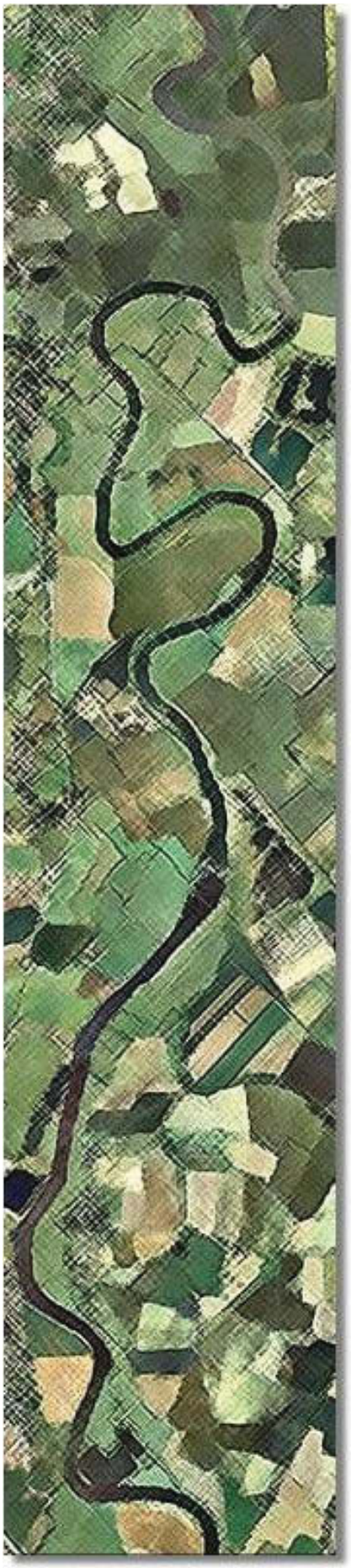

YORK ARCHAEOLOGICAL TRUST

Trent Valley GeoArchaeology 2002

Component 7: Review the Effectiveness of Field Evaluation in the Trent Valley: Whole Risk Reduction

John Walker, Keith Challis
York Archaeological Trust

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CONTENTS

1 THE BACKGROUND

1.1 Background

As far back as 1995 (English Heritage 1995, 16 Planning for the Past, volume 1: a review of archaeological assessment procedures in England 1982–1991) it was recognised that there were shortcomings in field evaluations. In 1998 (English Heritage, 1998, Exploring Our Past: Implementation Plan, 17.1) there was a widely supported call for 'new research into the theoretical and statistical basis of field evaluation techniques'.

This new study makes a bold assumption that no matter how successful the research there will always remain a residual risk. By looking at case studies, conducting interviews and examining current practice this report aims to identify the problems associated with this residual risk and how they might be addressed.

This study is based upon one of the most difficult areas to evaluate within England — the deep alluvial deposits along the river Trent. This area produces well-preserved archaeological remains but it is also an area scheduled to produce a significant proportion of the nation's aggregates over the next decade.

1.2 Introduction to the Report

The original project design for this report called for a Phase 1 semi-quantitative study of risk but this has been adapted following the success of other components. This report now touches on what were to be phases 2 to 4 (prescriptive analysis) of the study.

The planning process recognises that archaeology is a material consideration and that there is a need to preserve remains. Preservation can be achieved in many ways ranging from not destroying a site to excavating it before development. To choose between these various options requires a certain amount of information about the remains that is often gathered through an evaluation usually funded by the developer.

Planning Policy Guidance 16 paragraph 21 states:

Evaluations ... help to define the character and extent of archaeological remains ... and ... indicate the weight which ought to be attached to their preservation.

The success of the approach to archaeology contained in PPG16 has led to similar systems in closely related disciplines such as historic building conservation. In that area the approach has been developed into Conservation-Based Research and Analysis (COBRA) which consists of:

the research, analysis, survey and investigation necessary to understand the significance of a building and its landscape, and thus inform decisions about repair, alteration, use and management.

(K. Clark, Informed Conservation, English Heritage 2001, 21)

Unlike building surveys, archaeological evaluations serve not only to provide information on the nature of a site but also provide an opportunity to search for unknown sites.

Within the planning process for the aggregates industry archaeological remains are a 'material consideration' to be taken into account alongside other material considerations prior to a planning decision. Evaluations play a critical role in defining the nature of the remains and, as such, are a risk management tool.

Whilst it is relatively cheap and easy to gain information about sites near the surface, the quality of remains buried under alluvium is, because of ground and methodological problems, difficult to assess. Currently there is a substantive risk that unexpected discoveries are likely to be made, particularly in extensive quarry workings.

The study by Darvill and Russell (T. Darvill and B. Russell, Archaeology after PPG 16: archaeological investigations in England 1990–1999, Bournemouth University and English Heritage, 2002) showed a rise in the number of evaluations undertaken in England from 510 in 1990 to 1,249 in 1999. During that same period evaluations in advance of aggregates work fell from 46 a year to 37. The Planning and Casework survey 1997–1999 (R. Bourn and S. Bryant 2003, 12) confirmed the observation that around 90% of all fieldwork in England arises from the planning process and reported some 1,647 evaluations in 1999 accounting for some 12% of all archaeological planning recommendations. The Gazetteer of Archaeological Investigations in England produced annually by the British and Irish Bibliography lists all the reports lodged by contractors each year and this suggests that around 28% of all fieldwork operations were evaluations. The Gazetteer records some 1,222 operations in 1999. The Trent Valley Geoarchaeology Bibliographic Database recently compiled by Dr S. Brookes and Dr M. Pearce records a total of some 2,351 written works on evaluations and excavations undertaken within the valley study area.

Whilst these three sources do not agree they do suggest that there are a significant number of evaluations and that they account for a significant proportion of archaeological fieldwork.

The cost of these evaluations is not in the public domain due to issues of commercial confidentiality. Information available to the writer suggests, however, that the typical price for an archaeological evaluation on an aggregate site in this area is a five-figure sum but that a proportion involved low six-figure sums. Although costs, where known, appear proportional to area, there is insufficient data to establish whether or not they correlate to suspected archaeological complexity.

Evaluations are designed to provide data to reduce uncertainty about two different risks. The archaeologist hopes that they will reduce uncertainty about the extent and quality of remains that might exist within a proposed quarry. The industry hopes that they might provide data about archaeological costs and timescales.

This paper looks at how effective evaluations along the Trent have been in minimising these risks.

1.3 What is Risk?

At the time when most of the evaluations considered in this study were undertaken there were few British archaeological texts on risk and its management. The Standing Conference of Archaeological Unit Managers (Competitive Tendering in Archaeology, SCAUM 2002) and Greg McGill (Building on the Past, Spon, 1995, 292–311) produced texts on risk which tended to concentrate on contractual issues arising out of fieldwork**.**

In the same period HM Treasury in its code for civil servants volume, familiarly known as 'The Orange Book' (Management of Risk, HM Treasury, January 2001), defined risk as the exposure to:

the uncertainty of outcome (whether positive or negative). The term ***exposure*** *refers to the combination of the* ***probability*** *of these potential events and the magnitude of their* ***impact****.*

- ***Probability****: the evaluated probability of a particular outcome actually happening (including a consideration of the frequency with which the outcome may arise)*

- ***Impact****: the evaluated effect or result of a particular outcome actually happening*

This definition follows closely that used in the majority of academic and professional texts where risk is defined as:

Probability multiplied by cost

(R = p x c)

This concept of seeing risk as consisting of two elements, probability and cost, provides a useful framework for understanding current approaches to archaeological risk.

Whilst both are useful they do present some problems. To the general reader probability is usually divided into two simple classes: very rare events and possible events. Amongst the very rare are events such as death by lightning strike at 1 in 10 million; amongst the possible is death in road accidents at 1 in 16,600 (K. Smith, Environmental Hazards: Assessing risk and reducing disaster, Routledge, 1992). When it comes to taking action we tend to view the probabilities contextually; death by lightning becomes more pertinent on an open high moor in a storm. The probability of discovering a well-preserved site rich in organic debris in the alluvium of the Trent is much higher than on the limestone hills of the neighbouring Peak District.

Cost calculations can also be difficult in that the 'cost' to the industry of excavating a site is not immediately obviously the same as the 'cost' of the loss of a site to an archaeologist. Attempts to convert archaeological and environmental 'costs' into currency, which found favour at one stage, are now attracting consistent criticism (cf. G. Kelly and S. Muers, Creating Public Value, 2004, Strategy Unit, Cabinet Office). Commercial cost is also contextual being proportional to expected gain rather than an

absolute value. The cost of an evaluation appears much higher when you do not have planning permission than when you do.

Combining probability and cost to calculate 'risk' helps to clarify risk issues in that it can provide the key to ranking risks. This ranking of risk constitutes an approach that underpins many risk management systems discussed in later chapters.

1.4 Current Practice: Defining Probabilities

Fundamental to an adequate risk strategy based upon cost-effectiveness are methods for assessing the probability of unforeseen discoveries. In practice three main approaches to this issue of quantification can be discerned: sampling, extrapolation from existing evidence and expert opinion.

1.4.1 Sampling and methodology

Much of the discussion of sampling regimes within quarries has been shaped by the 2% sample rule. First promulgated in the Code of Practice for Mineral Operators involved in archaeology, this suggested that a 2% investigatory sample of an area affected by a planning application would be adequate. With the passage of time it has been assumed that this guidance was based upon underlying theoretical considerations and some effort has been expended in questioning its validity. The writer was present at a meeting of archaeologists where the 2% guidance was first drafted. It is certainly the writer's opinion that then as today this fraction was selected not on the basis of any underlying theoretical consideration but upon a pragmatic judgement of what the other partner, the developer, was likely to find acceptable. Despite the conclusion reached in 1998 that 'the idea of a 2% sample for field evaluations has been widely adopted without any reasoned basis' (English Heritage, EOP Implementation Plan 17.1), in practice this figure still plays an important part in some places in assessing the possible scale of evaluations in England.

Prof. Clive Orton has explored in depth the task of providing a deeper theoretical insight into sampling strategies within evaluations in the interest of greater efficiency and effectiveness. His summary of quantitative methods in archaeology (C. Orton, Quantitative methods in the 1990s, 137–148 in G. Lock and J. Moffett eds, Computer Applications in Archaeology, BAR Int. Ser. S577, 1992) provides a useful summary of mathematical approaches at that time. Orton's more recent work and his inaugural lecture concentrated upon devising more effective and reasonable methods of sampling derived from a Bayesian approach. Orton neatly summed up the difference between the classical approach and the Bayesian by pointing out that the classical approach assumed we were in total ignorance of the site whereas a Bayesian approach allows use to make use of any information (or concepts) we might have (C. Orton, Inaugural Lecture, www.ucl.ac.uk/archaeology/special/orton-inaugural-2003). It is certainly true that archaeological problems are relatively data poor but rich in prior information which gives strong philosophical arguments for the use of the Bayesian paradigm in archaeological research.

In 1995 the authors of Planning for the Past vol. 1 16 concluded that in the south:

The range of techniques deployed for field evaluation was comparatively limited and, surprisingly, appeared to be diminishing with time. Indeed, a considerable proportion of field evaluations adopted a 'one club' approach by using only a single field

technique, predominantly machine trenching. The methodologies that are used for field evaluation are generally those developed for research rather than the practicalities of archaeological resource management. Although such techniques do prove useful in assessment projects they have constraints in cost, time, and ease of use. Consequently, there is a need both for the critical examination of the techniques already in use in terms of the effectiveness and utility of their results and also for the development of new extensive survey techniques with direct application in field evaluation.

In addition, the survey adduced little evidence to suggest that those techniques that were being used were deployed in any way that took advantage of theoretical or statistical models and it noted instances where there was a disjunction between the methodologies applied and the results expected from assessment programmes. Of obvious concern here is the approach to sample size in the specification of field evaluations. There is good evidence from the survey that curators are successfully keeping field evaluation costs low but ... frequently adopting ... a 2% sample fraction without critical consideration of its appropriateness in particular circumstances.

In the same year Knight and Howard (D. Knight and A. Howard, Archaeology and Alluvium in the Trent Valley, 2nd impression 1995, 125–128, TPAT) summarised the wider range of field techniques in use in the Trent Valley and their views as to their limitations.

Darvill and Russell (2002, 34) listed the techniques used nationally in evaluations from 1990 to 1999, the last four years of which showed relatively little change from the reality recorded in 1995. Within the Trent Valley, particularly Nottinghamshire, the situation was more dynamic, with gradually increasing attention being paid to the recovery of data for geomorphological modelling of aggregate sites. This change recognised the fundamental point that most Trent aggregates sites with their various alluvial and riverine deposits were better approached as deeply stratified archaeological sites. Knight and Howard's volume (1995, 125–128) revealed the severe limitations of various methods in dealing cost-effectively with such deep deposits.

1.4.2 Extrapolation

The use of GIS and other similar systems has made it possible to identify geographical trends and formal extrapolation approaches are slowly developing within the Trent Valley. The following excerpt from a developer's private consultant's report illustrates simple pre-GIS extrapolation in action.

The Monuments at Risk Survey (The Monuments at Risk Survey of England 1995: Summary Report, English Heritage, 1998) attempted to review the known archaeology of England as a whole. It concluded that 'approximately 6.5% of the land-area of England contains recorded archaeological monuments or deposits' (op. cit. 5). The same source also reveals that between well studied and poorly studied areas of the country known monument density ranges from 1.41 per km^2 to 41.78 (op. cit. 5). The results of the original survey (Fig.19) suggested that around 13% of the corridor was occupied by deposits but a monument density of only 1.07 per km^2.

The discrepancy between a high amount of deposits but a low number of sites might be explained by the Brough phenomena. The Monuments at Risk Survey found that around half of all monuments are less than 3 hectares; the large size of Brough could account for the distortion. Taken as a whole, however, this comparison might suggest that the known deposits are well charted but that the possibility of encountering unknown site remains high.

Applying the usual margin of error formula at a 95% confidence interval suggests that the true number of monuments along the survey corridor is likely to be around 18/19, that is 3 to 4 more than encountered so far.

This general coarse statistical analysis from a national viewpoint suggests that there is a substantive possibility of encountering an additional 3 or 4 sites during construction.

This prediction subsequently proved to be correct.

1.4.3 Expert knowledge

There seems little doubt that the expert knowledge held by curators, contractors and consultants exerts a strong influence upon the design of evaluations. The following excerpt from a consultant's report illustrates both a high level of local expert knowledge and its limitations.

The imprecise nature of archaeology means that total reliance upon statistical indicators is likely to be misplaced. As an additional check on risk we need to form some view based upon the current state of knowledge of the area. Such a view will of course only represent an opinion and not fact.

Although not strictly an archaeological entity the area of floodplain and gravel in Nottinghamshire and Lincolnshire adjoining the Trent forms a useful geomorphological zone for such a review. The area has been the subject of a number of extensive surveys or reviews, perhaps the most significant of which is the Trent Valley Alluvium project and the original Fosse Way survey. In addition to these larger scale studies there have been a number of gravel extractions that have involved extensive or intensive surveys. In general terms the picture is one of an intensively settled landscape throughout most archaeological periods.

The unexpected discoveries made over the last 15 years within this zone or on similar deposits in adjoining areas seem to fall into the following broad classes:

1 Material resistant to discovery

From Holme Pierrepont and probably also Besthorpe have come graves where the bone material has been lost and the only surviving artefactual evidence has been metalwork. It is known that in the Besthorpe case this material did not show in fieldwalking, geophysical survey or metal detecting, all of which had proved successful on that site.

2 Material not conforming to standard models

At Rampton the Roman site had been the subject of an excavation, two evaluations and a range of survey techniques. This site was considered to be sufficiently well understood for a broad mitigation strategy to be agreed by the County Archaeologist, the Consultant Archaeologist and the archaeological Contractor. Underpinning in part this decision was a belief that rural Roman sites within the general locale were reasonably understood. In practice the site emerged as considerably more complex and extensive than originally envisaged.

3 Deeply buried material

From Girton has come a burnt mound, a type of site previously not thought to exist along the upper Trent, that was buried beneath 'alluvial' deposits and thus resistant to discovery using normal field survey techniques. Mention must also be made of the pioneering work of Dr C Salisbury which has served to reveal that in the floodplain proper extensive and well preserved deeply buried remains are relatively commonplace.

4 New types

During the survey along the A46 south of Newark traces of an open Palaeolithic site were encountered. Again this is a new type of site for the area.

Taken as a whole this evidence suggests that over the last decade there has been a pattern of wholly new types of site coming to light within this general zone. Sites have also been encountered that are resistant to discovery using standard field survey techniques.

We might conclude therefore that a risk exists of either encountering new types of site which because of their 'newness' will be seen to be important or of discovering sites in previously surveyed areas.

1.5 Residual risk

Whilst significant progress is being made in methodological and technical development, it is reasonable to ask whether we will ever have certainty over what lies buried within alluvium-rich areas.

Each of the techniques currently in use, sampling, extrapolation or expert knowledge, has its limitations. Orton's work on sampling, whilst it should lead to greater effectiveness, may remain circumscribed by the difficulty of agreeing what constitutes a site or remains. Survey methodology shows signs of improvement (*vide* Geophysical Survey in Archaeological Field Evaluation, English Heritage, 1995, Research and Professional Guideline Number 1) yet it remains true that with common methods such as geophysics 'detection of archaeological features at depths over 0.5m ... is major problem still to be fully overcome' (op. cit. 11). Geographical extrapolation may prove to be constrained by the difficulty of ensuring correct comparisons between apparently similar areas. Expert knowledge in an academic discipline like archaeology remains constrained by the adequacy of existing models, paradigms and debate.

Although improvements in methods and concepts are to be expected, the issue remains as to whether we are always likely to be left with a degree of residual risk. The following section of this report looks some of the real world problems.

2 CASE STUDIES: REALITIES OF ARCHAEOLOGICAL RISK

Two particular case studies have been selected as they represent some of the problems associated with residual risk. The first, Brooksby, reveals the limitations of evaluation when confronted with deep deposits; the second, Rampton (a.k.a. Moor Pool Close), looks at the interplay between paradigms, sampling and design.

BROOKSBY, LEICESTERSHIRE

The archaeology of Brooksby Quarry, Leicestershire, has two elements: a near surface archaeological component comprising cultural archaeological remains of prehistoric and Romano-British date, and a deeply buried component, the sand and gravel deposits beneath the site which are part of the Bagington (and earlier Brooksby) formation, laid down by the Pleistocene Midland River, which flowed eastward on approximately the line of the present River Wreake before the Anglian Glaciation (c.500,000 BP).

Component 1: Near Surface Archaeological Remains
Conventional evaluation through a combination of fieldwalking, geophysical survey and trial excavation revealed a complex arrangement of ditched enclosures, fields and trackways dated to the later prehistoric and Roman-British periods. A separate artefact scatter comprised mainly a concentration of prehistoric struck flint representing a past activity area — perhaps only intermittently preserved. The floodplain of Rearsby Brook, which crosses the southern part of the site, encompasses a buried land surface, with intact palaeosoil, provisionally dated to the medieval period by associated artefacts.

Component 2: Deeply Buried Bagington and Brooksby Deposits
The Bagington sand and gravel and Brooksby sand and gravel are buried by up to 10m of later till, and proved impossible to directly access using conventional evaluation. Instead, these deposits were examined through a programme of three-dimensional stratigraphic modelling using borehole records, and additional coring to recover samples of organic matter for assessment.

Archaeological Research Design
The scheme of treatment for the quarry, prepared for the Lafarge Aggregates Ltd by their archaeological consultant (Trent & Peak Archaeological Unit), was grounded firmly in recognised regional and national research themes used to guide the allocation of resources.

Evidence for earlier prehistoric activity on the Leicestershire claylands is relatively scarce and examination of the site presents an opportunity to expand knowledge of the contemporary exploitation of this topographical zone. The earlier prehistoric material of the Mesolithic/Neolithic allows examination of the nature of the Mesolithic activity area, whether it is a seasonally utilised site and the types of activities and functions undertaken.

Although the Holocene environmental archaeological potential of the site is modest the research programme includes opportunity for observations of the nature of palaeochannels, their fills and their relationship to the palaeosoil identified within the valley of Rearsby Brook. The extent, character and date of this palaeosoil was difficult to determine during evaluation and further opportunities are provided to identify and record the palaeosoil and any underlying deposits or features where these may be encountered.

Systematic examination of the Bagington sands and gravels is a key regional research theme. They are associated with structural features and organic remains with cold climate affinities. Andesitic handaxes, suggesting contemporary human activity, are often found in association with these deposits, although none has a firm provenance within the Bagington deposits and they are perhaps more likely to be

derived from the underlying strata, the Brooksby sands and gravels. At Brooksby examination as quarrying progresses will provide new information on the character of the Bytham River and its depositional environment.

The following key research themes have been identified:
- River flow direction
- Geological origin of inclusions within sediments
- Nature of climate at time of deposition
- Nature of environment at time of deposition
- Absolute dating of river deposits
- Investigation of organic inclusions (or rejection as coal/lignite)
- Identification of any cultural material associated with the Bagington deposits.

The Brooksby deposits, stratigraphically beneath the Bagington formation, are an organic-rich deposit, perhaps infilling a narrow steep-sided channel, and are associated with a flora with temperate affinities. Within the extraction area the Brooksby deposits are likely to be encountered only in the quarry floor. Experience elsewhere suggests that the deposits will probably occur in isolated areas where they have escaped erosion by the later Bagington deposits. The following are key research themes for the Brooksby formation:

- Character of deposition environment Absolute date
- Climate and environment at time of deposition
- Is there cultural material or surviving cultural horizons associated with the Brooksby deposits?

Archaeological Scheme
The final scheme of archaeological investigation prepared for the quarry is phased over a number of years to fit with the progress of aggregate extraction and includes both the preservation in-situ of key archaeological areas, principally the extensive later prehistoric and Romano-British settlement complex and a programme of excavation and recording of surface archaeological remains prior to quarrying, including both the full excavation on areas of significant remains and a watching brief during topsoil stripping with contingency recording elsewhere.

The deeply buried Bagington and Brooksby deposits can only be accessed as quarrying progresses and the scheme includes provision for a programme of recording and sampling from the quarry face during quarrying with provision for contingency recording should cultural material be encountered. There is also an opportunity for a geoarchaeology research team to examine and sample areas of Brooksby character deposit if they are exposed in the quarry floor. Finally, the chance finding of ancient artefacts is accommodated through monitoring of reject stone heaps on each quarry visit to recover any lithic material.

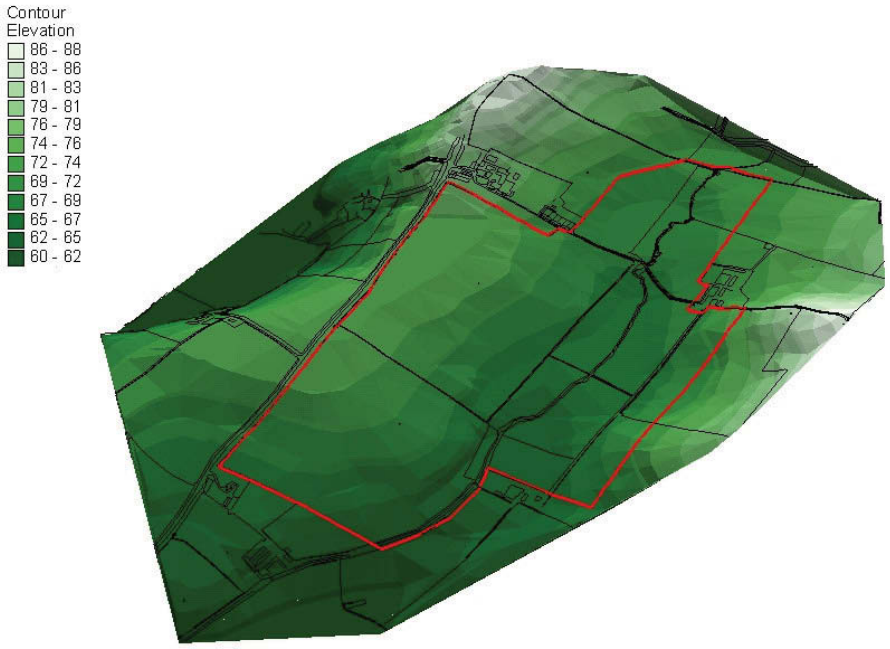

Fig.1 Brooksby Quarry. DEM of the modern land surface.

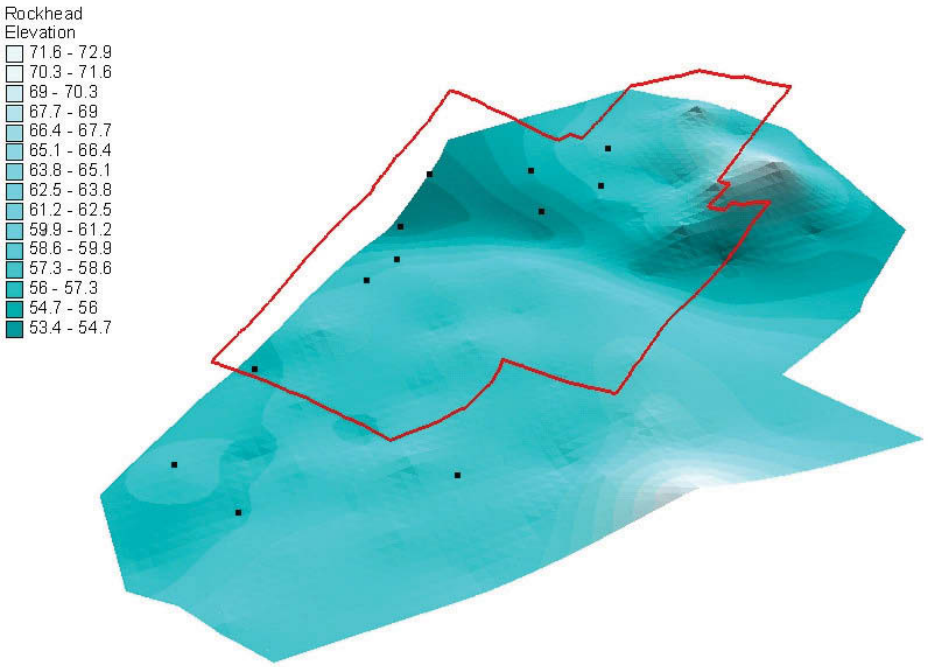

Fig.2 Brooksby Quarry. DEM of the surface of the bedrock (Lias Clay) showing the rockhead trough thought to be carved by the Brooksby river and the locations of organic deposits identified by boreholes.

MOOR POOL CLOSE, RAMPTON, NOTTINGHAMSHIRE

Project Background
Excavation by Trent & Peak Archaeological Unit (Knight and Southgate 2000) recorded the remains of an extensive and well-preserved later prehistoric and Romano-British settlement on a gravel island in the Trent floodplain at Moor Pool Close, Rampton, Nottinghamshire (SK820785).

After a long history of investigation the scheme of archaeological investigation and associated funding were based on expectations of low levels of archaeological survival, typical of hitherto excavated gravel terrace sites in the Trent Valley. In the event the spectacular preservation (up to 0.5m of stratified deposits beneath alluvial and aeolian material) led to rapid revision of the scheme during its execution. The result was a sample record of the archaeological remains present, with limited opportunity to examine and record the vertical stratigraphy that made the site exceptional. This case study, which is based on the excavation account (Knight 2000) and reflections from the excavator (Dr David Knight) and the County Archaeologist for Nottinghamshire (Mr M. Bishop) examines the history of investigation at Rampton and assumptions made about the archaeology of the site. It also describes the progress, results and significance of the excavated remains at the site.

Site Investigation and Evaluation
The site was discovered in the early 1960s by Mr R. Minnett and C.H. Bear of the Retford Archaeological Group. The site was identified by a scatter of Romano-British and later prehistoric pottery over an areas of approximately 3ha, and coincident with a slight rise in the floodplain, mapped by the geological survey as an island of floodplain terrace sand and gravel. Limited excavation by the group in 1965 revealed one ditch and an unexpected depth of 'stratified' deposits, including much Romano-British pottery, *tegulae* and coins.

In 1966 Michael Ponsford excavated several trenches (shown in green on fig.3). Interpretation of the rather unusual excavation record (published finally in 1992) was problematic, but remains of round houses, hearths and 'stratified' deposits, including alluvial silts and clays sealing part of the sequence, could be discerned, as well as numerous finds.

Unusually for the Trent Valley aerial photography has added little to understanding the site, although photographs taken by Robin Minnett in 1976 indicated the presence of three poorly defined cropmark enclosures and other linear features on the summit of the island.

In 1989 an application was made to extend an existing quarry at Rampton into the area of the archaeological remains. A programme of evaluation was devised and executed (by the present author, then employed at TPAU) comprising geophysical investigation and trial trenching. Resistivity survey of the entire surface of the gravel island was undertaken, but proved to be only marginally effective. Electromagnetic conductivity profiles through the alluvial deposits to the west of the island revealed a substantial palaeochannel, with a peaty organic-rich fill determined through augering and the excavation of test pits. Four relatively small machine-excavated trial trenches were positioned to examine the centre, eastern and western fringes of the island feature (red on fig.4).

The evaluation trench on the eastern fringe of the island identified later prehistoric and Romano-British features cut into natural sand beneath what was interpreted as a Roman agricultural soil, itself sealed by alluvial deposits. Substantial quantities of pottery were recovered. In the centre of the island one trench found only insubstantial features cut into natural sand (it had by chance been sited on an unusually poorly preserved part of the site), while another small trench was entirely within the fill of several substantial features and its excavation failed recognise this or make any sense of the material examined. On the western edge of the island a larger trial trench identified well-preserved features cut into natural sand and extensive alluvial deposits.

The evaluation failed to provide a full picture of the archaeology of the site. Although its potential was recognised in part (in particular with reference to limited stratigraphy, the presence of a finds-rich agricultural soil and palaeochannels to the west and possibly east of the island) there was no recognition of the spatial extent and depth of stratified deposits. In particular the evaluation failed to produce any evidence or recognition of the density of features and the stratified deposits subsequently found to surviving at the centre of the island.

Scheme of Archaeological Investigation
A scheme of archaeological investigation for the site was devised in 1990/1 on the expectation of relatively poor survival of archaeological deposits over most of the site; only features cut into natural sand and gravel were anticipated. This reflected the contemporary view of the site devised as a result of the evaluation, and the widely held beliefs about the likely levels of survival on river terrace sites in the Trent Valley current at the time.

In contrast to the prevailing trends in the excavation of similar sites along the Trent Valley the excavation strategy aimed to understand the articulation of the later prehistoric and Romano-British landscape through production of a complete plan of all of the archaeological features and determination of the horizontal stratigraphic sequence, principally through excavation of junctions of features and sample sections through linear features to recover dating material. The success of this venture rested largely on the assumption that relatively few features cut into natural sand and gravel would survive.

Although the scheme was drafted and agreed in 1990/1, excavation of the site at Moor Pool Close did not take place until 1999. In the intervening period further episodes of excavation at the site, principally for a pipeline to serve the adjacent power station, and changes in the view of character and survival potential of archaeological sites along the Trent served to question the expectations, targets and financing of the scheme of investigation.

Execution of the scheme of investigation began in 1999. As a first stage topsoil was stripped from the whole site under archaeological supervision. It became apparent that the site was far more complex than anticipated. As well as features cut into sand and gravel there were areas of stratified archaeology, some sealed by alluvial and aeolian deposits.

The original design called for a fixed sum approach in which adaptation was possible by the contractor suggesting alternative strategies to be approved or rejected following discussion with Nottinghamshire Senior Archaeological Officer and the aggregate company's archaeological consultant. The new excavation strategy comprised the recording of the finds scatter revealed by topsoil stripping as a guide to the date and density of features and the excavation of a number of test pits through the stratified deposits to establish their depth and character.

The test-pits demonstrated up to 0.5m of stratified material, much probably a deliberately created to raise ground levels. Full excavation of this substantial archaeological resource was not possible within the time and budget agreed. A compromise excavation strategy was agreed based upon trying to reveal the gross morphological development of the site, compiling a record of finds and structures made after each stripped spit, and reserving substantial intersecting north-south and east-west aligned baulks across the site to give a record of stratigraphy within which careful hand-excavation could be attempted.

The majority of features were recorded at their base, where they were clearly defined as cutting into natural sand and gravel deposits. A plan of the site was produced rapidly by using an EDM rather than traditional planning techniques. Interfaces between and section through linear features were excavated by machine with limited hand excavation to clarify stratigraphic relationships and gather dating material. Smaller features such as pits, post-holes and roundhouse gullies were hand excavated.

In the event, limited resources and time meant that only a 5 x 20m section of the substantial baulks was hand excavated, revealing the full potential of the site and allowing detailed soil micromorphology to be undertaken.

On the eastern fringes of the site a further substantial palaeochannel was identified. Deposits within the channel sealed Iron Age and Romano-British archaeological features providing a rich record of a complex sequence of flooding and land use.

Results and Conclusions
Excavations at Moor Pool Close were completed in 2000. The site produced a substantially greater quantity of material, and a far more extensive excavation record, than had been anticipated.

The excavations and evaluations were products of their time. The evaluation failed adequately to reveal the richness and complexity of the archaeology of the site. The original evaluation investigations

undertaken were very much a product of contemporary models, with an expectation of poor survival, and a focus on precise examination of individual features for evidence of dating There was no attempt at detailed modelling of the stratigraphy or geometry of alluvial deposits at the site, and very limited involvement of specialists in geology or geomorphology which might have more effectively revealed the complexity of the surface between the relic channels. The evidence for stratigraphic deposits was treated with circumspection as this evidence did not fit the contemporary paradigm for settlement along the Trent, and its significance went unrecognised.

The scheme of investigation for Rampton, with its emphasis on a shared iterative approach, was intended to be an innovative approach to a site seen as quite typical of those known in the Trent Valley. The rapidly revised scheme executed on site was a qualified success due to the willingness of all involved to abandon the initial strategy and the basic design that allowed them to easily devise a new one. However, though a record of the archaeology of Moor Pool Close was achieved, this record is but a relatively small sample of the total of archaeological deposits simply because of the limitations of the evaluation.

The planning and execution of work at Rampton was poised between the pre-PPG16 world of occasional public funded excavation on aggregate extraction sites and the new age ushered in by PPG16 of extensive developer funding, structured approach to assessment and evaluation, and adequate funding as a prerequisite of planning consent. In terms of this report the lesson to be learnt from the Rampton experience is the power of existing paradigms to shape evaluation designs and the interpretation of their might signal a paradigm-shift. The whole scheme approach adopted in the design proved resilient and effective in allowing adaptation to new discoveries but did result in a relatively limited sample.

Further reading

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Knight, D. and Southgate, M., 2000. Rampton, Moor Pool Close SK 820785, *Trans. of Thoroton Society, Notts*. 104, 159–160.

Ponsford, M.W., 1992. A late Iron Age and Romano-British settlement at Rampton, Nottinghamshire, *Trans. of Thoroton Society, Notts.* 96, 91–122.

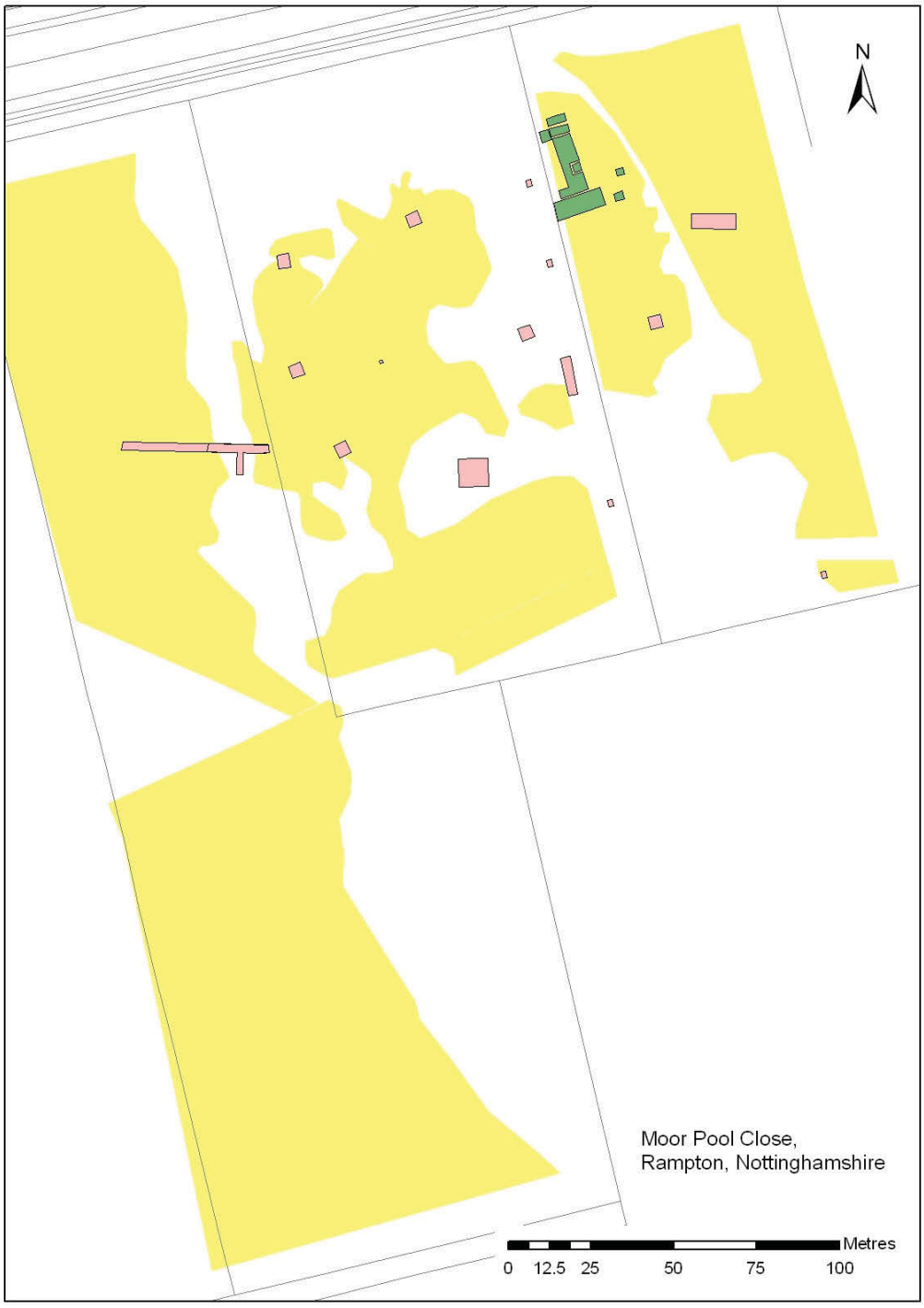

Fig.3 Moor Pool Close, Rampton, Nottinghamshire. Plan shows the locations of Ponsford's 1965 excavation (green), TPAU evaluation trenches excavated in 1990 and other trenches excavated prior to the main scheme of excavation (red). Alluvial deposits revealed and recorded during the excavation are shaded yellow (figure based on data provided by TPAU).

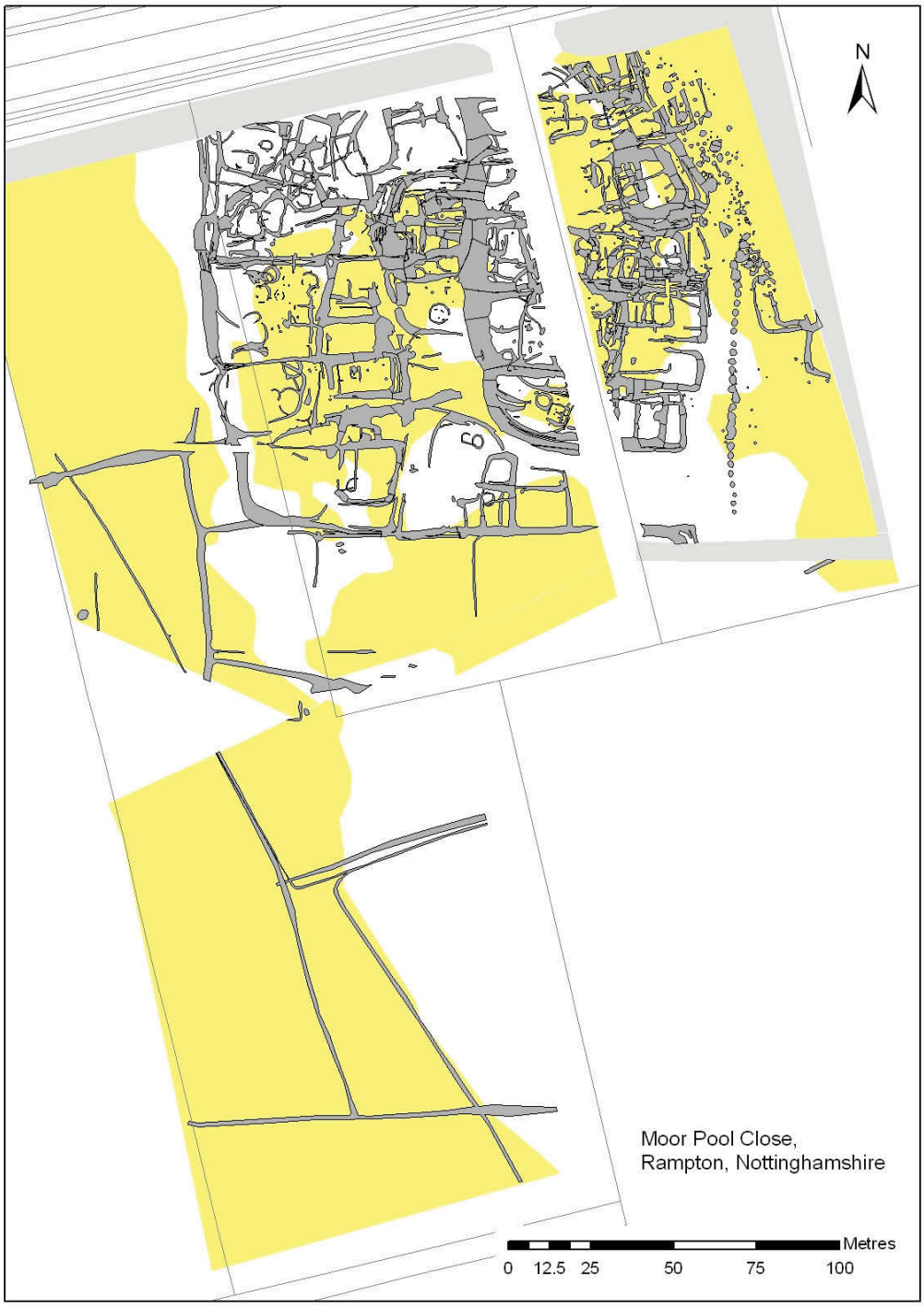

Fig.4 Moor Pool Close, Rampton, Nottinghamshire. Plan showing the Iron Age and Romano-British features recorded and excavated at the site. Alluvial deposits revealed and recorded during the excavation are shaded yellow (figure based on data provided by TPAU).

These two case studies have been selected to reveal the limits of evaluation in the longer term. Whilst others are working on issues of sampling, methodology and extrapolation (particularly through geomorphological modelling) there remain areas where limitations are likely to be encountered for a long time. The Brooksby case is one where, although the surface archaeology can at least be described, the deeper material cannot as yet be evaluated simply and cost-effectively.

At Rampton the inadequacies were not those of approach or method but of underlying understanding. Whilst with hindsight the clues to its eventual complexity were there, experience of similar period sites within the floodplain in those reaches of the valley provided no hint as to what was to be found. The case demonstrates that expert knowledge is critically dependent upon the paradigms held at the time.

These two cases show, therefore, some of the limits of current approaches. To them can be added not only the conclusions of the few formal reports on the issues of evaluation effectiveness but a wealth of incidental detail that tends not to appear in publications. Examples range from failure to recognise archaeological features due to inexperience through to features, particularly immediately south of Derby, which only show when the subsurface has been exposed to the weather for some time.

It is not the intention of this report to review the limitations of individual methodologies or sampling strategies but to seek to identify foreseeable limits to the effectiveness of evaluations in removing all risk and how that residual risk is perceived.

3 PERCEPTIONS OF RISK

3.1 Introduction

As approaches to risk are shaped by perceptions, a series of interviews were conducted with those most directly involved in dealing with the issue. Archaeological curators within the study area who had dealt with sites affected by alluvium were asked for their views. A variety of staff from the aggregates industry were also questioned. The interviews were conducted both face to face and by telephone, and were loosely structured in order not to predicate or steer observations. The following is a brief summary of an analysis of responses.

3.2 Perceptions of risk: archaeology

All curators report that the risk of greatest concern was unexpected discoveries particularly of high-quality material during subsequent extraction. The main fears were that:

1 important unexpected material that should not be destroyed was lost
2 important unexpected material could not be recorded before loss.

The approaches to this risk varied quite widely. Overall there was confidence that the existing system derived from PPG16 worked to a reasonable extent in many situations but the way in which this system was used varied. Some curators relied more strongly on their own professional judgement as to the likely archaeological issues and so produced quite detailed specifications and briefs for archaeological contractors

undertaking the work. Other curators, while equally confident of their judgements, allowed or required archaeological contractors to provide detailed proposals of their own design. In practice all were united in their view that evaluation was or should be an iterative process in which curators were kept closely informed and in which flexibility was important. One curator reported concern, however, over the basic ability of the contractors conducting the work.

Formal mathematical statements on the probabilities of unexpected discoveries were not reported nor were formal statistical analyses of sampling. Many curators reported, however, that professional judgements of likelihood were commonplace and indeed often informed the whole process. In this sense current approaches are driven by 'expert knowledge'. In cases where the contractor merely fulfils a specification, their role in contributing to this pool of expert knowledge is less than where they submit a design. Where consultants were involved, the contribution to the pool of 'expert knowledge' was likely to be higher.

The fears expressed encompass two issues, one of probability, the other of cost in the form of monument loss. In reviewing the literature available no formal probability statement was found. Probabilities were frequently addressed more indirectly by such mechanisms as modelling the topography, geomorphology or historical development of the site. The degree to which these fears were held varied from curator to curator. If there is any pattern to this variation it would seem the longer a curator is in place in a particular area the less the expressed concerns of unexpected discoveries. Darvill and Bronwen (2002, 35) reported what may have been signs of 'a real improvement in the quality of judgements' over evaluations made by curators over time.

An area of concern reported by two curators was the uncertainty as to how far palaeo-environmental evidence fell within the purview of PPG16. In practice there was a common acceptance that such evidence, where it occurred within an archaeological site, fell within PPG16. Debate and difficulties had arisen in a few cases where developers were asked to evaluate relic channel, mere and pond deposits adjacent to sites.

3.3 Perceptions of cost: archaeology

Unavoidable loss without record of any archaeological remains is to be regretted but the degree of regret is proportional to perceptions of value. Whilst a variety of schema for assessing the value of archaeological sites have been proposed, it remains true that those which appear in Annex 4 of PPG 16 probably have the strongest legal force. This view is based on the fact that failure to have consideration of those non-statutory criteria might provide a basis for judicial review.

The issue of value and how it should be assessed exercised all the curators consulted. Darvill and Russell (2002, 6) usefully drew attention to the basic difference between research-driven archaeology and planning-driven approaches. The former depends upon holding a view about the research issues and creating an approach from that stance. Planning-driven approaches rely more heavily upon a process leading to a mitigation strategy. How far this dichotomy is valid in practice is unclear. The curators' reliance upon their knowledge in itself means that value is being derived from what might be called a research agenda that reflects a particular paradigm.

Today the process of assigning value to archaeological sites continues to be the subject of intense discussion. There is a growing recognition that values are derived from differing contexts including local social groups and this is reflected in the ICOMOS Burra Convention. This Convention has recently been adopted within the draft scheme for assessing the archaeological worth of a site in Scotland.

Evaluations provide for archaeological contractors and consultants the primary data for calculating the cost of agreed schemes of treatment. Within archaeology there are no rate or cost books of the type familiar in other groundwork based industries (*vide* Spon's Architects and Builders Price Book). An attempt was made by The Standing Conference of Archaeological Unit managers to promote a structured approach to costing (Eyles) which has met with limited success. Two different mechanisms are currently in use: detailed item costing by experienced personnel and the use of general or ratio performance indicators by senior contracting personnel. It should be remembered that market testing serves only to fix prices provided to developers and not costs.

To varying degrees these costing methods tend to put particular emphasis on the following issues:

Extent
Type of site (e.g. cemetery, farm, flint spread)
Type of stratigraphy (e.g. vertical or horizontally diffuse)
Depth of stratigraphy
Overall depth of archaeology
Ground conditions
State of preservation (e.g. preserves bone, wood and leather).

It is a familiar complaint that many evaluations do not provide sufficient detail about these issues to allow precise cost calculations. In the absence of an agreed methodology for cost calculation it is difficult, however, to see how this problem might be addressed.

3.4 Perceptions of risk: aggregates industry

Discussions with representatives of the aggregates and coal industries identified a range of concerns. Concerns were expressed that unexpected discoveries might lead to additional costs through claims for variations, delays or altering the position of plant etc. A separate range of concerns focuses upon unexpected discoveries leading to misplaced bad publicity either for the company or the industry and how to judge archaeological prices.

The foremost issue was, however, the risk of not receiving planning permission and thus being unable to recover the cost of the evaluation. There are inherent cost risks in all gravel extraction, for example, the level of deposit surveys before commissioning is still surprisingly small. The profit to be made from a particular pit or quarry is also highly dependent upon end-use orders, with significant price differences being encountered at different times for the same product. Much of this variability can be catered for as today it is relatively easy to cut back or expand operations within a pit depending upon circumstances.

3.5 Perceptions of cost: aggregates industry

The capacity of a developer to deal with or finance an unexpected archaeological problem varies across the planning cycle. The economics of aggregate extraction are not the same as those of urban developers. A typical large-scale urban development is funded through loans aimed at achieving a known output and financial return. The certainty of this return is generally much greater than that in the aggregates industry where variations in ground conditions and the local economic scene have arguably greater effects. There is also a perception within the industry that in comparison to urban development there is a higher degree of uncertainty over whether an application will eventually be granted.

In many cases an individual quarry of a company is treated as an independent financial unit requiring five clear phases of expenditure:

1 identifying prospects
2 obtaining permission
3 installation of plant etc.
4 working the site
5 restoration.

Most companies pay particular attention to identifying opportunities and this, for reasons of commercial advantage, usually takes place outside the planning process. In some cases expert archaeological knowledge will be used to try to get an initial impression of any difficulties that might be associated with a particular project.

Once it is decided to pursue a planning application, expenditure in phase 2 is problematic as permission may not be granted and therefore the costs of evaluation may not be recovered. During phase 3 the high cost of plant etc. associated with new quarries represents a substantive cash drain although some income may come on stream. Phase 4 is the period where returns are maximised before a further net outflow of cash during restoration. It can be argued that in terms of capacity or ability to absorb costs, the companies are at their most vulnerable in phase 1 and then phase 2.

4 MANAGING THE RISK

4.1 Current practice archaeology

The most frequently referred to text on risk management in UK archaeology remains McGill (G. McGill, Building on the Past, Spon, 1995, 291–296) which looks at the issue in the context of urban development.

Management techniques within the valley differ from his model and reflect the particular issues arising from large scale aggregate extraction. Evaluations on gravel extraction sites provide data for three separate parties with distinct aims:

1 The curators and agencies whose task is to minimise and mitigate damage in the public interest

2 The companies and their archaeological consultants tasked with producing a strategic resource and shareholder return

3 The archaeological contractors tasked with dealing with the archaeology to an appropriate standard without exposing their organisation to financial losses.

Curiously the present system pays little attention to the role of the contractor, with some evaluations in the area not providing data necessary to create a fully costed competitive scheme of treatment.

The difficulties in calculating costs and the absence of probability statements make it difficult to use many of the more formal mechanisms available in risk management. It would seem unlikely that archaeologists will in the short term agree how to value different types of remains, although more clarity may be gained as a result of the current designation review. In practice, against a background of absence of probability estimates and uncertain values or 'costs', a variety of methods are being evolved to deal with risk.

Whatever evaluation technique is used there remains an element of residual risk that can often be substantial. This risk is substantial not only because archaeology is a truly exploratory discipline but because of the difficulties of calculating or agreeing value in archaeology.

Currently residual risk management is dealt with in a number of ways. In recent years there has been a gradual shift away from detailed Section 106 and similar agreements towards planning conditions. Whichever agreement method is used they usually culminate in a scheme of treatment or mitigation strategy for the archaeology. Four main approaches to residual risk can be identified:

1 Detailed design and variations
The archaeological approach to known sites is specified and costed in detail with subsequent unexpected discoveries dealt with by agreed variations.

2 Whole scheme approaches
A fixed time and cost is allocated to all the archaeological works as a whole, unexpected discoveries being dealt with by regular meetings between the contractor, the curator and the company. Resources are allocated from the whole pot as agreed at these meetings in line with broad design objectives.

3 Watching briefs
In some cases where evaluation has proved difficult because of depth or deposition issues a team of archaeologists is appointed to observe all groundworks. If discoveries are made they can then draw on an allocated sum following agreement between all parties.

4 Contingencies
The allowance of a specified sum or sums to be spent against previously identified risks if they occur.

In many cases watching briefs and contingencies form part of either the whole scheme or detailed design approaches.

Arguments for and against these different approaches were encountered during interviews. They can be summarised as follows:

1 Detailed design and variations

In practice this approach relies heavily upon the quality of the evaluation. The evaluation must provide sufficient detail to allow the contractors to calculate costs reasonably. Variations can prove difficult and complex for all parties and give rise to subsidiary disputes. From the point of view of the industry they provide some degree of certainty about final costs but can lead to high costs before determination of the application.

2 Whole scheme approaches

Popular with some practitioners, these schemes place more reliance upon the ability of the contractor to identify the significance of discoveries as they occur. They are also popular within the industry as they offer fixed timings and costs. Difficulties can occur over the need to make important iterative choices during the life of the scheme, but they provide a great deal of flexibility. They tend to take advantage of the fact that aggregate extraction always involves extensive soil stripping which can provide extensive and immediate data on the archaeological remains. Criticism tends to concentrate upon the issue of how the whole sum is initially calculated.

3 Watching briefs

Small-scale watching briefs to provide a mechanism to deal with residual risks are relatively commonplace and often form part of a wider approach. Larger permanent watching briefs arising from high levels of uncertainty are much rarer. As companies have exploited deeper deposits and moved in more complex depositional areas, these schemes have become more common. As far as we are aware no single scheme has as yet been seen through to completion. Criticism from the industry tends to centre upon cost-effectiveness of the approach (how long will archaeologists be standing idle?) and uncertainty about final cost. In recent years more attention has been given to observing stock and waste piles where there is a possibility of Palaeolithic deposits.

4 Contingencies

The majority of contingencies are designed to cater for specified residual risks. Given the nature of these risks certainty is rare and it can prove difficult to agree on the level of contingency required. Contingencies are unpopular with some elements of the industry, unsure as to whether to view them as inevitable costs or as very unlikely expenditure.

In practice, other approaches to residual risk issues have been reported. Firstly, all quarry excavation is phased in accordance with an agreed plan with the mineral authorities but in practice there is often considerable leeway. This leeway makes it possible to alter development more easily than is the case with urban development. The amount of leeway does depend, however, upon the quantity/quality of mineral involved and the impact of the alternative on other costly issues such as conveyer runs and the siting of the plant. Secondly, within some designs there are clauses that state that if unexpected remains are discovered beyond what the design reasonably caters for then all parties will appeal for grants from English Heritage. If the application fails, this is to be taken as evidence that the remains are not of importance.

Insurance against unexpected archaeological discoveries in urban contexts has been offered for a number of years but take-up appears to have been small. This low level of interest appears to be driven by the cost of the premiums (perhaps 6% of sum insured) and wariness as to what would qualify as unexpected. The author knows no case of such insurance having been used within the study area.

The existence of these various mechanisms are mute testimony to the fact that evaluations do not, indeed cannot, remove all risk. It is important to note, however, that since the introduction of PPG16 in 1990 there have been no public outcries about the failure to record archaeological remains in the study area prior to destruction. This in itself represents a creditable result and yet amongst the interviewees various strongly held concerns were expressed. Curators reported unease at having to make decisions on limited data, archaeological contractors fear over deriving costs from the same information. The industry was worried both by the scale of the financial commitment and its uncertainties and a concomitant uncertainty about what solutions to adopt.

The interviews and the risk management strategies that have been adopted suggest that in practice all parties (including curators) are behaving in a way that conforms to prospect theory. Many people are familiar with the concepts of the economists Expected Utility (EU) Theory. This assumes that people and organisations judge risky gambles by weighting the value of an outcome by its probability. EU is the foundation of theories of asset pricing, purchase of insurance, corporate structure, and personal decisions like investments in education. A behavioural alternative, 'prospect theory', incorporates psychophysical features that EU ignores: people adapt to what they have experienced and weight probabilities in a non-linear way. Adaptation implies that utilities are determined by gains and losses from some reference point or experience. Many studies suggest behaviour toward perceived losses and gains is different in two ways. In 'loss-aversion' studies, losses are disliked about twice as much as gains. Loss-aversion can explain the large gap between hypothetical buying and selling prices for non-traded goods, such as environmental damage. In most surveys, people ask for two to ten times as much money to accept damage to the environment (presumably because they are averse to the loss of environmental purity) as they are willing to pay to clean up the same damage, even though, in standard economic theory, these selling and buying prices should generally be close together. In EU, people weight a possible outcome by its probability. In prospect theory, in contrast, people are assumed to weight a possible outcome by a 'decision weight', a non-linear transformation of the outcome's probability. Ample evidence suggests that people overweigh low probabilities. This overweighting helps explain the widespread desire to gamble on low-probability events (e.g. lottery tickets) and to insure against low-probability catastrophes, which are not easily explained by EU (adapted from C. Camerer, Behavioral Economics: Reunifying Psychology and Economics, Proceedings of the National Academy of Science of the United States of America Vol. 96, Issue 19, 10575–77, September 14, 1999).

Put more simply the current evidence suggests that archaeological curators and contractors, in trying to reduce and assess risk, rely strongly upon their existing perceptions and may well in the view of developers overweigh the cost or loss element. The heart of the developer's dilemma is two-fold: risking large sums without

certainty of return and the contrast between the costs people demand to accept damage and their willingness to pay.

4.2 Other approaches

These kinds of problems are common to many similar planning issues and a variety of approaches have been developed. Within environmental disciplines concepts have been enshrined in statute or policy.

Pragmatic approaches include the following:

4.2.1 ALARP: Risk reduced to 'As low as is reasonably practicable'

'As low as reasonably practicable' is a wide statement of principles and forms the cornerstone of nuclear plant safety. A risk that has been reduced to ALARP corresponds to the concept of tolerable risk. This implies that any further reduction in the risk can be achieved only at grossly disproportionate cost and that the benefits afforded by reducing the risk are judged to outweigh the costs.

4.2.2 BATNEEC: Best available technique not involving excessive cost

The application of BATNEEC normally means that the additional costs of avoiding environmental damage are justified by the benefits. Therefore, BATNEEC would not require the reduction of risk from 'low' to 'negligible' if that would require very expensive techniques. Under the Environmental Protection Act 1990, the BATNEEC criterion is applied in integrated pollution control (IPC) and in the management of risks from the release of genetically modified organisms to the environment. Importantly, the application of BATNEEC means that the estimation of the risk associated with a particular activity can change over time as new techniques and technologies are developed, and the costs of existing techniques vary. Such changes may warrant another iteration of the whole risk assessment process. The BATNEEC criterion relies not only on technological solutions, but includes other approaches such as environmental management systems and staff training.

4.2.3 BPEO: Best practicable environmental option

The BPEO option provides the most benefit or least damage to the environment as a whole, at an acceptable cost in both the long and short term. The BPEO, as a concept with legal basis, was introduced with IPC under Part I of the Environmental Protection Act 1990.

The impact of approaches developed to deal with environmental risks is gradually becoming more apparent in archaeology. The proposed 'Guidance on the Risk Posed by Land Contamination and its Remediation on Archaeological Resource Management' introduces the use of explicit conceptual models based on the following steps:

Hazard identification
Hazard assessment
Risk estimation
Risk evaluation.

It views hazard identification and assessment as the approximate equivalent of a desk top assessment and sees evaluation providing data relevant to risk.

In contrast to these approaches central UK Government has adopted various different strategies for risk management. Annex 4 of The Green Book (HM Treasury, The Green Book: Appraisal and Evaluation in Central Government, London) argues for a pragmatic approach to risk based upon a structured approach including the production of a risk register. Within central government the aim of risk management is not merely to identify and manage risk but to identify the 'optimal allocation of risk rather than maximising risk transfer', the aim being to allocate risk to those best placed to deal with it.

One aspect of the government's approach is risk self-assessment (HM Treasury, Management of Risk: A Strategic Overview, January 2001), a bottom-up approach in which each party to the project specifies its perceived risk which is documented. Within the documentation or register proposed remedial actions are identified for each risk should it occur.

A typical risk register would contain the following:

Risk number (unique within register)
Risk type
Author (who raised it)
Date identified
Date last updated
Description
Likelihood
Interdependencies with other sources of risk
Expected impact
Bearer of risk
Countermeasures
Risk status and risk action status.

These different approaches all recognise to some degree issues that have been explored in this report: the problem of changing paradigms or perceptions, the limitations of methodologies and the seemingly inevitable issue of residual risk.

It is not the purpose of this report to provide solutions but to identify issues. It is clear that at the moment the most pressing issue is to recognise that residual risk is present and the need to agree how it is to be handled.

There is a strong argument that a debate is needed over the viability of approaches such as ALARP, BATNEEC and BPEO and their application to archaeology. To advance the study of the issue there is also perhaps a need explicitly to record perceived residual risks and possible solutions in the way favoured internally within government.

Those proposals are essentially processual and shaped by the existing planning system. It is important to recognise that there is another approach: agenda-driven archaeology. Each developer-funded recording exercise can represent an opportunity to drive forward archaeological research; indeed, some curators take an explicitly research-orientated approach. Such approaches have formed the justification for

public-funded archaeology over many years and have provided the key to allocating scarce resources. There are many who would argue that the value of any archaeological site lies in its contribution to knowledge and it is that value that defines the true risks involved. We can see that various trends in academic thought and practice seem to be leading towards the same general view. The application of Bayesian approaches to searches, the prospect theory model drawn from economics, and the use of explicit conceptual models are moving us away from evaluations as a tool of general search. The move is towards an explicit concept-testing approach in which perceived risks are recorded and published, and solutions suggested. To make this possible, however, all three parties, curators, contractors and companies, must work together. To make such an approach successful means that national bodies will have to agree as to the overall acceptable level of risk and perhaps choose between ALARP, BATNEEC and BPEO.

Such an approach could provide help to the developer by providing both greater understanding of archaeological risks and values and by allowing risk to be phased in accordance with their capacity at the time.

5 CONCLUSIONS

In the medium term some changes could be made which would assist all parties. The influential CBI Archaeological Investigations Code of Practice for Mineral Operators first appeared in 1982 and was revised in 1991 and has not been revised since. As the Council for British Archaeology has pointed, out changes since then have to all intents and purposes rendered it 'obsolete' (Consultation on Mineral Planning Policy Guidance Note 6). The Code did help all parties reach some communal understanding, and a new revision that dealt more clearly with approaches to residual risk (e.g. ALARP, BATNEEC, BPEO) could help all parties. Given the uncertainties amongst curators and developers about costs it would also help if tables of approximate costs for different types of archaeological work could be produced (*vide* Spon's 2003 Architects and Builders Price Book 791–808). Even in the highly competitive world of building such indicative lists are published and serve a useful role in first order estimates of risk by providing, above all, a public indication of costs to non-specialists. Whilst it is true that the variation in archaeological work is much more than in building it seems unlikely that this should prove a binding constraint given the fact that such indicators are used internally by archaeological contractors. Greater understanding of probability will come relatively quickly with the continuation of work on risk mapping reported elsewhere in this volume. Finally, the inclusion of a residual risk management statement in all mitigation designs, possibly based upon the risk register approach, would help all concerned.

There will always be residual risk and its possible costs should probably be allocated in accordance with the HM Treasury principle of optimal allocation, that is, capacity at the time. The incidents that occur may indeed be so significant that direct input from government or its agencies is required but this will almost certainly depend upon proving that a whole risk strategy and approach were initially adopted.

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