



A geophysics interpretation plot with archaeological anomalies highlighted in green with the results for phosphorous (P) overlain in purple, showing the measurements for samples taken from the surface as well as from the top of the substrate. The correlation with the geophysical evidence can be clearly seen, with the darker the colour the higher the concentration of phosphorous (© HS2 Ltd)

Geochemical sampling as a method for archaeological evaluation and prospection

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Archaeological Research Services Ltd carried out a programme of evaluation trenching in a low-lying relict flood plain setting with a high water table at Ladbroke, Warwickshire, as part of the HS2 archaeological enabling works during March 2020. This followed the long period of rain from October 2019 to March 2020 and the wettest February on record.

The works were undertaken for FUSION JV on behalf of the HS2 Company on and around a complex of buried archaeological remains thought to relate to a late Iron Age–Roman transition rural settlement site with potential for multiphase activity. Although it was possible to excavate some trenches the ground conditions in the lowest part of the site meant damage to archaeological remains was occurring during the trenching process, due to the impact of having a machine on such wet, soft ground and trying to excavate remains below the water table. A novel solution was identified to complete the evaluation of this site rapidly and under any weather conditions while keeping the works to timetable and budget. This comprised geochemical survey spaced on a 20m grid across the 7.8ha site with measurements taken using a portable XRF machine. This allowed the project to be completed to timetable while also producing a

data set that could be compared with the evidence for buried archaeological remains as identified by the pre-existing geophysical survey. It is very unusual to use geochemical survey to undertake large-scale archaeological evaluation and even rarer for such an approach to be deployed in a commercial archaeological context. The results have been compelling, showing a clear correspondence between certain key elements including phosphorous, zinc, copper and potassium and the areas of archaeology as identified by the geophysics, and similarly low counts where the geophysics identified little or no archaeology.

The geochemical extensive survey approach was selected for use on this project because it was non-invasive, high precision, rapid, cost-effective and there was an opportunity to innovate and test the technique in a way in

which it is rarely, if ever, utilised. Identifying ways to improve archaeological prospection and evaluation forms a key research question as part of the HS2 archaeological works and there was an appetite to test this novel application. The elemental range produced by portable XRF analysis can provide data that indicate a range of practices including burning (Mg, K, P), burial and disposal of animal remains (Ca, P), craft-working, especially metalworking (Cu, Sn, As, Pb), and a broad range of domestic activities (P, Cu, Zn, Pb). In this way the geochemical approach provided an appropriate method for rapidly and accurately assessing a large land parcel in advance of national infrastructure development that required a high level of information to inform the mitigation strategy. Another benefit of using this technique was that it minimised impact on the surviving buried archaeology, which meant key

relationships would stay intact until the mitigation phase.

The technique has proved very useful in helping to delimit the extent of buried archaeological remains at Ladbroke. It has also shown that there is evidently patterning to the human use of the site and further geochemical sampling on a finer-grained grid will help provide understanding of intrasite activities and their zoning across the site, as well as how this may have changed over time as the site evolved. The technique has also provided hints of other types of archaeological residues that may survive on the site – for example, the presence of lead might imply the use of pewter tableware or other non-ferrous activity on the site and this will help in framing research questions when mitigation take place. Given the speed,

accuracy, spatial precision and cost-effectiveness of applying this technique in this way, it shows considerable promise for wider use in UK pre-determination evaluation works, where it could be ideally applied alongside geophysics and/or fieldwalking in advance of highly targeted evaluation trenching, or be sufficient to inform the type and extent of any necessary mitigation works. Its use during open-area excavation or strip, map and sample excavations provides a further context of use at the site-based scale, where greater detail can be produced and questions addressed in relation to the specific use of key structures and spaces across a given site. The utility of geochemical survey in archaeology is only just beginning to be tapped and its potential and roll out in a commercial archaeological context is an exciting prospect.

A toolbox talk describing the geochemical survey approach to the field team under social distancing conditions (© HS2 Ltd)



A geochemical sample being taken in the field using the portable XRF machine (© HS2 Ltd)



Hammering in an augur for extracting a sub-surface sample for geochemical analysis and to record the geomorphological sequence (© HS2 Ltd)

Jay Carver



Jay is a field archaeologist and consultant, and managing director of 4AD Consultants Ltd.

“I’m delighted to be working with Fusion JV and ARS to develop new technologies in the detection, investigation, and characterisation, of archaeological sites. Archaeologists worldwide are constantly being challenged to adopt new scientific techniques to improve our practice, and understanding of the past”.

Roger Doonan



Roger is Head of Specialist Services at Archaeological Research Services Ltd where he co-ordinates a talented team of specialists. Prior to joining ARS Ltd, Roger was a university lecturer and directed UK Research Council and EU funded projects in Russia, China, across Europe, and the UK. He has a long commitment to innovation in practice and to supporting community-led initiatives.

Clive Waddington



Clive has worked as a field archaeologist, consultant, lecturer and since 2004 the founder and Managing Director of Archaeological Research Services Ltd amongst other things. With a wide range of specialisms he continues to contribute to national archaeological initiatives, publish books and papers, develop innovative approaches, liaise with sectoral partners and lead the development and growth of ARS Ltd.