

# Cornwall Aerial Survey 2008 - 2011

English Heritage Project Number  
5574

## Results of Aerial Reconnaissance



**Historic Environment (Projects)**



# **Cornwall Aerial Survey 2008 - 2011**

## **Results of Aerial Reconnaissance**

**Emma Trevarthen**

**August 2011**

|                         |                         |
|-------------------------|-------------------------|
| <b>Client</b>           | <b>English Heritage</b> |
| <b>Report Number</b>    | <b>20011R100</b>        |
| <b>Date</b>             | <b>August 2011</b>      |
| <b>Status</b>           | <b>Final</b>            |
| <b>Report author(s)</b> | <b>Emma Trevarthen</b>  |
| <b>Checked by</b>       | <b>Andrew Young</b>     |
| <b>Approved by</b>      | <b>Andrew Young</b>     |

Historic Environment

Cornwall Council

Kennall Building, Old County Hall, Station Road, Truro, Cornwall, TR1 3AY

tel (01872) 323603 fax (01872) 323811 E-mail [hes@cornwall.gov.uk](mailto:hes@cornwall.gov.uk)

[www.cornwall.gov.uk](http://www.cornwall.gov.uk)

## **Acknowledgements**

This project was undertaken with funding from English Heritage. Photography and flight direction were carried out by Emma Trevarthen and Steve Hartgroves. The Project Manager was Steve Hartgroves and quality assurance was carried out by Andrew Young, Senior Archaeologist for Cornwall Council.

Ainsley Cocks, Eleanor Breen, Charlie Johns, Graeme Kirkham, Anne Preston-Jones, Ann Reynolds, Carolyn Royall, Adam Sharpe and Megan Val Baker gave advice on potential targets, and assisted with navigation on flights.

The maps in this report are reproduced from the OS map with the permission of Ordnance Survey on behalf of Her Majesty's Stationery Office. © Crown Copyright and Landmark Information Group Licence no: 100019229. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings.

The views and recommendations expressed in this report are those of Historic Environment, Cornwall Council and are presented in good faith on the basis of professional judgement and on information currently available.

## **Freedom of Information Act**

As Cornwall Council is a public authority it is subject to the terms of the Freedom of Information Act 2000, which came into effect from 1st January 2005.

## **Cover illustration**

Cropmark remains of Iron Age/ Romano-British enclosures and field system at Bosence, St Hilary. Photograph © Historic Environment Cornwall Council, 22/06/2010; F99-056

## **© Cornwall Council and English Heritage 2011**

No part of this document may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the prior permission of the publisher.

# **Cornwall Aerial Survey 2008 - 2011**

## **Results of Aerial Reconnaissance**

### **Contents**

|  |           |
|--|-----------|
| <b>Cornwall Aerial Survey 2008 - 2011</b>                                | <b>5</b>  |
| <b>1 Summary</b>   | <b>8</b>  |
| <b>2 Background to the project</b>                                       | <b>8</b>  |
| 2.1 Circumstances of and reasons for the project                         | 8         |
| 2.2 Research Aims and Objectives   | 9         |
| 2.3 Project Scope  | 9         |
| 2.4 The project area   | 11        |
| 2.4.1 Geology of the project area  | 11        |
| 2.4.2 Archaeological resource of the project area                        | 13        |
| 2.5 Overview of current aerial reconnaissance methodology and technology | 15        |
| 2.5.1 Methodology  | 15        |
| 2.6 Logistical issues  | 19        |
| 2.6.1 Long periods of bad weather (Risk 1)                               | 19        |
| 2.6.2 Pilots/ plane unavailable during periods of good weather (Risk 2)  | 19        |
| 2.6.3 EH digital images standards may change during the project (Risk 7) | 20        |
| <b>3 Results of 2008 – 2011 aerial reconnaissance</b>                    | <b>21</b> |
| 3.1 Overview of results  | 21        |
| 3.1.1 New sites  | 22        |
| 3.1.2 Scheduled monument management and countryside stewardship          | 26        |
| 3.1.3 Other projects and illustrative work                               | 27        |
| <b>4 Conclusions</b>   | <b>31</b> |
| 4.1 Outcomes   | 31        |
| 4.2 Recommendations  | 31        |
| <b>5 References</b>  | <b>33</b> |
| <b>Project Archive</b>   | <b>34</b> |
| <b>Appendix 1 Post-reconnaissance workflow</b>                           | <b>35</b> |
| <b>Appendix 2 List of new sites recorded during the project</b>          | <b>39</b> |
| <b>Project outcome</b>   | <b>41</b> |

## List of Figures

Figure 1. Aspects of the Cornish landscape. Left: Upland rough ground at Trewint Downs surrounded by medieval fields and recently enclosed land, with A30 in the foreground (F100-088). Right: Castle Goff (foreground) and Newberry Round (centre): Iron Age rounds incorporated into medieval farmland. Delabole slate quarry, one of the oldest in the county, is in the background (F87-112).

Figure 2. Map showing simplified soil types for Cornwall.

Figure 3. Map showing the Historic Landscape Character types of Cornwall.

Figure 4. Close-up view of an Iron Age round at Tolcarne, on the Roseland Peninsula (Site ID MCO54985, Photograph F94-081). This photograph also includes eight control points, at the junctions of field boundaries.

Figure 5. Tolcarne round in its landscape setting overlooking the river Fal (F94-085).

Figure 6. Tolcarne round after rectification and transcription, as it appears on the HBSMR Monuments layer

Figure 7. Flight track and individual photo location points from GPS data.

Figure 8. Flight track and individual photo location points from GPS data.

Figure 9. Distribution of new sites recorded in the Cornwall HER, overlying areas of Agricultural Land Classification. The cluster of black dots in central Cornwall represents the results of flights F94 and F98. These two flights, from 2009 and 2010, targeted Grade 2 arable land (shaded pink) in the area of the Fal estuary.

Figure 10: Iron Age/ Romano-British settlement at Bosence. The features marked in blue represent existing information produced by the National Mapping Programme. In red are newly recorded features, visible as cropmarks on photographs taken during flight F99, 22<sup>nd</sup> June 2010. A new triple-ditched enclosure, cut by a later spoilheap, is visible at the eastern edge of the site (Site ID MCO55645).

Figure 11: Triple ditched enclosure at Trethewey near Tregony (Photograph F94-030; Site ID MCO54996)

Figure 12: (Left) multivallate enclosure at Cosworth Crossing, Site ID MCO55290 and (right) double ditched enclosure at Penberthy Cross, Site ID MCO55642

Figure 13: Pillow mounds near Creddacott Farm, Week St Mary (Photograph F87-221, Site ID MCO54214).

Figure 14: Gunwalloe, Lizard. In the centre of the image on the cliff edge is a Second World War Type 26 pillbox (Photograph F85-088, Site ID MCO54032).

Figure 15. Post medieval settlement and nineteenth century deer park on the island of Samson, Isles of Scilly (F92-059). Photography from flight 92 highlighted the extent to which gorse and bracken have engulfed scheduled sites such as this. Management work has since been carried out across the islands, and a second flight is recommended by the Council of the Isles of Scilly Historic Environment Field Advisor to provide evidence of the resulting improvements and to identify wider landscape features (E. Breen pers. comm.)

Figure 16. Works at West's Shaft, Wheal Fortune on the Mineral Tramways trail, showing coned shafts enclosed by a hedge and fence, and West's Adit portal, bottom centre. (F90-228)

Figure 17. Aerial photograph of Medlyn Moor engine house near Wendron, on the front page of the WHS website (F90-202)

*Figure 18. Smallholdings of eighteenth and nineteenth century date on former rough ground, at Skinner's Bottom, St Agnes. (F100-201).*

*Figure 19. The Carnmenellis upland, Wendron. A Bronze Age cairn lies immediately in front of a modern communications tower. To the right is a modern reservoir and in the background are eighteenth and nineteenth century fields and crofts (F90-037)*

## **Abbreviations**

|       |   |
|-------|---|
| ADS   | Archaeology Data Service                                |
| AOC   | Air Operator's Certificate                              |
| AONB  | Area of Outstanding Natural Beauty                      |
| CC    | Cornwall Council  |
| EA    | Environment Agency                                      |
| EH    | English Heritage  |
| GIS   | Geographical Information System                         |
| GPS   | Global Positioning System                               |
| HBSMR | Historic Buildings and Site and Monuments Record        |
| HE    | Historic Environment, Cornwall Council                  |
| HEEP  | Historic Environment Enabling Programme                 |
| HER   | Historic Environment Record                             |
| HLC   | Historic Landscape Character                            |
| MOD   | Ministry of Defence                                     |
| NMP   | National Mapping Programme                              |
| NMR   | National Monument Record                                |
| NMRC  | National Monument Record Centre                         |
| PDF   | Portable Document Format                                |
| OS    | Ordnance Survey   |
| RCHME | Royal Commission on the Historical Monuments of England |
| SM    | Scheduled Monument                                      |
| SHINE | Selected Heritage Inventory for Natural England         |
| UID   | Unique Project Identifier                               |

# 1 Summary

This report outlines the results of a three year programme of aerial reconnaissance in Cornwall and the Isles of Scilly, from April 2008 to March 2011. The project was funded by English Heritage through the Historic Environment Enabling Programme (HEEP).

The principal aims of the project were to:

- increase knowledge and awareness of the archaeological resource through the discovery of previously unrecorded sites
- to provide more effective monitoring of the condition of the historic environment
- inform the management of Scheduled Monuments, registered parks and gardens and battlefields
- raise awareness of, and promote appreciation of, Cornwall's historic environment to a wide audience
- support future research projects in Cornwall and the Isles of Scilly.

Data resulting from the flying programme fed into the Monument Management Programme, and all previously unrecorded sites were added to Cornwall's Historic Buildings, Sites and Monuments Record (HBSMR): the digital interface of Cornwall's Historic Environment Record.

The project achieved these aims by providing 50 new sites to the HER between 2008 and 2011, including 48 sites that were recorded during cropmark prospecting flights. A further 12 monument records were updated with new information provided by the project. Reports were made on the condition of more than 20 scheduled monuments using data from the project's aerial photographs. Images from the project were used in Historic Environment publications such as books and leaflets, and on the Cornwall Council and Cornish Mining World Heritage Site websites.

## 2 Background to the project

### 2.1 Circumstances of and reasons for the project

Steve Hartgroves, formerly Principal Archaeologist with Historic Environment, Cornwall Council (HE), has initiated and managed aerial reconnaissance projects in Cornwall and Scilly since 1984. These have been funded by English Heritage (EH) and formerly by the Royal Commission on the Historical Monuments of England (RCHME). Steve was aided by various members of the HE service, who acted as navigator/director and occasionally as photographer during flights. In 2007 Emma Trevarthen was co-opted onto these projects following training sessions organised by Damian Grady (Senior Investigator, Aerial Survey and Investigation) of English Heritage.

Over this time 100 flights were carried out, resulting in an archive of 7,341 black and white prints, 6,523 colour slides and 6,545 digital images.

It was considered appropriate that further aerial reconnaissance in Cornwall be undertaken by the Cornwall Council HE team for three principal reasons:

1. Aerial reconnaissance as a remote sensing technique has a great deal to offer in terms of coverage, quality and value for money. For instance, as a result of previous aerial reconnaissance more than 600 new cropmark sites had been photographed, mapped and recorded in Cornwall's HER.



2. Logistical factors, primarily the distances from airfields used by EH Aerial Survey and Cornwall's unpredictable weather conditions, favour a local base for reconnaissance flights
3. The HE team has more than 23 years experience of aerial reconnaissance in Cornwall and photographic equipment suitable for the task, as well as agreements with the local airfields and appropriate infrastructure in place.

## **2.2 Research Aims and Objectives**

The main aim of the Cornwall Aerial Survey Project 2008 – 2011 was to increase knowledge and awareness of the archaeological resource through the discovery of previously unrecorded sites, thus enabling better informed advice to be given regarding issues of land management such as agri-environment schemes, and in response to planning applications. The project results were also expected to improve our ability to assess the archaeological potential of 'blank' areas in the HER.

Further aims specific to this project are set out below:

1. **Provide more effective monitoring of the condition of the historic environment**
2. **Inform the management of Scheduled Monuments, registered parks and gardens and battlefields**
3. **Raise awareness of, and promote appreciation of, Cornwall's historic environment to a wide audience**
4. **Support future research projects in Cornwall and the Isles of Scilly**

The objectives designed to achieve these aims are:

1. **To carry out reconnaissance for previously unrecorded sites through programmes of summer flying targeting cropmarks, and winter flying targeting earthworks.**
2. **Reconnaissance designed to monitor the extent and effects of land management change. This includes the built environment.**
3. **A programme of Scheduled Monument reconnaissance directed by liaison with EH historic environment field advisors and the HE historic environment countryside advice officer.**
4. **Reconnaissance programmes designed to provide high quality images for inclusion in HE websites and other outreach initiatives**
5. **Reconnaissance directed by the needs of project development. Examples include the Lowland Cornwall Project and the Cornwall County Council Estate Audit**

## **2.3 Project Scope**

Since it began in 1984 the Aerial Survey Programme in Cornwall has photographed more than 640 plough-levelled sites that were previously unknown to the HER. Prospecting for new sites as cropmarks and soilmarks has been, and will continue to be, a primary objective of archaeological aerial reconnaissance and the current project has contributed significantly to this.

Reconnaissance aims have, however, evolved and expanded over the years to take account of changing archaeological perspectives, the requirements of research

projects and the development of local and national research agendas. Further changes and developments within the heritage sector, the continuing discovery of new sites during recent reconnaissance and perceived gaps in existing aerial photo cover of the county were compelling reasons for the reconnaissance programme to continue for a further three years.

A business case was made for the project, which took into account the following points:

- New targets for house building, as a result of policy relating to population growth, will have an effect on the edges of settlements and urban areas and may result in entirely new settlements in the countryside.
- Climate change: the increased risk to below ground archaeology posed by cultivation of biofuels and biomass crops and the replacement of traditional crops by those adapted to warmer and wetter conditions
- Climate change: the conversion of pasture to woodland
- Changes in agricultural practice: for example the creation of larger units, but reduction in overall livestock numbers
- Countryside access: increased leisure use of countryside and pressures of wear, tear and increased need for information, access and conservation.

The project scope therefore took into account both the aims and objectives of the project and the business case, and a wide range of desired targets and objectives resulted. These were designed to ensure the most effective use of resources by allowing a flexible approach in response to adverse or favourable weather conditions, the demands of individual projects and initiatives and changing priorities within the heritage sector:

1. Plough-levelled sites, visible as cropmarks or soilmarks.
2. Earthwork sites
3. Condition of Scheduled Monuments and other sites believed to be at risk
4. Recording of landscapes sensitive to change
5. Locations determined by current project work, likely to include some of the above as well as intertidal and estuarine areas, manor houses, estates, gardens, designed landscapes and settlements that were omitted from the recent Urban Survey and Industrial Settlements projects.
6. Recording of known archaeological sites and historic landscapes for illustrative purposes including reports, presentations, popular publications and websites.

## 2.4 The project area

Cornwall is a long tapering peninsula measuring roughly 110km east to west. The county boundary with Devon in the east runs for approximately 70km along the line of the river Tamar. The Isles of Scilly lie 40km west-south-west of Land's End and consist of five inhabited and numerous smaller, uninhabited islands.

The most obvious feature of the project area is its extensive coastline, which measures approximately 450km in length. The Atlantic coasts of north Cornwall, Land's End and the west side of the Lizard Peninsula are characterised by dramatic cliffs, whereas the Channel coasts of the south and southeast are more gentle in comparison. Along parts of the coast (particularly the south coast) river estuaries are characterised by finger-like inlets, and in some places the meandering tributaries have become silted with deposits of alluvium and waste washed down from mineral processing sites further upstream.

The landscape of Cornwall and the Isles of Scilly is predominantly rural in character, and supports a mixed farming regime. Agriculture takes up 86% of the land in the project area and the farming landscape is characterised by a patchwork of small fields, many of them resulting from the enclosure of open field systems in the late medieval and early post medieval periods. There are areas of unenclosed moorland; the most extensive occur on the Bodmin Moor uplands, but there are smaller areas on the Lizard Peninsula, in West Penwith, and elsewhere. There is only a limited amount of woodland, largely confined to the river valleys, but with some forestry plantations in the north and north-east of Cornwall

The population of 500,000 is housed largely in a dispersed network of farms, hamlets, villages and small towns.



*Figure 1. Aspects of the Cornish landscape. Left: Upland rough ground at Trewint Downs surrounded by medieval fields and recently enclosed land, with A30 in the foreground (F100-088). Right: Castle Goff (foreground) and Newberry Round (centre): Iron Age rounds incorporated into medieval farmland. Delabole slate quarry, one of the oldest in the county, is in the background (F87-112).*

### 2.4.1 Geology of the project area

The central spine of the south-west peninsula is formed by a series of granite intrusions or 'bosses' which form the upland massifs and moors. Five major intrusions fall within the study area: Bodmin Moor, Hensbarrow, Carnmenellis, West Penwith, and the Isles of Scilly. Lesser granite intrusions occur at Tregonning Hill, Carn Brea and Carn Marth in the west, St Agnes on the north coast, and Kit Hill and Hingston Down in the east. Surrounding the granite bosses are extensive metamorphic aureoles where rocks have been altered by the heat of the intruding

granite. Mineralization which occurred during the cooling of the granite, resulted in the intrusion of tin and copper in lodes (seams) running east–west, and lead, zinc and iron in lodes running north–south. At a later stage some granites were affected by hydrothermal activity, resulting in the transformation of feldspars to Kaolinite (china clay) which is found most extensively (but not exclusively) on the Hensbarrow massif.

Away from the granite areas the surface geology of Cornwall comprises three main elements. The oldest rocks in the county, likely to be Pre-Cambrian in origin, are found on the Lizard peninsula. The Lizard Ophiolite Complex is a nationally important sequence of intrusions of basic igneous rocks including gabbro, serpentine, gneiss and schist, cut in places by veins of basalt.

In the far north-east of the county are Carboniferous rocks forming the western edge of the Culm Measures which characterise extensive areas of west Devon. These deposits contain black shales, sandstones and thin limestones.

The underlying geology of most of Cornwall, however, consists of Devonian rocks. There are slight variations between the Lower, Middle and Upper Devonian beds, but generally the Killas, as it is known, is characterised by clays, shale, slates, siltstones and sandstones.

During Pleistocene times the project area was not glaciated, but fell in a periglacial zone subject to freeze/thaw processes. In the post-glacial period Cornwall has been subjected to sea level rise, resulting in a coast of submergence. Extreme low tides expose submerged forests at several localities (e.g. Mount's Bay) and submerged prehistoric fields (e.g. on the sand flats in the Isles of Scilly). Rias, or drowned rivers, are another feature of the submerged coastline (e.g. the rivers Fal, Fowey and Helford).

Much of Cornwall is covered by poor soils and most of the agricultural land is classed as Grade 3 in the Agricultural Land Classification of England and Wales. The only extensive areas of Grade 2 arable land are around the Camel estuary, in the southeast around St Germans, and around the Fal and Helford estuaries. The only soils classed as Grade 1 occur in a small pocket along the Hayle River. In previous years of flying, the Camel estuary had proved to be a reliable source of cropmark sites. In the project design for the 2008 – 2011 project, it was suggested that other Grade 2 areas might yield comparable results and that they should be targeted for cropmark prospecting (Trevarthen 2008). This has indeed been the case, since flying in the area of Grade 2 land around the Fal estuary has produced the bulk of new sites captured by the project (see section 3.1.1, figure 9).

A summary of the soil types in Cornwall and the Isles of Scilly is shown on maps produced by the Soil Survey of England and Wales, 1974. The project area is covered predominantly by brown earths associated with stagnogley soils, brown podzolic soils and rankers. The Devonian Killas, covering most of the county, yield a clayey loam with impeded drainage in the east, less so to the west of Truro. Much of the Lizard peninsula is characterised by loamy soils with a wet, peaty surface over a thin iron pan. In the northeast the Culm Measures yield wet, clayey soils.

Raw peat soils occur at the highest points on the granite, most notably on Bodmin Moor and the Hensbarrow uplands.

Raw sands occur locally at Hayle, Perranporth and Padstow and are the result of sand being blown inland to form extensive dunes known locally as Towans. Wind-blown sands also occur in the lower lying areas of the Isles of Scilly giving sandy, friable soils which are well drained but very shallow.

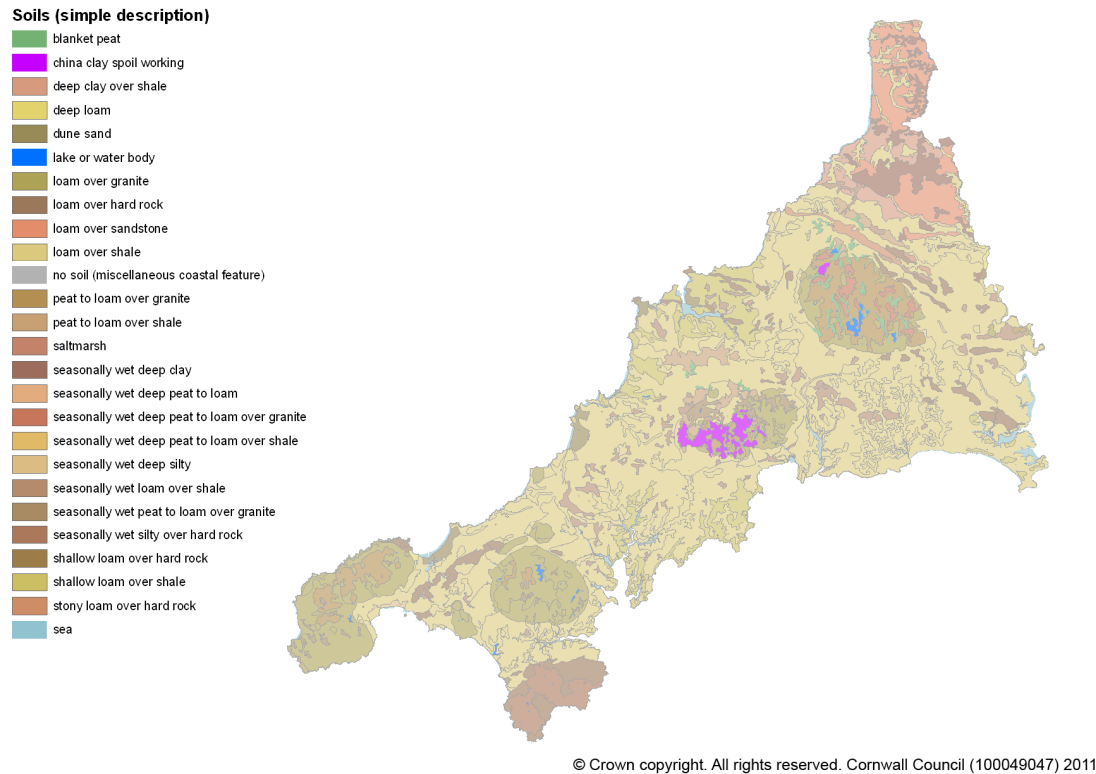


Figure 2. Map showing simplified soil types for Cornwall.

#### 2.4.2 Archaeological resource of the project area

Cornwall and the Isles of Scilly have a rich and varied archaeological heritage. The HER is one of the largest in the country and currently contains almost 56,000 records. Cornwall is relatively removed from intensive agricultural development and in many parts of the county stone has been used for building since prehistory. As a result, above-ground traces survive in a high proportion of the monuments recorded in the HER. This is reflected in the unusually high number of sites – almost 2,000 - designated as Scheduled Monuments.

The most visually evident elements of Cornwall's archaeological heritage are the remains of the eighteenth and nineteenth century tin and copper mining industries. The disused workings of these industries survive in great numbers in the granite areas of the county; so much so that the ruined engine house has become an evocative and iconic symbol of Cornwall. In 2006 the international importance of the mining landscape was recognised by its designation as a World Heritage Site.

The granite massif of Bodmin Moor is of enormous archaeological significance nationally. Extensive relict landscapes encompassing prehistoric settlements and fields, ceremonial and burial sites, medieval farms, and early tin workings all survive here. In Scilly, West Penwith and in parts of the Lizard peninsula there are similarly extensive remains.

In lowland Cornwall the prehistoric and historic farming (and settlement) heartland can be identified through Historic Landscape Characterisation (HLC). Areas classified in Cornwall's HLC as *Anciently Enclosed Land* contain numerous farms and hamlets first mentioned in early documents such as the Domesday Book or whose medieval or pre-medieval origins are inferred from place-name evidence. Some of these early settlements are set within a pattern of small, irregular fields which are likely to perpetuate the pre-medieval field pattern. Throughout much of

Cornwall, however, the present day field layout clearly derives from the enclosure of medieval open field systems, where groups of strips have been parcelled up by later enclosure. These fields are characterised by the generally sinuous nature of their boundaries (Herring 1998).

*Anciently Enclosed Land* is the farming heartland; it is land which was first cleared and used for growing crops and grazing cattle since the later Bronze Age. Being the ancient farmland, it is also the principal zone of ancient settlement. Of course many centuries of agriculture, including wholesale re-organizations of the layout of fields has obscured and denuded many earlier features and the above-ground survival of archaeological monuments does not compare with that in the granite uplands. At many locations, however, the earth and stone ramparts of late prehistoric or Romano-British enclosed settlements (locally known as 'rounds') have been re-used as field banks and incorporated into the present day field pattern. Elsewhere the below-ground remains of prehistoric settlement features have been identified through evaluations, watching briefs, geophysical survey or excavation in advance of development and as cropmarks on aerial photographs.

Areas classified as *Recently Enclosed Land* in Cornwall's HLC are characterised by regular field patterns consisting of rectilinear fields with straight, surveyed boundaries. These fields result mainly from the enclosure of former rough ground during the post medieval period, often in the nineteenth century. In the main the archaeological resource of *Recently Enclosed Land* is less rich than that of *Anciently Enclosed Land*, with few settlement features, although it can contain important monuments such as Bronze Age barrows and extensive mining remains (Herring 1994).

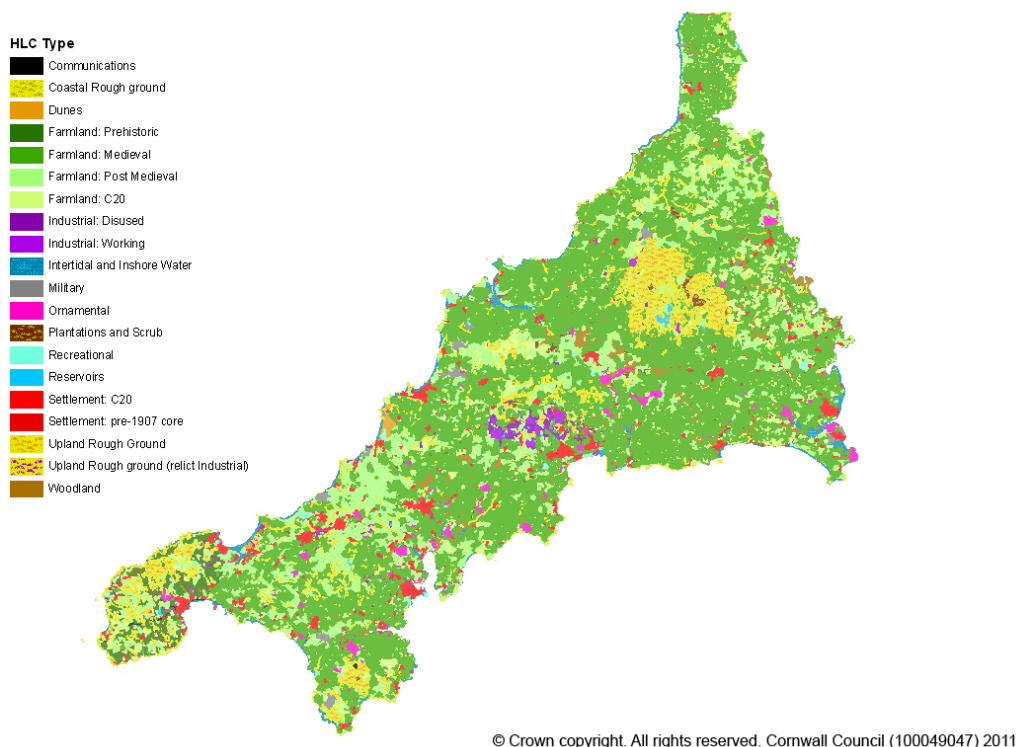


Figure 3. Map showing the Historic Landscape Character types of Cornwall.

## **2.5 Overview of current aerial reconnaissance methodology and technology**

### **2.5.1 Methodology**

#### **2.5.1.1 Review points**

At the beginning of each summer and winter flying season an assessment was carried out to determine suitable targets for reconnaissance. These assessments were held to coincide with review points in the project schedule. Many factors were taken into account, such as flight reports from previous flights that season and long-term weather forecasts. Input from the EH regional team and requests from HE staff for specific targets were additional factors that needed to be considered. During the summer reviews distribution maps of existing cropmark/ soilmark sites were also consulted.

Points covered in the review meeting agenda included technical matters and general workflow; targets met and targets outstanding; the project schedule and ongoing tasks; current project issues and risks. A highlight report was produced as an outcome of each meeting.

Monitoring meetings were carried out once a year between the projects team and the EH project officer. These coincided with one of the twice yearly review points.

#### **2.5.1.2 Flights**

Aircraft were hired as close as possible to the desired day and time of the flight. Booking a flight more than 24 hours in advance heightened the risk of cancellation due to poor weather conditions. The aircraft used during the project were either: a Cessna 182 light aircraft, hired from Westward Airways (Land's End), St Just; or a Bell 206 Jet Ranger helicopter from Castle Air Charters Ltd, Liskeard. Both companies cover the entire county of Cornwall as well as the Isles of Scilly. The decision to use a helicopter for some flights was due to difficulties hiring an aircraft from Land's End, during a review of operations within the Westward Airways organisation.

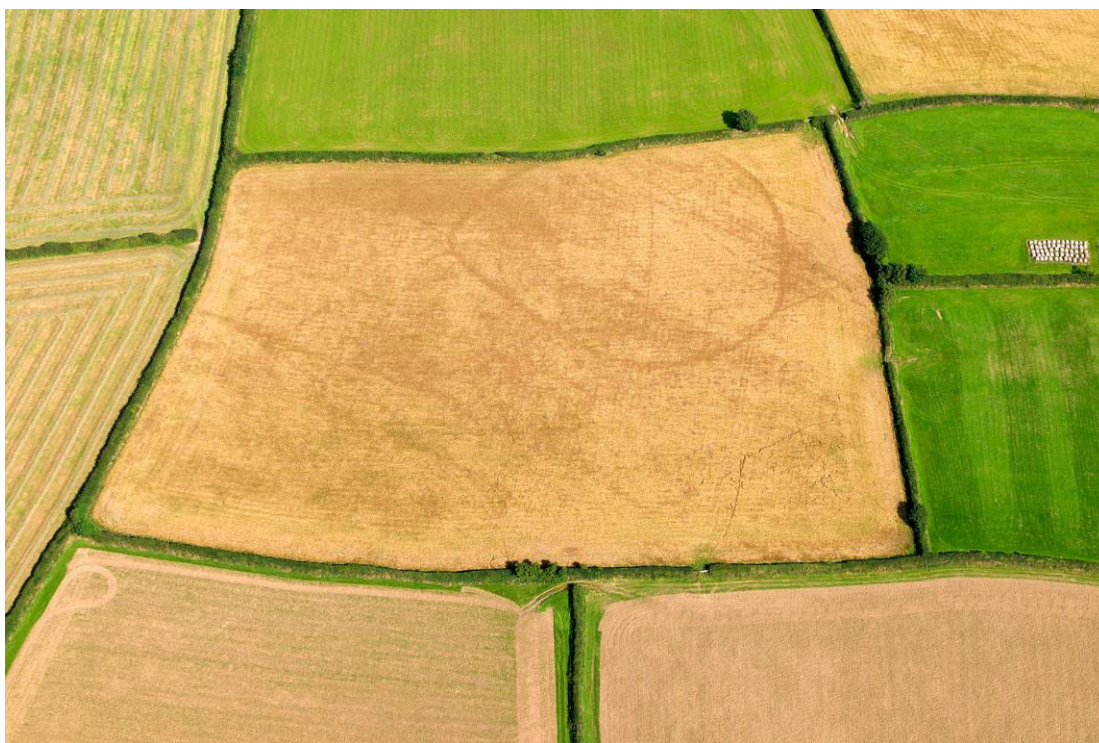
Each flight lasted an average of two hours, with the longest flight running to roughly two and a half hours and the shortest an hour and fifteen minutes. The two-person projects team alternated the tasks of photographer and flight director/ navigator. Although the Nikon D70 was on hand for every flight as a back-up camera, it was not used during the project.

A minimum number of frames were captured for all sites that required mapping, in particular cropmark features. These included: a close-up of the site for interpretation and analysis; a close-up frame that captured at least five points of control for rectification; a locating shot that encompassed the surrounding area to provide context and facilitate identification of the subject (figures 4 to 6).

In-flight recording of site locations and flight route was achieved automatically via a hand-held Global positioning System (GPS) unit, linked to the Nikon D300 (section 2.5.2).

The flight director/ navigator used the current list of targets, derived from the seasonal reviews, to guide the photographer and pilot. A written record of sites photographed and ground conditions was created by the flight director, and these records formed the basis of a short flight report and a crop condition bulletin. These were completed immediately after each flight. Crop condition bulletins were disseminated to all regional flyers via the English Heritage Senior Investigator responsible for aerial reconnaissance (see Appendix 1).





*Figure 4. Close-up view of an Iron Age round at Tolcarne, on the Roseland Peninsula (Site ID MCO54985, Photograph F94-081). This photograph also includes eight control points, at the junctions of field boundaries.*



*Figure 5. Tolcarne round in its landscape setting overlooking the river Fal (F94-085).*



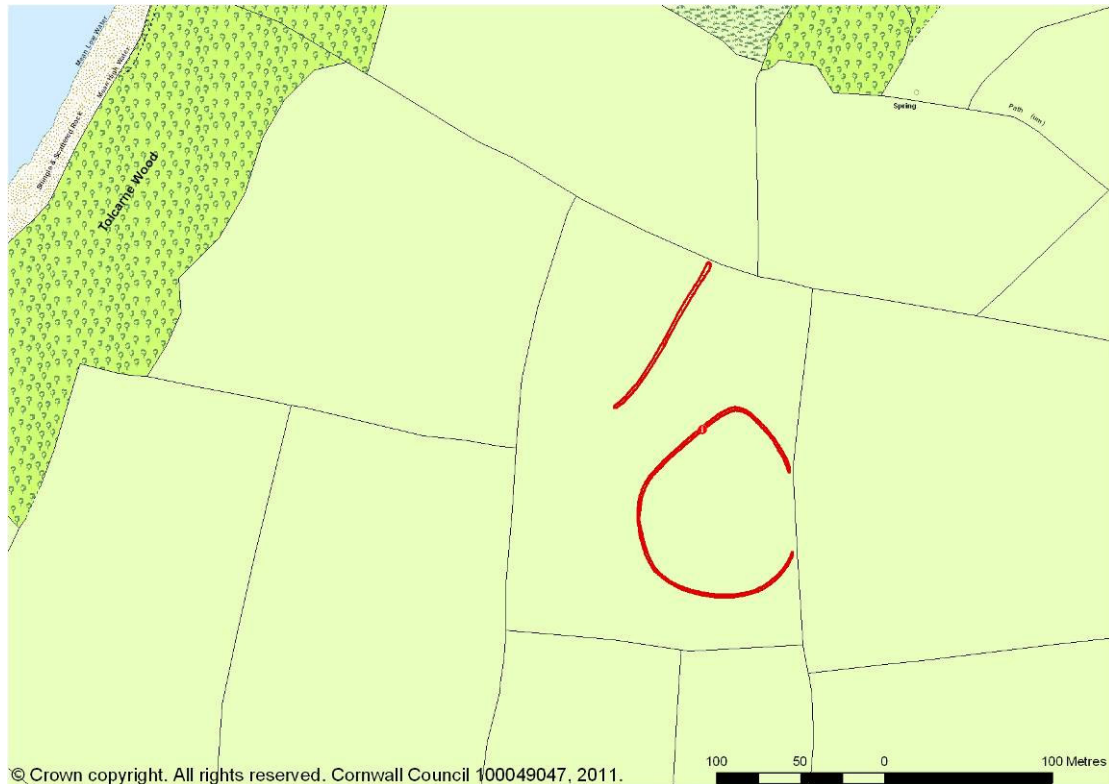


Figure 6. Tolcarne round after rectification and transcription, as it appears on the HBSMR Monuments layer

### 2.5.1.3 Post reconnaissance tasks and current technology

For the 2008 – 2011 aerial survey project, digital photography was the sole means of capturing images.

A Nikon D300 digital SLR and Nikon 24-70mm lens were purchased in 2009 for the use of the Cornwall aerial reconnaissance team. The Nikon D300 has the ability to connect to a hand-held Global Positioning System (GPS) unit. The use of a GPS device has enabled not only the global position of each photograph but also a flight track outlining the route covered by the aircraft to be recorded. Having a record of both sets of data highlights those areas that have been flown over, but where no sites have been observed (figure 7). Between 2007 and 2009 a Garmin GPS 12 was used but the availability of this unit, which is for the use of the entire HE Projects team, proved unreliable and in December 2009 a Garmin GPS 60 was purchased specifically for aerial reconnaissance use.

A post-reconnaissance workflow was drawn up so that the transfer, processing and archiving of digital images remained consistent throughout the project. Full details of the workflow are contained in Appendix 1.

Digital aerial photographs held by HE can be searched for and viewed in a number of ways. The images are archived as JPEGs and filed by flight number on the Cornwall Council network. The HE Photo database, which holds data about all ground and aerial photographs, in colour slide, black and white print and digital format, appears as point data on the HBSMR mapping.



## **2.6 Logistical issues**

The project design documented a number of potential risks which could affect the extent to which the original aims and objectives were met (Trevarthen 2008, Appendix 4: Risk Log). These risks included scenarios which did come to pass during the project and countermeasures, as outlined in the original risk assessment, were taken. Descriptions of those risks are discussed below.

### **2.6.1 Long periods of bad weather (Risk 1)**

This was considered a high probability risk that could have a high impact on the project aims and objectives.

Poor weather conditions did affect summer flying in both 2008 and 2009, although the number of new cropmark sites recorded in both years was still high. Heavy cloud affected the ability to fly and a dearth of warm, dry, sunny days during the months of May, June, and July limited the potential for cropmark sites to appear. The weather was monitored continually during these periods and at least one member of the projects team was always available throughout the summer months. Whenever flying conditions improved, attempts were made to book an aircraft on two consecutive days (Table 1). This action follows the countermeasure suggested in the project design: 'More intensive flying when weather improves'.

This proved successful for the following flights: F84 and F85 (22<sup>nd</sup> and 23<sup>rd</sup> July 2008); F91 and F92 (1<sup>st</sup> and 2<sup>nd</sup> June 2009); F93 and F94 (6<sup>th</sup> and 7<sup>th</sup> August 2009); F98 and F99 (21<sup>st</sup> and 22<sup>nd</sup> June 2010). In particular, flights F94 and F98 produced a high number of images of previously unrecorded archaeological sites (see section 3.1.1).

### **2.6.2 Pilots/ plane unavailable during periods of good weather (Risk 2)**

This was considered a medium probability risk that could have a high impact on the project aims and objectives.

In 2009, the availability of both aircraft and pilots decreased due to reorganisation within Westward Airways, the company that runs Land's End Airport. A suggested countermeasure in the Risk Log for this issue was to 'Investigate alternative airfields'. All alternatives within Cornwall and Devon were investigated but only Castle Air, a charter helicopter service based at Trebrow, near Liskeard, held an Air Operator's Certificate (AOC).

In March 2009 a Castle Air helicopter was used for two flights, since Land's End Airport could not provide an aircraft until the summer season began. Over the summer and early autumn of 2009 the project team were able to make use of a Cessna 182 from Land's End but availability ceased again in October 2009. The start of the summer season saw no change to this situation, and a helicopter was used for two flights in March and April 2010. A further two helicopter flights were carried out in late June 2010, and in that year only the final flight of the project, F100, was taken in a light aircraft.

The cost of using a helicopter was approximately twice that of using a light aircraft. Although this had not been considered as a risk in the project design, it was similar to risk no 6: 'Aircraft fuel costs escalate beyond those outlined in the project design'. The suggested countermeasures for that scenario were to carry out shorter flights and thus spend less per flight, or to carry out fewer flights in the final year of the project. The latter was considered the preferred option, since poor weather had already had an effect on the number of days available for flying.

| <b>Flight number</b> | <b>Date</b>                     | <b>Aircraft</b>       | <b>Purpose of flight</b>                |
|----------------------|---------------------------------|-----------------------|---|
| F84                  | 22 <sup>nd</sup> July 2008      | Cessna 182            | Cropmark prospection                    |
| F85                  | 23 <sup>rd</sup> July 2008      | Cessna 182            | Cropmark prospection                    |
| F86                  | 23 <sup>rd</sup> September 2008 | Cessna 182            | Earthworks recording/<br>SM monitoring  |
| F87                  | 31 <sup>st</sup> October 2008   | Cessna 182            | Earthworks recording/<br>SM monitoring  |
| F88                  | 10 <sup>th</sup> December 2008  | Cessna 182            | Earthworks recording/<br>SM monitoring  |
| F89                  | 18 <sup>th</sup> March 2009     | Jet Ranger helicopter | SM monitoring/ forts<br>in SE peninsula |
| F90                  | 19 <sup>th</sup> March 2009     | Jet Ranger helicopter | SM monitoring/ WHS<br>recording         |
| F91                  | 1 <sup>st</sup> June 2009       | Cessna 182            | Cropmark prospection                    |
| F92                  | 2 <sup>nd</sup> June 2009       | Cessna 182            | Scilly SM/ landscape<br>recording       |
| F93                  | 6 <sup>th</sup> August 2009     | Cessna 182            | Cropmark prospection                    |
| F94                  | 7 <sup>th</sup> August 2009     | Cessna 182            | Cropmark prospection                    |
| F95                  | 10 <sup>th</sup> September 2009 | Cessna 182            | Tamar valley sites/<br>SM monitoring    |
| F96                  | 11 <sup>th</sup> March 2010     | Jet Ranger helicopter | SM monitoring,<br>Bodmin Moor           |
| F97                  | 10 <sup>th</sup> April 2010     | Jet Ranger helicopter | SM monitoring, Lizard                   |
| F98                  | 21 <sup>st</sup> June 2010      | Jet Ranger helicopter | Cropmark prospection                    |
| F99                  | 22 <sup>nd</sup> June 2010      | Jet Ranger helicopter | Cropmark prospection                    |
| F100                 | 16 <sup>th</sup> October 2010   | Cessna 182            | SM/ moorland<br>vegetation monitoring   |

Table 1: Aircraft used for flying during the 2008 – 2011 aerial survey project, and the purpose of each flight.

### 2.6.3 EH digital images standards may change during the project (Risk 7)

This was considered a high risk, which could have a medium impact on the aims and objectives of the project. The countermeasure suggested for this was to apply for a variation for additional funds to buy hardware and software, and to pay for appropriate training in their use.

In 2009, EH introduced new colour management standards during a review of their Digital SLR Guidelines (English Heritage 2007a). The revised guidelines necessitated a requirement from the project for additional equipment and software, including a monitor, colour calibration device and image processing software. A variation request for £1428.68 was made to EH in February 2010, and was accepted by the EH Senior Officer responsible for the project, and by the Historic Environment Enabling Programme.

### 3 Results of 2008 – 2011 aerial reconnaissance

#### 3.1 Overview of results

Although the three summers covered by the project did not yield terribly good conditions for cropmark production, or for flying generally, a number of new sites were recorded. The preceding winters were unusually cold and were followed by dry, sunny springs that led into cloudy, wet summers. This meant that conditions for flying during the winter and early spring were very good due to a number of clear, dry days. However the period during which cropmarks have previously been revealed at their best and most prolific in Cornwall, the months of June and July, were not only poor for cropmark production but there were few opportunities to get airborne at all.

The new sites that were recorded included 48 visible as cropmarks, as well as a group of low earthworks and one structure (Table 2). A breakdown of individual sites is presented in Appendix 2. The number of site types photographed throughout the project is shown in Table 3.

| Period                      | Number of new sites | Site types  | Evidence                          |
|-----------------------------|---------------------|---|-----------------------------------|
| Bronze Age                  | 8                   | Barrow  | Cropmark                          |
| Iron Age/<br>Romano-British | 16                  | Round, field system                                   | Cropmark, soilmark                |
| Uncertain prehistoric       | 6                   | Ring ditch, pit, enclosure                            | Cropmark, soilmark                |
| Medieval/ Post medieval     | 16                  | Field boundary, field system, enclosure, pillow mound | Cropmark, soilmark, low earthwork |
| Modern                      | 1                   | Pillbox   | Structure                         |
| Undated                     | 3                   | Pits, trackway  | Cropmark                          |

Table 2: Number of sites added to the Cornwall and Scilly HER.

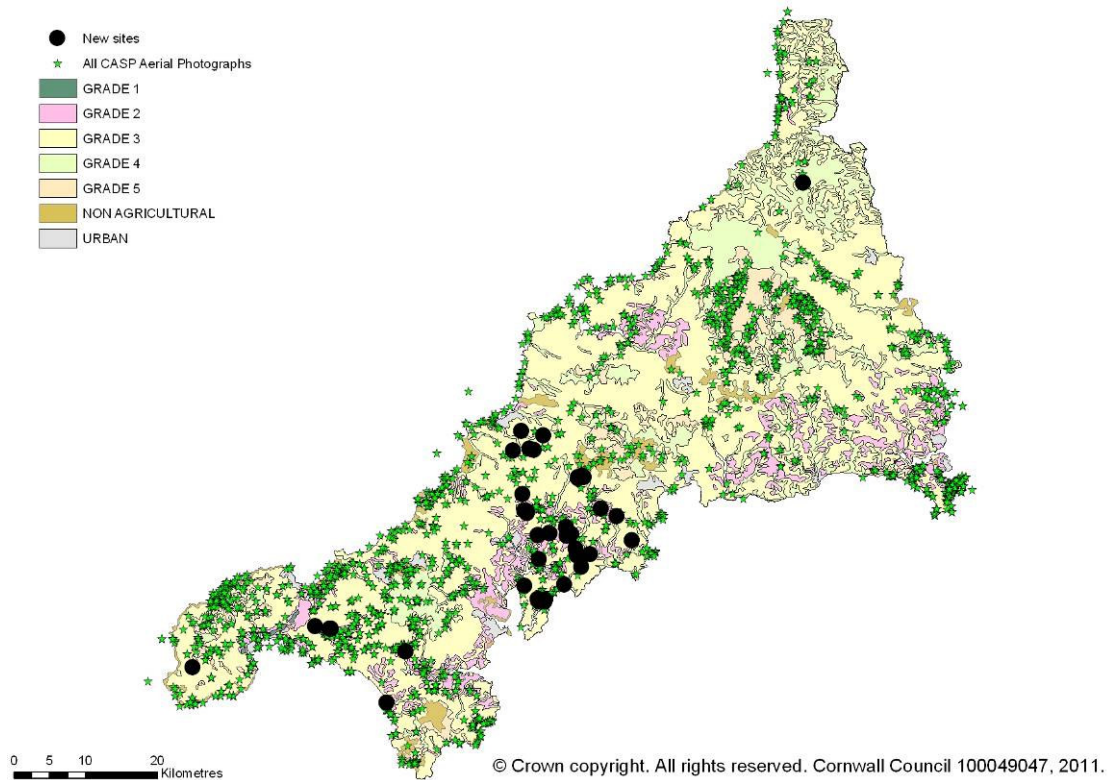
| Evidence             | Number of sites photographed | Number of new photographs |
|----------------------|------------------------------|---------------------------|
| Cropmarks/ soilmarks | 126                          | 502                       |
| SHINE sites          | 22                           | 52                        |
| Scheduled monuments  | 192                          | 638                       |
| Parks and gardens    | 13                           | 122                       |
| Listed buildings     | 40                           | 84                        |
| Conservation areas   | 53                           | 224                       |

Table 3: Range of site types photographed during the project



### 3.1.1 New sites

Of the 17 flights undertaken during the project, seven were flown primarily as cropmark/ soilmark prospecting flights. A further ten flights were carried out to monitor scheduled monuments and to record mine sites, earthworks and historic landscapes.



*Figure 9. Distribution of new sites recorded in the Cornwall HER, overlying areas of Agricultural Land Classification. The cluster of black dots in central Cornwall represents the results of flights F94 and F98. These two flights, from 2009 and 2010, targeted Grade 2 arable land (shaded pink) in the area of the Fal estuary.*

Two cropmark prospecting flights produced particularly good results. These are: flight F94, flown on 7<sup>th</sup> August 2009 between 3pm and 5pm; and flight F98, flown on 22<sup>nd</sup> June 2010, again between 3pm and 5pm. These two flights produced between them 24 new site records. Both were flown over land classified as Grade 2 arable land, which had produced excellent results in other areas of the county (Trevarthen 2008, 11).

Ten new sites were subsequently added to the Selected Heritage Inventory for Natural England (SHINE). This inventory highlights archaeological and historic sites that are undesignated but lie within areas currently in environmental stewardship schemes, or within areas that have been put forward as potential candidates for Entry Level Stewardship (ALGAO 2009). The potential for below ground archaeological remains in these 10 areas had not been flagged up until they were photographed and recorded as part of the CASP flying programme.

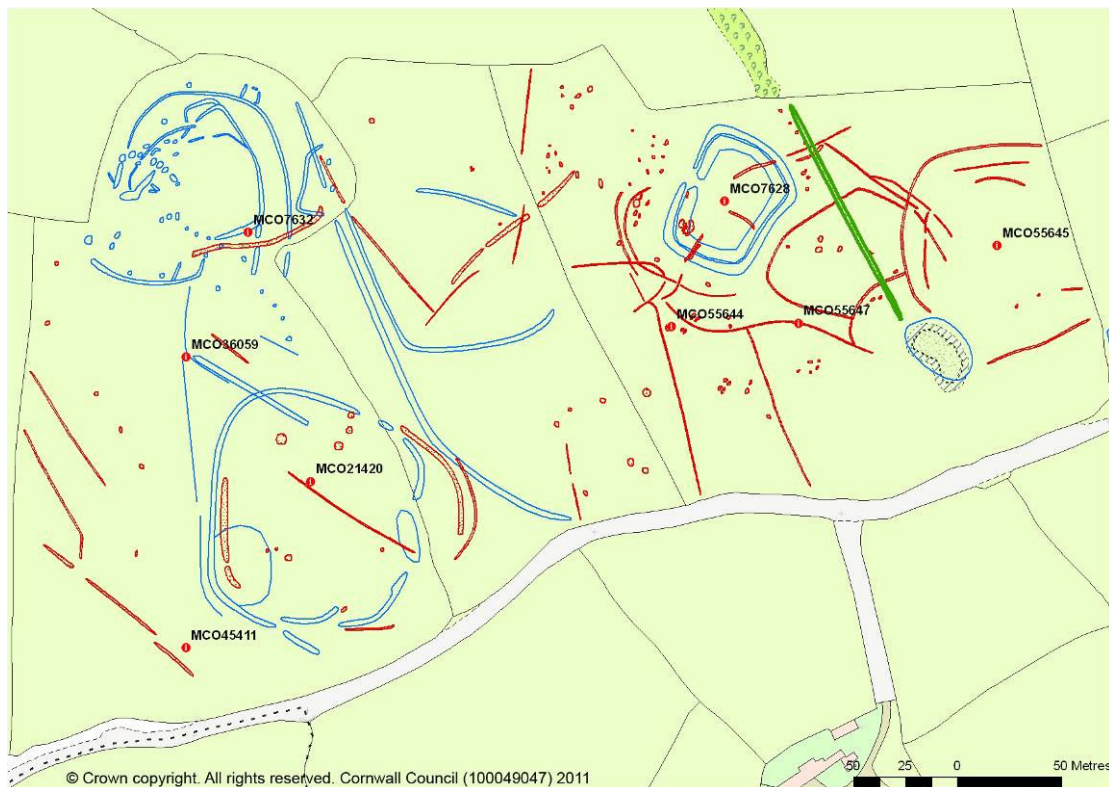
#### 3.1.1.1 Prehistoric sites

A total of 31 prehistoric sites, ranging in date from the Bronze Age through to the Romano-British period, were recorded for the first time during the project. The types of sites included 12 possible Bronze Age round barrows, 15 enclosures likely to be of

Iron Age/ Romano-British date and the remains of two potentially prehistoric field systems.

Eight of these sites were highlighted by the HE Countryside Advice Officer as sites of archaeological importance within current or proposed environmental stewardship schemes, and they were added to the SHINE inventory. The sites included three multivallate enclosures at: Trethewey near Tregony; Cosworth Crossing near Indian Queens; and Bosence, St Hilary, where a large triple-ditched enclosure (Site ID MCO55645) was visible as a cropmark in 2010 on the eastern edge of a complex site that included three known Iron Age/ Romano-British enclosures.

At Bosence, not only does the newly recorded enclosure appear to be a multivallate site but a previously mapped round, Site ID MCO21420, can now be seen to have had at least three outer ditches. A further section of external ditch has been recorded surrounding a known rectilinear enclosure (Site ID MCO7628) that has been dated to the Romano-British period and is considered likely to have ceremonial or religious significance (Rose and Johnson 1983). Further sections of ditch surrounding MCO7628 are likely to be the remains of a field system of possible Iron Age/ Romano-British date (see figure 10; cover illustration).



*Figure 10: Iron Age/ Romano-British settlement at Bosence. The features marked in blue represent existing information produced by the National Mapping Programme. In red are newly recorded features, visible as cropmarks on photographs taken during flight F99, 22<sup>nd</sup> June 2010. A new triple-ditched enclosure, cut by a later spoilheap, is visible at the eastern edge of the site (Site ID MCO55645).*

A group of Bronze Age round barrows at Tresithick (Site IDs MCO55564 to MCO55568) and a rectilinear enclosure at Lower Treave (Site ID MCO54031) were also added to the SHINE inventory. Of the remaining sites recorded as prehistoric, all were listed as probable sites for future inclusion in the inventory. These include a D-shaped enclosure at Trevenen Bal and potential rounds at Nancolleth, Methers Collyn, Treffry, Tolcarne, Truthan and Tresithick.



Figure 11: Triple ditched enclosure at Trethewey near Tregony (Photograph F94-030; Site ID MCO54996)



Figure 12: (Left) multivallate enclosure at Cosworth Crossing, Site ID MCO55290 and (right) double ditched enclosure at Penberthy Cross, Site ID MCO55642

As well as the three multivallate enclosures previously mentioned, a double ditched site at Penberthy Cross was recorded during flight F98, and another at Trendrean during flight F93.

Nine single ditched enclosures interpreted as possible Iron Age/ Romano-British rounds were recorded during flights F93, F94 and F98. These include a site at Tolcarne, in a position overlooking the Fal Estuary (see figures 4, 5). This site is reminiscent of an enclosure at Kemyell, near Lamorna (Site ID MCO8090), discovered in 2005 from aerial photographs. Both comprise a curvilinear single ditch enclosure, on level ground overlooking a natural harbour.

The ongoing discovery of prehistoric enclosures throughout the county highlights the importance of aerial reconnaissance as a tool that will enable further analysis of the shape, size, distribution and location of this site type.

### 3.1.1.2 Medieval and post medieval sites

Fifteen sites were recorded that are considered likely to be medieval or post medieval in date. They include a group of pillow mounds (Site ID MCO54214), three field systems, ten field boundaries and a rectangular ditched enclosure that is likely to be the remains of a field.

The pillow mounds, earthworks built to house rabbits for their fur and meat, are at Creddacott Farm near Week St Mary in North Cornwall. They are visible as a group of ten low earthworks, photographed late in the afternoon during a winter flight, F87, on 31<sup>st</sup> October 2008. The low winter light clearly captures the mounds which have never previously been recorded. The size and shape of the mounds within the group vary from cigar-shaped mounds between 20m and 50m long to almost circular



mounds from 16m to 25m in diameter. The existence of both round and elongated mounds within the same group is not necessarily unusual; there are other known examples throughout the country (Miles 1977), and other potential examples in Cornwall at Davidstow Moor, mapped from aerial photographs, and Bodwen.

There are only 24 known sites of pillow mounds in Cornwall and eight of these are at Godolphin Warren. Of the remainder, the majority are situated in the north of the county with the exception of sites at St Agnes and Carn Brea. The Creddacott Farm pillow mounds lie within the northerly group of sites and will contribute greatly to the understanding of size and distribution of this type of site in Cornwall. Because the features are extant, there is high potential for further investigation. The site has been entered into the SHINE inventory.



Figure 13: Pillow mounds near Creddacott Farm, Week St Mary (Photograph F87-221, Site ID MCO54214).

### 3.1.1.3 Modern and undated sites

Three sites recorded during the project are of uncertain date. These include a trackway and the fragment of a possible ditched enclosure at Higher Pennance Farm (Site ID MCO55572 and Site ID MCO55936 respectively), and a group of pits at Bosence (Site ID MCO55644). One modern site was photographed at Gunwalloe: a Second World War pillbox, not previously recorded (Site ID MCO54032). A pillbox had been described as part of a military installation 60m inland (Site ID MCO49421) but the site of the existing structure was not accurately located, nor was its current condition recorded. The hexagonal Type 26 pillbox is still in excellent condition but its location, on a weathered cliff edge, is precarious.



Figure 14: Gunwalloe, Lizard. In the centre of the image on the cliff edge is a Second World War Type 26 pillbox (Photograph F85-088, Site ID MCO54032).

### 3.1.2 Scheduled monument management and countryside stewardship

A consequence of having fewer opportunities to prospect for cropmark and soilmark sites during the summer months was that more time and a greater proportion of the budget was available to fly in the winter and early spring, when vegetation cover was less pronounced and low, early evening light highlighted many low earthworks.

Two of the principal aims of the project were to 'provide more effective monitoring of the historic environment' and to 'inform the management of scheduled monuments, registered parks and gardens and battlefields'. Both these aims have been met through targeted winter flying. In August 2008 an initial meeting was held to determine winter flying targets. Present were the CASP projects team, the Cornish Mining WHS officer, the HES countryside advice officer and the senior archaeologist responsible for scheduled monument management. A number of targets were agreed, including more coverage of moors and heaths especially where management is changing, for example where more grazing is taking place than in previous years.

A total of six winter flights (between 1<sup>st</sup> October and 31<sup>st</sup> March) were carried out during the project. Of those flights, four were planned specifically to record scheduled monuments, moors, heathland and mining sites. Four further flights were carried out in the spring and summer that included these site types in their itinerary.

Aerial photographs provided by the project are in constant use by the Senior Archaeologist responsible for the Monument Management programme; of the 3,566 aerial photographs taken during the project, over 600 are specifically of scheduled monuments, covering 192 individual sites. They are routinely analysed as part of the monitoring programme and Scheduled Monument site reports are completed using current aerial photography. The examination of aerial photographs acts as an assessment in the same way that a site visit would. Flights 85, 89, 96, 97 and 100, as well as flight 92 to the Isles of Scilly, were targeted either fully or in part towards recording monuments at risk.



The SHINE inventory has previously been discussed with relation to new records. The current condition of a further 12 sites, already highlighted during the environmental stewardship application process, was recorded during the project. Flight 100 was targeted primarily towards recording the condition of archaeological sites on Bodmin Moor that are in Entry and Higher Level countryside stewardship.



*Figure 15. Post medieval settlement and nineteenth century deer park on the island of Samson, Isles of Scilly (F92-059). Photography from flight 92 highlighted the extent to which gorse and bracken have engulfed scheduled sites such as this. Management work has since been carried out across the islands, and a second flight is recommended by the Council of the Isles of Scilly Historic Environment Field Advisor to provide evidence of the resulting improvements and to identify wider landscape features (E. Breen pers. comm.)*

### **3.1.3 Other projects and illustrative work**

Projects carried out by the HE regularly use aerial photographs to illustrate current work in reports and presentations. Recent aerial photography is often preferred, not only because it presents the most up to date record available but because it can often be compared with the condition of the site in previous years from older photography. Since 2008, two large scale projects in particular have made use of aerial photography from the 2008 – 2011 flying: the Cornish Mining World Heritage Site, and the HEATH project.

#### **3.1.3.1 Cornish Mining World Heritage Site work**

A previous aerial survey project was designed to create a photographic record of urban and industrial settlements in Cornwall, in order to complement three CAU projects: the Cornwall and Scilly Urban Survey (CSUS), Cornwall Industrial Settlements Initiative (CISI) and the Cornish Mining World Heritage Site Bid (WHS) (Hartgroves 2001). The CSUS and CISI projects are now complete, and WHS status was inscribed in 2006. The need for photographic records of urban and industrial sites continues however, and the WHS team in particular require aerial photographs

of mining sites within the designated WHS areas. These are used for monitoring purposes and for outreach activities such as power point presentations, booklets and leaflets and on the WHS website. In March 2009 a flight was undertaken with the primary aim of capturing images of industrial sites that had not previously been photographed, or where work had recently been undertaken. These sites included: Trewavas Mine, situated on the cliff top at Rinsey Head, which was undergoing restoration work; Wheal Metal engine house at Sithney, one of a number of engine houses not previously photographed; Tregurtha Downs grade II listed engine house and stack, recently restored and not previously photographed; shafts made safe along the Redruth and Chacewater railway, now part of the Mineral Tramways trail. Images from this flight in particular have been used to illustrate reports and web pages (e.g. Sharpe 2009).



*Figure 16. Works at West's Shaft, Wheal Fortune on the Mineral Tramways trail, showing coned shafts enclosed by a hedge and fence, and West's Adit portal, bottom centre. (F90-228)*





Figure 17. Aerial photograph of Medlyn Moor engine house near Wendron, on the front page of the WHS website (F90-202)

### 3.1.3.2 Managing Cornwall's Rough Ground: the HEATH project

The HEATH project in Cornwall ran from 2004 to 2008 with the aim of restoring heathlands by reintroducing traditional farming practices. The HE team at Cornwall Council provided detailed archaeological information and advice on future management of heathland landscapes, through a programme of field surveys and desk based research. The work culminated in two publications: 'Managing the historic environment on West Cornwall's rough ground' (Kirkham 2011) and 'Goon, hal, cliff and croft: the archaeology of west Cornwall's rough ground' (Dudley 2011). Both of these, as outlined in the original project design (Dudley and Herring 2005), made extensive use of aerial photography including 23 images from the 2008 – 2011 aerial survey project. Flight 100, flown on the 16<sup>th</sup> October 2010, was targeted in part towards photographing sites discussed in the two publications. The range of photographs available to the HEATH project allowed the team not only to illustrate the range of sites discussed in the texts and present them in the context of the wider Cornish landscape, but also to contrast the condition and management of heath in Cornwall over a period of almost 20 years.





*Figure 18. Smallholdings of eighteenth and nineteenth century date on former rough ground, at Skinner's Bottom, St Agnes. (F100-201).*



*Figure 19. The Carnmenellis upland, Wendron. A Bronze Age cairn lies immediately in front of a modern communications tower. To the right is a modern reservoir and in the background are eighteenth and nineteenth century fields and crofts (F90-037)*

## 4 Conclusions

The project fulfilled its aim of improving knowledge of the archaeological resource, by providing a fuller awareness of the range and extent of archaeological remains within the project area.

The enhanced awareness of the archaeological resource will facilitate management of the area's historic environment on a site specific as well as a strategic level.

The main outcomes of the CASP 2008 – 2011 project and recommendations for further survey and research are set out below.

### 4.1 Outcomes

- **HER enhancement:** 50 new sites were recorded as a result of targeted flying.
- **Monuments at risk monitoring:** More than 600 images of 192 scheduled monuments were created and use of these photographs to monitor sites is ongoing.
- **Countryside advice enhancement:** 10 sites were entered into the SHINE inventory as a direct result of the CASP project. The current condition of a further 12, already captured in the inventory, was recorded. Inclusion in the SHINE inventory contributes to the protection of 'at risk' features.
- **Outreach/ publication:** use of aerial photographs from the project is ongoing, and to date includes images on the Cornish Mining World Heritage Site and Cornwall Council websites; two popular publications published by Historic Environment Cornwall Council; numerous unpublished reports and presentations.
- **Successful risk management:** countermeasures outlined in the project design risk log proved invaluable in guiding the direction of the project when problems occurred.
- **Successful use of new technology** for photographing, recording and disseminating information.

### 4.2 Recommendations

- **Continue targeted cropmark prospecting.** Flights to prospect for cropmarks were particularly successful in the area to the east of the Fal estuary, an area of Grade 2 arable land similar to that in the Camel estuary. Reconnaissance targeted to this area over two summer seasons produced promising results, and further flying in areas of the county classified as Grade 2 land are expected to yield further new sites. In particular, the south-east of the county around St Germans would benefit from future cropmark prospection flights.
- **Continue to monitor the condition of scheduled monuments via aerial photographs.** Monitoring of the condition of archaeological sites is a continuous process and ongoing aerial reconnaissance should be considered a standard component of this work. Of particular note is the need to record evidence of gorse and bracken management on the Isles of Scilly.
- **Further reconnaissance projects.** Not only were a significant number of important new sites recorded during the project, but a large number of images were used to investigate and monitor the condition of known archaeological sites. This demonstrates the effectiveness of continuing aerial reconnaissance. Further projects that target specific site types should be determined by current project works.

- **Further investigation of sites recorded from aerial photographs.** Although almost 50 new sites have been recorded from aerial photographs, without field work and excavation it is difficult to give any more than the broadest of analyses of those sites. For example, the date and function of many features and their relationships at complex sites such as Bosence, is unclear, as is the context of the pillow mounds at Creddacott Farm. A programme of ground based investigation of a sample of the sites recorded through aerial reconnaissance, involving field walking, geophysical survey and excavation, would significantly enhance current knowledge of prehistoric and medieval settlement.



## 5 References

- Association of Local Government Archaeological Officers, 2009. *SHINE brief introduction* [Online] Available at: [http://www.algao.org.uk/Cttees/Countryside/Agri-envEng/SHINE\\_Introduction.pdf](http://www.algao.org.uk/Cttees/Countryside/Agri-envEng/SHINE_Introduction.pdf) [Accessed 11 August 2011]
- Baker, D, 1999. *An Assessment of English Sites and Monuments Records for the Association of Local Government Archaeological Officers. Historic Environment Conservation Report 97/20*. N.p.p.: ALGAO
- Dudley, P and Herring, PC, 2005. *HEATH, West Cornwall. Project Design for integration of historic environment involvement*, Truro (Historic Environment Service, Cornwall County Council)
- Dudley, P, 2011. *Goon, hal, cliff and croft: the archaeology and landscape history of west Cornwall's rough ground*, Truro (Historic Environment Cornwall Council)
- English Heritage, 2005. *Good Practice for taking aerial photographs*
- English Heritage, 2007a. *Digital SLR Camera Guidelines for Aerial and Archival Standards for the NMR, v1.4*
- English Heritage, 2007b. *MIDAS Heritage: The UK Historic Environment Data Standard*. [Online] Available at: <http://www.english-heritage.org.uk/publications/midas-heritage/> [Accessed 2 August 2011]
- English Heritage, 2010. *NMP Manual, Appendices 6-8*, English Heritage internal document
- Herring, P C, 1998. *Cornwall's Historic Landscape: presenting a method of historic landscape character assessment*. Truro (Cornwall County Council and English Heritage)
- Kirkham, G, 2011. *Managing the historic environment on west Cornwall's rough ground*, Truro (Historic Environment Cornwall Council)
- Hartgroves, S, 2001. *Cornwall and Scilly Aerial Survey project. Project Design 2001 – 2004: Urban and Industrial Cornwall*, Truro (Cornwall Archaeological Unit)
- Miles, H, 1977. Bodwen, Lanlivery, Part 6: The Pillow Mounds in Harris, D, 1977. Bodwen, Lanlivery: A Multi-period Occupation, *Cornish Archaeology* **16**, 57-59
- Rose, P and Johnson, N, 1983. Some Cropmark Enclosures in Cornwall, *Cornish Archaeology* **22**, 99-106
- Sharpe, A, 2009. *The Mineral Tramways Project, Cornwall: archaeological consultancy and watching briefs during shaft treatment works*, Truro (Historic Environment Cornwall Council)
- Tapper, B, 2011. *Cornwall and Scilly Historic Environment Record Audit: A Report to English Heritage*, Truro (Historic Environment Cornwall Council)
- Trevarthen, E, 2008. *Project Design for Aerial Reconnaissance of Archaeological and Historical Sites in Cornwall and the Isles of Scilly*, EH Internal Report
- Young, A, forthcoming. Prehistoric and Romano-British enclosures around the Camel Estuary, Cornwall, *Cornish Archaeology*.

## **Project Archive**

The HES project number is **2011R100**

The project's documentary and drawn archive is housed at the offices of Historic Environment, Cornwall Council, Kennal Building, Old County Hall, Station Road, Truro, TR1 3AY. The contents of this archive are as listed below:

1. A project file containing the project design, project correspondence and administration.
2. This report held in digital form at: G:\Historic Environment (Documents)\HE Projects\Aerial Survey\5574\_CASP 2008-11\Final report
3. The photographs held in digital form at: R:\Historic Environment (Images)\Aerial Survey

All data supplied to English Heritage, the NMR and Cornwall Council was to English Heritage digital photography standards and in line with English Heritage minimum standards for monument recording (English Heritage 2007a, English Heritage 2007b).

Copies of the Project Design, Final Report and all other relevant project documentation will be deposited with Cornwall Council and English Heritage. The PDF version of the report will be deposited with Archaeology Data Service (ADS).

## Appendix 1 Post-reconnaissance workflow

### Transfer images to PC

The camera will be set to record RAW images in the Nikon Electronic Format (.NEF)  
NEF images are around 27mbs in size, TIFs are 72 mbs and JPGs are around 7mbs  
The recommended way to transfer images from the camera to the PC is via the card reader. Apparently this conserves the charge in the camera battery.

Use Windows Explorer to locate and transfer images.

A copy of all images is stored on a portable USB drive which is kept off-site as an additional level of security

Make a new set of folders for each flight:

On the remote disk the format will be:

```
Aerial surveys
  F90-19-03-09
    F90 NEF
    F90 TIF
    F90 JPG
```

On the network the file structure for the NEFs and TIFs will be:

```
R:\Historic Environment (Images)
  Aerial Surveys
    NEF Archive
      F90-19-03-09
        F90 NEF
        F90 TIF
```

For the JPGs it will be:

```
R:\Historic Environment (Images)
  Aerial Surveys
    F90-19-03-09
      F90 JPG
```

The intention behind this is that network users will find the JPGs straight away, and will not be tempted to use the NEF or TIF files - which are the project archive and not for general circulation.

Individual images in all these directories will be identified as:

F90-001.NEF, TIF or JPG

### Select and edit images

Having copied the raw images from the camera card into the NEF Archive on the 'R' drive, open them using BibblePro or Adobe Bridge to review the results. Ensure that the monitor colours have been calibrated to the standards set out by EH (English Heritage 2007a).

Delete all 'bad' images and then adjust the exposure, vibrance, saturation and contrast of the remaining ones as necessary. Rotate and crop if necessary. Keep these initial modifications to a minimum.

Review results and select images to be retained – delete the rest. Aim for a minimum of three shots of a typical small site – one wide angle location or context shot, one as vertical as possible and one oblique. Retain images which record field boundaries and junctions as these will be useful when images are rectified. Keep **more** images of the less distinct sites, rather than fewer. Try to get at least one 'aesthetic' image of each site.

### **Renumber images, add IPTC data, convert to TIF and JPG**

BreezeBrowser Pro has a better interface than Bibble for these tasks, and handles the IPTC data in the way required by English Heritage.

In Breeze, renumber the selected images consecutively (in the format: F90-001.NEF) and then add the IPTC data: 'Edit - Select All' and 'Edit IPTC Data'. Load the IPTC data saved from the previous flight, edit the date and photographer fields, and save it in the same folder as the new NEFs. Then select 'Apply to selected'.

Back in Bibble, 'Batch Convert' the images to 8-bit TIFs and 8-bit JPGs and place them in the appropriate folders.

Delete the NEF images on the portable drive and copy the selected NEFs, TIFs and JPGs from the network. Take the portable drive off-site

### **GPS Flight Track**

To retrieve the flight track from the GPS, input it to the GIS and convert it to a continuous line:

Connect the GPS to your PC's COMs port (usually on the back or side).

Switch on the GPS and go to the Main Menu page; scroll down to the Setup Menu, select 'Interface' and set this GRMN/GRMN.

Open G7toWin, go to Tracks and select 'Download tracks from GPS' – a counter indicates the progress. Select 'File', 'Save As' and output file in CSV format to the 'L' drive:

```
L:\Historic Environment (Data)
  HE Information
    Aerial_Survey_Flight_Log
      F94
        F94 track.csv
```

When you are sure you have successfully downloaded the track data reset the GPS

Main Menu > Setup Menu>Interface> NMEA/NMEA, 4800 baud

Open file in Excel, remove the spurious Å character with the Edit/Replace option (if it is there), delete all extraneous columns, and save as F94 Track.TXT file in the same directory. This is just the result of a glitch in the export routine.

Start Grid Inquest, open the TXT file and convert the Lat Long and Alt fields to coordinates and add them to the same table (see appendix 1 for detailed procedure). The GPS records values as Degrees and Decimal Minutes (DDM). Save as F94 Track.TXT file

In Excel, open table, delete all spurious columns, format Lat/Long and Alt fields as Numeric, with 2 decimal places; rename the new columns as X-Coords, Y-Coords and Alt, and save result as F94 Track.DBF file.

Open ArcView9, go to Tools, select Add X/Y data, navigate to the 'track dbf' file, check X and Y coordinates are present, insert the British National Grid into the coordinate system window, and type OK – the data should appear in the themes bar to the left of the screen (see appendix 2 for detailed procedure)

Convert the data to a shapefile and save in the track directory: Right Click on layer, Data, Export Data, save as shapefile and add to view.

### **Photo Locations to GIS points**

To extract photo locations from the camera's EXIF data and display them as points strung along the flight track:

Start EXIF PRO and navigate to the images in the JPG directory (*It is preferable to use the JPGs as the path can serve as a hotlink to the image from the GIS point*)

The fields to be exported are already set in the software – they are Filename, Date+Time, Path to image, GPS Lat, GPS Long, GPS Alt, Time.

Select 'Tools', 'Export EXIF', select 'comma' as the separator, and identify folder for output:

```
L:\Historic Environment (Data)
    HE_Information
        Aerial_Survey_Flight_Log
            F94
                F94 photo.txt
```

The next stages are the same as those for the Flight track:

In Excel, remove spurious Â character and unwanted fields, and save as TXT.

In Grid Inquest, convert Lat Long and Alt to Coordinates, add to table and save as TXT

In Excel clean table, reformat and rename fields and save as DBF

In Arcview, Tools, Add X/Y Data, add to view and convert to shapefile

### **GPS WayPoints to GIS Lines**

To convert the GIS track shapefile from points to lines,

- In ArcView, go to 'Tools' on the menu bar.
- Choose 'Customize' on the drop-down list
- Choose the 'Commands' tab
- Click the 'Add from file' button
- Browse to:

```
L:\Historic Environment (Data)\ArcView\ArcView_8.x\Extensions\ShapefileConvert
```

- Choose the only available file (ShapeConvert.dll); double-click or 'Open'
- This tool will now appear in the 'Commands' tab. Highlight the icon in the right-hand window and drag it onto the menu bar.

## Transcription

The results of the mapping were produced entirely in digital format using AutoCAD.

1. .TIF format digital photographs were used to produce rectified images.
2. Digital transformations of the archaeological features visible on the photographs were produced using AERIAL (Version 5.29). Digital copies of current OS 1:2500 MasterMap were used for control information and as a base for mapping in AutoCAD (Version Map3D 2010). All digital transformations will therefore be within a level of accuracy within 5m to true ground position, but typically less than 2.5m to the base map. Where necessary digital terrain models (DTM) were used to aid more accurate rectification of the photographs.
3. The rectified images were imported into an AutoCAD drawing.
4. Archaeological features were digitally transcribed in AutoCAD according to a nationally agreed layer structure and using agreed line and colour conventions as specified by Aerial Survey and Investigation (EH 2010).
5. Each AutoCAD drawing was exported as an ArcGIS shapefile to Cornwall's HBSMR GIS. Each mapped site could then be linked to the project database through the MapLink tool in the HBSMR number.

## Project database

During the project, the project team had access to the Cornwall HBSMR and therefore project recording was undertaken directly. The database automatically generated unique Project UID numbers and contained fields enabling monument indexing to be carried out to NMR and ALGAO standards (English Heritage 2007). Appropriate data was entered into this database for each archaeological feature mapped.

## Data dissemination

The flight director/ navigator used the current list of targets, derived from the seasonal reviews, to guide the photographer and pilot. A written record of sites photographed and ground conditions was created by the flight director, and these records formed the basis of a short flight report and a crop condition bulletin. These were completed immediately after each flight. Crop condition bulletins are disseminated to all regional flyers via the English Heritage Senior Investigator responsible for aerial reconnaissance.

Example of crop condition bulletin:

### 06 May 2008 Cornwall

Prospecting for early cropmarks in the Roseland and south-east Cornwall. We did see and record a small number of green-on-green cropmarks, pretty faint, and some geology, but not a great haul for a long flight (2 ½ hrs). Whilst airborne we also recorded some church sites, houses, parks and gardens, extant prehistoric enclosures, settlements, field systems and coastal features – and the site of the newly discovered Roman Fort at Calstock – you can see the back-filled excavation trench but no trace of the ramparts etc.

Steve Hartgroves  
Cornwall Historic Environment Service

## Appendix 2 List of new sites recorded during the project

| Name                 | PRN      | Site Type                | Period                   | Flight/Photo number | SHINE entry? |
|----------------------|----------|--------------------------|--------------------------|---------------------|--------------|
| Trencreek            | MCO55265 | Barrow                   | Bronze Age               | F94/018-023         | NO           |
| Higher Pennance Farm | MCO55937 | Barrow                   | Bronze Age               | F98/085-086         | NO           |
| Trethem Mill         | MCO55633 | Barrow                   | Bronze Age               | F98/146             | NO           |
| Tresithick           | MCO55565 | Barrow                   | Bronze Age               | F98/177             | NO           |
| Tresithick           | MCO55566 | Barrow                   | Bronze Age               | F98/177             | NO           |
| Tresithick           | MCO55567 | Barrow                   | Bronze Age               | F98/177             | NO           |
| Tresithick           | MCO55568 | Barrow                   | Bronze Age               | F98/177             | NO           |
| Tresithick           | MCO55564 | Barrow                   | Bronze Age               | F98/177             | NO           |
| Cregoe               | MCO55261 | Ring ditch/ barrow       | Bronze Age/ Iron Age     | F94/038-041         | <b>YES</b>   |
| Cregoe               | MCO55947 | Ring ditch/ barrow       | Bronze Age/ Iron Age     | F94/038-041         | <b>YES</b>   |
| Freewater            | MCO55635 | Ring ditch/ barrow       | Bronze Age/ Iron Age     | F98/025-029         | <b>YES</b>   |
| Polhendra            | MCO55573 | Ring ditch/ barrow       | Bronze Age/ Iron Age     | F98/148             | NO           |
| Lower Treave         | MCO54031 | Enclosure                | Iron Age/ Romano-British | F84/191-193         | <b>YES</b>   |
| Nancolleth           | MCO55284 | Round                    | Iron Age/ Romano-British | F93/022-023         | NO           |
| Cosworth Crossing    | MCO55290 | Multi-ditched enclosure  | Iron Age/ Romano-British | F93/026-028         | <b>YES</b>   |
| Trendrean            | MCO55256 | Enclosure                | Iron Age/ Romano-British | F93/009-010         | NO           |
| Trethewey            | MCO54996 | Round                    | Iron Age/ Romano-British | F94/024-032         | <b>YES</b>   |
| Methers Collyn       | MCO55254 | Round                    | Iron Age/ Romano-British | F94/071,075,078     | NO           |
| Methers Collyn       | MCO54999 | Round                    | Iron Age/ Romano-British | F94/071-073         | NO           |
| Tolcarne             | MCO54985 | Round                    | Iron Age/ Romano-British | F94/080-084         | NO           |
| Trestrayle           | MCO44992 | Round                    | Iron Age/ Romano-British | F94/137-140         | NO           |
| Treffry              | MCO55258 | Round                    | Iron Age/ Romano-British | F94/149-150         | NO           |
| Treffry              | MCO55940 | Round                    | Iron Age/ Romano-British | F94/149-150         | NO           |
| Truthan              | MCO55636 | Round                    | Iron Age/ Romano-British | F98/004-005         | NO           |
| Tresithick           | MCO55569 | Round                    | Iron Age/ Romano-British | F98/174-176         | NO           |
| Penberthy Cross      | MCO55642 | Double-ditched enclosure | Iron Age/ Romano-British | F99/038-041         | NO           |
| Bosence              | MCO55645 | Ditched enclosure        | Iron Age/ Romano-British | F99/056-038         | <b>YES</b>   |

|                      |          |                    |                          |              |            |
|----------------------|----------|--------------------|--------------------------|--------------|------------|
| Bosence              | MCO55647 | Field system       | Iron Age/ Romano-British | F99/056-058  | <b>YES</b> |
| Penberlan Farm       | MCO55563 | Field system       | Prehistoric              | F98/106-109  | NO         |
| Trevenen Bal         | MCO54033 | D-shaped enclosure | Prehistoric              | F85-081-086  | NO         |
| Pennance             | MCO55570 | Enclosure          | Prehistoric/ medieval    | F98/089-093  | NO         |
| Bosence              | MCO55643 | Field boundary     | Medieval                 | F99/047-048  | <b>YES</b> |
| Freewater            | MCO55641 | Field boundary     | Medieval                 | F98/025-029  | NO         |
| Manuels              | MCO55291 | Field boundary     | Medieval                 | F93/032-035  | NO         |
| Pennance             | MCO55571 | Field boundary     | Medieval                 | F98/091      | NO         |
| Trerice Manor Farm   | MCO55287 | Field system       | Medieval                 | F93/024-025  | NO         |
| Creddacott Farm      | MCO54214 | Pillow mounds      | Medieval                 | F87/221-225  | <b>YES</b> |
| Trennow Vean         | MCO55267 | Field boundary     | Medieval                 | F94/129-130  | NO         |
| Calendra             | MCO55264 | Field system       | Medieval/ post medieval  | F94/045      | NO         |
| Freewater            | MCO55640 | Field boundaries   | Medieval/ post medieval  | F98/025-029  | NO         |
| Freewater            | MCO55639 | Field boundaries   | Medieval/ post medieval  | F98/025-029  | NO         |
| Halvose              | MCO55637 | Field system       | Medieval/ post medieval  | F98/164-1655 | NO         |
| Higher Pennance Farm | MCO55935 | Field boundary     | Medieval/ post medieval  | F98/085-086  | NO         |
| Methrose Farm        | MCO55252 | Field boundaries   | Medieval/ post medieval  | F94/113-116  | NO         |
| St Michael Penkivel  | MCO55638 | Field boundaries   | Medieval/ Post medieval  | F98-050-056  | NO         |
| Gwendra              | MCO55266 | Field system       | Post medieval            | F94/051-058  | NO         |
| Gunwalloe            | MCO54032 | Pillbox            | Modern                   | F85/088      | NO         |
| Higher Pennance Farm | MCO55572 | Trackway           | Uncertain date           | F98/085-086  | NO         |
| Higher Pennance Farm | MCO55936 | Enclosure          | Uncertain date           | F98/085-086  | NO         |
| Bosence              | MCO55644 | Pits               | Uncertain date           | F99/056-058  | <b>YES</b> |



## **Project outcome**

A series of folders was produced containing all digital images created during the project, as raw images (.NEF), JPGs and TIFFs.

The Cornwall HER held by Cornwall Council in Truro was updated with information and descriptions of all archaeological sites mapped during the project.

The AutoCAD drawings with Access data attached were exported as ArcGIS shapefiles.