEY	DRIFT MINE	HOLLOW-WAY
CIRCULAR ENCLOSURE	DYKE (DEFENCE)	HUT PLATFORM
COAL DEPOT	ENCLOSED SETTLEMENT	INCLINED PLANE
		IRONSTONE MINE

IRONSTONE WORKINGS	RAMPART	WATER CHANNEL
LIMEKILN	RECTILINEAR ENCLOSURE	WOOD
LIMESTONE QUARRY	REVETMENT	WOOD BANK
LYNCHET	RIDGE AND FURROW	
MILL DAM	RING DITCH	
MILL POND	ROAD	
MILL RACE	ROBBER TRENCH	
MINERAL RAILWAY	ROUND BARROW	
MOUND	ROUNDHOUSE	
NARROW RIDGE AND FURROW	SAND AND GRAVEL EXTRACTION SITE	
OVAL ENCLOSURE	SAND PIT	
PADDOCK	SCARP	
PALISADED ENCLOSURE	SHAFT	
PEAT CUTTING	SHAFT MOUND	
PIT	SHEEP FOLD	
PIT ALIGNMENT	SPOIL HEAP	
PLATFORM	STOCK PEN	
PLOUGH HEADLAND	TANK	
POND	TERRACE	
PRISONER OF WAR CAMP	TOFT	
QUARRY	TRACKWAY	
RAILWAY	TRAMWAY	
RAILWAY CUTTING	TREE ENCLOSURE RING	
RAILWAY EMBANKMENT	TRIANGULATION STATION	
RAILWAY SIDING	WAGONWAY	
	WALL	

APPENDIX 3:

BELOW-GROUND INTERVENTIONS IN THE REFINED AREAS

A3.1 BRAMPTON KAME BELT

- A3.1.1 A watching brief and archaeological evaluation were conducted at Stone House in the village of Hayton (CFA 2003a; 2003b). Features associated with the garden were observed and included a cobbled path, flower beds, well, culvert, revetment wall and a set of steps. There were no features pre-dating the garden.
- A3.1.2 Four linear trenches were excavated at Low Gelt Quarry, but there were no archaeological features and the only finds were modern (NPA 2009b).

A3.2 LOW PLAINS

- A3.2.1 An archaeological assessment, comprising a watching brief and walkover survey, was undertaken in 2000 (OA North 2000a). It highlighted, as the only site of archaeological significance, a small sub-circular cropmark that was associated with ditches or divisions within a large circular area that was *c* 10-12m in diameter, perhaps of Iron Age or Roman date (HER 19239).
- A3.2.2 This, alongside three other sites (HER 19240, HER 5989) and a sand hill (to the south of HER 19239), were further investigated during archaeologically supervised soil-stripping and excavations centred on NGR 349971 541661 in 2003 (OA North 2003b). During these investigations, *c* 5000 square metres of topsoil was stripped to a depth of 0.30-0.60m to reveal the underlying natural glacial till, but no features were located of any significance, although the positions of the sites were particularly targeted. There was one find of a retouched flint flake, possibly of Neolithic date, that was recovered from the topsoil.
- A3.2.3 In 2004, there was a further evaluation centred on NGR 350000 541700, which examined an area of around 4000 square metres in the wake of the observation of three small burnt areas and pottery during sand and gravel extraction (OA North 2005a). These were found to be cremation burials, with a fourth cremation burial found in the course of archaeological cleaning as the trench was extended. The archaeological remains occupied an area of *c* 40 square metres. Two cremations contained Bronze-Age pottery and cremated remains, but two were associated only with bone. Topsoil, to a depth of *c* 0.50m, was removed to the surface of the underlying sand and gravels. The base of the cuts of these features was 0.15-0.25m below the surface of the machined subsoil and they had clearly been truncated. Cropmarks indicate that the area had been ploughed prior to modern quarrying, and, indeed, abrasions on the upper body sherds of the cremation urn attest to *in-situ* damage.
- A3.2.4 A further watching brief took place in 2005 during the removal of an approximate area of 10,500 square metres of topsoil centred on NGR 349970 541660 in the area to the west of the cremations found in 2004 (OA North 2005c). A depth of 0.50m of topsoil was removed to the surface of the natural subsoil. No features of any archaeological significance were located, although one retouched flint,

perhaps of Neolithic date, was recovered from the surface of the natural subsoil. Linear cuts in the natural subsoil may represent ploughing of relatively recent date.

- A3.2.5 A watching brief in 2009 (NPA 2009a) found the remains of a post-medieval ditch. A possible Roman ditch, *c* 27m in length and 0.24-0.70m in depth, was also found, containing fragments of metal slag and possible kiln material. Five potentially prehistoric pits, each 0.15m in depth, had scorched-stone inclusions.

A3.3 CARDEW MIRES

- A3.3.1 There have been no below-ground archaeological interventions in this area.

A3.4 ABBEYTOWN RIDGE

- A3.4.1 In 1992, Professor GDB Jones excavated the signal station at Raise Howe (NGR 313600 548500) and found that it was associated with a linear or circular ditch (Burnham *et al* 1993). Some 42 square metres were excavated and all the trenches contained significant archaeological remains. The maximum depth of archaeological stratigraphy was in a ditch, which was *c* 1m deep.
- A3.4.2 At NGR 309700 646350, a cropmark site known as Old Mawbray Enclosure (HER 607; which totalled 4400 square metres), was investigated (Bewley 1993). A sample of 33 square metres was excavated, all containing archaeological remains to a depth of *c* 0.80m below the ploughsoil. A probable defensive ditch (maximum depth 1.0m) of Neolithic date and a series of post-pits were identified.
- A3.4.3 Edderside settlement was the focus of archaeological investigation in 1988 (HER 605; Bewley 1998). The remains of a ditch, an enclosure, a possible pond and five large post-pits (with a central posthole of *c* 0.50–0.60m) were uncovered. Some 101 sherds of second- to fourth-century pottery indicate Romano-British occupation, but it is entirely possible that the site was reused and that its origins were in the prehistoric period.
- A3.4.4 In 2006, a watching brief was undertaken at the Waste Water Treatment Works at Edderside (NGR 309900 545500), observing the removal of 3.5 square metres of topsoil to a depth of 2m through the sub-stratum (OA North 2006b). No archaeological horizons or features were observed, with just two small sherds of post-medieval pottery being encountered.
- A3.4.5 To the south of the Newton outfield settlement, land at New Cowper Farm, centred on NGR 311600 545780, underwent a desk-based assessment and rapid field inspection to collate a gazetteer of sites (LUAU 1999).
- A3.4.6 A total length of 374m of trenches was excavated at New Cowper Farm at NGR 311600 545780 (Headland Archaeology 2000). Three cultivation furrows were found across an area *c* 70 x 50m, *ie* 33% of the site. There were no finds.
- A3.4.7 An evaluation, comprising an area of topsoil stripping and 14 trial trenches (a total of 8720 square metres), was undertaken at New Cowper Farm (NGR 3115 5460), which found truncated features (cut to a depth of *c* 0.13-0.45m). These comprised a possible trackway, with two phases of ditches, an enclosure, and linear sequences of postholes and post-pits. Also found were two small and very abraded

pieces of possible late prehistoric pottery, one burnt flint and three fragments of rubbing stone. The archaeological remains were seen across *c* 50% of the area of topsoil stripping (HER 40814; Headland Archaeology 2003b). Thirty-one linear trial trenches were excavated at NGR 311584 545989, revealing possible archaeological features in *c* 33% of the excavations (Headland Archaeology 2004). The features were *c* 0.10-0.64m in depth. One pit had large quantities of charcoal and fragments of Iron-Age pottery. Cereal grains were recovered from palaeoenvironmental samples, primarily barley, with some oats.

- A3.4.8 As a result of this work, in 2003 an evaluation and excavation was undertaken (by Headland Archaeology) prior to works at New Cowper Quarry. The assessment of this was written up in 2006, together with two further excavation reports of large areas directly north of this field (NPA 2006a). The excavations of 2003 were centred on NGR 311500 546000 and excavated an area of 9500 square metres of topsoils that were 0.40-0.50m deep, where large numbers of significant archaeological features were discovered in association with 165 sherds of Bronze-Age pottery and 26 pieces of worked lithics and debitage. The features, all truncated, varied in depth from 0.20m to 0.36m, with one ditch having a fill that was 0.70m deep.
- A3.4.9 The two sites to the north of this field, centred on NGR 311500 545900, were excavated in 2005. The western excavation extended over 10,000 square metres, stripping off topsoils 0.40m in depth to find Neolithic pottery, a flint blade and a polished stone axe, and six spatially grouped pits and postholes, including perhaps the remains of a Bronze-Age palisaded structure, and of another possible Iron Age / Romano-British feature, comprising a linear ditch, pits and postholes (NPA 2006b). These prehistoric remains were truncated by post-medieval ridge and furrow.
- A3.4.10 The excavation to the east occupied an area of 0.8ha, centred on NGR 311854 545989, and revealed significant remains of Early Neolithic pits, an Early Bronze-Age funerary cairn, linear features and a boundary ditch, perhaps of Iron Age / Roman date, and a number of isolated pits and postholes. The natural subsoil was revealed at a depth of 0.50m and the depth of archaeological features ranged from 0.08m to 0.70m (NPA 2007).
- A3.4.11 At Overby Quarry, at NGR 312300 546700 and NGR 312700 547300, in 2006, four linear trial trenches successfully located four definite and two possible archaeological features, although these remain undated. The cuts of the features were 0.20-0.60m in depth. One pit (in Trench 3) contained charred grain, and produced a radiocarbon date of the Early to Middle Bronze Age (NPA 2006c).
- A3.4.12 At Overby Quarry, 48 trial trenches were excavated in five areas at NGR 312350 546750 (NPA 2008b). Area A yielded no archaeological features, but in Area B, there were five well-preserved *in-situ* cremations, four in pits and one in a Bronze-Age collared urn. Area C contained small linear gullies and pits. Areas D, E and F revealed no archaeology, excepting for linear boundary features, which related to those seen on nineteenth-century mapping (*ibid*).
- A3.4.13 Given the identification of the five well-preserved *in-situ* cremations in 2008 (*Section A3.4.12*), Area B was enlarged to excavate an area of 120 x 40m. Some 36 prehistoric features were concentrated in an area of *c* 110 square metres of the

site, including 30 cremations, of which eight were in vessels. The vessels were collared urns, except for one Bronze-Age food vessel (NPA 2010).

- A3.4.14 An evaluation was undertaken at Dixon Hill, High House Quarry, in 2002 (CFA 2002), and subsequently, a targeted evaluation at High House Quarry, West Newton (NPA 2006d), excavated a single linear trench. This uncovered three, perhaps modern, features and one undated pit. The depth of the features was *c* 0.15-0.30m.
- A3.4.18 Eighteen trial trenches were excavated at High House Quarry, and archaeological deposits were found in ten of the trenches (NPA 2008a). Possible prehistoric features comprised a continuous linear feature across five of the trenches, with a second linear feature at right-angles to this. These correlated with cropmark evidence and geophysical anomalies, and may represent a Bronze-Age field system. There were no finds. The depth of the features was *c* 0.20–0.80m.

A3.5 MOOTA

- A3.5.1 On the west-facing slopes of Moota Hill, at NGR 314500 536500, close to the site of a medieval beacon (*Section 12.4.3*), a quarry extension necessitated an archaeological evaluation in 1999 (Headland Archaeology 1999). Six trenches were excavated, totalling 578m in length, all of which were 2m wide and 0.30m in depth. There were no archaeological features or finds, except for narrow ridge and furrow, encompassing *c* 20 square metres of archaeological remains.
- A3.5.2 In the same area, at NGR 314500 536500, in 2006, there was a further evaluation in advance of the extension of the quarry (Headland Archaeology 2006). Twelve trenches, with a combined length of 850m, were excavated, each being 2m wide and 0.25-0.65m in depth. No archaeological features or finds were encountered in any of the trenches.
- A3.5.3 A small overlapping part of the watching brief area for Tallentine Wind Farm lay on the western edge of the Moota study area (Wardell Armstrong 2013). There, topsoils were stripped to the depth of between 0.10m and 1.00m, including the 23 x 25m area of the substation, which just clipped the study area. No archaeological features or finds were recorded.
- A3.5.4 On the eastern edge of the Moota study area, on the site of the Roman road at Wharrock Hill, roadworks necessitated a watching brief at NGR 314900 535700 (NPA 2006e). The trenches were dug to a depth of 1m but no features of archaeological interest were noted.

A3.6 TENDLEY

- A3.6.1 The early medieval inhumations recorded in the HER prompted a series of archaeological investigations centred on NGR 308900 528500. During 2003, an archaeological evaluation, using the results of an earlier walkover survey and geophysical survey to position a series of seven trial trenches, totalled an area of 560 square metres at NGR 308900 528550 (Headland Archaeology 2003a). Truncated features of a regular medieval or post-medieval ridge and furrow were found sealed by topsoils, and these were seen to a depth of 0.10m below the topsoil. Some 248 artefacts were found, mainly ferrous (a metal detector was

used) and those finds that could be dated were post-medieval. This assemblage was likely to have represented manuring practices in the post-medieval period. In addition, three other areas of archaeological remains were in an area of c 3 square metres.

- A3.6.2 In 2008, a geophysical survey and archaeological evaluation were undertaken at NGR 308400 528850 (OA North 2008a). Four evaluation trenches were positioned to target geophysical anomalies thought to indicate ridge and furrow and quarrying/infilling activities. The trenches totalled 80m in length, each with a 2m width, and were excavated to a depth of c 0.50m. A possible posthole and a lens of burnt or decomposed dark material were the only identified features.
- A3.6.3 In 2009, a further programme of trial trenching was undertaken in advance of extraction (NPA 2009c). Seventeen trial trenches, all 2m wide and excavated to a depth of between 0.60m and 1.4m, covered 965 square metres of the proposed area, centred on NGR 308900 528400. A linear deposit of river-worn cobbles was sealed by a deposit of brick and mortar; this was thought to be a possible field boundary. There was a finds assemblage of 80 modern items, but otherwise, there were no archaeological remains.
- A3.6.4 In 2011, a further 18 evaluation trenches were excavated at NGR 308900 528400, totalling 1050 square metres, and these were excavated to a depth of between 0.4m and 1.20m. There were no archaeological features or finds (NPA 2011).

A3.7 ESKETT AND ROWRAH

- A3.7.1 There have been no below-ground archaeological interventions in this area.

A3.8 PEEL PLACE

- A3.8.1 There has been a series of archaeological projects at the Peel Place quarries, prompted by a large number of prehistoric find-spots in the area. In 1997-9, three phases of investigation took place, and in total 24 trenches were excavated; these were found to contain no significant archaeological deposits (LUAU 1997; 1998). Sieving for finds retrieved one iron nail and some post-medieval and modern ceramic artefacts.
- A3.8.2 In 2003, a desk-based assessment and evaluation were undertaken (OA North 2003a). The evaluation comprised the excavation of 13 trenches, centred on NGR 306700 501200; they were all 20m in length and each had a width of 1.7m (thus the area excavated totalled 260 x 1.7m), and each was dug to a depth of 0.3-0.65m. Within these trenches, only post-medieval farming activity was identified, represented by three modern gullies and two tree throws. The finds, all within topsoil, comprised modern pottery and one clay pipe fragment.
- A3.8.3 Expansion of the quarry in 2004 resulted in a desk-based assessment, a geophysical survey and walkover survey, and four evaluation trenches were excavated in areas where geophysical anomalies had been identified and where a hollow-way was located by the walkover survey (OA North 2004a). The four trenches were centred on NGR 306500 501100; they varied from 15m to 30m in length, and totalled 85m of trenching; all had a width of 1.8m. They were dug to a depth of 0.40-0.90m. A single archaeological feature was observed, comprising a

ditch or relict field boundary, containing seventeenth- to early twentieth-century pottery (totalling 2 x 1.8m of archaeology).

- A3.8.4 During 2005, another archaeological evaluation was undertaken at NGR 306700 501100, in advance of a further area of extraction (OA North 2005b). Ten evaluation trenches were excavated, each 25-30m in length and varying in width from 1.75m to 3.3m wide (thus, a total of 795 square metres was excavated). They were excavated to a maximum depth of 0.70m. The only feature found was an iron pipe in the southernmost trench, and 27 post-medieval finds were retrieved from the topsoil. All were fragmentary and likely to be a result of spreading manure and midden across the fields. A further two finds of potential waste flint chunks could not be dated closely.
- A3.8.5 In 2008, a further programme of evaluation trenching was undertaken, centred on NGR 306650 501228, when 17 trenches were excavated (OA North 2008b). These totalled a length of 414m. All the trenches were 2.3m in width and the maximum excavated depth was 1.17m. Most were randomly placed, except for five of the trenches, which were positioned to target a possible medieval field system and hollow-way. No archaeological evidence was identified within these targeted trenches, but some linear features were seen in five other trenches, in an area of approximately 60 x 2.3m.
- A3.8.6 In 2010, the second part of a quarry expansion occurred immediately to the north-west of the site evaluated in 2008, and a programme of excavation of 20 archaeological evaluation trenches was undertaken at NGR 306640 501234 (OA North 2010b). The total length of trenching was 4075m; all the trenches were 1.8m wide and were excavated to a maximum depth of 0.26-0.42m. Most trenches were randomly positioned, but five were placed in an area marked on the first edition OS map of 1867 (OS 1867f), which suggested that medieval strip fields may once have existed, and also in response to the point at which the physical landscape rose to a peak in the centre of the field. Archaeological remains of ridge and furrow were observed in ten of the trenches on the west of the site. Further trenches showed evidence of a ditch, field boundaries, and a rutted trackway. Archaeological remains, including the ridge and furrow, were seen in *c* 50% of the site area. The evidence suggested that the site had been used for agricultural activity dating back to the medieval period, with relatively little change during the post-medieval period.

A3.9 GHYLL SCAUR

- A3.9.1 Within the Ghyll Scaur study area, an archaeological assessment and evaluation took place in the south of Millom Park. This comprised two watching briefs, one during the demolition of Park House (HER 16784) at NGR 316501 482000, which found an earlier farmhouse in the form of a two-celled structure, and the second during tree-felling (LUAU 1995). The area of tree-felling was to the north-west and north of the, then, quarry site, at approximately NGR 316800 482800, but no upstanding archaeological features were located. The evaluation centred on NGR 416800 582700, and comprised ten trial trenches, totalling 118m in length; each trench was 2m wide. Natural bedrock was found at depths of 0.10-0.95m below the ground surface. Only a single archaeological feature of significance was found, comprising a thin band of coarse gravel directly above the silt subsoil, *c*

0.65m wide and 0.05m in depth. It was interpreted as a path and thus was taken to be a modern feature.

A3.9.2 The felling of 130 trees at NGR 316700 482400 and the removal of their tree stumps was undertaken under archaeological supervision. No archaeological features or finds were observed within the topsoils, which lay directly over natural subsoils (Headland Archaeology 2005).

A3.9.3 A watching brief at Bank House Pumping Station, to the east of Millom Park at NGR 317000 482200, was undertaken in 2005, to monitor the stripping of topsoils (to a depth of 0.30m) and the construction groundworks (OA North 2006c). Some 240 square metres of topsoils were stripped, but no significant archaeology was found there, although some sherds of post-medieval pottery and one flint/struck lithic were recovered.

A3.10 ROOSECOTE

A3.10.1 An archaeological evaluation was undertaken in 2000 at the extreme eastern corner (NGR 422100 568900) of the western edge of the Roosecote area (OA North 2000b). At the south-eastern end of one trench, which was dug to a depth of 1.15m, was a small sub-circular pit. A sherd of modern pottery was in the fill.

A3.10.2 An archaeological evaluation in 2001 opened 12 trenches (HER 40768) within the area of the current Roosecote study area, at NGR 423130 468030 (Headland Archaeology 2001b). These trenches varied in length from 50m to 125m, but each was 2m wide, making a total area excavated of 1950 square metres. The trenches were dug to depths of between 0.30m and 0.90m, where the topsoils lay directly on subsoils. In three trenches, the topsoils sealed truncated cuts into the subsoils to a maximum depth of 0.10-0.40m, but no finds were recovered. However, in one trench (NGR 32300 46800), a large circular pit and its fills were excavated, which produced sherds of Neolithic pottery, two small arrowheads, a retouched curved flint-flake, fire-cracked quartz stones and a fragment of a probable polished stone axehead. The pit was cut into the subsoil to a depth of 0.40m; this, and its size, suggest that it was used as a hearth. Another truncated pit was identified, with a depth of only 0.12m. This was oval and clay-lined, and perhaps used for storage. Archaeological remains were present in an area totalling *c* 90 square metres within the evaluation. The hearths, pits and pottery suggest occupation of a site centred on a raised area during the fourth millennium BC.

A3.10.3 In 2014, an evaluation, totalling 1456 square metres, at NGR 423100 568370, uncovered a small number of features which were mostly of modern date and of little archaeological significance. Three possible prehistoric pits were identified, however, containing several large unworked pebbles, perhaps pot boilers (OA North 2014a).

A3.11 ROAN EDGE

A3.11.1 In 2004, a desk-based assessment and walkover survey, centred on New Hutton Common, was undertaken. The work highlighted an area of poorly drained moss (at present being used for rough grazing) at NGR 358400 492300, that had been enclosed in the nineteenth century, but remained unimproved and uncultivated (OA North 2004b).

A3.11.2 A programme of palaeoenvironmental sampling was undertaken in 2006 to assess the survival and extent of the peat deposits. This found only two small pockets of peat, one of which, at NGR 358400 492500, was 1.54m in depth, and had a well-preserved environmental record of mid- to late Holocene vegetation (OA North 2006a).

A3.11.3 In 2010, on the same site, two boreholes were drilled to a depth of 1.30m at NGR 358200 492600, and sub-samples were taken. These were used for palynological and plant macrofossil analysis (Cotswold Archaeology 2010).

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