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THE SOUTH DOWNS NMP PILOT AREA 1
WORTHING TO THE WEALD

NATIONAL MAPPING PROGRAMME REPORT

Edward Carpenter

AERIAL SURVEY
AND INVESTIGATION

ENGLISH HERITAGE

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THE SOUTH DOWNS NMP PILOT REPORT 1

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SUMMARY

This National Mapping Programme survey involved the interpretation, transcription and recording of all archaeological features seen on aerial photographs within this traditionally well researched landscape. It forms part of a programme of work by English Heritage designed to characterise the historic environment of the proposed South Downs National Park. The survey area includes the downland to the north of Worthing with a contextual area that encompasses part of the coastal plain, the Weald and the River Adur valley.

Of the features mapped, Neolithic flint mines, Bronze Age barrows, and cross-ridge dykes occupied prominent parts of the South Downs. There is evidence of large prehistoric and Roman field systems, sometimes integrated with enclosures and trackways, over much of the downland. Medieval features include remains of salt production in the Adur valley. New discoveries were made for all periods except the Neolithic, but the majority date to the Second World War. These have a wide distribution and include evidence of extensive anti-invasion works on the coast and inland and military training areas.

The photographs also show the effects of extensive post-war ploughing. Ploughing was undertaken partly in response to food shortages, and resulted in the levelling of many archaeological earthworks.

CONTRIBUTORS

The interpretation, transcription and recording was carried out by Edward Carpenter and Fiona Small.

ACKNOWLEDGEMENTS

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This project was carried out in collaboration with Cambridge University's Unit for Landscape Modelling (ULM): their contribution being the loan of material from the Cambridge University Collection of Air photographs (CUCAP).

The photograph on the front cover is a detail of NMR TQ1308/40 (23309/30) 18-JAN-2004 ©English Heritage NMR.

ARCHIVE LOCATION

The National Monuments Record Centre,
Kemble Drive,
Swindon
SN2 2GZ

DATE OF SURVEY

2006

CONTACT DETAILS

Aerial Survey
English Heritage
Kemble Drive
Swindon
SN2 2GZ

AerialSurvey@englsih-heritage.org.uk

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INTRODUCTION

Background

The South Downs has not only been considered the jewel of the Sussex crown but, during the early 20th century, was considered 'a national icon of a landscape regarded as quintessentially English' (Brandon 1999, xv). During the 18th century the name 'South Downs' only referred to the open chalk downland in East Sussex but, by the late 19th century, the name also included the chalk of West Sussex. The modern definition, concerned with geography and ecology, has extended the Downs into Hampshire (Brandon 1999 2-3).

The various threats to this culturally important landscape (see Brandon 1999, xv-xvi for a summary) led to the creation of the Sussex Downs Conservation Board in 1992 which, in 2005, became part of the South Downs Joint Committee. The process of designating the South Downs as a National Park began in 2000, with a decision expected in 2008. In support of the management of the South Downs a multi-disciplinary programme of archaeological work designed to characterise the archaeological sites and historic buildings of the South Downs is being undertaken by English Heritage and includes this pilot programme of aerial survey.

Project area

The archaeological aerial survey area consists of a transect across four different landscape zones including the Downs themselves (Fig 1). The area of downland selected is to the north of Worthing and includes the well known landmarks of Cissbury Ring and Chanctonbury Ring. The popularity of this area with visitors means that it is considered a gateway to the South Downs. In addition to this, a contextual area around the chalk downland, which included parts of the coastal plain, the Weald and the River Adur valley, was surveyed; the total pilot area measured 165sq km.

Summary of methodology

Over 10,000 aerial photographs were consulted; mapping and interpretation was carried out to NMP standards (Bewley 2001) by English Heritage investigators (Edward Carpenter and Fiona Small). This project forms part of English Heritage's on-going National Mapping Programme and involved the interpretation, transcription and recording of all archaeological features (from the Neolithic (4500 BC) to the end of the Second World War (1945)) seen on aerial photographs.

See appendix for detailed description of methodology and mapping conventions.

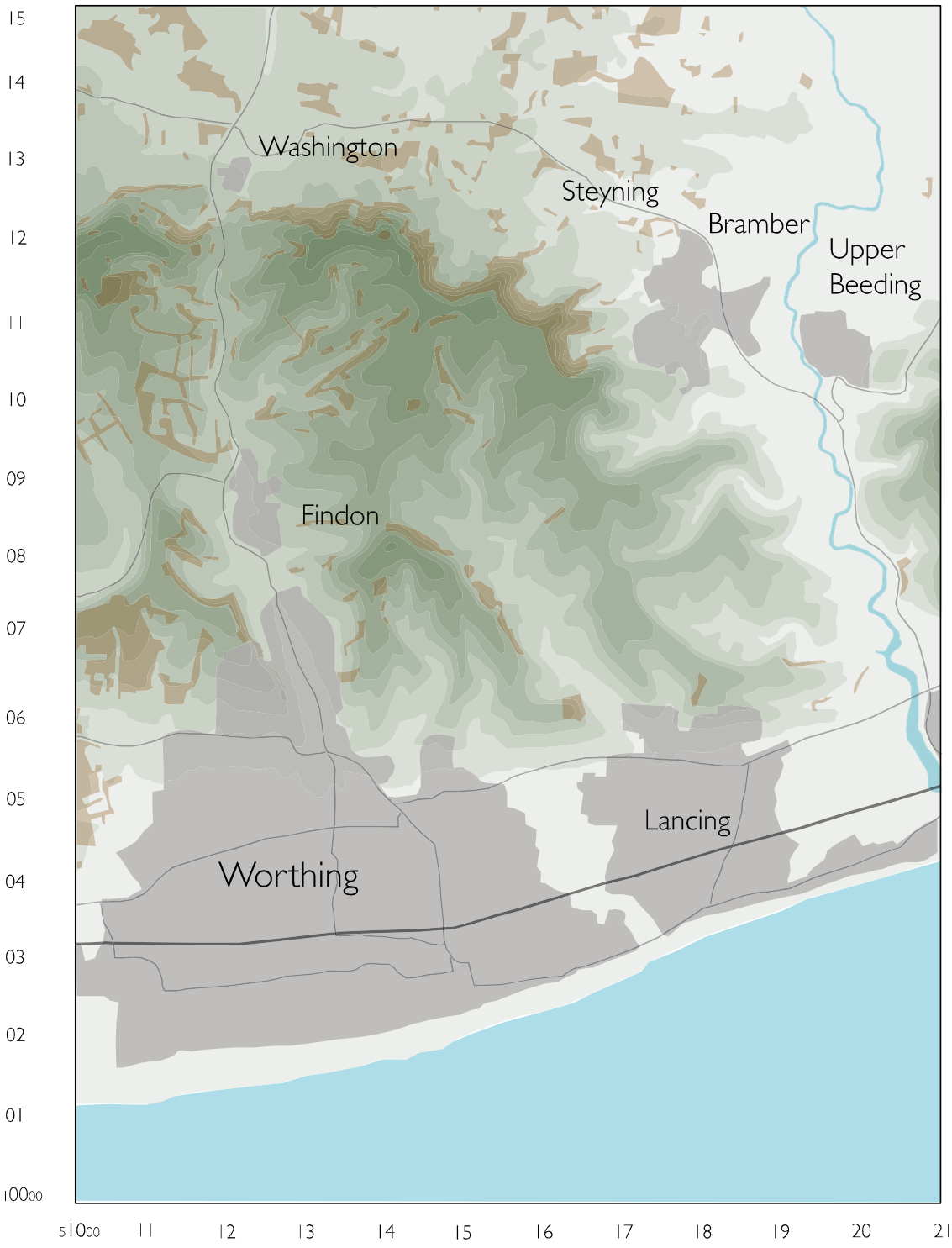

Fig 1: The project area. Contours are shown in green, the darkest shades representing the highest ground. Woodland is shown in brown.

GEOLOGY, TOPOGRAPHY AND MODERN LAND USE

The predominant geology of the survey area (BGS maps 318 & 333) is a series of Cretaceous chalk beds which form the Downs. These dip towards the coast where they are overlain with brick-earth and coombe deposits to create the coastal plain. Northwards the chalk rises to over 200 metres OD where erosion has created a dramatic scarp edge and exposed the clays and Greensand of the Weald. The predominant geology of the eastern edge of the project area is the alluvium of the Adur valley.

The coastal plain is almost entirely covered by the urban areas of Worthing and Lancing. The growth of Worthing was primarily a result of the increasing popularity in visiting the seaside during the 19th century but the fastest period of development came in the 1920s and 1930s (Hudson 1980, 101). The quality of the soil enabled a large market garden industry to grow up in Worthing: there were 130 acres of glasshouses in the town in 1949 and many of these are clearly visible on the early RAF aerial photographs (Fig 2).

The Downs are a smooth and rounded chalk landscape with occasional patches of clay-with-flints; the permeable nature of the chalk means that no streams form here. From the Middle Ages the Downs provided sheep pasture as part of a complementary regime, with cereal production on the lower slopes. This resulted in an open landscape with few trees, although there is a concentration of woodland on parts of the steep northern scarp slope. Arable farming was extended across the Downs during and after the Second World War and only 3-4% of the original area of ancient chalk downland survives (Brandon 2006, 122).

A mixed regime of orchards, arable and livestock farming is currently followed in the Weald and this diversity reflects the differing nature of the soils here. Compared with the Downs, there is more woodland and a greater density of settlement, particularly along the spring-line at the foot of the scarp.

Fig 2: Glasshouses in Worthing. The large white buildings that can be seen in this photograph taken in September 1946 are the glasshouses that made up the numerous market gardens in business at that time. At the date of this photograph, market gardens were still Worthing's main industry, with flowers beginning to replace tomatoes as the main crop. The industry declined in the following decade and much of the land was eventually sold for residential development.
Detail of RAF CPE/UK/1751 3062 21-Sep-1946

THE AERIAL PHOTOGRAPHS

The photographs consulted consisted of both vertical cover (9763 prints) and specialist obliques (890 prints). The survey area is comprehensively covered by RAF photography which dates to the mid-1940s, the 1950s and early 1960s. After these dates good coverage is provided by the Ordnance Survey photographs and that taken by the commercial air survey company Meridian Air Maps Ltd.

The vertical air photographs were not taken to record archaeological features and so the date and time of photography may not coincide with the best conditions to identify such remains. Despite these shortcomings possibly the paramount strength of an aerial survey of this part of the South Downs are the historic photographs: the mid-1940s photographs show archaeological earthworks that have since been levelled by ploughing. Vertical photographs from every successive decade records the gradual expansion of arable farming over the Downs.

Complementing these non-archaeological vertical photographs are the specialist oblique photographs taken of archaeological or, more rarely, architectural sites. The emphasis of this collection is on the prominent earthwork sites such as Cissbury Ring but also includes some cropmark sites. The majority of these photographs were taken from the 1970s onwards.

Some of the earliest photographs consulted was taken during the Second World War by the RAF. Much of this was taken by 1416 Flight, 140 Squadron, and 1 Photo Reconnaissance Unit (PRU). The main task of 1416 Flight (later 140 (Army Cooperation) Squadron) was to reconnoitre British beaches (Fig 3). In this instance there is a coincidence of interest between what was being photographed and what is being mapped that usually only occurs with more recent specialist oblique photographs of archaeological sites. Although concentrating on the coast, some photographs were taken of sections of the inland defence lines, but none at all of other known defended areas. This coverage may indicate which areas were considered a priority by the War Department but, as some of these sorties may have been flown for training purposes and not all the wartime photographs have survived (Damon Spiers pers. comm.), conclusions such as this cannot be drawn with certainty.

Fig 3: The anti-tank cubes that form the coastal defence here at Worthing can be seen on this photograph taken by 140 Sqn on 13th January 1943. The anti-invasion measures also included the removal of a section of the pier.
Detail of RAF AC178/140 0012 13-Jan-1943

PREVIOUS ARCHAEOLOGICAL WORK

The excellent state of archaeological earthwork preservation that once existed on the South Downs led Pitt-Rivers (1827-1900) to state that 'perhaps no part of England would more quickly repay the prehistoric archaeologist the trouble of exploring it' (quoted in Brandon 1999, 34). This combination of well preserved earthworks and open downland where they could be clearly seen has meant that the archaeological monuments of the South Downs have been the subject of numerous programmes of field survey and excavation since the 18th century.

Dr John Tabor (1667-1729) carried out fieldwork on 18 'camps' on the Downs between the Trundle and Belle Tout (Farrant 2001, 13). John Tabor was also the author of Sussex's first printed archaeological report, published by The Royal Society in 1717. The subject was an excavated villa at Eastbourne identified by tesserae found by workmen, though the local inhabitants were familiar with both cropmarks and surface finds in the vicinity (ibid).

The map makers Thomas Yeakell (d.1787) and William Gardiner (c.1739-1800) produced four of an intended total of eight map sheets of Sussex at a scale of 2 inches to the mile, the first of which was published in 1778. These maps include depictions of Cissbury Ring and Chanctonbury Ring as well as the two dykes to the west and south east of this hillfort.

In 1867 Pitt-Rivers (1827-1900) - then known as Lane Fox - undertook a survey of many of the earthworks situated on the higher ground of the South Downs, work that included ground plans of Chanctonbury Ring, Cissbury Ring and their associated monuments (Lane Fox 1869a). He also carried out excavations on the flint mines at Cissbury (Lane Fox 1869b, 1876).

One of Pitt-Rivers' assistants was Herbert Toms (1874-1940), a somewhat overlooked pioneer of analytical field survey and founder member of the Brighton and Hove Archaeological Club (Bradley 1989, 29). Other groups which have carried out work on the Downs include the Sussex Archaeological Society. Two members of this society were father and son, Eliot Curwen (d.1950) and Cecil Curwen (1895-1967), who carried out field survey and excavation on a number of sites across the South Downs. The subjects of their work within the pilot area included the settlement and field systems at Park Brow, the flint mines at Cissbury as well as a number of cross-ridge dykes. A comparison of Cecil Curwen's earthwork plan of Park Brow with that carried out in this NMP project illustrates the accuracy of his survey work. George Holleyman (1910-2004) was involved with both these societies and undertook excavations and surveys of the South Downs which included, it is implied, the use of aerial photographs (Holleyman 1935). Working outside of Sussex's archaeological 'establishment' was John Pull (1899-1960). Largely self-taught, he excavated a number of sites from the 1920s onwards including Church Hill and Cissbury (Russell 2001).

An extensive survey of burial mounds across the whole of the Downs was carried out by L.V. Grinsell (1907-1995). He combined the results of his field work with earlier references to barrows and published these in the Sussex Archaeological Collections (Grinsell 1934, 1940, 1942).

Many archaeological features were recorded by the Ordnance Survey's Archaeology Division (incorporated into the Royal Commission on the Historical Monuments of England (RCHME) in 1983 and now part of English Heritage). In particular, some field systems were identified from aerial photographs and their extent, though not form, indicated on the OS 1:10,560 field sheets (information which now appears on English Heritage's desktop Geographical Information System (GIS)).

Work by the RCHME in the area has included a survey of Cissbury Ring, at the request of the National Trust, and the flint mines at Cissbury and Church Hill, undertaken as part of the national survey of Neolithic flint mines (Barber et al 1999).

SUMMARY OF NMP RESULTS

The majority of archaeological remains that can be seen from the air were originally relatively large earthworks (Fig 4). Although some earthworks do remain unaffected by later land use many are levelled, often as the result of continual ploughing. Levelled features, however, may still have some surviving sub-surface remains which, in certain conditions, can produce soilmarks or affect the covering vegetation to produce cropmarks. Some of these levelled monuments can be seen as earthworks on the older aerial photographs. This ability to see archaeological features that can no longer be easily identified on the ground is the great strength of aerial survey.

Of the 256 new sites mapped in the course of this project, 55% were from the Second World War. This figure reflects the fact that this period has not been studied until relatively recently and can be contrasted with those for periods with a longer history of fieldwork: Prehistoric (5%) and Iron Age/Roman (6%). The temporary nature of the Second World War constructions means that the majority of these new records relate to features that have been removed. With the exception of the Second World War monuments, the distribution of sites by period is not uniform across the project area and, while Prehistoric and Roman remains are concentrated on the Downs, most of the medieval and post-medieval monuments are located in the Weald and the Adur Valley.

The 1940s photographs of the Downs shows various earthworks, most of which have since been levelled by the plough as large areas of downland were converted to arable. Neolithic flint mines, Bronze Age barrows and cross-ridge dykes can all be seen to have occupied prominent parts of the South Downs, most notably along the edge of the escarpment and on individual hills such as Cissbury. Over a wider area of the Downs there were large field systems whose origins are thought to be in the Bronze Age but which continued in use, modified and extended, through the Iron Age and Roman period. A considerable area of these field systems was already under the plough by the mid-1940s. Other features such as Iron Age or Roman enclosures and trackways were only seen as cropmarks.

Little from the medieval or post-medieval periods can be seen on air photos on the Downs; there is some evidence of farming in the form of farmstead remains and strip lynchets and some of the dewponds identified may date to this period. The Weald contains fragmentary evidence of medieval settlement, including moated sites as well as the remains of ponds and channels possibly relating to watermills. The paucity of sites in the Weald seen on air photos suggests that not only has this area been intensively

ploughed for a considerable time, thereby removing the evidence, but also that the heavy and poorly drained soils do not create the best conditions for cropmarks to form. The most extensive medieval remains recorded during the survey are the waste mounds created through the salt production that was carried out in the Adur Valley.

The monuments with the widest distribution belong to the Second World War. Defensive lines were constructed to protect both the coast and the vulnerable gap in the Downs through Findon. Emergency Water Supplies (for fighting fires caused by air raids) are distributed throughout the urban area. Public parks had been turned over to allotments as part of the 'Dig for Victory' campaign. On the Downs, many of the remains relate to the military exercises carried out there after the area was requisitioned by the army in 1942. Others form an inland defensive 'nodal point' centred on Findon. Military camps can also be seen in the Weald and the coastal plain.

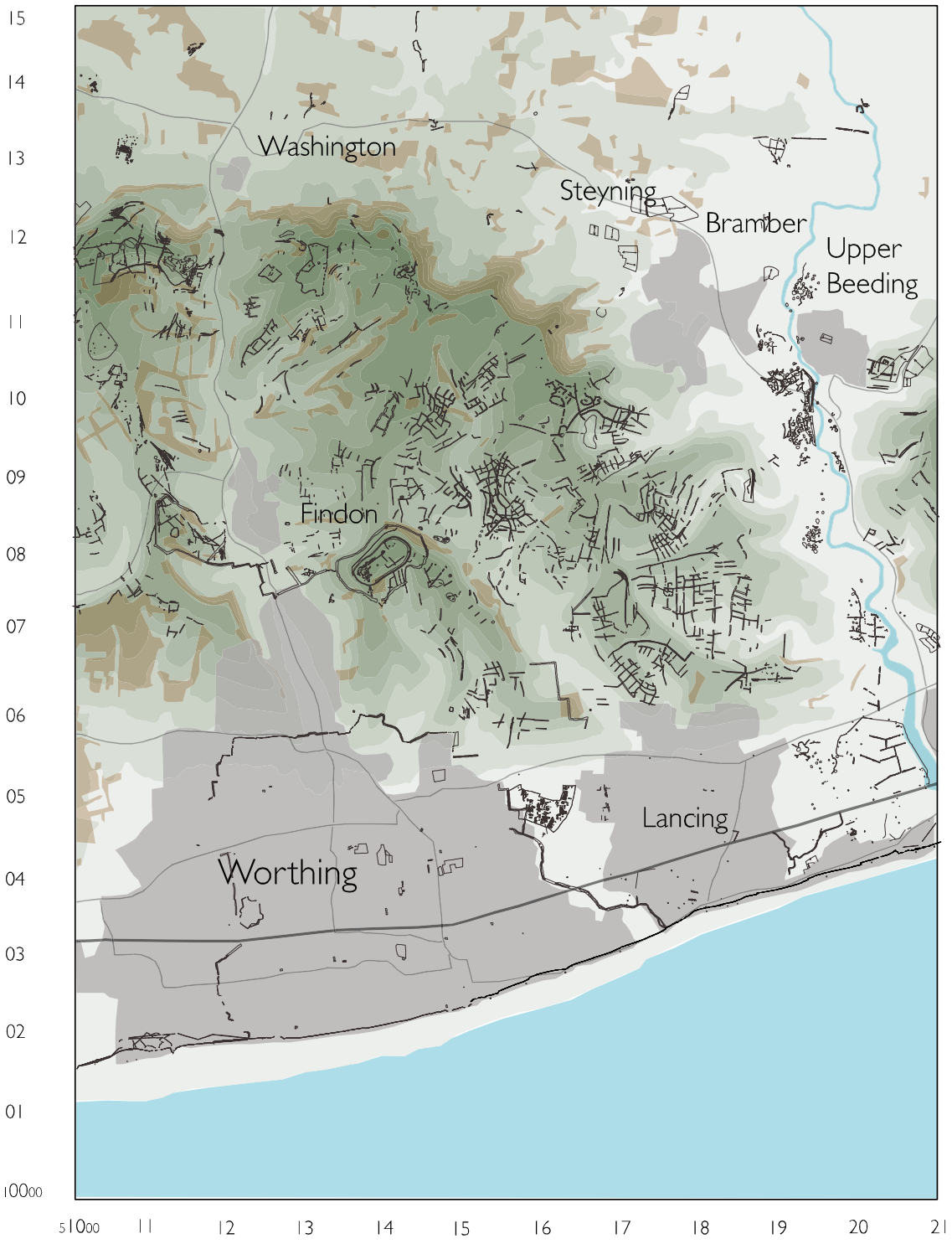

Fig 4: An overview of the archaeological features mapped in the course of this project. For clarity at this small scale all archaeology here and on subsequent distribution maps is shown in the same colour. These features were originally mapped to specific conventions (see appendix) which are followed in the detailed mapping extracts included in this report. The features shown above may have been seen as earthworks, cropmarks or structures.

SURVIVAL OF EARTHWORKS

The extent of the expansion of arable across the Downs by the late 1950s is clearly indicated by the title of a 1957 newspaper article: 'Corn Ousts Sheep' (Anon 1957, 7) and this conversion to arable is discussed in the final chapter 'Ploughing up the Downs'. Of the downland that existed before 1939, 40-50% was made up of ancient chalk grassland; it now accounts for a mere 3-4% (Brandon 2006, 122). While this delicate turf is destroyed in a single episode of ploughing, the earthworks within this landscape can be more resilient and complete levelling may only result after a number of years ploughing. This has resulted in a variable survival of the archaeological earthworks within the project area.

It is difficult to obtain, from aerial photographs alone, an accurately dated history of the destruction that has taken place on the Downs through ploughing. One problem is in ascertaining whether an earthwork has been completely levelled, as very slight earthworks can be difficult to identify if the lighting conditions were not good when the photograph was taken (a particular problem with photographs not taken for archaeological purposes). Another issue is the date of this evidence; the most recent available photographs, although offering a relatively recent view of the landscape and providing a good contrast with those taken in the 1940s, can be over a decade old and does not provide a contemporary picture of the Downs. Despite these specific points, aerial photographs do provide good images of the Downs throughout the post-war period from which an outline of the major changes in land use can be gained.

Anther survey technique that can provide a good 'snapshot' of the state of earthwork survival is airborne laser mapping known as lidar (LIght Detection And Ranging). Although not used in this survey, the recent application of lidar to archaeological aerial survey has, in certain areas, proved valuable in revealing additional information. Lidar has shown the presence of slight earthworks where only cropmarks were thought to exist and has enabled the identification of earthworks within woodland (Bewley et al 2005; Devereux et al 2005; Crutchley 2006). However, lidar only records difference in height and the images produced still need to be interpreted, often with the help of aerial photographs.

Since the Second World War some earthworks in the project area appear to have escaped ploughing entirely. In particular, the area on the edge of the escarpment around Chanctonbury Ring still has some barrows, a cross-ridge dyke and a dewpond surviving as earthworks (Fig 5). These survivals are atypical and the majority of the monuments mapped were in the process of, or had already been levelled by the late-1940s. This can be illustrated by the example of Barnsfarm Hill and Highden Hill which in the mid-1940s contained a range of earthworks including three Bronze Age cross-ridge dykes. Almost the whole of this area had been ploughed by 1959, and much had been levelled although the more substantial earthworks of the cross-ridge dykes still survived to some extent. Continual ploughing meant that by 1981 little could be seen of these cross-ridge dykes with the notable exception of the northern end of the eastern dyke. By 1994 however this, too, had been levelled by the plough.

Fig 5: A number of earthworks do survive on this part of the escarpment east of Washington. Chanctonbury Ring is to the top of the photograph on the very edge of the Downs. Other remains include a Bronze Age barrow, a prehistoric cross-ridge dyke and a nineteenth century dewpond.
NMR TQ 1312/13 (23312/31) 18-Jan-2004

The pattern of post-war ploughing to the east of Findon Park has affected the prehistoric field system to varying degrees (Fig 6). As in the previous example, the mid-1940s photographs show well preserved earthworks, though these are, in part, obscured by scrub. Ploughing had extended across this area by 1959 and continued ploughing has

levelled most of these earthworks. Some of the lynchets have survived, however, as they were incorporated in to the modern field boundaries. One new field appears to have been ploughed less frequently and the earthworks within it, although denuded, can still be made out on the 1994 photographs.

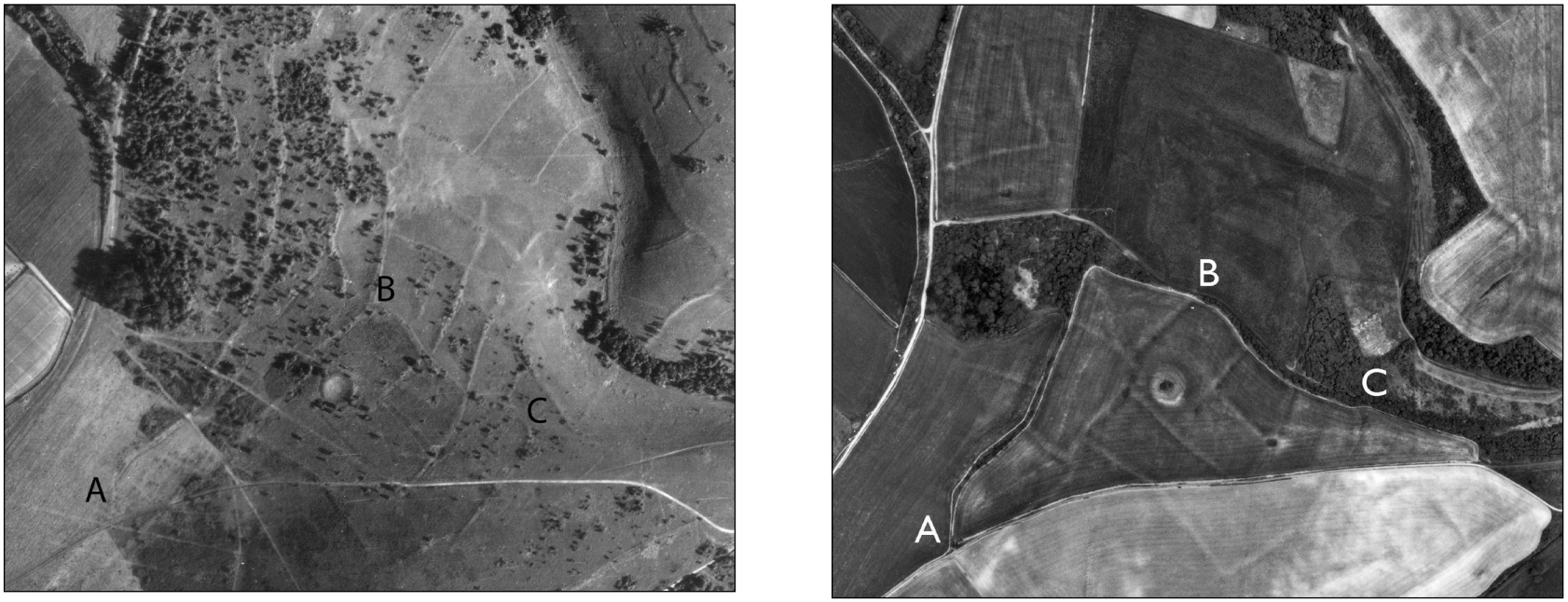

Fig 6: The same prehistoric field system to the east of Findon Park photographed in 1946 (left) and 1981 (right). Near the centre of each photograph is a circular dewpond and, to help in orientation, three points have been marked in each photograph as A, B and C. The fields are defined by lynchets formed through the gradual accumulation of soil at their edges and good earthwork survival can be seen in the photograph taken in 1946. Thirty-five years later the dewpond is still visible at the centre of the photograph and now sits within a triangular field which is partly defined by preserved lynchets. While most of the other lynchets have been levelled and show as cropmarks or soilmarks, ploughing has been less intensive north of the triangular field and the prehistoric fields still survive as low earthworks.
Details of RAF CPE/UK/1751 3147 21-Sep-1946 and MAL 8112 165 7-May-1981

NEOLITHIC AND BRONZE AGE (4500-700BC)

The earliest features that may be visible on aerial photographs in Britain date from the Neolithic, the period when the first substantial earthworks are thought to have been created. Neolithic activity within the project area is represented by the flint mines at Cissbury and Church Hill, situated to the east and west of Findon. Neolithic long barrows and causewayed enclosures are so far unknown within the central area of the South Downs, within which this project area falls (Drewett 1999, 17). Some Early Bronze Age barrows were mapped within the project area, as well as the Late Bronze Age or Early Iron Age cross-ridge dykes. The relatively small size of these monuments has meant that they have been particularly susceptible to levelling through ploughing. The mapping has generally been derived from photographs of these barrows while still earthworks although some levelled examples have produced cropmarks. The dating of cross-ridge dykes to both the Bronze Age and Iron Age illustrates the fact that some monuments do not clearly fit into any one prehistoric period and attempts to arrange the results of this project by period are not entirely satisfactory. The field systems seen here on the Downs can relate to the Bronze Age, Iron Age and Roman period. Because the final form of many of these fields dates to the Roman period (Drewett 1978 74), they are discussed in the Iron Age and Roman section.

Flint mines

Flint mines are some of the earliest earthworks known in England. The surface remains of the mines are often in the form of a series of circular hollows (and associated spoil heaps), which at Cissbury range in diameter from 3 metres to 36 metres. Investigations of these depressions at Cissbury in the 1850s resulted in the misinterpretation that they were livestock enclosures. It was only after the excavations of similar depressions at Grimes Graves (Norfolk) between 1868 and 1870 and the discovery of a deep galleried shaft that the date and purpose of this type of site was first understood. The work in Norfolk led to a series of excavations at Cissbury during the 1870s, which demonstrated that the hollows at Cissbury were also the tops of mineshafts that opened out onto galleries exploiting the flint seams.

Cissbury is the largest mine complex within the project area and is thought to have comprised of at least 270 mine shafts, the remains of which can be seen on the western slopes following the contours of the hill (Fig 7). The smaller mine complex is situated on the south eastern slope of Church Hill and consists of an irregular group of hollows. John Pull identified thirty six shafts in the course of the work he undertook during the 1930s, 40s and 50s, but the majority of these have since been levelled by ploughing.

Both Church Hill and Cissbury are dated by material from poorly documented contexts. Finds from Cissbury indicate that mining was carried out there during the first half of the 4th millennium BC, and those from Church Hill suggest an even earlier date (Barber et al 1999, 68).

Cissbury and Church Hill mines are situated on two of the higher points within the project area. Along with Blackpatch and Harrow Hill, which are a little to the west of the project area, they make up the eastern group of mines on the South Downs. Situated on

downland between the rivers Arun and Adur these mines are evenly spaced (approximately 2km apart) and have a degree of intervisibility (Barber et al 1999, 55).

Fig 7: Gorse bushes grow in many of the shallow depressions of the Neolithic flint mines within the Iron Age ramparts of Cissbury Ring.
NMR TQ 1307/29 (136078) 30-Jan-1995

At the north-west foot of Church Hill is an area of extraction known as Tolmere Pond. It has been suggested that some of these depressions are the result of Neolithic flint mining but the evidence is inconclusive and much of the digging here may be related to the post-medieval limekiln at the northern end of the group (Barber *et al* 1999, 76). Although this aerial survey did not extend the distribution of flint mines, aerial photographs have illustrated the setting of these monuments.

Bronze Age barrows

A wide range of round barrow types have been noted in Sussex but the vast majority of these are bowl barrows (Grinsell 1934, 221), although this categorisation has been questioned as, in some cases, it was based on the remains of considerably eroded barrows (Garwood 2003, 50).

Only a few barrows within the project area have been properly excavated. For the whole of Sussex, information derived from excavation is available for approximately 130 of the 1000 known barrows (Garwood 2003, 48). These barrows are thought to have been built during the Early Bronze Age (2500-1500 BC) though the absolute dating evidence is poor (Garwood 2003, 50).

In many examples, all that can be identified from the early vertical photographs is the mound: examples transcribed measure 10m to 14m in diameter. Some barrows recorded through field survey have proved impossible to see on aerial photographs, primarily due to the poor lighting conditions when the photos were taken. Aerial photographs have, however, also included evidence of up to three previously unknown barrows situated to the east of the river Adur on the south western slope of Beeding Hill.

Barrows within the survey area, including those known only from field survey, were concentrated on the northern edge of the Downs and on prominent features within the Downs, such as Church Hill. They are shown to be isolated or positioned in small groups; on the northern edge of the Downs, Barnsfarm Hill and Highden Hill had five barrows, although only two of these are close to each other. Similarly, over a dozen barrows were positioned across Chanctonbury Hill, but discreet groupings never exceeded three barrows. This can be compared with the large cemeteries of over 30 mounds to the east, outside the project area (Field 1998, 310). The sparse distribution seen in the project area continues westwards.

Cross-ridge dykes and spur dykes

On the South Downs there are a number of linear earthworks usually referred to as cross-ridge dykes or spur dykes. At least 80 are known in Sussex (Hamilton 2003, 77), and 16 of these are situated within the project area (Fig 8). In common with other earthworks seen on early aerial photographs, many of these dykes have been levelled by ploughing since the mid-1940s.

The majority of dykes have not been accurately dated, as even when excavated, few datable finds are recovered. Sections cut through the ditch at Upper Beeding produced some Early Iron Age pottery (Bedwin 1979, 13). Excavations at the dyke at Alfriston Down (outside the project area) produced material from which a date range of Late Bronze Age to Early Iron Age has been tentatively assigned (O'Conner 1976, 160). An excavation of the cross-ridge dyke to the west of Chanctonbury, however, produced one Roman pottery sherd at the base of the bank (Bedwin 1980, 182). The alignment on Early Bronze Age barrows does provide some relative dating evidence and, taken with results from excavation, the majority of Sussex dykes are thought to be from the Late Bronze Age or Early Iron Age.

A certain amount of variation exists in the form of these cross-ridge dykes as seen from the air, which raises the possibility that they were not all built for the same purpose. This variation is also evident in ditch profiles recorded on excavation (Bedwin 1979, 15; Bedwin 1980, 182; O'Conner 1976, 156). The majority of dykes within the project area consist of a single bank and ditch, the bank tending to be positioned down-slope of the ditch. Less frequently they are seen as a double bank with a central ditch, as on Highden Hill. The majority of these dykes are constructed across the top of a ridge or spur but do not extend as far down as the bottom of the coombe, tending to stop as the ground gets steeper. Two dykes appear to have been built only on one side of a ridge, stopping short of the summit.

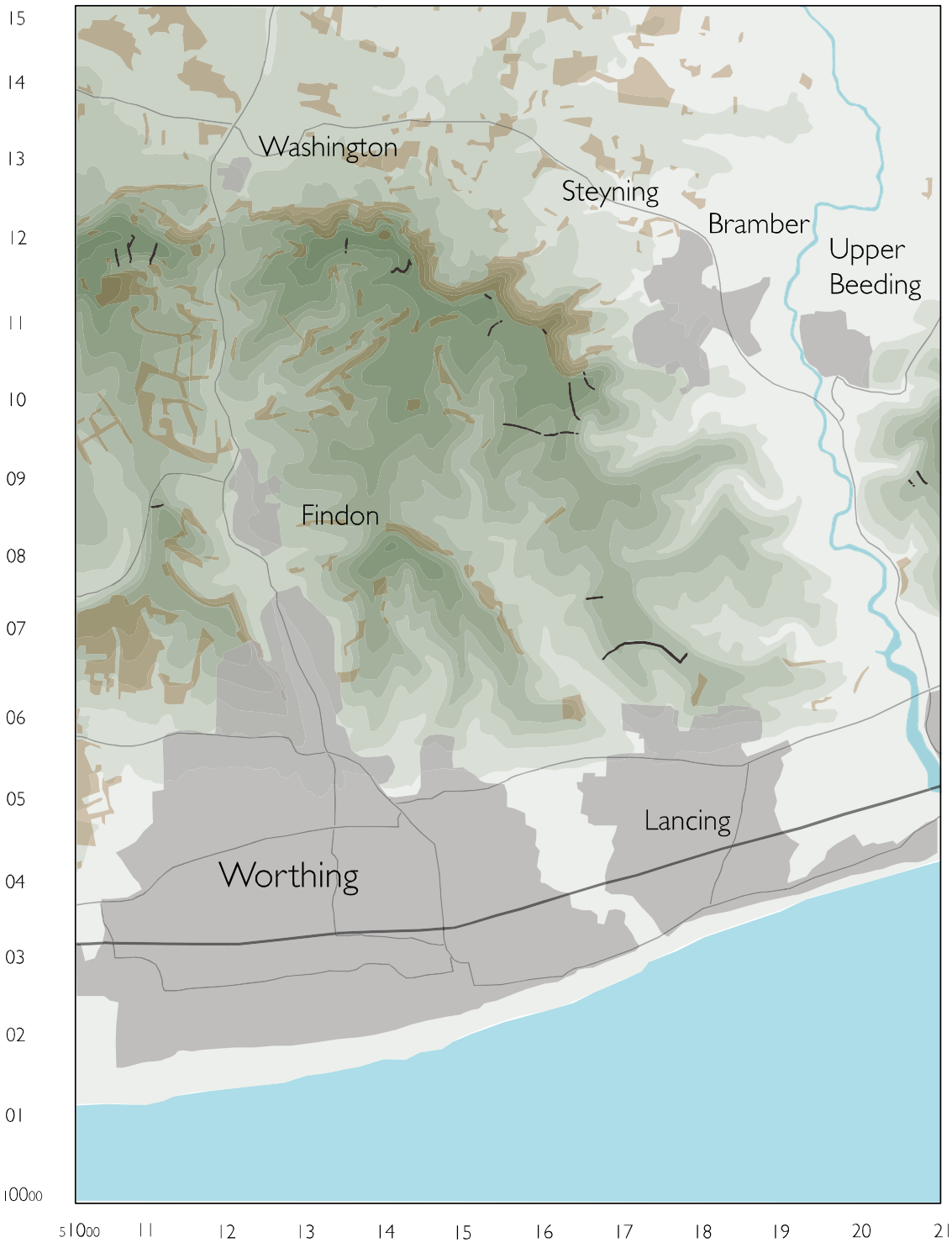

Fig 8: Distribution of cross-ridge dykes

A relationship between dykes and other archaeological earthworks can sometimes be seen and two dykes are aligned on barrows which have been incorporated into the linear earthwork. As these barrows are situated on the centre of the ridge they, in effect, mark the centre point (and highest point) of the dyke, and often herald a slight change of direction. At Highden Hill, fieldwork has shown that the double-banked dyke passed

immediately to one side of a barrow. The eastern cross-ridge dyke on Steyning Hill appears to link up with what has been interpreted as a double-banked trackway (Fig 9). This winds its way down slope to the east possibly cutting through the field system there. At Lancing there is a curved double-banked cross-ridge dyke which connects to a terrace-way, thought to have been in use by the Late Iron Age (Frere 1940, 157).

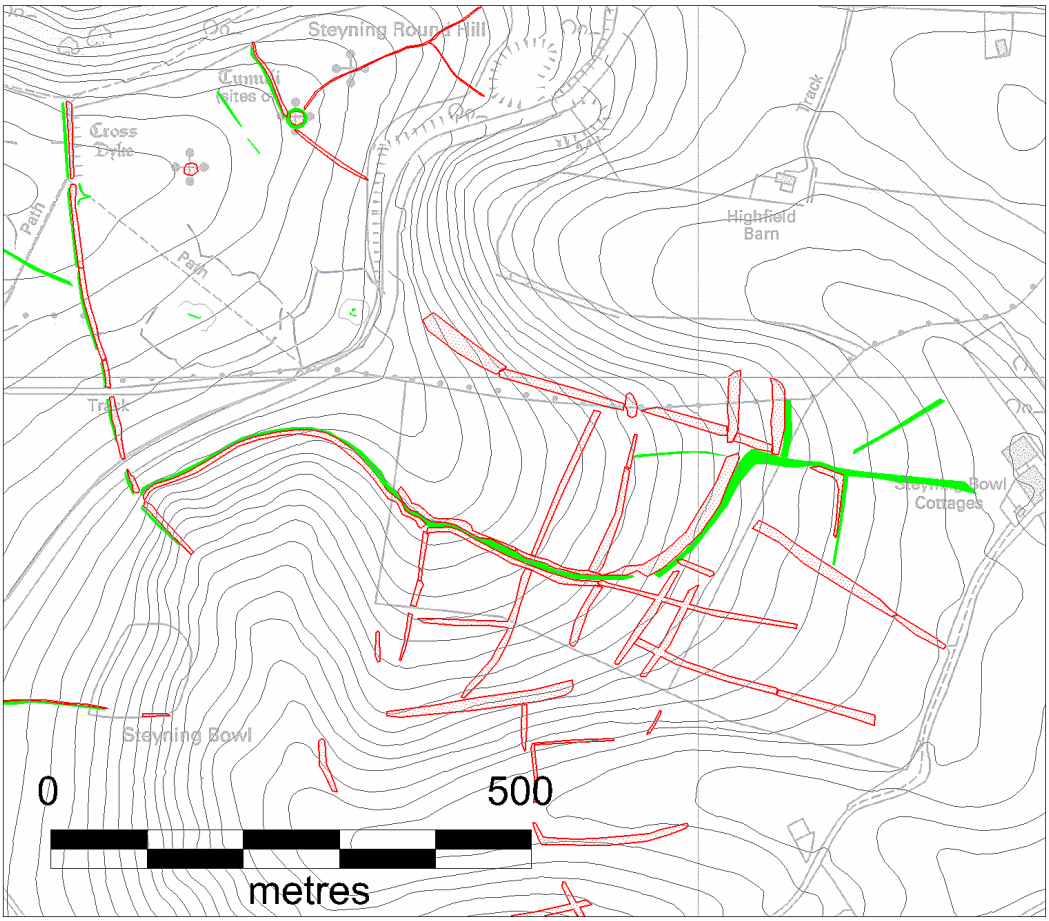

Fig 9: Cross-ridge dyke, track way and field systems south of Steyning. Background map acquired from the Ordnance Survey. Licence number 100019088 ©Crown copyright. All rights reserved

Despite the variation in form, there is a concentration of both cross-ridge dykes and spur dykes on the northern edge of the Downs. The exceptions are the dykes on Steep Down and Church Hill. Steep Down itself could, however, still be interpreted as the outer edge of this part of the Downs, as it is the last scarp-like formation before the chalk gently descends eastwards to the Adur valley. A rapid consultation of the Ordnance Survey maps indicates that these dykes are also seen along the northern edge of the South Downs outside of the project area, although there are very few between Wolstonbury Hill and Ranscombe Hill.

Discussion

Although entire landscapes are thought to have held symbolic significance to earlier societies, it is probably the more dramatic elements that received special attention (Field 1998, 321). The flint mines cannot be seen as a purely practical response to the need for flint, as surface deposits of flint are widespread and easily obtainable. Although it is true that surface flint can suffer from flaws, it is not always the case that mined flint was of the best quality (Barber et al 1999, 53). Flint mines, therefore, may have been positioned at locations which were already important to society, something that may have been the result of activities that took place there, or because of the possibly ritual significance that some prominent landscape features were given (Barber 2001, 23). The implication of this is that the two prominent hills within the project area, Cissbury and Church Hill, possessed some cultural significance in the Neolithic.

The significance of the natural landscape can be seen in the succeeding period with regard to the positioning of the round barrows, situated as they are on high ground within the Downs and on the scarp edge. The construction of burial mounds in elevated positions has long suggested that they were intended to be viewed from a distance and, if on a false crest, indicating from which direction. The positioning of some barrows on Church Hill and Cissbury may be, in part, due to the close proximity of the earlier mines. It has been argued that the symbolic significance of these areas, first identified in the Neolithic with the digging of mine shafts, may have developed or been given new meaning during the Bronze Age (Barber et al 1999, 70).

There appears to be some association between Late Bronze Age/Early Iron Age dykes and Early Bronze Age barrows. While both are present on the South Downs, the North Downs has almost no burial mounds or any dykes (Field 1998, 313; English Heritage monument database). However, the area with the greatest concentration of Bronze Age burial mounds (outside the project area between Wolstonbury Hill and Ranscombe Hill) is also the area with the fewest dykes. This near-absence of dykes in areas with larger groups of mounds has also been noted in North Yorkshire (Vyner 1994, 34).

While some examples, elsewhere in England, suggest that dykes demarcate areas of barrows, this is not always the case, and associations are not always 'close or especially clear' (Vyner 1994, 34). Within the project area there is no clear demarcation: for example on Steyning Round Hill, barrows are present either side of the dykes. The distribution of dykes within the project area seems more influenced by the scarp edge than the position of barrows, and Church Hill is the only example of a group of barrows not on the escarpment that is associated with a cross-ridge dyke.

The construction of these cross-ridge dykes creates both a boundary and a barrier. The asymmetrical nature of these earthworks suggests that one elevation faces outwards, the other inwards, which would mean that both the direction of approach and the area excluded could be determined. Alternatively, these dykes could be 'read' the same way from either direction with neither feature exclusively representing inside or outside. This duality of meaning could also be seen in the various types of Early Bronze Age barrows whose outer limit by is defined by either a bank or a ditch.

The examples of dykes with two banks flanking a central ditch may suggest that it was the bank that was intended to be viewed. This seems to be supported by the layout of the two dykes on the east and west slopes of Rackham Hill (west of the project area) which could be interpreted as working together to define the summit of the hill. If so, then both these dykes have an inner ditch and an outer bank.

However, every example of a single-bank dyke so far seen is built with the bank on the lower side, something which may have been done for ease of construction. Furthermore, the idea that dykes were paired to demarcate an area may be simplistic. When four sets of paired dykes on the North York Moors were investigated, it was shown that the dykes within each pair had been constructed differently and, it was concluded, at different times (Vyner 1994, 36).

During the Early Bronze Age the linear nature of the escarpment is emphasised by the grouping of barrows there, and the linear arrangement of monuments elsewhere has been thought to follow or mark routes (Bradley 1991, 137). The importance of procession in the prehistoric period is seen elsewhere in the form of avenues, as at Avebury and Stonehenge (Bowden & McOmish 1989, 13). Although the Late Bronze Age dykes are concentrated on some of the same elements of the landscape as the barrows, they are acting in a contrary way. Instead of emphasising the linear nature of the escarpment, they act to break it up and, in the case of the spur dykes, possibly to prevent or impede access.

This aerial survey has not dramatically altered the picture of the Neolithic and Bronze Age within this part of the Downs. No new Neolithic monuments were identified, and flint mines remain the only monument from this period within the project area. This and the fact that very few new Bronze Age sites were discovered can be explained, in part, by the considerable number of archaeological investigations that have previously been undertaken in this area. However, that some new sites were seen as cropmarks does highlight the potential of aerial survey to make new discoveries in well researched areas.

IRON AGE AND ROMAN (800BC-410AD)

The Downs were once widely cultivated in both the prehistoric and Roman periods, although few of the earthworks of these field systems have avoided destruction by the plough. Despite their prehistoric origins, the final form of many of these fields appears to be Roman (Drewett 1978, 74) and, as a result, they are discussed in this section. The cropmarks of a number of enclosures and possible settlements have been discovered, some clearly associated with the trackways and field systems also recorded in the course of this project. Although the majority of these enclosures are not firmly dated, two have produced Roman dates and while this may suggest a similar date for the remainder, an Iron Age date for some should probably not be excluded. What may be cropmarks of the Greensand Way Roman road have been identified to the east and west of the river Adur. This road ran east-west and was situated to the north of the Downs linking Pulborough with two roads that headed north through the area of ironworking in the Weald and on to London (Rudling 1999, 24). The best surviving earthworks from this period are the two Iron Age hillforts of Chanctonbury Ring and Cissbury Ring.

The hillforts

Chanctonbury Ring is the one early hillfort within the project area and, although it is visible on aerial photographs, much of its detail is obscured by trees, the first of which were planted in 1760 (Brandon 1999, 8). This oval earthwork is defined by a single bank and ditch enclosing 1.25 ha with a single entrance on the eastern side. The limited excavations revealed little to suggest that Chanctonbury acted as a settlement and the surrounding area was not ploughed and unlikely to have been intensively grazed (Bedwin 1980, 186). Chanctonbury Ring is located on the northern edge of the Downs with views into the Weald. This positioning is a characteristic that is common to many of the Late Bronze Age or Early Iron Age hillforts, as is their inter-visibility (Hamilton 2003, 76), and excavations have produced pottery dated to the Early Iron Age. The site was abandoned at the beginning of the Middle Iron Age (400BC) but reused in the mid-1st century AD, when a Roman temple (not visible on aerial photographs) was constructed (Bedwin 1980).

The largest earthwork by far in the project area is Cissbury Ring, which is one of four Middle Iron Age hillforts in Sussex and was surveyed by the RCHME in 1993 (Donachie & Field 1994). Cissbury is a pear-shaped earthwork defined by a bank and ditch (with a small counterscarp bank), that encloses 24 ha. There were originally two entrances to the hillfort, one on the east and the second on the south. Evidence from excavations dates the construction of the hillfort to the beginning of the Middle Iron Age (400BC), and the presence of fields in the interior dating to the Late Iron Age (100BC-43AD) suggests that it had gone out of use by this period (Hamilton & Manley 1997, 101, 103).

Cissbury is situated on an elevated end of a ridge within the Downs and orientated to the south. The ramparts partially enclose the filled-in shafts of the Neolithic flint mine, and other interior features include possible Romano-British settlement remains and the lynchets of a field system of a similar date.

Discussion – Cissbury

A wide range of monuments varying in form, location and date have been categorised as hillforts, and it is now clear that the design and position of some of these enclosures means that they can no longer be considered as purely defensive structures (Bowden & McOmish 1987, 1989). Elements of ritual can also be seen in both the construction of hillforts and their monumentality (Bowden & McOmish 1987, 76).

At Cissbury, the relationship between the ramparts and the Neolithic flint mines, where the majority of the mine shafts have been enclosed, suggests that these shafts held some significance to the Iron Age population. Although there had been a decline in the importance of flint by this period and flint mines were no longer the focus of funerary activity, the shafts may have been given new significance relating to a mythological past (Barber 2001, 25; Gosden & Lock 1998). This significance may have been due to both the prominent nature of the hill and the ritual role of pits in the Iron Age (Hill 1989, 1993), although the assumption that shafts and wells also acted as ritual foci in this period has been challenged (Webster 1997). A similar relationship between Neolithic mining and an Early Iron Age enclosure can be seen at Harrow Hill (Sussex). At Harrow Hill it has been suggested that the remains of Neolithic mining gave the hill a ritual significance in the Iron

Age which led to the construction of an enclosure to act as the focus for cult activity (Manning 1995, 136). It is noted, however, that not all the shafts are enclosed at either Cissbury or Harrow Hill.

The enclosure at Cissbury perhaps creates social isolation by restricting access to this hilltop as well as enhancing the social prestige or acting as a symbol of those responsible for its construction and maintenance. Maintenance is suggested by the presence of a counterscarp bank; excavations at Danebury hillfort (Hants) showed that the counterscarp bank was built up gradually over a considerable period of time and may have been the result of periodic clearing of the ditch (Cunliffe 2005, 577).

Although the ramparts limit access, they do not completely obscure the interior. Instead, the interior is framed for viewing from the outside. These enclosures were 'about "looking-towards"' from the outside, rather than "looking-out" from the inside' (Hamilton & Manley 1997, 104). The interior of Cissbury is clearly visible from the south and there are also good views into it from the ridge to the north (D. McOmish pers. comm.). Despite these good views into the interior of the hillfort, when approached from the north Cissbury appears closed-off. Due to the steepness of the slope, there was no original entrance on the north side, and the rampart is positioned high above the ridge that leads to the hillfort from this direction.

The two breaks in the ramparts on the south and east, each located at the end of ridges leading from the coastal plain, may have served as separate entrances and exits and allowed ritual procession through the enclosure (Cunliffe 2005, 576). Rituals are intended to induce a religious experience (Wait 1985, 9 fig. 1.1) and at Cissbury this experience may have been enhanced by the falling away of the ground either side of the ridges on which the procession may have followed. There is cropmark evidence for a trackway on Tenants Hill, one of the ridges that leads up to the eastern entrance. However this is situated approximately 1km to the south of Cissbury and no direct association can be made.

The cropmark trackway on Tenants Hill, along with field systems and enclosures mapped in the course of this project, have enable Cissbury to be put into a possible contemporary landscape.

Field systems and settlements

Aerial survey has provided evidence of both settlement and farming on the South Downs. In particular, the aerial photographs have enabled the once widespread, but now predominantly levelled, prehistoric and Roman field systems within the project area to be accurately mapped (Fig 10). The overview of these fields in Figure 10 shows that much of the Downs was enclosed by fields at some point during the late prehistoric and Roman periods, although these were not necessarily all in use at the same time.

What can be seen on aerial photographs is the earthworks or possibly, if ploughed away, the cropmarks or soilmarks of the lynchets that defined the fields. The fields would originally have been marked out in some way, for example, by fences, ditches or hedges. At Valley Barn, modern ploughing has revealed the cropmark of a ditch beneath a field bank which may possibly be evidence of the original marking out (Fig 14). These lynchets

are themselves the by-product of the ploughing of these early fields, and were formed as plough-soil moved downhill and accumulated on the field boundary. These individual fields are grouped together to form the field systems.

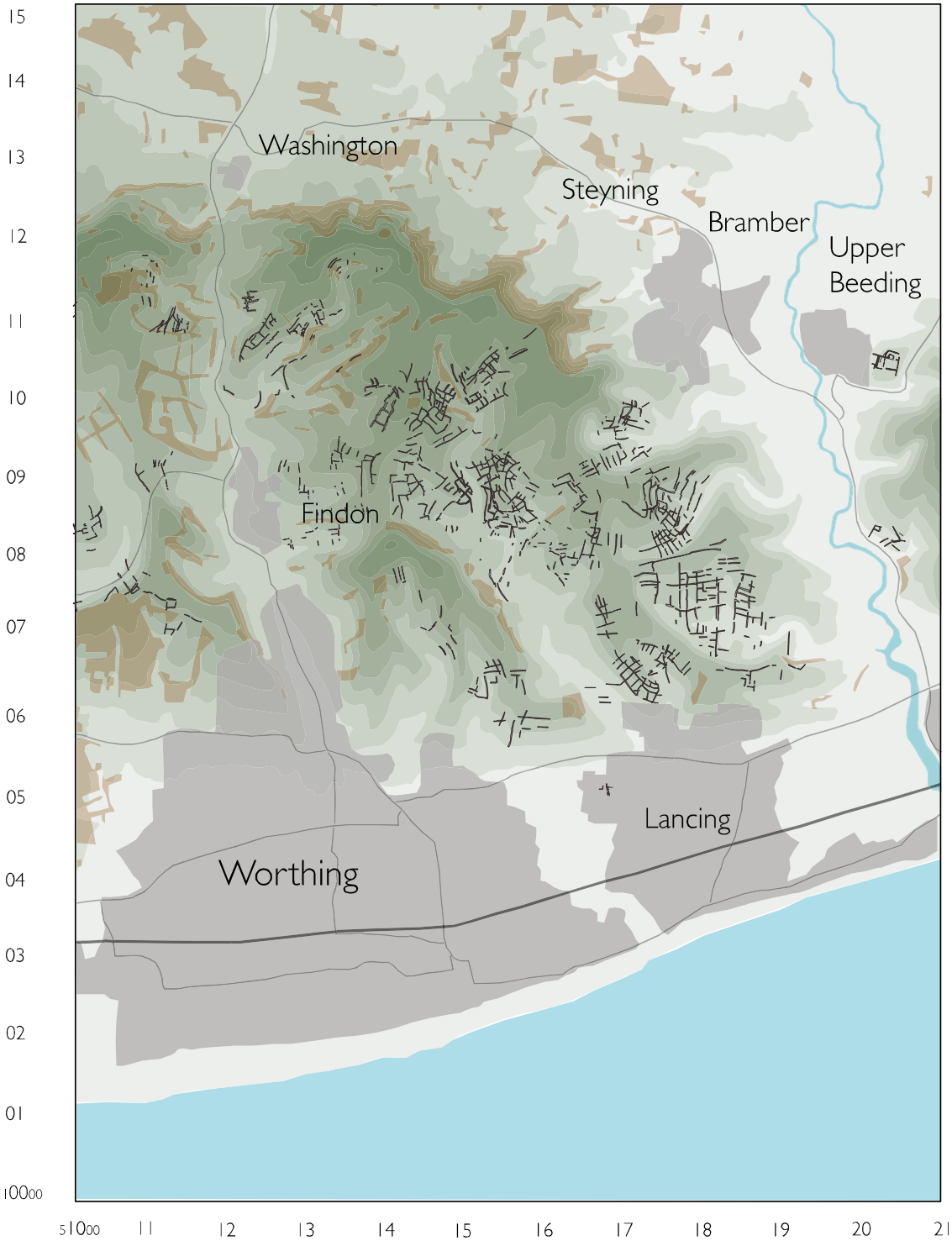

Fig 10: Evidence for late prehistoric and Roman field systems has been seen as earthworks, cropmarks and soilmarks.

Although there is some evidence for these fields across much of the Downs, the degree of survival is varied. In the western half of the project area the picture is very fragmentary with, at best, only small groups of fields or isolated banks visible. In the eastern part, extending almost to the Adur valley, the remains were more extensive. Even here, however, the fields do not run on continuously and there are a number of gaps creating a series of distinct blocks (Fig 11).

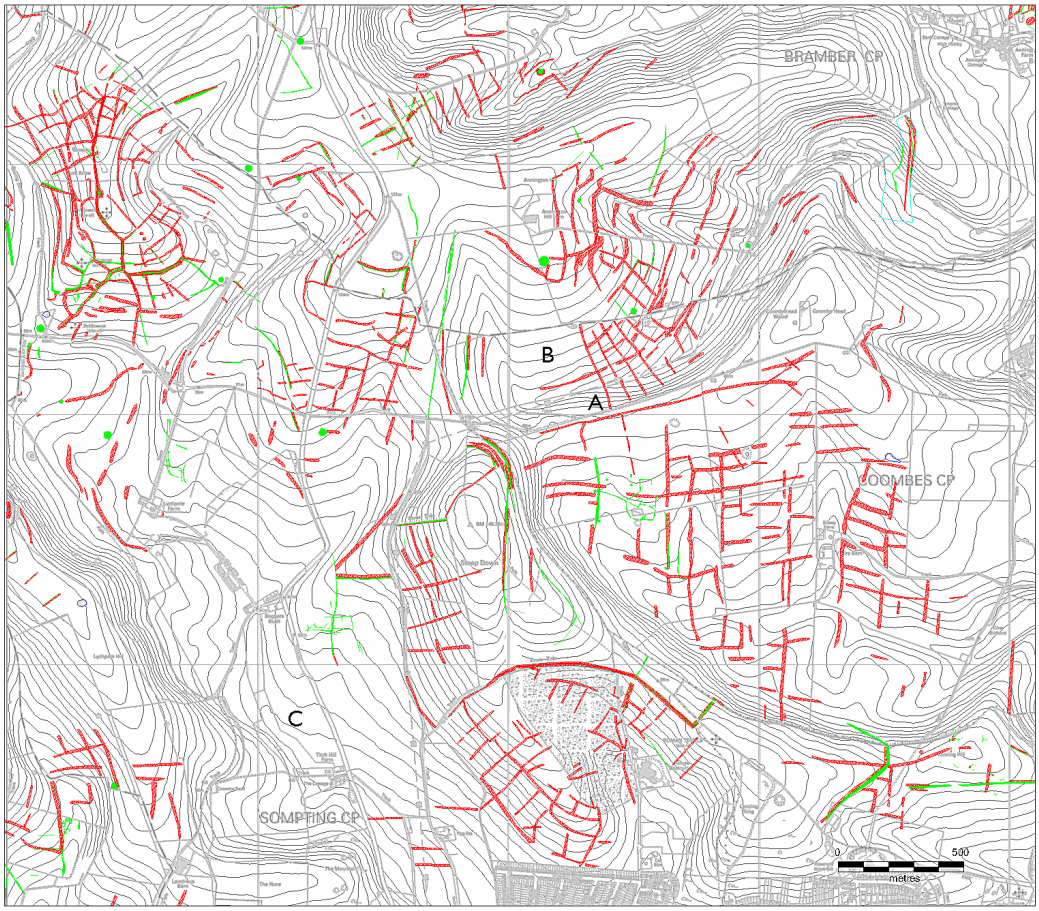

Fig 11: A more complete reconstruction of the field systems on the eastern side of the project area has been possible. This area is north of Sompting and south of Steyning. Steep Down is at the centre and Park Brow top left.
Background map acquired from the Ordnance Survey. Licence number 100019088

Each of these blocks is laid out on a different axis, each of which appears to be dictated by the topography, and the impression gained is of a number of field systems laid out independently of each other. This impression is further strengthened when two systems come close to connecting (A on Fig 11). The lynchets that form the southern end of the field system on Annington Hill, after descending to the bottom of the coombe, then ascend the next slope, stopping within 25 metres of the next field system. Clearly the steepness of the slope here was no barrier to the laying out of fields, and yet the different field sizes and orientations suggest that these two areas were marked out at different times.

Fig 12: There is a patchwork appearance to the arable fields to the south of Lychpole Farm. The distribution of these fields coincides with a gap in the distribution of prehistoric and Roman field systems and suggests that their absence here is not genuine, but is instead due to later land use.
RAF 106G/LA313 3091 17-May-1945

Not all of the gaps between field systems are genuine, but it is not always possible to ascertain with any certainty which are or are not. There is no topographical reason why many of the areas with no fields could not have been farmed. For example, although the southern slope of Annington Hill is of a relatively even gradient, no evidence of fields can be seen on the western side (B on Fig 11). Some of these gaps are likely to be genuine breaks in the prehistoric arable landscape, and may indicate areas of former pasture or woodland. Environmental evidence from Chanctonbury Ring has suggested that, during the Early Iron Age, the area around the hillfort was neither ploughed nor intensively grazed (Bedwin 1980, 186). Other gaps may be the result of later land use and, in particular, ploughing is likely to have been responsible for the destruction of some earlier field systems. This is a possible explanation for the lack of evidence of prehistoric field

systems in an area to the north of Sompting between Lychpole Hill and Steep Down (Fig 12; C on Fig 11), an area already occupied by arable fields in 1945.

This pattern – a number of separate field systems laid out at different times – can be compared to the evidence of the field systems on Salisbury Plain (Wiltshire). Here very large field systems were laid out on the axis north east/south west irrespective of the underlying topography, which suggests that they were created in one episode or a number of programmes of work each following quickly after the other (McOmish *et al* 2002, 54).

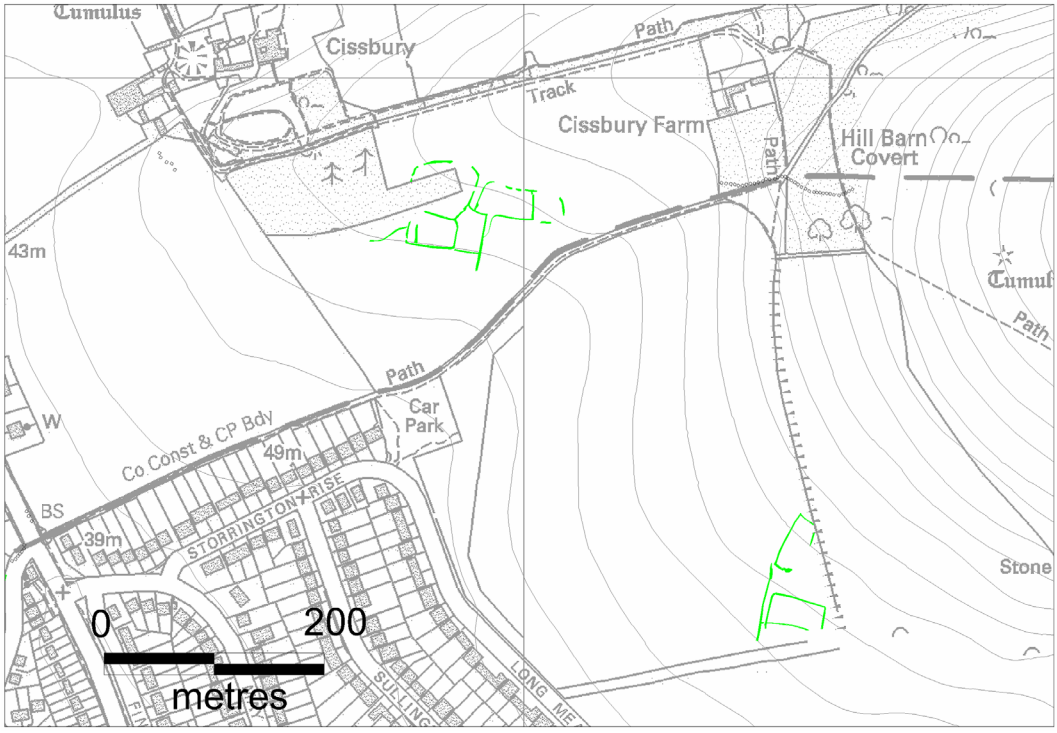

Fig 13: Two cropmark sites to the west of Cissbury Ring. The northern site was excavated and produced evidence of occupation in the Roman period.

Although exact dating of early field systems can be difficult (McOmish et al 2002, 52), possible dates can be derived from those obtained from the excavation of associated features. These excavations have produced a range of dates. Park Brow, one of the best known sites within the project area, was surveyed and excavated in the 1920s (Wolseley *et al* 1927). Evidence of three different phases of occupation, dating to the Middle Bronze Age, Iron Age and Roman period, was discovered. The associated field system is thought to follow a Middle Bronze Age field pattern subsequently modified in both the Iron Age and the Roman period (Drewett1978, 72). The field system at Findon Park is dated to the Iron Age as it is considered to be contemporary with an Iron Age settlement (unidentifiable on aerial photographs) excavated there in the 1920s (Fox & Wolseley 1928). Excavations at Cissbury Ring have shown that the lynchets within the hillfort are Roman and post-date the construction of the fort (Curwen & Ross-Williamson 1931).

A group of conjoined enclosures (Fig 13) west of Cissbury Ring, first seen as cropmarks in the 1960s, was partly excavated. This revealed that one enclosure included a possible hut circle and produced finds dating the site to the 2nd century AD. Subsequent photographs have provided further detail and revealed another group of enclosures to the south east. Neither of these two sites has a clear association with the nearest field system, which is to the north.

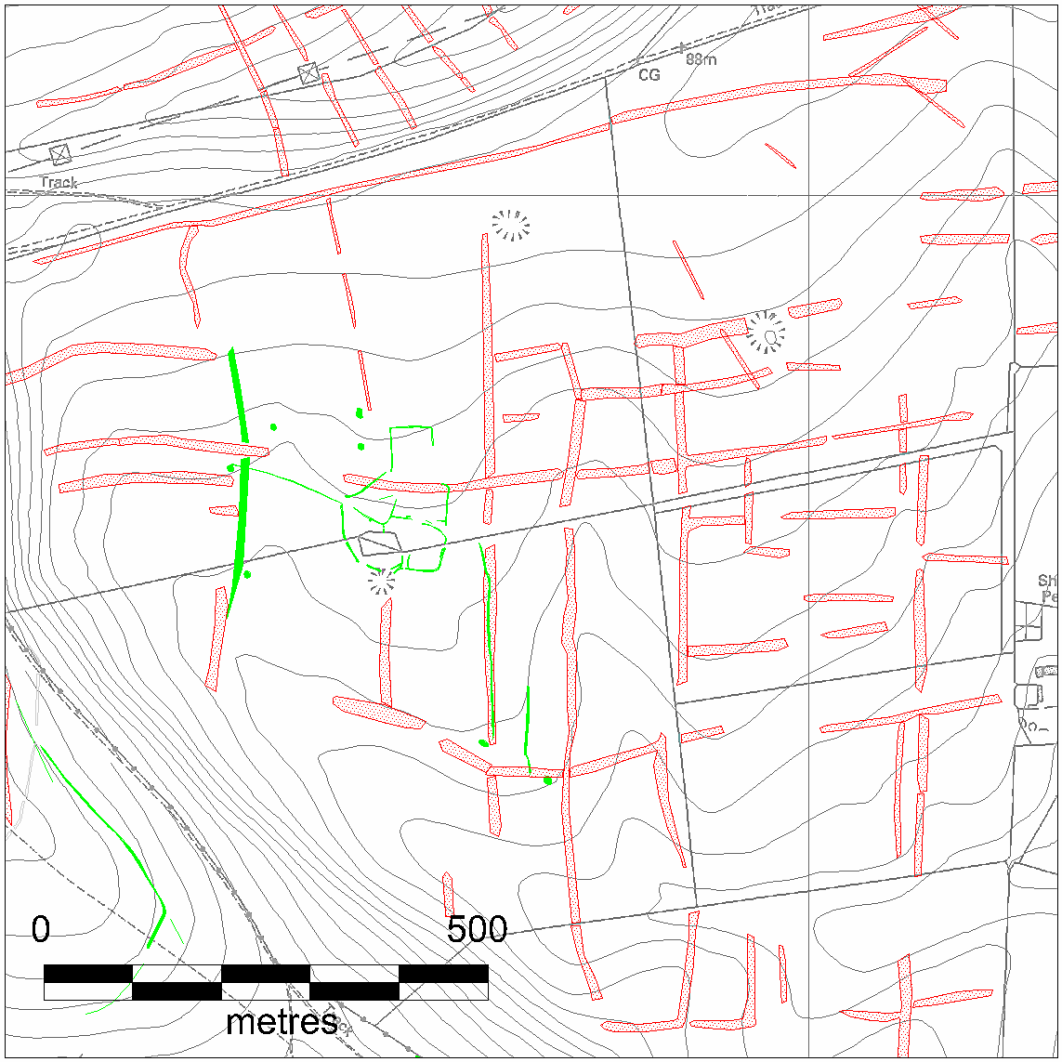

Fig 14: Enclosures, field ditches and field banks near Valley Barn.
Background map acquired from the Ordnance Survey. Licence number 100019088

Other newly discovered cropmark sites do indicate some relationship with the field systems (Fig 14). To the east, near Valley Barn, is another group of conjoined enclosures, similar in form to the excavated example at Cissbury. The combination of curved and rectilinear enclosures may suggest different phases of construction. Part of this site is overlain by the bank of a later field system which, based on its form, is possibly Roman in date.

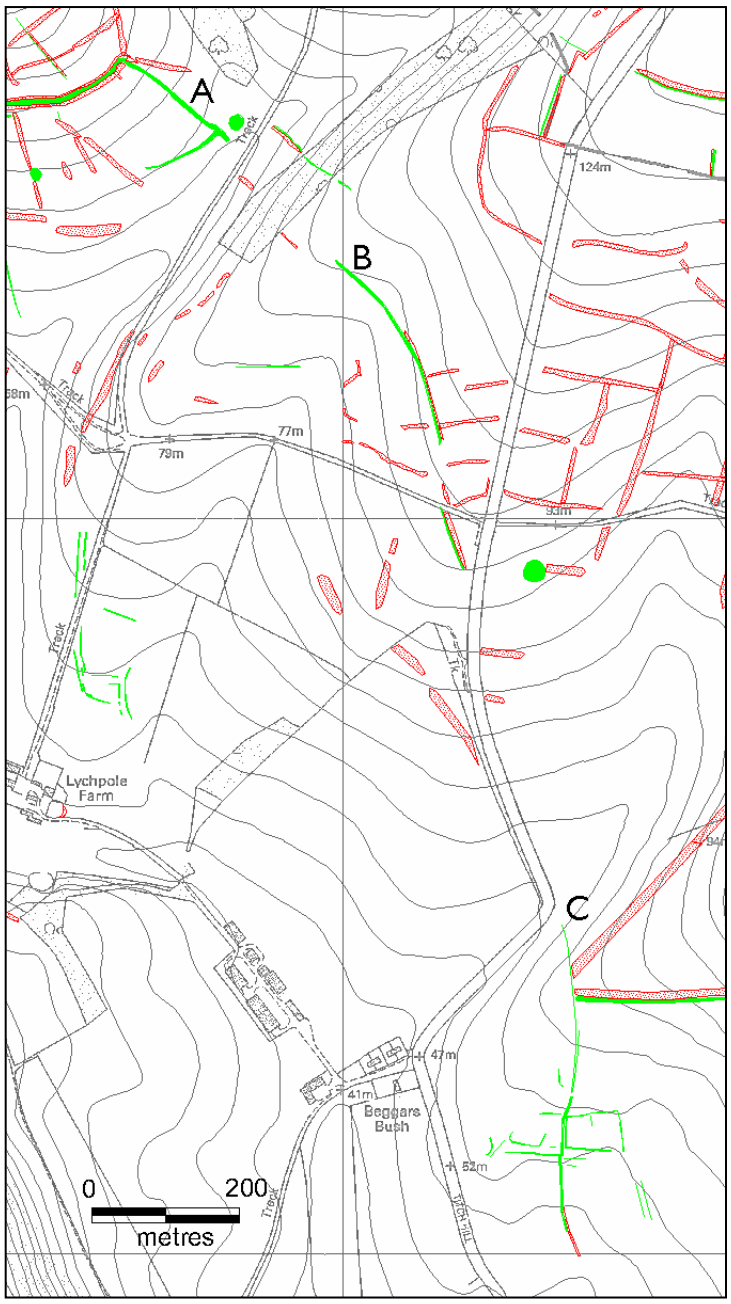

Fig 15: The extension of the track way south of Park Brow (A) may have connected with two further features seen in the course of this project (B and C).
Background map acquired from the Ordnance Survey. Licence number 100019088
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Although the general impression is of individual blocks of fields and isolated enclosures some possible relationships can be tentatively suggested, thanks to new detail seen on aerial photographs during the course of this project. At Park Brow, a cropmark of a continuation of the trackway at the southern end of the complex has been identified (A on Fig 15). This cropmark of a hollow way (there is no trace of any flanking banks) heads south east for over 170m and is joined, near its end, by a second possible track from the west. Some 217m south of this is the remains of a field system and an associated track

which is on the same alignment as the first hollow way (B on Fig 15). Approximately 500 metres south of this is another cropmark track east of Beggars Bush which continues south and is flanked by two possible Iron Age or Roman enclosures (C on Fig 15).

The line between these last two cropmark tracks is described by a modern track, which raises the possibility of some continuity of routes across the Downs. This coincidence between modern routes and cropmarks of older tracks is also loosely seen in the only example of Roman settlement (dated through excavation) identified in this project on the coastal plain. Cropmarks of possible enclosures and a trackway defined by two parallel ditches were seen at Sompting in the grounds of Templars First School, the recreation ground to the north and in an area now covered by houses to the south. The northern end of this cropmark trackway ends close to the start of Dankton Lane, which heads northwards across the Downs. Although these are imperfectly aligned, they suggest that at least part of the route followed by Dankton Lane was in use in the Roman period.

The preservation of many of these prehistoric or Roman field banks until the mid-20th century implies a prolonged period of grazing on the Downs after their abandonment as arable fields. Evidence on aerial photographs points to widespread land enclosure on the South Downs during the prehistoric and Roman periods by a number of individual field systems laid out at different times and each on a different axis. While some fields, such as at Park Brow, were in use and modified over a long period of time other areas, such as around Valley Barn may be Roman in origin. The identification of new enclosures and trackways has suggested possible connections between these otherwise disparate sites. The cropmarks of enclosures and a possible settlement discovered at Sompting highlights the fact that settlement was not confined to the Downs, as do the results of excavations in Worthing, which revealed Late Bronze Age structures (Yates 2007, 52).

MEDIEVAL AND POST-MEDIEVAL (410-1899)

Information from early medieval Sussex (410-1066) is derived from a number of sources including burial evidence (both in the form of cemeteries and burial mounds), some settlements and random finds. Little evidence dating from this period is visible from the air and in the course of this project only previously identified features have been seen on aerial photographs. These include possible burial mounds near Chanctonbury Ring and the modification of the entrances to Cissbury Ring which may have taken place in this period. These alterations to Cissbury have been linked (but not proved) to the supposed use of Cissbury Ring as an early 11th century mint (Donachie & Field 1994, 31). Salt making may well have been undertaken in the Adur Valley during the early medieval period but there is no direct evidence (Holden & Hudson 1981, 123). Better evidence for the remainder of the medieval and post-medieval periods has been identified from the air. This includes a number of settlement sites often identified from the earthwork remains of water management, such as channels or moats and earthworks created as a result of ploughing. Some field banks and dewponds may date to the 17th and 18th centuries and relate to agricultural improvements carried out at this time. Although discussed in this section, many of these ponds may have their origins in earlier periods. The largest body of evidence relates to the salt industry that flourished along parts of the river Adur from the early medieval period until the 14th century. Another industrial site is a 19th century brickworks, represented by the remains of the extraction pits which are situated north-west of Steyning.

Fig 16: Possible Saxon barrows south east of Chanctonbury Ring.
Detail of NMR TQ1412/1 (23312/27) 18-Jan-2004

Burial mounds

Four mounds have been tentatively assigned an early medieval date on the basis of form. They are circular and range from 5m to 8m in diameter and are surrounded by a quarry ditch approximately 1m in diameter. Three of these four mounds could be seen on aerial photographs. They are situated on the northern edge of the Downs to the south east of

Chanctonbury Ring. Two are positioned close to three low barrows which have been suggested as either dating to the Bronze Age or the Saxon period (Fig 16) (Bedwin 1980, 174).

Settlement

Five possible moated sites within the project area are recorded in the English Heritage monument database, two of these can be seen on aerial photographs in the Weald at Buncton and at Stretham. The moat at Buncton is circular, although incomplete, and is associated with a possible pond and a number of now dry channels connected with the water management of the site. The moat at Stretham is square and situated on the eastern side of the river Adur from which it was fed.

There are a number of earthworks at Wyckham between Wyckham Cottage and Wyckham Farm. These include ridge-and-furrow, linear banks and a possible windmill mound. There are also earthworks that relate to water management and two banks appear to channel the stream and may be the remains of a pond. Further east is a channel to the north of the stream which forms three sides of a square, the fourth being defined by the stream and these may relate to a watermill at the site. These remains may all be associated with the 11th century grange of one William de Braose at Wyckham or the later manor of Wyckham, thought to be the same site (Hudson 1980, 229).

A windmill mound was mapped at Upper Beeding and a windmill is depicted at this location on a map of 1778-1783. A possible watermill site was seen at Abbot's Farm, Wiston, where there are the earthworks of a long narrow pond and associated water channels.

Farming

The survey area sits within Sussex's wealthiest medieval agricultural region that included much of the coastal plain, the Downs and the scarp foot (Gardiner 1999, 38). This is also the area of Sussex where open fields predominated, although this style of large, unenclosed and communally regulated arable farming was not widespread in the county (Gardiner 1999, 38). Little trace of these fields can be seen from the air. Earthwork evidence associated with medieval ploughing are strip lynchets (see below) and, more specifically with open fields, ridge-and-furrow and their associated headlands (strips of unploughed land at the end of the furlongs). However, ridge-and-furrow is not essential for open fields and the absence of ridge-and-furrow in parts of Devon and East Anglia (Taylor 1987, 87) reflects a regional preference for ploughing the fields flat.

The aerial photographs show that by the 1940s, the scant evidence for ridge-and-furrow in the Weald was only as cropmarks, though earthworks of ridge-and-furrow in the Adur valley survived a little longer. Earthworks have been seen on land reclaimed in the medieval and post-medieval periods and, south of Upper Beeding, ridge-and-furrow overlies the remains of medieval salt works. Although it is possible that some fields in Sussex were ploughed flat, the fact that some evidence of ridge-and-furrow and headland banks has been seen in the Weald and the Adur valley suggests that the paucity of remains is more likely to relate to poor survival.

Evidence of arable farming in the form of strip lynchets can be seen on the scarp in the parishes of Washington, Sullington and Upper Beeding. Strip lynchets are terraces running approximately parallel with the contours of the slope. As these lynchets seem to indicate the expansion of cultivation onto land not normally ploughed, many are thought to date to the 12th and 13th centuries due to the then rising population (Taylor 1987, 91). The remains of lynchets may be more extensive than has been mapped, due to the tree cover on the scarp: those on the wooded scarp at Plantedfield were only seen because a narrow band of trees had been felled.

Despite the documentary evidence for the keeping of sheep on the Downs nothing survives that can be securely dated to the medieval period. Most surprising is the absence of any identifiable sheepcotes which were used to over-winter flocks during the medieval period (Dyer 1995). The earthworks of sheepcotes tend to be of long narrow buildings and these have been identified in Yorkshire, Wiltshire and Gloucestershire (ibid, 138). This apparent absence of sheepcotes in this part of Sussex could be explained if the sheepcotes were built within settlements, where there is a greater chance that they have been totally removed or obscured by later building (ibid, 150).

One feature of a chalk landscape is the absence of water due to the permeability of the rock. To avoid herding livestock to spring lines or streams elsewhere, so-called dewponds were dug which, despite the name, were primarily filled by rainwater (Fig 17). A number of pond earthworks have been seen on the Downs and the majority of these are circular and have a diameter of between 20m to 30m. Some ponds just appear as depressions, others have banks either encircling the entire pond or built-up along the down slope side (see dewpond in foreground of Fig 5).

There are also four much smaller circular ponds without banks. Three of these shallow depressions measure approximately 10m across, the fourth 15m. Six ponds are oval, the smallest measuring 26m by 15m, and the largest 44m by 27m. These too have banks either part-way or all around the pond. The circular ponds are distributed across the Downs, whereas the oval ponds are within a relatively small area around Findon.

Little firm dating evidence exists for ponds. Two circular ponds on Chanctonbury Hill were constructed in the 1870s by the Rev Goring, although this cannot be used to date similar ponds on the Downs, and circular ponds are known from other areas of England such as the Cotswolds. However, on Salisbury Plain dewponds of a standard shape and size were all constructed by a single family (McOmish *et al* 2002, 11) and similar situation may have existed at Findon with a single family or individual responsible for all the oval ponds seen there. A possible date for some of these ponds is the 17th and 18th centuries, an age of agricultural improvement, when the South Downs, in common with other areas of chalk downland, became the home to even larger flocks of sheep than were kept in the Middle Ages (Taylor 1987, 133). Associated with one of these ponds, at Middle Brow north east of Findon, are low narrow earthwork banks which may be contemporary and relate to stock management. Some ponds may have had their origins in earlier periods: evidence of possible ponds from the Bronze Age has been identified at the settlements at Blackpatch (Field 1999, 30), and Plumpton Plain (Holleyman & Curwen 1935), and it is possible that a least one of the dewponds at Park Brow has prehistoric origins.

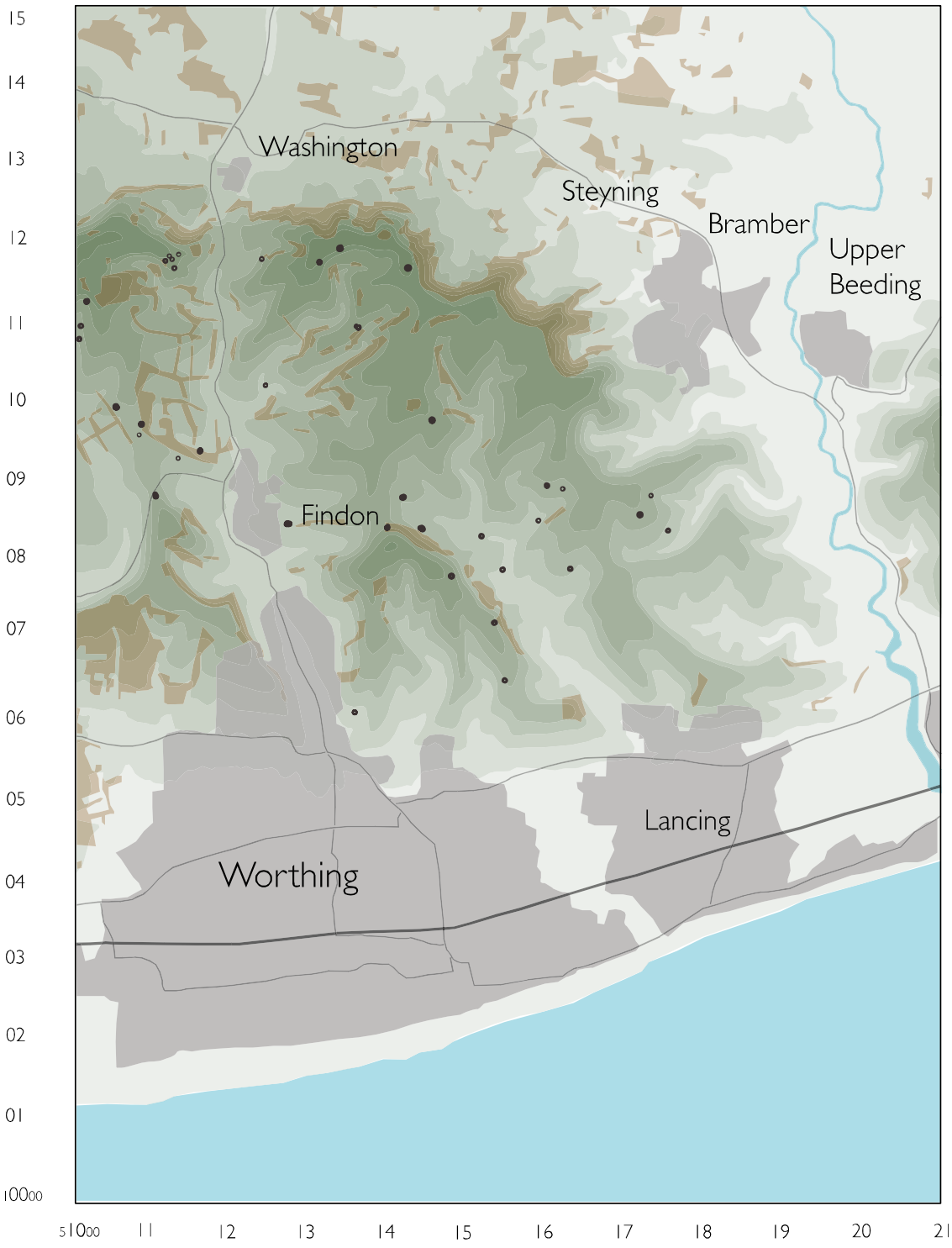

Fig 17: Dewponds mapped by the project. Although the dates of some ponds are known many are not and, despite being included in this section, the origins of some ponds could pre-date the medieval and post-medieval periods.

Fig 18: The dewpond to the south east of Chanctonbury Ring. The needs of the flock seen in this photograph are now met by the water tank, to the left of the pond, and the trough, to the right. The curving earthworks to the left are the remains of possible Late Bronze Age or Iron Age cross-ridge dyke.
Detail of NMR TQ 1411/8 (23312/28) 18-Jan-2004

Salterns

There is widespread evidence on aerial photographs for salt production in the Adur valley, in the form of large irregular waste mounds. During the Middle Ages the importance of salt lay not only in its use as a preservative but also in its symbolic value. Salt was associated with purity and incorruptibility and was used in the baptism ceremony. The importance of salt can also be seen in the manufacture of large and elaborately decorated salts (salt cellars) that would form the focal point of the high table. The selective survival of documentary sources relating to the salterns in the Adur valley show the majority, but not all, belonged to religious houses. It is possible that the large number of salterns endowed to religious houses (Holden & Hudson 1981, 127) was a reflection on the spiritual symbolism of salt.

A number of different techniques for the production of salt exist (see Grady 1998 for a summary) but the popular method used during the Middle Ages was sand-washing. In this process, a high tide left salt on and in the sand; this salt-rich sand was scraped off and the sand was filtered out, leaving a strong brine. This brine was then boiled to evaporate the water leaving the salts. The waste product from the filtration and boiling process was dumped on-site and waste mounds built-up as a result. These mounds, known as salterns, have an irregular outline and can be quite large, some measuring approximately 50m by 30m. As these mounds became too big they were abandoned, the works repositioned and the process started again (Holden & Hudson 1981, 127).

Distinct groupings of salterns can be seen between New Monks Farm, in the south and Upper Beeding, in the north (Fig 19). The river valley narrows from 2.4km in the south to an average of 0.52km for much of its length as far as Upper Beeding. The river is not

centrally placed and the valley is wider to the west. It is on this side that most of the salterns can be seen, exceptions being to the north of Upper Beeding and also to the south, opposite Botolphs. Although the river Adur is tidal for a further 8km, no salterns have been seen along the upper tidal reaches.

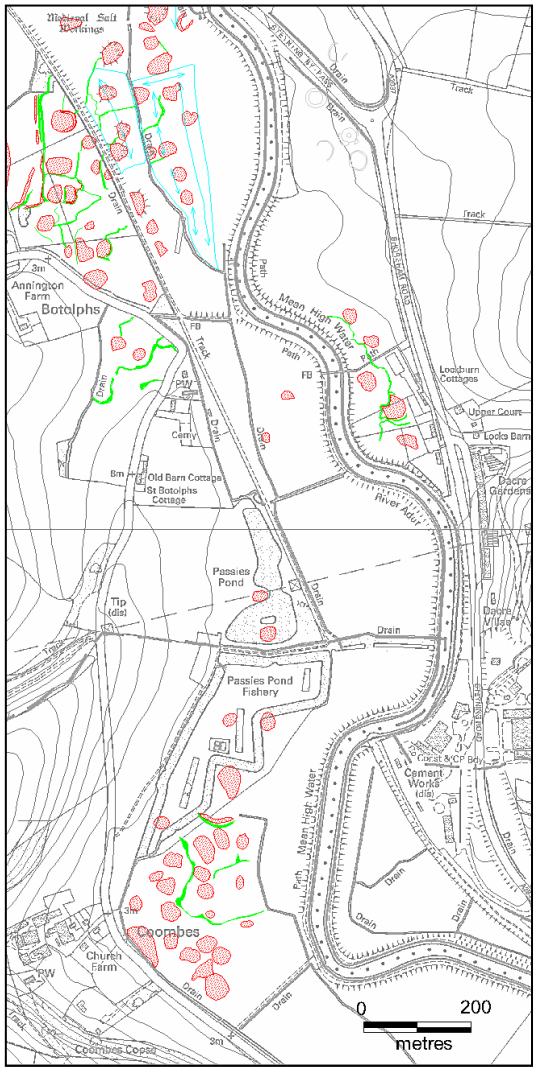

Fig 19: Salterns near Botolphs.
Background map acquired from the Ordnance Survey. Licence number 100019088
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The gaps in the distribution of salterns can be explained as reflecting either differential survival or a genuine distribution. With the exception of the extreme northern and southern group of mounds, the remainder are situated in parts of the river valley that pass through the Downs. This may reflect an expansion of farming in the Weald over former salterns which has removed all trace of them. If, however, the absence of salterns further north is genuine, it may suggest that the salt water was diluted upstream, making salt production in that region unprofitable. Alternatively, their absence here may relate to certain rights. In some parts of the country salt production would not be possible if peat

cutting rights (for fuel) were not already granted (Grady 1998, 83), and a similar lack of rights here could have prevented salt production from taking place.

Salt making in the Adur valley is thought to have taken place on a part-time basis from the early medieval period until the 14th century, although some did continue after this date (Holden & Hudson 1981, 128). The decline in salt making here is thought to have been due to a rise in sea level, which would have reduced the area from which salt could be retrieved, and the introduction of cheaper salt from France (Holden & Hudson 1981, 141). It would seem that Sussex salt making was in a precarious position as these same factors did not cause the decline of salt making elsewhere, and Lincolnshire's salt making, for example, continued until the early 17th century (Grady 1998).

In contrast to earlier periods, medieval and post-medieval evidence visible from the air is not concentrated on the Downs. Due to the generally good earthwork preservation here until the mid-20th century, a stronger case can be made that the absence of certain medieval remains on the Downs is genuine. Medieval and post-medieval distributions on the Downs are dominated by dewponds, the presence of which confirms the use of the Downs as pasture. The exception is on the extreme western edge of the project area, where there are the remains a farmstead near Tolmare Farm (abandoned in the 14th century), and another possible farmstead to south east of Cobden. Although remains from this period off the Downs have survived better than those from other periods, they have still suffered from the destructive nature of ploughing or the equally destructive expansion of towns. Much of this destruction occurred before the earliest aerial photographs were taken and the scraps of ridge-and-furrow can only hint at the way this area was actually farmed. The destruction of many of the salterns came later and these have been well photographed but, even here, the absence of salterns along the river Adur north of the Downs suggests destruction.

THE SECOND WORLD WAR (1939-1945)

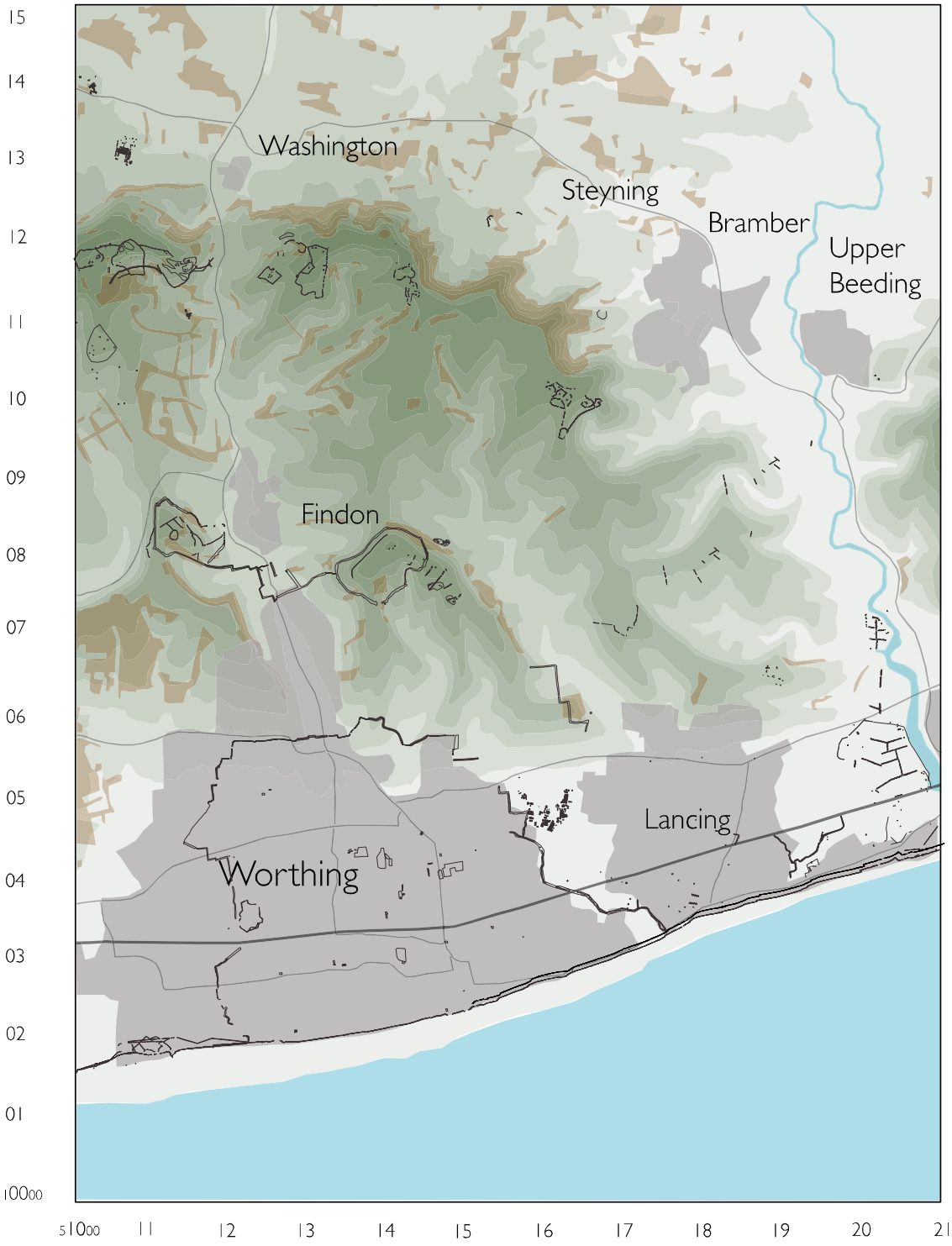

Fig 20: Overview of all mapped features dating to the Second World War.

Although the worsening political situation in 1938 caused some apprehension to the wider public, it was the issuing of gas-masks and digging of make-shift air raid shelters in

the autumn of that year that made the British people realise what war would mean to them (Hennessy 1993, 6). The Second World War was to be 'a people's war' brought to them by the enemy's bombers. This situation worsened after the rapid German advances of early 1940 when an invasion of Britain then seemed imminent. One of the responses to this threat was the construction of great defensive works along the coast and further inland, and the construction of these lines must have had a similar effect on the population as the issuing of gas-masks did two years before. The value of aerial photographs to the study of wartime defences has been demonstrated by the work carried out on the Suffolk coast (Hegarty & Newsome 2007). Wartime and immediate post-war aerial photographs intentionally and unintentionally documents this widespread but short-lived landscape of air-raid shelters, anti-aircraft batteries and anti-tank lines (Fig 20).

The bomber will always get through

The somewhat fatalistic, but ultimately correct, belief that 'the bomber will always get through' (a phrase from a speech in parliament made by the Conservative MP Stanley Baldwin in 1932) illustrates how, in the inter-war years, the defence of Britain was concerned not with a possible invasion but with attack from the air. An Air Raid Precautions (ARP) Department was set up in 1935 and was to deal with a range of topics that included air-raid shelters, gas attack and incendiary bombs and fire precautions (Dobinson 2000, 108). Air-raid precautions became mandatory when the Air Raid Precautions (ARP) Act became law on 1st January 1938 (ibid, 27). One component of air-raid precautions which may be seen on aerial photographs is air-raid shelters. Various designs were built during the war, ranging from small domestic shelters to larger structures for schools, factories and the general public.

Fig 21: Public shelter situated at the south eastern corner of Broadwater Green. The shelter was entered from the south. The white circles are emergency exits. Although damaged as a result of road widening, much of this shelter still survives.
Detail of RAF 58/81 5300 28-Jul-1948

The majority of shelters identified are those that were built within school grounds. One public shelter can be seen at the south east corner of Broadwater Green at the junction of Ardsheal Road and Broadwater Street West (Fig 21), but the inability to identify on

aerial photographs the public shelter at Steyne Gardens suggests that more examples than those mapped probably existed. Shelters are also present at the largest factory in the project area, the Southern Railway Carriage works in Lancing (Fig 22). No domestic shelters were identified.

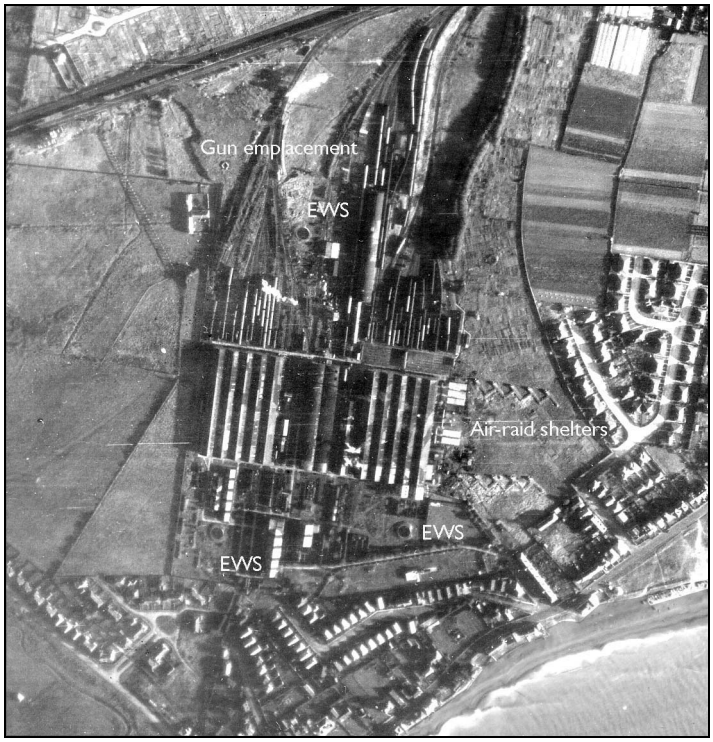

Fig 22: The Southern Railway carriage works at Lancing. There are three Emergency Water Supply (EWS) reservoirs at this site and two rows of air-raid shelters. The roof of the works has been painted with a camouflage pattern.
Detail of RAF CPE/UK/1751 3054 28-Sep-1946

With the exception of those at the railway works, shelters in the project area were not photographed from the air until 1944, and yet they were almost certainly built by mid 1942, the date by which the majority of Britain's shelters had been constructed (ibid, 1). The shelters at the railway works are first seen on photographs taken in November 1940, and may have been built before the outbreak of war as a result of the Civil Defence Act (1939) which made ARP measures compulsory at factories (Dobinson 2000, 69). The public shelter at Broadwater Green must have been built later than 1938, as it was built on the site of a school that is depicted on a map of that date. Despite the lack of early photographs a very early date for shelter construction in Worthing and the surrounding area seems unlikely, as the town was a destination for evacuees at the start of the war.

One of the numerous problems encountered by the fire brigades of Britain while fighting the fires of the Blitz of late 1940 and early 1941 was the inadequacy of water supplies caused by the rupturing of the water mains during air raids (Demarne 1989 58-65). A solution was to establish permanent reservoirs of water, each reservoir known as an Emergency Water Supply (EWS). Although some were constructed in early 1941 (Demarne 1989, 59) the national scheme, proposed in February of that year, was not

undertaken until after the amalgamation of the country's numerous fire brigades into the National Fire Service in August (Demarne 1989, 63).

Fig 23: Various EWS photographed after the war and empty of water. The photograph top left shows two EWS in West Worthing at the junction of Anscombe Close and Anscombe Road. The possible drains are seen as dark squares along one side of each tank. The EWS top right is situated in front of what is now Broadwater Manor School and has circular drains. Bottom left is an example of a circular EWS in Lancing, at the junction of Manor Road and Griffith's Avenue.
Details of RAF 58/9 5261 8-May-1948; RAF 58/9 5246 8-May-1946; RAF 58/9 5181 8-May-1948

Twenty five EWS tanks have been identified and these are of two designs: straight sided (usually rectangular), and circular (Fig 23). The rectangular examples measure up to 31 metres by 21 metres and the circular reservoirs measure between 10 and 12 metres in diameter. Although the circular tanks are smaller, the exact quantity of water held by these two designs is unknown. Some of the straight sided examples are seen empty of water on photographs taken in 1948. The bottoms of these tanks appear to be constructed of a number of concrete sections and they have a series of dark circles or squares approximately one metre across along one side, which may possibly have been drains. Two of these EWS tanks were clearly dug into the ground and they have a large mound of spoil next to them.

The national plans for EWS tanks of August 1941 divided the country into three categories according to risk and estimated the quantity of water that needed to be maintained in these areas. Category A was high risk and category B was population centres of 100,000 or more. With a population of just 33,108, Worthing fell into category C which covered the remainder of the country (Demarne 1989, 61). EWS were situated in public parks and school fields as well as waste ground (Fig 24). The distribution of these tanks was obviously determined by the need to provide adequate coverage for the urban area but there is no evidence, from either the photographs or the 1938 Ordnance Survey map, that any demolition had to take place prior to construction. The centre of Worthing is well provided with EWS and established water supplies, such as the boating pool by Beach Parade, would have also held a sufficient volume of water to be useful. The distance served by these reservoirs varies from 600m to over 1km. Even accounting for loss of water pressure due to friction from the hose, few pumps would be needed to pump water over these distances. The relatively low density of houses between West Tarring, Durrington and Salvington at this time may well explain the lack of EWS there.

No EWS are visible on aerial photographs taken in March 1941, even though the sites of five reservoirs subsequently photographed are included in the photographs. The next available photographs were taken in March 1942 and these show six reservoirs but it is likely that all were constructed at about the same time (late 1941 or early 1942) coinciding with the creation of the National Fire Service.

Fig 24: Distribution of EWS in Worthing and Lancing identified on aerial photographs. The background maps were published in 1938 and provide a near contemporary context for the positioning of these water tanks. Circular examples are indicated by circles, straight-sided examples by rectangles.

Various schemes for the organization of Britain's air defences were put forward between the wars. These were concerned with the location of Anti-Aircraft (AA) batteries throughout the country, to create Gun zones, and their integration with Air fighting zones and Searchlight zones (Dobinson 2001). AA Command included a mixture of static and mobile batteries and the process of constructing these permanent batteries was commenced in late 1937 (ibid, 124). The number of guns available grew throughout the war and their disposition altered to deal with the ever changing type and location of attack. No evidence of static Heavy Anti-Aircraft batteries (HAA) can be found until January 1943 when one is seen on a run of military obliques between Lancing and Shoreham-by-Sea (Fig 25). This, along with a second battery to the north east of Shoreham-by-Sea (outside the project area) is recorded in a gazetteer of HAA sites (ibid, 581). A third battery, not included in the gazetteer, has been mapped by the river Adur north-west of Shoreham. These batteries may have been built to provide defence for the port.

Fig 25: Heavy Anti-aircraft battery situated between Shoreham-by-Sea and Lancing in an area now occupied by a caravan site. This photograph was taken in 1948 after the guns had been removed.
Detail of RAF 58/3 5034 6-May-1948

Worthing suffered air raids throughout much of the war but it is possible that their frequency increased between March 1942 and June 1943, a period of low-level attacks on coastal towns with no military significance that became known as 'fringe target' attacks or 'tip-and-run' raids (ibid, 351). These raids were quick and involved a small number of planes, their most frequent targets being railways and gasworks (Fig 26) (ibid, 352). They eventually led to large numbers of light anti-aircraft artillery (LAA) guns being moved to the south coast from September 1942 until the following June. The only aerial photographs taken during this period are a run of obliques taken in January 1943. None of the LAA guns that may have been sent to Worthing has been identified, possibly due to the limited coverage provided by this sortie.

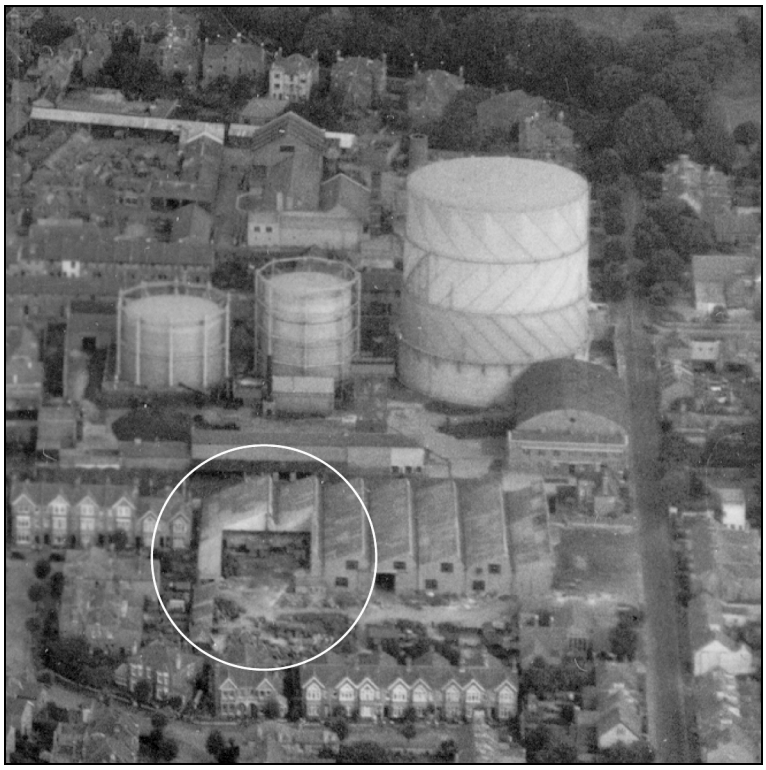

Fig 26: This oblique photograph taken in 1947 gives some idea of the kind of target the gas works must have offered low-flying enemy aircraft approaching the town from the south. The evidence for air raids in this photograph is the damage to the depot to the south (circled), but it is likely that the gas holders were the intended target.
Detail of RAF CAL/UK/8 100 22-Aug-1947

Dig for Victory

A campaign to encourage the keeping of allotments was commenced during the first weeks of the war under the slogan 'Dig for Victory' (Crouch & Ward 1997, 75). At the same time a Cultivation of Lands (Allotments) Order gave councils the power to take possession of land for allotments (Anon 1939). Aerial photographs of Worthing show that allotments were also laid out in public parks, school playing fields and sports grounds (Fig 27). No allotments in these parks or playing fields can be seen on aerial photographs taken in 1941, but they are present on the next set taken in March 1942. Whereas most of Victoria Recreation ground and Homefield Park became allotments, parts of Manor Sports Ground and the adjacent school playing field were left free from cultivation to allow some sporting activity to take place. Striking a balance between food production and sport was a concern that had been expressed in 1940 by the National Playing Fields Association, who lamented the financial implications of the loss of sports grounds to allotments and, once gone, the resultant negative impact on health and morale (The Times 24th May 1940 page 9, column E).

Fig 27: Victoria Park, Norfolk Road, Worthing
A number of allotments were created within Worthing during the Second World War as part of the Dig for Victory campaign. These were often on waste ground but public parks or school playing fields were also turned over to food production. This photograph shows almost the entire area of Victoria Park under allotments, the exception being the southern end in which an Emergency Water Supply (EWS) has been built. Neither the allotments nor the EWS can be seen on a photograph taken in March 1941 but both are present by March 1942. The allotments continued in use for some time after the end of the war (this photograph was taken in May 1948) but were gone and the park reinstated by 1950. Detail of RAF 58/9 5177 8-May-1948

To meet an invasion

An invasion of Britain was not seriously considered as a possibility by pre-war strategic planners or even after the declaration of war (Dobinson 1996, 14). These views were rapidly revised in spring 1940 after the invasion of France, Belgium and Holland when, with possession of the channel ports, a full-scale invasion became a possibility. It was from this time that preparations for the defence of Britain against an invasion were made.

Initial works concentrated on the defence of ports and airports (ibid, 16). Defensive measures included the obstruction of potential aircraft landing grounds, and a series of aircraft obstruction ditches were dug to prevent troop carrying aircraft from landing in the area to the north of Shoreham airfield (Fig 28). Shoreham airport is also seen with a series of dark lines marked across the airfield, which were intended to appear as hedgerows from the air. This may have been carried out early in 1940, in an attempt to prevent enemy landings here, as they do not appear on later wartime photographs.

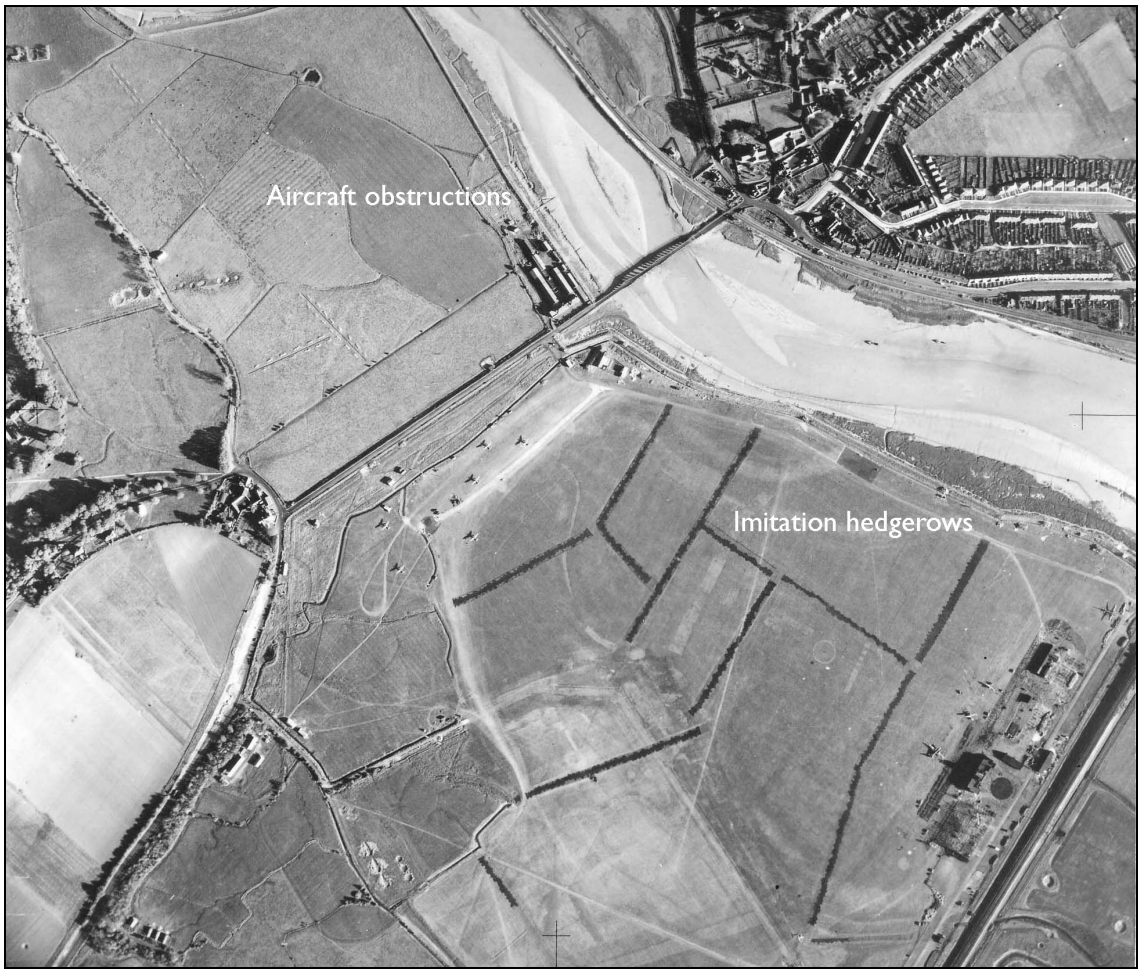

Fig 28: Shoreham airfield is at the bottom of this photograph with the terminal buildings bottom right. The dark lines are 'fake field hedgerows' that have been painted onto the ground, possibly to prevent enemy aircraft landing here, or to disguise against air attack. In the field to the north a series of banks and ditches have been dug as aircraft obstructions, sometimes known as anti-glider trenches. Their purpose was to interrupt open areas to an extent that made the landing and then take-off of enemy troop carrying aircraft impossible. Detail of RAF S 653/H9/140 027 07-Nov-1941

Fig 29: Part of the northern arm of the inland defence line around Worthing. The thin dark line set within a broader white one is the anti-tank ditch and can be seen lower left at A and top right, within Durrington Cemetery, at C. Between these two points can be traced a line of anti-tank cubes. The course of this line changes from one side of the A27 to the other at B and there is evidence of a road block at this point.
RAF HLA/430/1PRU 6022 26-Mar-1942

Defensive measures soon extended beyond ports and airports to include the coast (ibid, 20). The layout of the coastal defences has been primarily mapped from the RAF's wartime photographs, and the five sorties flown between 1940 and 1941 all focus on the coastline. The defences consisted almost entirely of anti-tank cubes (Fig 3), possibly supplemented by a length of bank and ditch at Goring-by-Sea. Along this line a number of pillboxes were constructed as well as an emergency coastal battery at the end of Grand Avenue. These defences were in place by November 1940 and were probably laid out in the summer and autumn of that year after the 'enormous beach reconnaissance' carried out in late May and early June (ibid, 26).

In addition to the coastal defences, inland defences were also constructed within the project area. These linear inland defences were built in Britain at the instigation of general Ironside, who was Commander-in-Chief, Home Forces, for the short period from 28th May to 17th July 1940. They were developed in response to the rapid advances made by the German army in France and the Low Countries and were intended to slow the enemy to allow a counter attack (ibid, 31).

From a military point of view, the most vulnerable point of this part of Sussex would appear to be the dry valley that runs north from Worthing, which provides a way through the Downs, a route followed by the Findon/Worthing Road (A24). The first inland defence line cuts off this route by enclosing Worthing from Goring-by-Sea, in the west, to the coast between Worthing and Lancing, in the east. Most of the eastern arm of this line is defined by the Teville Stream which had been re-cut to create a more effective barrier against tanks. At Broadwater, the line is defined primarily by an anti-tank ditch and anti-tank cubes. The ditch cuts across Hill Barn and Worthing golf courses as well as Durrington Cemetery (Fig 29). The western arm mainly consists of anti-tank ditches and some cubes. A short length probably follows a water course, but no evidence of re-cutting could be seen. Other existing features were utilised, such as a quarry at Charman Dean and a pond in the grounds of Courtlands at Goring-by-Sea. Also at Goring, a row of houses on Alinora Crescent was incorporated into the line (Fig 30).

Fig 30: Part of the western arm of the defences around Worthing. This is primarily defined by anti-tank ditches and cubes, both of which can be seen to the top left and bottom right of this photograph. Between these points a row of houses on Alinora Crescent has been incorporated into the defensive line.
Detail of RAF S427/H11 75 21-Aug-1941

Although wartime photographic coverage of the entire line is incomplete (most of the western end of the line can only be seen on post-war photographs after the anti-tank ditch had been filled-in) photographs taken in March 1941 are the first to show the anti-tank ditch at Goring-by-Sea. However, the line is not finished, as the anti-tank cubes are not in place. These are not seen until August 1941, when the next available photographs were taken. At the Lancing end, a short line of anti-tank cubes cuts across the southern end of Western Road and is aligned on the Teville Stream which, at this date (November 1940), had yet to be re-cut. The presence of these cubes may suggest that the inland line was under construction in November 1940.

Another group of anti-invasion defences was some 5.5 kilometres north of the coast (Fig 31), centred south of the village of Findon. An area around the Findon/Worthing Road (A24) was enclosed by an anti-tank ditch and anti-tank cubes. From this, a ditch headed east and encircled Cissbury Ring. A second ditch headed west and, combined with anti-tank cubes, encircled Church Hill. A number of gun emplacements can be seen within and without Cissbury Ring as well as some straight banks and ditches crossing the ridge extending south east of the hillfort. This work is first clearly seen on a photograph taken in 1944, by which date some of the ditch had already been filled in. Although difficult to date accurately, these works may be roughly contemporary with the inland defence line to the south and possibly completed during 1941.

Further north, still on the edge of the Downs, are arrangements of barbed wire and trenches. Some of these are thought to relate to military training exercises but the group on the western end of Chanctonbury Hill may be a small 'defended locality'.

Fig 31: Findon Nodal Point. Both Cissbury Ring and Church Hill have been enclosed by an anti-tank ditch and, in places, anti-tank cubes. These two enclosures are connected to a third south of Findon.
Composite details of RAF 106G/UK/LA313 4082 and 4084 17-May-1945

Training and billeting the army

Much of the South Downs was requisitioned by the War Department during the Second World War and used for military training exercises. Evidence for this is most clearly seen on Barnsfarm Hill and Highden Hill, south west of Washington. Across these hills are lines

of coiled barbed wire, known as 'dannert wire' which, in places, has formed enclosures. Within these enclosures are some gun emplacements, trenches and pillboxes. On the south side of the hill is an anti-tank ditch. The pillboxes are badly placed, of an unusual design and are thought to have been constructed purely for training purposes (Mace 1996, 29). It is to training that all of these features can probably be assigned. Most enigmatic of all are two areas of black marks on these hills which seem to be the result of burning and are probably the result of training with flame throwing tanks (Fig 32). This type of training is documented as having taken place on parts of the Downs, and the nearby Windlesham House was the headquarters of the Offices of Petroleum Warfare (Longstaff-Tyrrell 1998, 58).

A number of military buildings were seen on the available photographs. In some cases these seem to provide extra accommodation at an existing building which was probably requisitioned for the war effort, such as at Windlesham House and Sandgate Park. A camp not associated with a country house can be seen at Barns Farm. Evidence for a large camp has been seen to the south of the A27 between Broadwater and Sompting. This camp appears to have consisted of both buildings and tents, but was only photographed after it had gone out of use in 1946. By this date, many of the buildings and all of the tents had been removed, but outlines of these structures could still be seen. It is not clear what the purpose of this camp was and there is some discrepancy between the wartime diary for this camp and an oral account of the site (Letter held by West Sussex County Council ref JPFH/K1 701 & notes on war diary WO/166/16293). The photographs show that it was built after April 1944 and had been abandoned by September 1946. This date range suggests that it may have played some role in the lead-up to D-Day in June 1944 or with the return of troops or even the arrival of prisoners of war after this date.

What may be vehicles parked along residential streets in Worthing can be seen on aerial photographs taken in January 1943 and April 1944. The scale of the photographs is such that they cannot be accurately identified but there are personal histories which recount the billeting of soldiers in requisitioned houses and hotels and the parking of tanks, bren-gun carriers, lorries and dumps of supplies and equipment on streets in Worthing (bbc.co.uk/ww2peopleswar article ID: A8060933 & A4430071).

Fig 32: A variety of military remains can be seen on Barnsfarm Hill and Highden Hill, all of which are thought to relate to training exercises. The dark marks top left and bottom right may be scorch marks suggesting the use of flame throwing tanks. The light coloured curve in the centre is an anti-tank ditch and the narrow dark lines are formed by coiled barbed wire. The dark diagonal line running along the top of the lower group of scorch marks is a Bronze Age or Iron Age cross-ridge dyke which has been incorporated into a barbed wire enclosure.
Detail of RAF 106G/LA/205 2068 3-Apr-1945

Discussion

Dobinson has stated that Britain's Second World War defences can be conceived of at three spatial levels (Dobinson 1996, 9-11), and a similar hierarchy is no doubt applicable for other wartime monuments. At the macro level, the route taken by a linear defence is determined. At an intermediate level, the relationship between elements in a defensive system can be understood and, at a micro level, the location of these elements can be indicated to a greater degree of accuracy (ibid). While documents have provided much information at the macro level, study 'at this [micro] level is pre-eminently a task for fieldwork' (ibid, 11). As for future work, 'Now the routes of the linear systems are known, fieldwork, and perhaps air photographic research, could be used to explore what remains today' (ibid, 200).

Aerial photographs can, however, do more than just illustrate known lines of defences. In the course of this project, aerial photographs have revealed some of the realities of defence against an invasion, food shortages, tip-and-run air raids and military exercises. This information has come from a succession of wartime photographs showing the

evolution of the landscape and post-war photographs, where a number of phases of wartime activity are shown together in an individual frame.

It is assumed that the extensive military works seen on aerial photographs at both Worthing and Findon relate to the 'nodal points' (a form of area defence usually centred on a settlement; see Foot 2006, 9) that are documented at these two locations by a central four-figure grid reference (Defence of Britain records). Aerial photographs have provided both the macro detail – the course of a defensive line – and, through accurate mapping, the micro detail of the anti-tank ditches, anti-tank cubes, barbed wire, pillboxes, re-cut watercourses and road blocks. They also show the integration into the defences of existing landscape elements such as a quarry, pond and rows of houses.

The importance given to taking aerial photographs of the defensive lines during the war has meant that enough sorties were flown between 1940 and 1945 to obtain a basic chronology of the construction. Although many of these photos appear to be taken to record the linear defences or for training purposes, they also show the development of the wartime landscape such as the appearance of EWS reservoirs, anti-aircraft batteries and the conversion of public parks to allotments.

The construction of the defences, in particular, is a good indicator of the scale of the threat faced by Britain in the early years of the war. Ironside's linear inland defences can also perhaps be interpreted as the product of a siege mentality fostered by the growing isolation of Britain during early 1940. Indeed, Ironside himself was not confident that the Germans could be defeated and, nine days before he was made Commander-in-Chief, Home Forces, he told Anthony Eden (Secretary of State for War) that he did not believe that Britain could hold out alone for more than a few months (Lukacs 1999, 18). In fact, these stop lines were not popular with many in the British Army, most significantly Ironside's successor General Brooke, and they diminished in importance after Brooke's appointment in July 1940 (Dobinson 1996, 40).

Long before the Second World War, the rural landscape had come to represent an idealised 'England' (Appleyard 1989, 12). The South Downs represented one of a select few landscapes where this idealised England was perceived to have survived. This image provided stability in times of conflict and, during the First World War, had 'lived in the minds' of those in the trenches (ibid). Idealised images of the countryside were still used as an inspiration to fight during the Second World War, and the South Downs were the subject of a poster produced as part of a series entitled 'Your Britain, Fight For it Now'. These ideas and images can be contrasted with the reality of the Army's requisition of much of the Downs, the construction of defences, and the associated closing of the beaches. This not only placed significant restrictions on the movement of the population (Newsome 2003 considers the wartime restrictions imposed on the population and includes some Sussex examples), but also meant that the rural landscape itself was divided up by anti-tank lines and, in places, literally cut-up by the anti-tank ditches constructed in the early years of the war.

The importance of preserving military sites has been outlined by Schofield (2002) and some surviving sites, such a D-Day embarkation points, have become the focus for acts of remembrance (ibid, 153). In cases such as Worthing, where little survives, the information derived from aerial photographs enable the detailed recording of this now vanished

wartime landscape, and can provide a link to the war years which is no-longer available through physical remains.

With peace, the apparatus of war, such as sandbags and tin-hats, at once became historical relics (Barnett quoted in Appleyard 1989, 4). In some cases, this was happening before the war had ended; much of Worthing's coastal defences were removed in early 1945 (Fig 33). The 'war had become heritage: odd, distant and sentimentally cherishable' (Appleyard 1989, 5), and one factor that may have contributed to these post-war feelings of distance and sentimentality was the relatively rapid removal of most of these wartime constructions.

Fig 33: In the last months of the war, anti-tank cubes from Worthing's seafront were removed to this abandoned quarry off Hill Barn Lane, north of Broadwater. The quarry has since been filled in.
Detail of RAF 51/81 5265 28-Jul-1948

PLOUGHING UP THE DOWNS

The character of the South Downs has changed dramatically since 1939 (Brandon 1999, xiii) and this can be clearly seen when the earliest aerial photographs consulted (taken in 1945 and 1946) are compared with the latest (taken in the 1990s). These photographs, taken almost 50 years apart, show the transformation of a predominantly grassland landscape to one dominated by arable farming. The 19th and early 20th century writings of authors such as Kipling and Belloc eulogised this downland landscape and were instrumental in creating the myth that the Downs were immune from change and that they had for centuries only been utilised for sheep grazing. However, evidence for earlier phases of ploughing on the Downs is apparent on the aerial photographs as well as from documentary sources (see Godfrey & Short 2001).

The claim that the wartime ploughing marked the return of the plough after an absence measured in centuries could only be made by ignoring many similar periods of downland conversion, some as recently as the First World War. This misconception has possibly made the undeniably dramatic and widespread expansion of arable onto the Downs seem even more momentous. The factors that resulted in this wholesale change of land use are varied and, in part, relate to the profitability of arable at the expense of sheep farming, driven by the urgent post-war requirement for home-grown cereals. They are also concerned with contemporary attitudes to the countryside, where the prime concern was to ensure the efficient organisation of the land and the welfare of those who worked on it.

A precedent is set: ploughing on the Downs from prehistory to early 20th century

The earliest evidence of ploughing on the Downs appears in the form of prehistoric field systems. These are thought to have originated in the Bronze Age and to have continued in use, modified and extended, through the Iron Age and into the Roman period. The majority of these fields are square or rectangular and are defined by lynchets which were created by the movement of soil when the individual fields were ploughed. The mapping produced by this project shows how extensive the prehistoric ploughing of the Downs was, with more complete field systems visible in the east of the project area and their presence to the west suggested by the isolated remains of field banks. The prehistoric and Roman field systems seen in this survey and the basic distribution of field systems to the east of this project area, between the Adur and the Ouse (Holleyman 1935) show that ploughing was widespread across the Downs in the later prehistoric and Roman periods. Ploughing in the medieval period is represented by some earthworks, mainly in the form of lynchets on the edge of the Downs. Other areas of arable are recorded from this period in the Victoria County History (Hudson 1980) but have left no trace visible on aerial photographs.

The destructive nature of the plough means that episodes of ploughing can be inferred by the presence of levelled earthworks. The prehistoric field system identified in the vicinity of Valley Barn, Coombes, appears to have been almost totally levelled by 1945 and could be seen as low earthworks or cropmarks. The coincidence between the contemporary field boundaries visible on the photographs and those depicted on Ordnance Survey mapping of 1879 suggests that the levelling of these earthworks took place before the

1870s. Some of this ploughing appears to have been undertaken in the middle of the 19th century when there was an expansion of arable, as there is evidence that farmers from both Coombes and Botolphs were converting downland in the 1840s (Godfrey & Short 2001, 76). However, much of the land that was converted to arable at this time was abandoned during the late 1880s with the onset of an agricultural depression; the area between the rivers Arun and Adur had more land under the plough in 1840 than in 1941-43 (ibid, 76). Arable farming was again expanded during the First World War but could not be sustained after the repeal of the Corn Production Acts in 1921, which had guaranteed minimum prices for wheat and oats (Brandon 1999, 158).

The return of the plough: arable farming on the Downs from the Second World War onwards

By 1939 Britain imported over 60% of her foodstuffs, but this supply was threatened with the outbreak of war. As a result, there was an immediate move to increase the amount of home grown produce and land was ploughed up, ready to be planted by spring 1940 (Ministry of Information 1945, 10-11). During the course of the war, under the direction of the War Agricultural Executive Committees, abandoned or derelict land throughout the country, including parts of the South Downs, was reclaimed and ploughed up. Nationally between 1939 and 1945 6,500,000 new acres were ploughed: the 1943-44 harvests for wheat barley and potatoes were all more than doubled from the 1934-38 average (ibid, 95). The South Downs, however, contributed little to these totals. Much of the wartime expansion of arable was halted in 1942, when 22,000 acres was requisitioned by the War Department for use as a military training area.

Britain's record harvests of 1943-44 had only been achieved by farming on an exhaustive scale and with a bias towards cereal production. After 1944 a return to a more balanced crop rotation and the recovery of livestock herds was planned, and this included the reduction in the amount of land under the plough by 450,000 acres a year between 1946 and 1948 (Anon 1946a). These plans had to be abandoned as the scale of the post-war food shortage became apparent. The government's response was, once again, to encourage ploughing, this time of land that had recently been laid down to grass, in the form of an extension to the £2 an acre ploughing-up grant. This immediate post-war food crisis meant that bread was rationed for the first time, and although this has subsequently been considered as unnecessary, there was 'a genuine feeding problem in the first two years after the war' (Hennessy 1993, 276). With the South Downs still in the possession of the army until early 1947, much of the surviving downland was still not affected by the government's attempts to increase yields.

The first aerial photographs that provide good coverage of the Downs after the army left date to the early 1950s. They show that ploughing had taken place in a number of areas such as to the south east of Chanctonbury Ring and at Park Brow (Fig 34). Contemporary references to the ploughing of archaeological sites suggest that this ploughing took place soon after the army departed. The damage to archaeological sites that resulted from ploughing was first commented upon by the Sussex Archaeological Society in February 1948 (Sussex N&Q XII, 24), and attention was drawn to the damage of Park Brow in October 1948 (Sussex N&Q XII, 91).

Fig 34: Park Brow seen in 1946 (left) with the earthworks extant and in 1950 (right) after ploughing. Details of RAF CPE/UK/1751 3083 21-Sep-1946 and RAF 541/54 4128 20-Apr-1950

This initial post-war ploughing on the South Downs, and the resulting destruction of chalk downland, may have been considered by some farmers as unwelcome but necessary. This was certainly the case for the National Trust, who owned Crowlink, an area of downland outside the project area which had been saved through a public appeal in 1931. The Trust felt that the need for farmland was greater than that for amenities and decided to convert it to arable. Similar decisions were also made by local authorities who owned areas of downland (Brandon 1999, 189). There is pragmatism to these decisions – people have got to eat – but they must, in no small way, have been encouraged by the recent wartime attitude of sacrifice and 'victory at all costs'.

Two examples may suggest that this initial ploughing was originally intended to be a short-term response to the current food crisis. In reply to concerns about Park Brow, assurances were given in 1949 that 'after cropping the area would be laid down to permanent grass' (Sussex N&Q XII, 155). West of the project area, the Neolithic flint mine at Blackpatch was ploughed c.1950 (after the earthworks were first levelled by a bulldozer) but the site was then returned to pasture and has not been ploughed since (Martyn Barber pers. comm.).

The next series of photographs showing the Downs was taken in 1959, and these show an even larger area under the plough. Documentary evidence suggests that this expansion of ploughing got underway in the early years of the decade; certainly by the mid-50s complaints are being voiced about the level of destruction of the Downs through ploughing and the resulting alteration of the character of the landscape (Anon 1954; The Times 14th August 1954 page 5, column E).

In 1952, two government grants were introduced which must have had some influence on the farming of the South Downs. By February, a £5 an acre grant was introduced to encourage the ploughing and sowing, with an approved crop, of land that had been under grass for four years or more. The emphasis now was to grow feedstuffs for the increasing number of livestock being kept. By August 1952 a £10 an acre ploughing-up grant was introduced: this was specifically intended to help farmers with the cost of clearing grassland that is difficult to work due to the need to clear scrub or boulders (Anon 1952).

The paradox in ploughing up the Downs is that it resulted in the destruction of a landscape that was greatly valued; something that is attested to by the wealth of literature and painting that has the South Downs as its subject (see Brandon 1999, 195-204). The archaeological landscape of the Downs, although not a dominant subject, did feature in some of this work; Kipling's Sussex refers to 'The barrow and the camp…' while specific sites such as Chanctonbury are mentioned in The Run of the Downs (in Eliot 1976, 105, 244). However, popular images of the South Downs were often sentimental and emphasised the Downs' idyllic remoteness from modern life. These views ignored the realities of the agricultural depression which, by 1939, had resulted in run-down or derelict farms all across the Downs (Brandon 1999, 158). Much of Britain's pre-war farming landscape was more accurately described in 1945 as consisting of 'tumbledown buildings, idle tools, fields strangled by weed and flood' (Ministry of Information 1945, 10). The poor state of British farming had dire consequences for those who worked the land and, in the 1920s, at least one author drew attention to some of the problems that were faced in the British countryside (Robertson Scott 1947).

The Agriculture Act 1947 had a 'threefold aim…of feeding the population, keeping down food imports and maximising production' (Kynaston 2007, 169). The result would be a dramatic transformation of the countryside, including technical change, larger fields, trimmer hedges, and the removal of redundant farm buildings (Matless 1998, 215). It was accepted that picturesque elements of the countryside would be 'sacrificed' to enable efficient farming, producing the maximum food from the minimum of effort. In this context, efficiency was presented as a law of nature and any farmer not adopting the most efficient type of farming (whatever elements of the landscape may be destroyed in the process) would be 'going against nature' (Anon 1946b, 116). Change was welcomed by those who saw much of the land to be at best, stagnating and, at worst, derelict. Those who expressed concern about these changes to the countryside were criticised for being too interested in the picturesque and for showing a greater concern with the 'welfare of the land' than the welfare of those 'human beings upon it' (Matless 1998, 218). This attitude may provide the context within which many of the objections that were voiced about the destruction of archaeological sites by the plough were dismissed. It is certainly not clear if any positive outcome arose from the discussions between the Sussex Archaeological Society and the East and West Sussex Agricultural Committees in the late 1940s (Sussex N&Q XII, 24, 44, 91).

The dominant vision for the post-war countryside as a whole was of 'technology, prosperity and aesthetic order' (Matless 1998, 218) and, for the South Downs, it was the tractor-drawn plough that was to make productive this landscape that had suffered the inter-war agricultural depression and five years of occupation by the army. Nationally, ploughing is presented as the key to the recovery of the countryside. One of the perceived problems of pre-war agriculture was that 'Many farmers were forgetting the use of the plough altogether; they were becoming no longer cultivators of land but cattle ranchers.' (Ministry of Information 1945, 8). The return of the plough was the key to making the land work: 'fertility lay like a priceless vein beneath the surface, waiting only for the plough's knife and the farmer's skill to release it and turn it into bread' (ibid, 15). To some, there was also an aesthetic appeal to cultivated land. Uncultivated, the field was seen as 'barren and dull…sterile, ugly and sad' (Stewart Collis 1988, 276). Human intervention, by ploughing and sowing, causes a transformation 'and in due season that bare stretch of earth will wave and glitter with so much beauty…' (ibid). To those who bemoaned the transformation of the South Downs an appeal was made to 'adjust our aesthetic senses to appreciate the beauty in a full crop of corn, or in a young productive grass ley' (The Times 17th Aug 1954, page 7, column E).

CONCLUSION

The Downs are no longer the 'barrow hunter's dream' (Grinsell quoted in Brandon 1999, 35) that they were up until the mid-twentieth century. The significance of this post-war ploughing of the Downs is not that it was a new phenomenon (although it was often portrayed as such) but that, unlike earlier episodes, it almost entirely obliterated the remaining ancient downland and those archaeological monuments within it. The army's wartime occupation of the South Downs delayed the expansion of arable until after the war, thereby allowing these last vestiges of downland to be photographed.

That many sites identified on aerial photographs were already known can, in part, be attributed to the fact that this is a well researched landscape where good preservation and wide open vistas encouraged early discovery. Despite this, the NMP survey has identified new monuments for all periods but the Neolithic. This highlights the potential of systematic large area aerial survey to make new discoveries in well researched areas.

Even when monuments were previously recorded, such as the prehistoric or Roman field systems, many were only identified by a central grid reference. This project has recorded the extent of these field systems as well as field shape, size and orientation, and has identified good photographs of these monuments before they were destroyed. Evidence on aerial photographs points to widespread land enclosure on the South Downs in the prehistoric and Roman periods, and the identification of new enclosures and trackways has suggested possible connections between these otherwise disparate sites. Future NMP projects on the South Downs will further enhance our understanding of later prehistoric and Roman settlement.

Areas traditionally less well investigated, such as woodland, are relatively scarce on this part of the Downs. One small area of felling on the scarp edge did reveal a series of lynchets, and this minor discovery highlights the potential for earthwork survival in wooded areas. While this example shows that traditional aerial photographs can provide an occasional glimpse beneath the trees if the photography happens to coincide with periodic felling, the airborne laser mapping technique known as lidar has the ability to 'see through the trees' and a strong case for its use in wooded areas can be made (see Devereux et al 2005). The implications of this may be significant for the more wooded western part of the Downs, such as between Kingley Vale and Cocking. The non-wooded areas of the South Downs may also benefit from a lidar survey to help in determining whether features thought to have been levelled do, in fact, survive as slight earthworks.

The increasing importance with which the remains of the Second World War are now viewed has led to a number of studies which primarily utilised documentary sources or fieldwork to identify surviving examples (Dobinson et al 1997, Defence of Britain Project 2002). This South Downs pilot project has further illustrated the value of aerial survey in identifying and enabling accurate mapping of a wide range of invariably short-lived wartime constructions. Future aerial surveys will allow detailed depiction of hitherto poorly recorded sites. There are, for example, 88 nodal points recorded in East and West Sussex (Defence of Britain records). Aerial survey results would also provide a context for well researched areas such as the coastal defences at Cuckmere Haven (Foot, 2006).

Over the South Downs, levelled archaeological sites are more likely to show in the spring or autumn as either soilmarks or germination marks or, if under grass, as parch marks in only the severest of droughts (D Grady pers. Comm.). Those sites identified as 'cropmarks' during the course of this project can now be monitored by aerial reconnaissance. The degree of visibility from the air of these known sites will indicate whether conditions are favourable for the potential discovery of other sites in a landscape that often reveals little.

The results of this project have indicated a range of topics that would repay further work. In particular, a better understanding of the relationship between individual field systems would benefit from future research. This work could also consider how these fields connected to other contemporary elements in the landscape and related to earlier features, in particular, the range of monuments known as cross-ridge dykes. It is hoped that future work will benefit from any new information derived from the continued aerial reconnaissance of this area.

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APPENDIX

Methodology and archaeological scope of the survey

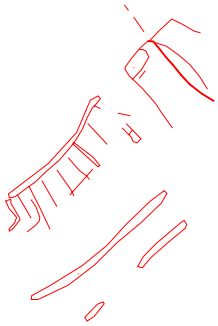
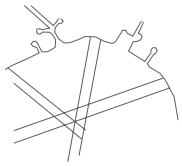
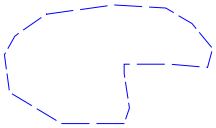
The objective of the National Mapping Programme (NMP) is to enhance our understanding of past human activity by identifying, interpreting and transcribing archaeological features dating from the Neolithic to the twentieth century that are visible as cropmarks, soilmarks or earthworks on aerial photographs. The background, philosophy and approach to English Heritage's National Mapping Programme are explained in Understanding England's Historic Landscapes: An Aerial Perspective (Bewley 2001).

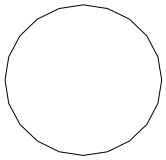
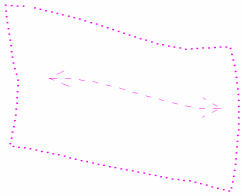
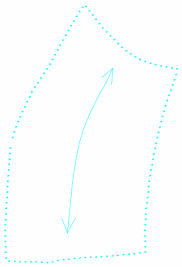
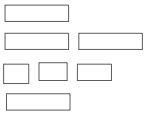
For this pilot area 10,653 aerial photographs from English Heritage's National Monument Record (NMR) and the University of Cambridge's Unit for Landscape Modelling were consulted. Photographs with relevant archaeological features were scanned and then rectified using AERIAL 5.29 Photograph Rectification program designed by John Haigh at the University of Bradford. Control information was taken from digital copies of Ordnance Survey 1:2500 scale maps with a level of accuracy of ±3m and digital terrain models were created from the Ordnance Survey Land-Form Profile digital height information.

The resultant rectified photographs were imported into Autodesk Map 2004 and archaeological detail was transcribed using the appropriate layers and conventions (see pages 80-81).

Cropmarks and soilmarks of cut features, such as ditches, and built-up features, such as banks, have been mapped. The remains of extractive industries were not mapped; nor were certain cropmarks, if they prove to be the remains of removed field boundaries that appear on earlier editions of OS maps.

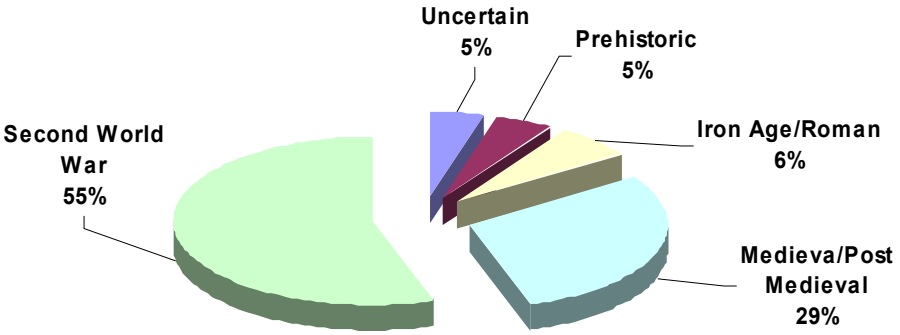
Areas of ridge-and-furrow were mapped indicating the extent and direction of the furrows. All twentieth century wartime features have been mapped; these include buildings and defensive structures, such as anti-tank cubes, and non-military features, such as Emergency Water Supplies and wartime allotment gardens

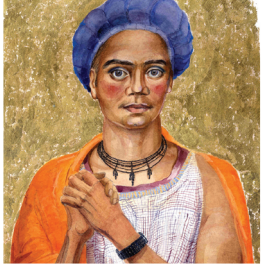
Layer name Colour Linetype	
BANK 1 (red) CONTINUOUS The outline of all features seen as banks or positive features, eg platforms, mounds and banks; also to be used for the agger of Roman Roads. Thin banks will appear on this layer as a single line. BANKFILL 1 (red) FILL: DOT SCALE: 2.25 ANGLE: 53 A stipple that fills the bank outline 'bank'.	
DITCH 3 (green) CONTINUOUS All features seen as ditches; also excavated features, eg ponds and pits. DITCHFILL 3 (green) FILL – SOLID	
EXTENT OF AREA 8 (grey) DASHEDX2 The extent of large area features such as the perimeters of airfields, military camps, mining/extraction areas.	
LARGE CUT FEATURE 5 (blue) ACAD_ISO02W100 Formerly the 'T-hachure', now represented by a dashed line. To be used for large cut features such as quarries, ponds, and perhaps scarps that can not easily be depicted with the use of either bank or ditch.	

Layer name Colour Linetype	
MONUMENT POLYGON 7 (white) CONTINUOUS Used to define the extent of a group of AutoCAD objects corresponding to a single monument in the NMR database.	
RIGARRLEVEL 6 (magenta) ACAD_ISO03W100 Arrow depicting direction of rig in a single block ridge-and-furrow, seen as earthworks or cropmarks, but known to have been ploughed level. RIGDOTSLEVEL 6 (magenta) DOTX2 Outline of a block of ridge-and-furrow, seen as earthworks or cropmarks, but known to have been ploughed level.	
RIGARREWK 4 (cyan) CONTINUOUS Arrow depicting direction of rig in a single block of ridge-and-furrow seen as earthworks on the latest available aerial photographs. RIGDOTSEWK 4 (cyan) DOTX2 Outline of a block of ridge-and-furrow still surviving as earthworks on the latest available aerial photographs.	
STRUCTURE 9 (grey) CONTINUOUS Used for features which do not easily fit into other categories because of their form, eg tents, radio masts, paint (camouflaged airfields).	

Layer name Colour Linetype	
TRAMWAY 200 (purple) TRACKS Used to indicate the presence (or implied presence) of tramways, mainly associated with industrial areas.	
Other Layers:	
(VIEWPORT) 7 (white) CONTINUOUS Used in conjunction with the printing macros	
(SHEET) 7 (white) CONTINUOUS Used in conjunction with printing macros	
GRID 7 (white) CONTINUOUS Drawn automatically by a macro at correct NGR	
RASTER 7 (white) CONTINUOUS Used to load raster images so they can be easily switched off.	

Monument records for each site mapped by the South Downs NMP project have been added to English Heritage's AMIE database. Each record is linked by a unique identifier reference number to a monument polygon, defining the geographical extent of the record. The main elements of the monument record comprise location, indexed interpretation, textual description and main sources, including the aerial photograph which best illustrates the site.
A total of 265 new sites were mapped and recorded and the chart below shows these sites by period.





ENGLISH HERITAGE RESEARCH DEPARTMENT

English Heritage undertakes and commissions research into the historic environment, and the issues that affect its condition and survival, in order to provide the understanding necessary for informed policy and decision making, for sustainable management, and to promote the widest access, appreciation and enjoyment of our heritage.

The Research Department provides English Heritage with this capacity in the fields of buildings history, archaeology, and landscape history. It brings together seven teams with complementary investigative and analytical skills to provide integrated research expertise across the range of the historic environment. These are:

* *Aerial Survey and Investigation*
* *Archaeological Projects (excavation)*
* *Archaeological Science*
* *Archaeological Survey and Investigation (landscape analysis)*
* *Architectural Investigation*
* *Imaging, Graphics and Survey (including measured and metric survey, and photography)*
* *Survey of London*

The Research Department undertakes a wide range of investigative and analytical projects, and provides quality assurance and management support for externally-commissioned research. We aim for innovative work of the highest quality which will set agendas and standards for the historic environment sector. In support of this, and to build capacity and promote best practice in the sector, we also publish guidance and provide advice and training. We support outreach and education activities and build these in to our projects and programmes wherever possible.

We make the results of our work available through the Research Department Report Series, and through journal publications and monographs. Our publication Research News, which appears three times a year, aims to keep our partners within and outside English Heritage up-to-date with our projects and activities. A full list of Research Department Reports, with abstracts and information on how to obtain copies, may be found on www.english-heritage.org.uk/researchreports

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