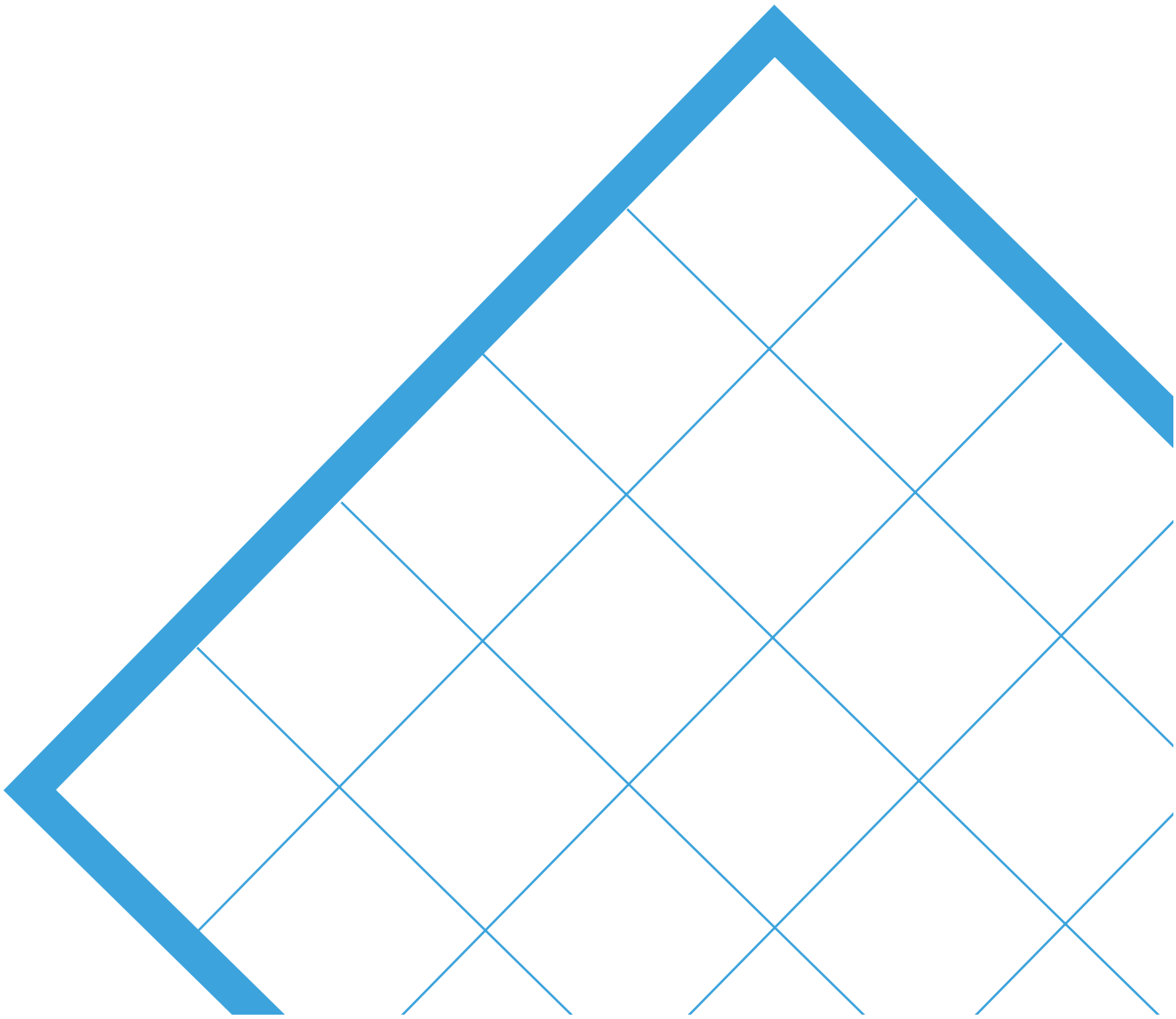
Historic England

Aerial Reconnaissance

Management of Research Projects
in the Historic Environment: PPN 5



Preface

MoRPHE Project Planning Notes (PPNs) form an integral part of the Management of Research in the Historic Environment (MoRPHE) Project Management Methodology.

They are intended to be presented together with, and read in conjunction with, the 'MoRPHE Project Managers Guide' which gives generic guidance on project management. The Project Managers Guide can be downloaded from the Historic England website: HistoricEngland.org.uk/projectmanagement

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Comments to assist future versions are welcome, and should be sent to:
guidance@HistoricEngland.org.uk.

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1 Introduction

1.1 This Project Planning Note is intended to cover the taking of oblique aerial photographs of the historic environment. It is intended to be used in conjunction with the guidelines listed in Section 4.1.

1.2 This PPN assumes that projects will cover a one year flying and reconnaissance cycle. Shorter projects may make use of this PPN, replacing the seasonal Execution Stages with a single Flying Stage

1.3 Projects involving the interpretation and mapping of aerial photographs are covered by *MoRPHE Project Planning Note 7: Interpretation and mapping from aerial photographs and other aerial remote sensed data* (July 2012) by H Winton, Y Boutwood and P Horne.

1.4 This PPN does not cover the commissioning of vertical photography or Small Unmanned Aircraft (SUAs) commonly referred to as drones. Advice on vertical photography, is best covered by the Royal Institute for Chartered Surveyors Vertical Aerial Photography and Digital Imagery, RICS Practice Standards UK (RICS 2010). Historic England is in the process of writing guidance on the use of SUAs, but in the meantime advice can be sought from paul.bryan@HistoricEngland.org.uk

1.5 This PPN has been based on the experience of advising on the development of standards and guidelines over the last two years. It will be updated to reflect further experience and comment from readers.

2 Planning

2.1 Setting objectives

2.1.1 Although a large degree of flexibility should be built in to a reconnaissance project all the objectives are expected to contribute to the understanding and management of the historic environment. Particular emphasis should be given to describing the potential for integrating the results of the reconnaissance project with existing archaeological research and the possibilities for future research that may emerge from the project.

2.1.2 Projects commissioned by Historic England should cross-reference their aims and objectives to our Corporate Action Plan and research priorities (www.HistoricEngland.org.uk/research/approaches/research-principles/).

2.1.3 All projects should make reference to Regional and Thematic Research Frameworks where these are available (www.HistoricEngland.org.uk/research/support-and-collaboration/research-resources/) and where necessary specialist and World Heritage Site research agendas.

2.2 Useful techniques for estimating time and budget

2.2.1 At an early stage it will be necessary to identify a suitable aircraft with an Air Operators Certificate (AOC) or by a company that meets the entire legal requirement for operating aircraft. Also discuss with the operator where and when you wish to undertake survey flights as they can advise on the local flying restrictions and the duration of flights. Given the sparse distribution of AOC aircraft it is important to estimate how long it will take to travel to the airfield and how much flying time is required to transit to your survey area. Before entering in to an agreement with an aircraft operator check that the aircraft is suitable for aerial photography ie high wing and an opening window.

2.2.2 The staff responsible for flight planning must become familiar with the geology and land use of the survey area so flights can coincide with optimum conditions. This is particularly important when attempting to discover cropmarks and soilmarks. For example chalk is good for soilmarks, gravel is not; some clay soils can reveal cropmarks slightly later than gravel and chalk; and cropmarks in wheat appear before marks in sugar beet.

2.2.3 Attempting to time flights with the optimum conditions for cropmarks is not an exact science, but Soil Moisture Deficit (SMD) figures from the Met Office can be helpful in helping to assess the dryness of the soil across the country. There are cheaper alternatives to SMD data such as the Vegetation Health Index available at www.orbit.nesdis.noaa.gov/smcd/emb/vci/VH/vh_browseByCountry.php although not as detailed as the Met Office information.

2.2.4 An alternative to finding out how cropmarks are developing is to stay in touch with other aerial archaeologists. From April to September Historic England co-ordinates reports from archaeologists flying in England, Scotland and Wales and sends out regular crop condition observations via e-mail.

2.2.5 Constantly monitor weather forecasts for suitable opportunities to fly and stay in touch with the aircraft operator to check the availability of aircraft.

2.2.6 For staff new to flying in a light aircraft ask the pilot to familiarise them with aircraft procedures (booking out with air traffic, pilot checks, taxiing, take-off and landing, looking out for other aircraft), aircraft instruments (air speed indicator, altimeter, compass, fuel gauges), aircraft maintenance schedule and radio protocol. An understanding of the general aviation industry operates will assist in the efficient planning and execution of a survey flight.

2.2.8 Make sure that sufficient resources are set aside for suitable IT equipment to download and process large amounts of digital images quickly. It is easy to underestimate how much time is spent manipulating digital photography. Historic England reconnaissance teams can provide advice on suitable hardware and software.

2.2.9 Allow time for preparing images to agreed standards and for deposition with the Historic England Archive and/or local photographic library (see Section 4.1).

2.3 Risks and their management

2.3.1 Aerial reconnaissance can be affected by many factors outside the control of the project team such as aircraft availability and weather conditions. Therefore it is anticipated that any reconnaissance project will be designed to be as flexible as possible to take advantage of changing circumstances

2.3.2 Project managers should ensure that key members of the project team have the flexibility to fly at short notice, especially during the cropmark season (beginning of June to the end of September), to take advantage of the weather conditions and aircraft availability.

2.3.3 At times unseasonable weather conditions may hamper progress. Conversely extremely good weather conditions, in the cropmark season for instance, could result in a large amount of new discoveries. An aerial reconnaissance project design should have a number of prioritised objectives including discovery of cropmarks; monitoring of scheduled monuments, parks and gardens and battlefields; recording of earthworks and landscape character; and illustrations for popular publications and websites. A large number of objectives give the flight director the flexibility to alter course during a flight or from one season to the next to take advantage of conditions suitable for each objective. This minimises the risk of adverse weather conditions badly affecting the overall project.

2.3.4 Another important risk factor is aircraft availability. AOC aircraft are often in high demand for pleasure flights, pilot training and require regular maintenance checks. This often coincides with optimum flying conditions! A good project design will anticipate this as a Risk so this might be an opportune time to bring forward tasks normally left to later in the project such as cataloguing and archiving of photographs from earlier flights.

2.4 Likely list of products or outcomes

2.4.1 The initial outcome will be aerial photographs in digital form to current archive standards. The photographs should be accompanied by a basic catalogue that identifies the location of each photograph along with Metadata (date of photography, photographer, etc) and preferably stored on a GIS with a view to making the catalogue and, if practical, the images available on-line. The photographs should then be interpreted and new information incorporated in to the Historic England Archive and local Historic Environment Record (HER) either as a basic monument record or mapped as part of the National Mapping Programme. The interpretation and mapping of the photographs may require a separate project. For photographs taken for monitoring purposes, assessments will have to be made about the condition of the site and whether further intervention is required.

2.4.2 Depending on the size and length of the project a report may be necessary. This should highlight new discoveries, demonstrate how

Stage	Research Products	Archive products	Dissemination products
Start up	Objectives for flights documented in Project Proposal		
Review Point R1	Is the budget secured for the proposed years flying?		
Initiation	Assessment / evaluation of likely targets List of summer targets and flight maps marked up	Project Archive file created	Communication with potential stakeholders.
Review Point R2	Do the proposed targets support current local and national research agendas? Is the plan for the flight time realistic? Are all appropriate stakeholders aware of the proposed target list?		
Summer reconnaissance	Summer reconnaissance flights completed Summer flight reports completed Processing/printing of photographs completed Photographs prepared for archiving, cataloguing. Basic catalogue to identify location of photographs Interpretation of photographs completed List of winter targets and flight maps marked up	Target list added to project archive file. Summer flight reports added to project archive Negatives and/or RAW digital images. Prepared for archive Numbered prints and archive ready digital images prepared. Monument records/ mapping in GIS	Reports on crop conditions to other flyers. Major discoveries publicised.
Review point R3.1	Have objectives for summer flying been met? OK to proceed with winter reconnaissance? Are stakeholders aware of the proposed target list?		
Winter reconnaissance	Flight reports Basic catalogue to identify location of photographs Project Report	Draft target list added to project archive file. Negatives and/or RAW digital images. Numbered prints and archive ready digital images. Monument records/ mapping in GIS	Reports on ground conditions to other flyers. Major discoveries publicised
Review point R3.2	Have objectives for winter flying been met? Is the Project Report appropriate? Are archive arrangements for photographic material in place? Have NRHE and HER records been updated?		
Closure	Update research agendas for subsequent flying years Update guidelines to reflect new techniques		

the project has answered specific research questions and suggest opportunities for further reconnaissance, fieldwork and research.

2.5 Likely project stages

2.5.1 As a minimum, the following project execution stages are recommended. This covers a one-year flying programme. Shorter programmes would require substitution of a single Flying stage to replace the Summer and Winter reconnaissance stages. Projects spanning more than one flying year will defer the Closure stage until the planned end of the project.

- Start-up - This includes the project proposal and/or project design stages, and confirmation of the budget
- Initiation - this includes Assessment/ Evaluation of targets for summer reconnaissance. This should include drawing up target maps and assessing weather and crop conditions
- Summer reconnaissance – flights to reconnoitre the selected targets, or substitutes if these are not available, and targets of opportunity. Includes work on the preparation of the archive e.g. downloading, processing/printing, cataloguing, archiving photographs from summer reconnaissance, and dissemination of initial results. Includes planning for the winter season flights
- Winter reconnaissance – flights, plus downloading, processing/printing, cataloguing archiving photographs from winter reconnaissance and dissemination of results. Preparation of the Project Report
- Closure

2.6 Team structure and skills

2.6.1 At the project design stage it is important to define who is going to be responsible for planning and directing each flight, taking the photographs, processing images, cataloguing and undertaking interpretation and mapping. In the air the role of flight director and photographer can be carried out by one person. If the roles are split between two people, team work is essential.

2.6.2 **Flight director:** The flight director should be responsible for guiding the pilot to the target area, but once over the site the photographer is responsible for talking the pilot in to positioning the aircraft while the flight director fills in the flight report form and records the position on the GPS.

2.6.3 **Photographer:** The photographer should be familiar with the camera equipment and have received the necessary training. This is particularly important if there are long gaps between flights. It is advisable that the person taking the photographs is also responsible for downloading and archiving.

2.6.4 **Pilot:** In the unlikely event of using a non-AOC aircraft it is important that the pilot has a current Commercial Pilots Licence (CPL) with the necessary medical certificates and has undertaken the statutory number of landings over the previous 90 days.

< Table 1: Typical stages and products in a one year aerial reconnaissance project

2.7 Project design

2.7.1 The project design is the principle product of Project Initiation and a detailed checklist of can be found in the Project Managers Guide. For aerial reconnaissance projects as well as paying attention to setting objectives in Section 2.1 it is important to pay particular attention to:

- Defining the project area in terms of the topography, geology, land use and growing season. This should be done alongside an assessment of previous aerial reconnaissance work.
- Provide details of which aircraft operator is going to be used and from which airfield
- State the format of cameras and lenses to be used and who will be carrying out the photography.
- Provide details of proposed archive arrangements.
- State how the imagery is to be processed.
- Provide details of in-flight recording system.
- State how many hours of flying will be required, the cost of aircraft and pilot hire.
- If taking photographs with a view to using them for mapping, it is necessary to demonstrate an understanding of how photographs will be framed to enable this to happen.

3 Project Execution

3.1 Advice about successfully taking oblique aerial photographs is provided in the guidance documents listed in Section 4.1, but particular emphasis must be placed on the following:

- Use of a suitable aircraft that meets all safety and legal requirements
- Use of a pilot that is familiar with the needs of an aerial photographer
- A suitably skilled archaeologist/ photographer who is a trained air photo interpreter and is familiar with all aspects of working in the confined space of a light aircraft
- Good quality cameras and lenses suitable for aerial photography
- In-flight recording techniques using a combination of GPS, flight reports and maps (hard copy or on a tablet).
- Assessment of how many hours of flying is required to complete the project
- All aspects of image processing
- IT hardware and software for digital photography
- Awareness of current archive standards

4 Review

4.1 Relevant standards and guidelines

4.1.1 For advice on undertaking an aerial survey refer to:

- Good practice for taking aerial photographs (English Heritage 2011)
- Code of conduct for aerial reconnaissance v2.1 (English Heritage 2011)

4.1.2 For advice on taking oblique aerial photographs to be used in Structure from Motion software refer to Bedford, J., 2014 Application of Structure from Motion and Multi-view stereo approaches to archaeological recording (English Heritage Research Report 79/2014).

4.1.3 For advice on archiving of digital aerial photographs and metadata refer to Digital SLR Camera Guidelines for Aerial Reconnaissance v2 (English Heritage 2011).

4.1.4 Digital files should be kept in secure conditions. Long term arrangements should be in place for the deposit of digital images in a secure archive which conforms to BS 5454: Storage and exhibition of archival documents (*see* 6 below).

4.1.5 If advice on aviation rules and regulations is required look up the Air Navigation Order 2009 (ANO) on the CAA website (www.caa.co.uk), but only if you have a simple query. The ANO is a very complex document that is best left to an aviation expert/lawyer to understand.

4.2 Approaches to assessment of quality

4.2.1 The quality of the photographs taken will be one of the key factors in assessing whether a project has been successfully completed. All photographs should be correctly exposed, in focus with no camera shake and with no parts of the aircraft obstructing the target. Processing should be to a high standard (appropriate contrast and sharp). Photographs of cropmark and earthwork sites should contain good control information if to be used for mapping.

4.2.2 One of the most important elements to review is the results of the projects for example the number of new discoveries and how this has impacted on the research questions asked at the beginning of the project. Also has the survey helped evaluate the condition of heritage assets? All of which should be reviewed in the context of whether it has been a good or bad year for reconnaissance.

5 Archive and Dissemination

5.1 A minimum requirement is that copies of all aerial photographs and associated project reports must be archived with the Historic England Archive and/or local HER to agreed archival and copyright standards.

5.2 Ideally the catalogue and if possible the aerial photographs should be added to a GIS and made available on-line or at least web pages created to highlight the existence of the newly archived material.

5.3 In addition monument records should be created for the National Record for Historic England (NRHE) and HER for new information. In the longer term the photographs should be used for NMP or updating mapped areas.

5.4 Any regionally or nationally important discoveries should be written up for inclusion in an appropriate journal.

6 Where to Get Advice

Damian Grady, Aerial Reconnaissance Manager,
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Email damian.grady@HistoricEngland.org.uk.

For additional information on the storage of photographs the following is recommended:

British Standard recommendations for storage and exhibition of archival documents. PD 5454:2012 *Guide for the storage and exhibition of archival materials.* London, British Standards Institution 2012

Caring for Digital Data in Archaeology: A Guide to Good Practice 2013 (Archaeology Data Service and Digital Antiquity Guides to Good Practice) Edited by Adam Brin, Francis P. McManamon, and Kieron Nive

For details on how to access the Historic England collection of aerial photographs go to: www.HistoricEngland.org.uk/images-books/aerial-photos

Cambridge University holds another important collection of aerial photographs (www.geog.cam.ac.uk/cucap/).

For contact details for local HERs *see* Heritage Gateway (www.heritagegateway.org.uk). Many of these will hold their own collection of aerial photographs.

6.1 Contact Historic England

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