MANAGING ARCHAEOLOGY:

Evaluation techniques that reduce uncertainty

The following pages present case studies that highlight the importance of field evaluation in a successful project. Field evaluation ground-tests what might be found and frequently supports pre-planning consultation or a planning application: for infrastructure projects, it may contribute to a more detailed understanding of a chosen site or route. It can involve a wide range of intrusive or non-intrusive fieldwork techniques to prospect for archaeological features, structures, deposits, artefacts or ecofacts, and to establish nature and extent.

The first case study outlines the approach to the assessment and evaluation of archaeological potential and impact from a mega-project, the construction of the High Speed 2 (HS2) rail link, emphasising the importance of using competent, accredited professionals to design and deliver appropriate programmes of work.

The second outlines how metal detecting and fieldwalking have been under-utilised as archaeological evaluation techniques and how these two approaches can be combined in a cost-effective way.

The third sets out the case for using a wider spectrum of techniques for evaluation, arguing that a phased approach supports more targeted, question-led trial trenching and, ultimately, better decision-making.

The final case study explains that the first stage of archaeological evaluation often involves non-intrusive techniques such as geophysical survey. It includes the recent advances in archaeological geophysics and how using the right technique can support positive outcomes for clients and developers.

These case studies illustrate some of the evaluation techniques and approaches used to manage archaeology and reduce uncertainty, and we hope that they inspire those who are undertaking archaeological projects to seek advice and support from a CIfA-accredited professional.

Approaches to evaluation and assessment for linear infrastructure

Metal detecting as an evaluation technique

A geoarchaeological approach to evaluating large land parcels

Placing geophysical survey at the centre of archaeological and heritage services

Approaches to evaluation and assessment for linear infrastructure: HS2 Phase One

John Halsted MCIfA, HS2 LTD

In this case study, John Halsted outlines the approach to the assessment and evaluation of archaeological potential and impact on a mega-project, the construction of the High Speed 2 (HS2) rail link. HS2 may not be a 'typical' project but it has provided opportunities to test evaluation techniques on a large scale. The HS2 Historic Environment Research and Delivery Strategy (HERDS) emphasises the importance of using competent, accredited professionals to design and deliver appropriate programmes of work which minimise risk and maximise the opportunity for archaeological work to create value for business and society.

HS2 Phase One extends for 225km across the landscape through a variety of topographical and geological areas and potentially a wide variety of archaeological remains. Through the Environmental Minimum Requirements, notably the Heritage Memorandum,[1] a programme of historic environment works was enacted in advance of construction. HS2 as a client, employed a number of contractors in a tiered supply chain in order to deliver and manage the archaeological works alongside an in-house embedded historic environment team.

Geophysical survey results, Iron Age and Roman settlement ©HS2

A strategy was developed, following a process of industry and stakeholder consultation, which sought to focus upon clear objectives for archaeological investigation (the Historic Environment Research and Delivery Strategy)[2]. In order to better understand and define the location of archaeological assets, a variety of different methods were applied which can provide a useful insight into the potential approaches to evaluation.

In support of the Hybrid Bill process and in advance of the Heritage Memorandum, the scheme was subject to an Environmental Impact Assessment.[3] This sought to establish the known heritage assets on the scheme and the potential impacts of the scheme design on those assets.[4] This assessment also included defining a series of archaeological character areas as a means of providing an overview of archaeological potential across different landscapes. Building on this work, with the initial 'urgent works' construction programme in mind, an archaeological risk model was developed. From a construction perspective, areas of higher risk were determined on the basis of locations where relatively little was known but where a set of criteria

[1] Environmental minimum requirements for HS2 Phase One – GOV.UK (www.gov.uk)

[2] https://www.gov.uk/government/publications/hs2-phase-one-historic-environment-research-and-delivery-strategy

[3] HS2 Phase One environmental statement: documents – GOV.UK (www.gov.uk)

[4] HS2 Phase One environmental statement volume 5: cultural heritage – GOV.UK (www.gov.uk)

indicated that there may be high potential for unknown archaeology to be present. Known archaeological and heritage assets were not deemed high risk in this model, as they could be factored into programmes of mitigation. This assessment of risk was undertaken prior to any field evaluation and fed into the design of initial evaluation work in the form of a geophysical survey and evaluation trenching.

The field evaluation programme primarily utilised a combination of LiDAR data, geophysical survey, trial trenching and borehole data to assess the presence of archaeological deposits. In addition, detailed and extensive route-wide desk-based assessments for specific themes, such as geoarchaeology or palaeoenvironmental archaeology, sought to indicate areas of higher or lower potential.

A variation on standard approaches to evaluation was undertaken for a section of the scheme in areas where geophysical surveys returned limited results (in regions and on geologies where the technique otherwise worked well). Here, a bespoke approach was employed across what appeared to be ‘blank’ areas.

A predictive model was devised in order to determine locations where, for example, earlier prehistoric activity may be more likely. These remains are often present as flint scatters in topsoil or insubstantial sub-surface features, which are arguably less easily identified through geophysical survey. This model formed the basis for extensive test pit work and the sampling of topsoil. Novel approaches such as geochemical survey were also trialled, where anomalies in the data helped determine follow-up intrusive work. The predictive model and intrusive fieldwork successfully identified earlier prehistoric archaeology in a number of locations, with other areas indicating a genuine lack of past human activity.

In conclusion, the historic environment works for HS2 Phase One demonstrate that having a robust and well-considered understanding, both of known heritage assets and an assessment of the potential for unknown archaeology, can help determine a suitable evaluation strategy that will help to identify and define any archaeological deposits on a site and reduce the risk of unexpected discoveries. The approach can be tailored to the type of archaeology that the preceding assessment and non-intrusive work has considered most likely to be present or which specific research objectives have been highlighted as a priority for investigation. This approach to evaluation can help to define targeted mitigation strategies which are suited to the archaeological aims of the investigation.

Targeted trial trenching as part of the HS2 historic environment works ©HS2

Metal detecting as an evaluation technique: Detailed and Partial Artefact Survey (DAPAS)

Keith Westcott, Director of the Institute of Detectorists CIC and Chair of The Detectorists Foundation

Metal detecting, and fieldwalking, have been under-utilised as archaeological evaluation techniques. In this case study, Keith Westcott describes how these two non-intrusive approaches can be combined in a cost-effective way. Detailed and partial artefact survey enables the identification of both metallic and non-metallic finds, supporting greater understanding of the significance of archaeological remains and the potential impact of construction work on that significance.
To maximise the benefits that archaeology creates for business and society, it must be carried out with professionalism. The Institute of Detectorists CIC and The Detectorists Foundation promote the importance of professional standards for metal detecting, enabling detectorists to work alongside archaeologists within a shared ethical framework.

Gathering material evidence of our past enables archaeologists to build a robust assessment of our heritage, where often there is no written evidence. Important evidence discovered in situ during excavation provides valuable contextual dating evidence but also, as fieldwalking demonstrates, spatially recording surface finds can contextualise a landscape, providing a tangible insight into our cultural history.

Metal detecting has traditionally been limited to scanning spoil heaps ©Charlie Newlands

Technological advances have brought positive changes to the assessment and evaluation of archaeological significance in the 21st century. Photogrammetry, remote sensing with LiDAR and geological surveys producing images and mapping all contribute to a non-intrusive approach to archaeological evaluation. To confidently define a site and reduce uncertainty, determining archaeological evidence through key indicators requires a process of initial desk-based assessment, remote sensing surveys and, before forming a mitigation strategy, possibly surveying for tangible dating evidence.

Fieldwalking, though labour intensive, is a tried and tested evaluation technique to help determine human activity in an area and is an important tool in the archaeologist's assortment of available field survey options. So too is the metal detecting survey.

Although both fieldwalking and metal detecting surveys utilise 'collection units' (a gridded and transect approach) and look to achieve the same outcome of assessing the archaeological potential of an area, the two disciplines are rarely carried out by the same organisation or individuals. However, despite the obvious benefits in collecting and spatially recording all material artefacts from the archaeological record, fieldwalking and metal detecting surveys are not the norm in today's commercially sensitive archaeological world. Conversely, and leading to the ultimate

Reducing the volume to surface area ratio of spoil makes it more suitable for scanning ©Keith Westcott

destruction of the archaeological record, it is not unusual in commercial archaeological investigation to 'strip off' topsoil.

COMBINING FIELDWALKING AND METAL DETECTING UTILISING TRAINED DETECTORIST PRACTITIONERS

Although the metal detector has been under-utilised as an archaeological tool in the past, where surface conditions are suitable for fieldwalking, the technology can be successfully used to pinpoint portable metal antiquities buried in the topsoil. A community interest company, the Institute of Detectorists CIC, has now been established to promote the embedding of metal detecting into professional practice. The Institute has developed a standard for ensuring a consistent approach to the use of metal detectors on archaeological sites called the 'detailed and partial artefact survey' (DPAS), which can be tailored to suit varying site conditions. In addition, the institute is building a national resource of 'practitioner detectorists' who have been educated to understand and adopt archaeological methods.

Importantly, one of the key benefits of this approach is that detecting no longer needs to be limited to spoil heaps and topsoil; the use of skilled detectorist practitioners and DPAS methodology enables metal detection to progress to the investigation of trenches and for searching subsoil layers down to the natural, undisturbed strata. This enables us to locate and protect our portable heritage from the effects of mechanical excavation and to identify positions for archaeologists where metal finds from antiquity lie in undisturbed stratigraphy.

Stating the obvious, time and money are two governing factors here, not only in the human resources required to complete two independent surveys, but also to process,

Using a metal detector to pinpoint targets for investigation on an archaeological site ©Keith Westcott

post-excavation, the resultant archive of portable heritage. However, is there a wider value beyond the information gained from artefacts? Could adopting DAPAS bring a commercially viable and consistent approach to learning from and saving our portable heritage?

DPAS BASIC PRINCIPLES – COMBINING FIELDWALKING WITH METAL DETECTING WHEN REQUIRED

- **Detailed:** offers a consistent approach to retrieving dating evidence, set to a site-determined discard policy, offering an accurate and detailed sweep of 200m² grids through two-metre transects, located over important archaeological remains identified by a geophysics team or through desk-based assessment. With an initial GPS location point, the search area location grid can be efficiently moved or expanded, utilising set rope lengths to give a measured distance.
- **Partial:** covers larger search areas following a predetermined density of transects. The partial approach considers the required coverage of hectares to numbers of detectorist practitioners, against sweep rates. For example, a partial approach was recently utilised on an HS2 section where metal detecting, geochemistry and magnetic susceptibility were combined, based on 20m transects, while other sites may require a greater density of, say, five-metre transects.
- **Detailed and partial surveys:** look to maximise the effectiveness of searching for what can often be very small finds (a medieval coin can weigh as little as one gram). By setting out to a predetermined plan, achieving a consistent coverage of the search area, findspots will then be GPS-located and spatially plotted as dating evidence to be presented in the final report. Where possible, fieldwalking will be carried out at the same time as metal detecting.
- **Trenching and excavation:** utilising the metal detector to locate topsoil and subsoil in-situ metal artefacts, marked-out trenches are swept before digging and before each drawback of a mechanical excavator. Targets spots can be flagged for excavation.
- **Spoil:** volume to surface area makes locating finds in spoil heaps particularly inefficient. A maximise the potential for finding artefacts of all materials by restricting the depth of spoil and laying it out in lines away from the trench, relevant to layers excavated.
- **Finds retrieval:** detectorist practitioners are best placed to perform artefact extraction from topsoil when an object is located, rather than flagging it for extraction by others, as pinpointing the target is integral to the accurate retrieval of the artefact. Deeper signals will be flagged and reported to be

Detectorist practitioners carrying out a detailed survey to DPAS standards ©Nathan Portlock-Allan

excavated by an archaeologist.

- **Recording:** collecting small finds and the GPS logging of finds are often performed separately. Our three-stage approach includes bagging the find, writing details such as the context number and find depth on the bag and also on a separate tag attached to a plastic stake, allowing the small finds to be retrieved before spatial coordinates are logged.
- **A no-metal zone:** it may sound obvious but utilising metal stakes to set out a 'detailed' surface detecting area, or laying spoil on metal-eyed tarpaulins, is not conducive to an efficient survey. Detectorist practitioners will comply with health and safety requirements by wearing non-metallic composite safety boots and hard hats secured and suited to the practice of removing artefacts from the ground.

Further information on DPAS and detectorist practitioners will be publicised through a forthcoming website operated by the institute and its charitable counterpart, the Detectorist Foundation, under the joint banner of the Detectorists Institute and Foundation, thedif.org.uk.

A geoarchaeological approach to evaluating large land parcels

Clive Waddington MCIfA, Managing Director, Archaeological Research Services Ltd

In this case study, Clive Waddington, MD of CIfA Registered Organisation ARS Ltd, sets out the case for using a wider spectrum of techniques for evaluation. He argues that a phased approach based on high-quality data from a wider range of non-intrusive techniques supports more targeted, question-led trial trenching and, ultimately, better decision-making. Engaging the services of accredited archaeologists who have committed to working to professional standards at an early stage means they are able to advise clients on the most effective approaches for their development to create positive outcomes for both clients and the public.

Aerial view of the wetland basin after soil stripping where two pond-side Early Mesolithic camps were discovered ©Archaeological Research Services Ltd

Excavation of one of the Early Mesolithic tepee-type structures with the hearth and the remains of its last fire visible in the foreground ©Archaeological Research Services Ltd

Finding rapid, cost-effective ways to evaluate large land parcels for archaeological and palaeoenvironmental remains has always been a challenge for developers and archaeologists. Archaeologists acting for developers have used various techniques over the years to evaluate sites in advance of development, with some, such as aerial photograph transcription, general remote sensing and geophysical surveys, making huge contributions to the number and location of new sites. For those areas where there is little pre-existing remote sensing data or which have geologies, soils or ground conditions unfavourable to crop or soil mark formation, and/or which have restricted scope for geophysical survey, other approaches for evaluation of these areas need to be found.

Following an in-depth study in the Till-Tweed basin by the author and colleagues, a geoarchaeological methodology has been devised, termed the 'landform element' approach. Importantly, this is a phased approach, whereby archaeologists initially map, take sediment cores and survey a given land parcel to partition it into a series of discrete landforms. For each of these landforms they identify the archaeological potential and the types of methods most appropriate to their evaluation and they use this to drive the subsequent evaluation of the area.

The case study from Killerby Quarry, North Yorkshire was approached in this way. Here, as part of the desk-based assessment for this new quarry, we created a detailed geoarchaeological landform element map for the land parcel. We followed this with a phased programme of evaluation that included targeted sediment coring, range finder dating and assessment of data collected from ancient features on the floodplain, such as buried channels and basins, that could tell us about past environmental conditions. We undertook an extensive fieldwalking survey at close spaced intervals to maximise finds recovery, with a particular emphasis on chipped stone artefacts. Following

Aerial view of excavations following initial stripping and sampling works on one of the kettle holes ©Archaeological Research Services Ltd

on from these studies we conducted targeted geophysical survey and evaluation trenching. Once this site received planning permission, we undertook archaeological recording, analysis and dissemination of the results, based on a scalable watching brief or strip, map and sample planning condition, together with the targeted sample excavation of specific floodplain features.

We selected this approach as it provided an appropriate method for rapidly and accurately assessing a large land parcel. The planning authority required a high level of information to inform its planning decision on this large-scale development. The approach enabled us to devise the most appropriate approach to post-permission works and gave confidence to the developer regarding what the scale and cost was likely to be. By creating a tailored, question-led approach we could determine what was significant about this landscape and the type of archaeological and geoarchaeological records it contained. From the outset and in a phased approach, we targeted the investigation in a way that avoided the need for digging several hundred evaluation trenches across this landscape. This meant that

- there was virtually no impact on surviving sub-surface archaeological remains during the evaluation
- we left no large scars on the field surface

View across the Late Mesolithic timber platform, built out into the kettle hole pond where chipped flints and timber posts were found ©Archaeological Research Services Ltd

- we avoided a high carbon footprint from extensive machining
- we could work quickly
- our clients considered the cost of the works good value for money

This phased approach meant that the bulk of the client's investment took place after planning permission was granted, when the client's revenue was assured, and it was spent on gathering new and significant information in a targeted programme of archaeological investigation.

The technique proved highly successful, as we were able to focus on a kettle hole (a type of hollow formed by melting ice) and enclosed wetland basins, examining their archaeological remains as well as their palaeoenvironmental sequence for one of the first times in British commercial archaeology. The results have been stunning and have added genuinely new knowledge and data to our understanding of the transition period from the end of the last Ice Age. This has included the discovery of three Early Mesolithic pond-side camps, with the structural timbers and hearth of the tepee-like dwellings surviving in remarkable condition, despite dating to about 9000 BC. We found a substantial Late Mesolithic timber platform dating to about 5500 BC, extending out into a small pond inside a kettle hole

Recording a well preserved sediment stack within the kettle hole containing the Late Mesolithic timber platform. A detailed and highly informative paleoenvironmental record from the Late Glacial through to the mid-Holocene was retrieved. ©Archaeological Research Services Ltd

along with finds of cattle teeth, chipped flints and a stone rubbing tool, as well as posts, postholes and other features. We have interpreted this as a platform for processing animal skins and potentially curing hides in the pond. This site also had successive occupation in the Neolithic and Bronze Age, stratified above the Mesolithic remains. In both cases these well-preserved archaeological remains also had preserved alongside them a continuous palaeoenvironmental sequence of deposits that can tell us about landscape development and human activity in the immediate surrounding landscape.

These are remarkable discoveries that have been found as a result of the application of a specific evaluation technique and not by chance. We have ground tested the landform element approach in real-world settings on a large scale and on several sites. It has proved effective in identifying the best range and use of evaluation techniques, recovering what is archaeologically significant about an area, as well as in directing the best use of spend, at the right times, in the discharge of planning requirements.

Placing geophysical survey at the centre of archaeological and heritage services

Rok Plesnicar, Geophysicist, Nicholas Crabb ACIfA, Senior Geophysicist, and Tom Richardson ACIfA, Terrestrial Geophysics Manager, Wessex Archaeology

The first stage of archaeological evaluation often involves non-intrusive techniques such as geophysical survey. In this case study, the team from CIfA Registered Organisation Wessex Archaeology outline recent advances in archaeological geophysics and how using the right technique can support positive outcomes for clients and developers.

Registered Organisations are led by Members (MCIfAs) and have demonstrated their ability to act ethically and comply with professional standards, assuring clients that the work will meet their needs and be carried out in the public interest.

Typical gradiometer setups used in terrestrial geophysics: A) a handheld Bartington Grad601 dual sensor system; B) a non-magnetic cart mounted Bartington Grad-13 sensors; C) an all-terrain vehicle towed array with SenSys FGM650/3 sensors. In optimal conditions, handheld systems allow for approximately 2 ha of survey data to be collected in a single day, whereas cart-based systems and vehicle-towed systems can facilitate more than 5 ha and 10 ha respectively. ©Wessex Archaeology

The advent of contemporary digital technologies such as GIS, remote sensing and geophysical survey has had a tremendous impact on archaeological practice. These tools have become commonplace and they enable us to investigate beyond the 'site' to consider what is happening within the wider landscape. Geophysical survey, in particular, has made significant technological advances over the last 30 years with new instruments and sampling strategies making fieldwork faster, more sophisticated, and more cost effective.

Terrestrial geophysical survey incorporates a variety of non-destructive methods used to identify subsurface variations through the measurement of physical properties of the ground. Each technique has specific advantages and limitations and when deployed in appropriate conditions they can be extremely effective. More recently, the towing of these instruments on vehicle-mounted arrays and integration of GPS/GNSS data enables rapid data collection at very high resolution. This allows entire archaeological sites and landscapes to be mapped at unprecedented levels of detail. As such, it is fair to say that the evolution of geophysical prospection has been one of the most important methodological advances of field archaeology in recent times.

At Wessex Archaeology, geophysics is utilised alongside a range of archaeological and heritage services. This enables us to draw upon a breadth of experience and leads to a cohesive approach, where different disciplines meet throughout the lifecycle of a project. As geophysics techniques are often deployed at the outset of a project, this can be critical in helping clients achieve successful planning outcomes, engage communities and stakeholders, and enhance the value of national historical assets.

Greyscale plot of magnetic gradiometer survey, illustrating a wide range of archaeological features that can be detected through this technique. Digital data reproduced from Ordnance Survey data. ©Crown Copyright (2020). All rights reserved. Reference Number: 100022432

THE VALUE OF GEOPHYSICS IN THE PLANNING PROCESS

Today, geophysical survey plays a major role in developer-funded archaeology. It is now regularly deployed over vast areas, with preliminary results normally available shortly after completion. This allows an initial assessment of the potential archaeological impact of a development scheme and facilitates a proactive planning approach that can maximise available resources and time. Surveys can be undertaken pre-planning or ahead of land purchases to inform development design and potentially reroute schemes if significant remains are encountered. Effective interpretation of these datasets helps to focus resources in subsequent phases of investigation, either through the targeted application of complementary geophysical survey methods or by informing the location of intrusive evaluation or mitigation strategies. This can reduce costs for the client and provide enhanced detail of any archaeological remains that may be preserved in situ. For example, at the development site shown in the greyscale plot of a magnetic gradiometer survey (see greyscale image on page 34), an extensive and complex array of enclosures were discovered, with those in the east of the site forming a ladder settlement. These were dated to the Iron-Age and Romano-British periods in subsequent evaluation trenching. The clarity and detail provided by the survey meant that the design of the development could be adjusted, leaving the focus of the settlement outside of the impact of the scheme.

The most widely used geophysical method in the UK is magnetic (fluxgate) gradiometer survey. This is because it responds well to the broadest range of archaeological features, is effective in most rural environments and can cover large areas quickly. Although results can be poor on some geologies and where there are extensive superficial deposits (for example alluvium), deeper geophysical methods, such as lower-frequency ground-penetrating radar (GPR), electrical resistivity tomography (ERT) and electromagnetic induction (EMI) can delineate landforms and subsurface variation, which in turn can be related to archaeological potential. The application of appropriate methods in different landscape settings can therefore be a powerful tool in managing the impact of developments on the historic environment.

Multi-channel GPR survey in progress at Queen Anne's house in Greenwich, London (NHLE 1002060). The survey was undertaken using an Impulse Radar Raptor array, which contains eight transmitter and receiver antennae spaced 8cm apart, with a central frequency of 450 MHz. Credit: Wessex Archaeology

Greyscale plot and interpretation of multi-channel GPR survey from Queen Anne's house in Greenwich, illustrating the location of the observation towers of King Henry's tiltyard. Digital data reproduced from Ordnance Survey data.