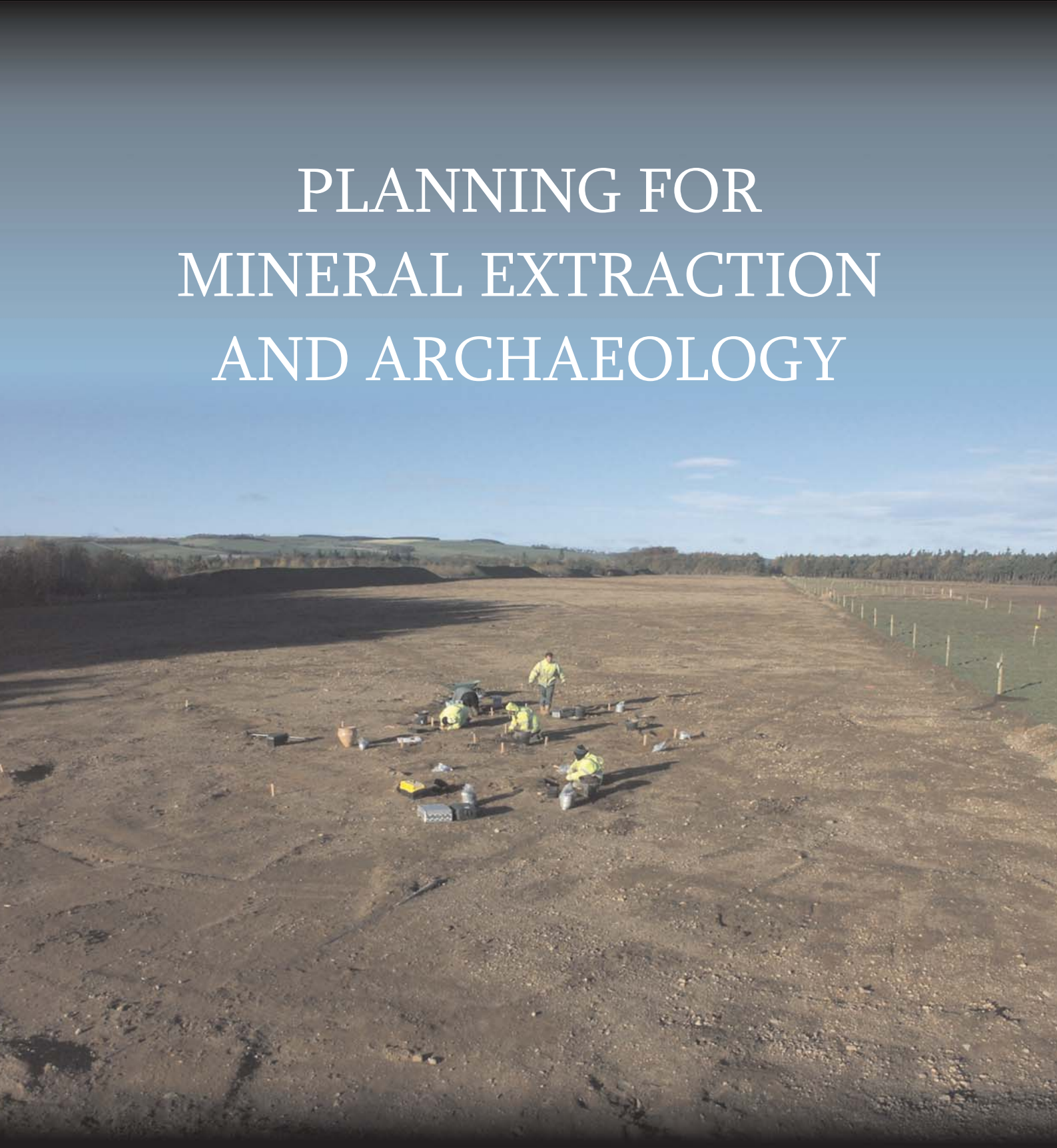
PLANNING FOR MINERAL EXTRACTION AND ARCHAEOLOGY



PRACTICE GUIDE

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Front Cover: Excavation of a Bronze Age House at Lanton Quarry.

PREFACE

This document has been prepared by the Minerals and Historic Environment Forum as an aid to planning authorities, mineral planners, operators, archaeologists and consultants.

Current Government planning policy relating to archaeology and mineral extraction is set out clearly in Mineral Policy Statement 1 and Planning Policy Guidance Notes 15 and 16. Further supporting information is contained in the CBI Archaeological Investigations Code of Practice.

The Practice Guide supplements this by providing a clear statement on how existing policy and guidance can best be applied in practice to ensure a satisfactory outcome for all stakeholder interests.

The Forum was formed in 2006 to address concerns over the application of policy and guidance. The forum firmly believes that the cornerstone for successful outcomes is an improvement in the dialogue between all stakeholders. This Practice Guide focuses strongly on achieving better dialogue and the Forum will continue to work towards improving practice.

CONTENTS

INTRODUCTION

1. This guidance document aims to provide planning authorities, the minerals industry, archaeological curators, consultants and archaeologists with a common tool for managing the impact of mineral extraction on England's archaeological resource. For the purposes of this document the term 'archaeology' encompasses all those elements of the historic environment including buried remains, earthworks, historic buildings, landscapes and areas, as well as palaeoenvironmental deposits.

2. The challenge facing planners, archaeological curators and developers is to strike an appropriate balance between conservation and development objectives. This guidance is intended to encourage early and continuing dialogue and provide a coherent, transparent and informative guide that sets out a clear approach for managing developments that affect the historic environment. As minerals planning and development always requires careful strategic consideration, it is important that the implications of developing a site are assessed and appreciated at the earliest opportunity. It is vital that archaeological curators seek to provide appropriate input to the Local Development Framework to ensure that risk to sensitive archaeological areas can be taken into account before a planning application is made. This Practice Guide provides a bridge between national planning and historic environment policy and day to day practice.

3. Dovetailing mineral extraction with the objectives of this guidance will help direct mineral planners to the key issues important for safeguarding and understanding archaeological remains. There should always be a clear and understandable purpose behind archaeological recording supported by clearly defined objectives. It is therefore timely that the regional research agendas for the historic environment of England are being brought to publication.

4. There is immense public interest in the archaeology and history of this country and this is no more apparent than in the viewing figures for television documentaries. The results of a recent MORI poll[1] found that 95% of people in England think heritage is important for giving us places to visit and things to see and do, for encouraging tourists to visit (94%), and creating jobs and boosting the economy (88%). Furthermore, 96% think heritage is important to teach us about our past and 76% agreed that their lives were richer for having the opportunity to visit and see examples of the country's heritage. The contribution that commercial archaeology makes to this enjoyment and understanding is highly significant. It accounts for the majority of archaeological fieldwork that takes place in England today, contributing around £80m per year.

5. At the same time there is a public expectation that their needs for jobs, homes, transport and services, such as schools and hospitals, will be met and many of those needs can only be satisfied if a steady and adequate supply of essential minerals is provided. Mineral extraction and the historic environment need not be in conflict. This Guidance demonstrates how that can be achieved.

Archaeological work in progress above a working quarry face.

6. Reconciling the national need for minerals with the safeguarding of other important resources is one of the many important functions of the planning system. Archaeological resources are one of a diverse range of assets that must be considered in order to safeguard the landscape and countryside, natural flora and fauna, our cultural heritage and quality of life.

7. The primary aim of this Practice Guide is to assist local planning authorities, mineral planning authorities, mineral planners, mineral operators, consultants and archaeologists in their essential roles within the land use planning system, to ensure that archaeological remains are not unnecessarily affected by minerals development.

8. This guidance is intended to provide a framework for improved dialogue between mineral planners, operators, archaeologists and English Heritage as it is the principal means of ensuring that all interests are properly represented and protected.

9. There is already a strong and well-tested policy basis for this document in Planning Policy Guidance Notes 15[2] and 16[3]. This is supported by the CBI Archaeological Investigations Code of Practice for Mineral Operators[4]. The motivation for introducing additional guidance at this time is to ensure that informed decisions can be made regarding the level of archaeological knowledge that is necessary at each stage of the planning process, to ensure that the full range of up to date and appropriate investigative techniques is considered, and to promote greater consistency in planning authority responses, proportionate to the archaeological potential of the site and reasonable in all other respects.

10. The English landscape has formed over millions of years. A complex patchwork of landforms has been created that host distinctive archaeological and environmental remains dating back many millennia. At the same time, the underlying geology that has been the principal factor in the formation of these landforms, dictates where mineral interests occur.

11. The lowland areas where sand and gravel deposits occur have always formed important foci for settlement, being free-draining, level, close to fresh water and usually free from flood-risk. As a consequence they are often a particularly rich archaeological resource. The regions where harder, more resistant rocks have produced the upland areas of England are no less significant; the extensive upstanding archaeology of the Pennines being a case in point. In marine settings, where mineral extraction takes place, there is the potential for very early Stone Age as well as later remains to survive, as Britain remained connected to the continent until around 6500 BC. Being a waterlogged environment organic materials such as wood, bone and leather will survive whereas on land such remains are rarely found.

The remains of a Dark Age house situated on a sand and gravel terrace at Cheviot Quarry, Northumberland, with the green strip beyond showing where an evaluation trench had previously missed the site.

12. Only by combining good conservation practice with cost-effective development can the goal of a sustainable society be achieved. When carefully planned, development can be beneficial to the historic environment by providing opportunities to progress research, improve conservation techniques and to train students and professionals. Furthermore, significant social and educational benefits can be gained through the provision of outreach, education, and interpretative materials that engage schools, local residents and visitors and enhance public appreciation and enjoyment.

13. This document provides advice on good practice for all stakeholders, from the strategic considerations required in Local Development Frameworks (LDFs), through the detailed matters involved in the submission and determination of individual planning applications, to the measures that are used when development takes place. It is based around five guiding principles.

The restored gravel workings at Attenborough, Nottinghamshire, where a visitor centre has recently been opened (© courtesy Tim Cooper).

GUIDING PRINCIPLES

14. Guiding Principles

- A steady, adequate and sustainable supply of minerals is essential to the nation's prosperity, infrastructure and quality of life.

- Minerals are finite and irreplaceable resources that can only be worked where they occur.

- Archaeological remains may occur anywhere. They are finite and irreplaceable resources that in many cases are highly fragile and vulnerable to damage and destruction.

- Archaeological resources are not all equal in value; those of international or national importance require the highest level of protection from competing development. Equally, few archaeological resources are without value.

- It is the role of the planning system to reconcile the needs of the historic environment and minerals development.

These guiding principles are explained more fully below.

Evidence for prehistoric quarrying at Hunterheugh Crags, Northumberland, where a Bronze Age cairn overlay a quarried rock outcrop inscribed with 'cup and ring' rock art.

A steady, adequate and sustainable supply of minerals is essential to the nation's prosperity and quality of life.

15. "Minerals are essential to the nation's prosperity and quality of life, not least in helping to create and develop sustainable communities. It is essential that there is an adequate and steady supply of material to provide the infrastructure, buildings and goods that society, industry and the economy needs but that this provision is made in accordance with the principles of sustainable development" (paragraph 1, MPS1)[5].

Minerals are finite and irreplaceable resources that can only be worked where they occur.

16. Mineral extraction can only occur where the minerals are found. In that respect it is different from most other forms of development in that the scope for considering alternative locations is severely limited by geology; particularly in the case of less abundant minerals such as coal, industrial minerals, silica sand and distinctive building stone which themselves may be locally, regionally and internationally important. What is often forgotten is that although recyclable, primary minerals are finite and irreplaceable; in the context of sustainability, it is essential to secure their prudent and efficient use and to prevent needless sterilisation of mineral resources.

Archaeological remains may occur anywhere. They are finite and irreplaceable resources that in many cases are highly fragile and vulnerable to damage and destruction.

17. England has been continuously occupied by people since the last Ice Age that ended around twelve thousand years ago. Evidence of human activity can be recognised in different forms and at different scales ranging from the very local to whole landscapes.

18. However, there are large variations in the number and type of archaeological remains between different areas. There is a direct link between the origin and age of a landform, the history of land-use and both the likely characteristics of any archaeological remains and the probability of them surviving.

19. Typical of this are sand and gravel terraces where remains are often abundant, being areas which are known to have been particularly favoured, for example, for Neolithic monuments, later prehistoric and Roman settlements and field systems and Anglo-Saxon settlements. In hard rock areas where there may be little or no drift cover, the archaeological associations may be different with, typically, upstanding stone cairns, standing stones, house stances, field systems, prehistoric rock art, rock shelters, cave sites and artefact scatters.

20. The planning system relies upon the archaeological curator to provide overview and insight to guide the archaeological aspects of the Local Development Framework as well as all subsequent stages in the planning process. The archaeological curator responsible for providing advice to local planning authorities and mineral planning authorities can be expected to have an in-depth knowledge and understanding of their local area. Both the planning authority and developers should look to the archaeological curator for the identification of those areas that have archaeological potential, together with guidance on the approaches to the assessment of that potential. Archaeological curators should be regarded as the focal point in all arrangements for archaeological work on individual development sites.

21. Provided that sufficient archaeological, geological and geomorphological information is available, it should be possible to identify the type of archaeological remains that are likely to be present and the particular techniques that should be most applicable for investigating and managing that resource.

Archaeological resources are not all equal in value; those of international or national importance require the highest level of protection from competing development. Equally, few archaeological resources are without value.

22. In addition to predicting the types of archaeological remains that are likely to be encountered, it is equally important to take into account the likely importance of any such archaeological remains when assessing the archaeological potential of sites and areas.

23. Where sites are internationally recognised or are scheduled, their importance will be clear. Planning Policy Guidance Note 16 (PPG 16)[3] includes a presumption in favour of the preservation *in situ* of nationally important remains and their settings, whether scheduled or not. Clearly, undesignated sites may also be of national importance and a set of criteria against which to assess national importance is contained within PPG 16 (Annex 4)[3].

The engine house at Botallack tin mine, Cornwall, that now forms part of a World Heritage Site (© Jon Humble, English Heritage)

24. In areas where remains are relatively abundant, an additional find of a similar nature to others may not add significantly to overall knowledge. However, if there are indications that something could be present which is unique or special to that particular environment or significant in some other way, then it is likely to be of much greater value. The regional archaeological research frameworks for the historic environment set out the key research priorities and questions for each English region and assessments of importance should relate back to these and any associated documents, such as national, sub-regional or local research strategies or policies.

It is the role of the planning system to reconcile the needs of the historic environment and minerals development.

25. Government planning policy (e.g. Minerals Policy Statements 1 and 2 or MPS 1 and 2[5], and Mineral Planning Guidance Notes for coal[6], cement[7], peat[8] and restoration[9]) and planning guidance (PPG 15[2] and 16[3]), underpinned by the voluntary agreement embodied in the CBI Code of Practice for Mineral Operators[4], provide an ordered framework, based on a phased approach, for the consideration of archaeological issues in relation to mineral working.

26. It is the Government view that the key to the future of the great majority of archaeological sites, historic buildings and landscapes lies with local authorities, acting within the framework set by central government, in their various capacities including in their role as planning authorities.

27. Local planning authorities are required to produce Local Development Frameworks (LDF) to guide decisions about planning applications and to provide a 'spatial plan' to help shape the future of their areas. Protection of archaeological interests should be provided by the adoption of appropriate policies within the Local Development Framework. The LDF should give clear guidance to developers and all other stakeholders as to where development will and will not be acceptable. An area should not be allocated for mineral development in a LDF unless the mineral planning authority is satisfied in principle that mineral working could occur. Wherever possible, areas of higher and lower archaeological potential should be defined within the LDF to ensure that planning authorities give appropriate consideration to archaeology when identifying future working areas. The LDF should provide general guidance about the information necessary in support of any planning application and, wherever possible, alert prospective developers to any particular archaeological issues that will need

to be addressed in respect of allocated sites. The archaeological curator should seek to ensure that planning authorities are provided with the information and advice to inform and underpin the LDF.

28. The Local Development Framework should aim to provide a clear guide to mineral operators, the public and other stakeholders about the locations where mineral extraction may take place, in the process of ensuring a steady, adequate and sustainable supply of minerals. The better the quality of the information available, the greater the certainty with which those locations may be identified and the lower the potential risks to all parties and to the archaeological resource. Early identification of the issues involved with a proposal and the potential impacts of the development is a key element in working towards the goal of achieving sustainable minerals development. Pre-application discussions are strongly recommended to assist applicants in the formulation of proposals. Applications which are not supported by adequate information can take longer to determine, because further information will need to be requested. Further advice on the archaeological input to LDFs is included in paragraphs 38-39 below.

29. When a mineral proposal comes forward and the planning authority believes that a pre-determination archaeological evaluation is required to provide information necessary for an informed and reasonable decision to be taken, the rationale should follow a strategy that draws on field techniques appropriate to the landforms and types of archaeology expected. The local archaeological curator should provide a balanced archaeological overview and insight to guide development of the pre-determination programme in accordance with the detail in paragraphs 41-44 of this Practice Guide. The programme should be consistent with best practice across the country, proportionate to the archaeological potential of the site and reasonable in all other respects. PPG 16, paragraph 21[3], states that pre-determination evaluation should normally be a rapid and inexpensive operation which helps to define the character and extent of the archaeological remains that exist in the area of a proposed development. In the majority of instances, the results of evaluations are also the key to identifying the order of costs involved in the further treatment of remains.

30. An archaeological assessment of the proposed development, including the findings of any initial investigations, should be incorporated within the Environmental Impact Assessment (EIA) accompanying the planning application. Further information on the EIA process and content can be found on the Planarch website[10] and the EIA Centre website[11]. The developer should be prepared for additional investigation to be requested by the planning authority in the light of information gathered by the initial work. This is entirely reasonable, provided that it does not go beyond the requirements set out in paragraph 29 and PPG 16 paragraph 21[3].

31. If planning permission is granted, this may be subject to further archaeological work being undertaken or subject to the requirement to preserve remains *in situ* which may have been identified during pre-determination evaluation. Further detail of the measures that can be specified through planning conditions and obligations is contained in the section on 'Post-Permission Mitigation Measures' (paragraph 76 below).

THE PLANNING PROCESS

32. All planning applications must be determined in accordance with the Development Plan unless material considerations indicate otherwise. The Development Plan comprises the Regional Spatial Strategy and Local Development Frameworks (LDFs) which have been prepared by individual planning authorities. Consequently it is essential that the best possible archaeological information is available when the LDFs are being drafted and consulted upon. In particular, at this stage curators should provide appropriate information and advice that will assist in identifying areas of potential archaeological sensitivity. If appropriate policy provision is not made when an LDF is drafted it makes protection of archaeological interests much more difficult later, when individual planning applications are considered.

33. At all phases, provision for archaeological work should follow a question-led approach with clear research goals linked, wherever possible, to local, regional and national research agendas. Of particular importance is the linking of any programme of work to the regional research frameworks for the historic environment, and any other local research strategies or policies. The table below summarises the archaeological input required during each phase of the planning application process.

Phase	Actions
1. Screening	Determining whether or not a planning application should be accompanied by an EIA (in most cases minerals extraction applicants will submit one). Archaeological curators should be consulted at this stage, even if it is to state authoritatively (based on the necessary research) that there are no known archaeological considerations to be taken into account.
2. Scoping	This is the process of determining what should be included in the EIA, including archaeological requirements. Scoping will invariably identify the need for including an environmental statement on the historic environment, the elements which need to be considered (e.g. buried remains, earthworks, standing structures, historic landscape character *etc.*) together with the methods that will be appropriate for assessing the potential impacts of development and proposing appropriate mitigation measures.
3. EIA	The EIA process must be completed before submission of the planning application. During this phase a range of techniques may be employed to evaluate the archaeological potential of the proposed development area. The starting point for the historic environment component of the EIA is typically a desk-based assessment and then moving to other pre-determination measures. Different techniques may work more effectively on different landforms and in relation to different types of sites of different periods. The techniques adopted should be suited to the type of archaeology anticipated, the nature of the landform/s and clearly defined archaeological objectives.
4. Pre-Determination	Following the submission of the planning application , the planning authority may request additional archaeological work prior to the determination of the application.
5. Determination	At this stage a decision is taken on whether the development is to be approved, and whether any planning conditions or obligations are attached to a permission in relation to the historic environment.
6. Post-Determination Measures	The measures taken at this stage could range from no further work being required, through excavation and recording, to preservation *in situ* of archaeological remains.

Table 1. Archaeological Input to the Planning Application Process.

Local Development Frameworks

34. The Planning and Compulsory Purchase Act 2004 introduced a new system of development planning, to be prepared as Local Development Frameworks and Minerals and Waste Development Frameworks. Planning Policy Statement 12 (PPS12)[12] provides national policy on preparing the new development documents and this is supported by a practice guide. An important part of the new development plan system is stakeholder and public engagement in the plan preparation before key decisions are taken.

35. Archaeological curators should seek to ensure that they are involved in the preparation of LDFs to ensure that archaeological interests are addressed. The planning authority should take account of the advice provided by archaeologists in drafting policies and proposals for the LDF. Ideally, areas of known archaeological potential should be flagged and considered in the LDF and, if possible, mapped, drawing on the best possible data available at the time. PPG 16 (paragraph 15)[3] states that "development plans should include policies for the protection, enhancement and preservation of sites of archaeological interest and of their settings. The proposals map should define the areas and sites to which the policies and proposals apply." By identifying areas of known potential at the earliest opportunity the risks to archaeological assets, mineral operators and planning authorities are reduced. To ensure effective consideration of archaeological interests in the LDFs, it is important that archaeological curators have an in-depth knowledge and understanding of the local and regional archaeology.

36. The table below summarises the input required of archaeological curators to the LDFs. The flagging of archaeologically sensitive areas within LDFs is vital to protect archaeological interests and safeguard developers from going ahead with expensive applications for sites that later present significant risks in relation to archaeological interests.

Phase	Actions for curators
1. Issues and Options	Ensure all issues associated with archaeology are brought to the attention of the Mineral Planning Authority (MPA) through early dialogue. That the MPA should seek to ensure no proposals are put forward as options which would clearly have an unacceptable impact on archaeological interests.
2. Preferred Options	Respond to the consultation making it clear if any proposals would have an impact upon archaeological interests that would be contrary to national or regional policy. Where possible, put forward suggestions/alternatives for consideration which would remedy the situation.
3. Submission	Respond to the consultation noting if any of the submitted proposals are "unsound" i.e. that they do not pass one or more of the "tests of soundness" set out in PPS12[12]. Where possible, put forward suggestions that would make the policy or proposal sound from an archaeological perspective.
4. Sustainability Appraisal (integral to each of the phases set out above)	Liaise with the MPA to ensure that the appraisal has parameters that include the historic environment.

Table 2. Archaeological Input to the Local Development Framework.

37. A useful mechanism for providing high quality data that can be used to underpin archaeological provision within a LDF is the use of aerial photographic archaeological data, in combination with the mapping of key landform units. This approach, digitally integrated into a county Historic Environment Record (HER, also known as the Sites and Monuments Record or SMR), allows areas of potential to be explicitly identified in areas with good coverage and inferred in others. Research has shown that there is a direct link between certain types of landforms and certain types of archaeological and environmental remains (e.g. Bishop 1994[13]; Passmore et. al. 2002[14]; Waddington and Passmore 2006[15]; Knight and Howard 2004[16]). In some instances landforms may overlie earlier sediments that may contain earlier remains. Different landforms present different circumstances for the preservation and evaluation of archaeological and palaeoenvironmental remains. This enables the identification of areas of higher and lower sensitivity which is important as the response to proposed developments on different types of landform can take this into account.

38. By making high quality map-based data easily accessible, it provides all stakeholders involved in landscape planning and mineral extraction with the same information on which to base their decision-making, strategic planning and mitigation strategy. Such mapped data requires informed interpretation by the archaeological curator so that areas of varying archaeological potential are linked to relevant policies within the LDF. This should assist in bringing greater consistency to planning responses as well as providing better information on which to base decision-making. Before any development proposals are drawn up, it is always best to consult the archaeological curator at the earliest opportunity.

Geoarchaeologists assessing the archaeological potential of a sand and gravel quarry at Hedgeley, Northumberland.

Screening

39. Certain types and scales of mineral development will require an Environmental Impact Assessment (EIA) and the submission with the application of an Environmental Statement (ES) detailing the results of the EIA (for further definition of the EIA and ES see paragraph 41 below). The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999[17] and Circular 02/99 set out the circumstances when planning applications require an EIA. The information contained in an ES will be taken into account in determining the proposal. If applicants consider that their proposals are likely to require an EIA they should seek guidance at an early stage on the need for an EIA ('screening opinion'). The archaeological curator should be consulted at this stage, if not before, to ensure that any issues of concern are raised at the earliest opportunity. All submitted planning applications will be screened and applicants advised if an ES is required, if not already submitted.

Scoping

40. Before making a planning application, a developer may ask the planning authority for their formal opinion on the information to be supplied in the Environmental Statement (a 'scoping opinion'). This allows the developer to be clear about what the planning authority considers the main effects of the development are likely to be and therefore the topics on which the ES should focus. The planning authority should consult its archaeological curator at this stage to ensure that any issues of concern are raised at the earliest opportunity. English Heritage may be a statutory consultee in certain circumstances. PPG 16[3] states that early consultation with historic environment curators is highly desirable to agree methods to be used in all archaeological work beyond the scoping stage. Under listed buildings legislation, six expert national 'amenity societies' must be formally notified of applications significantly affecting listed buildings, and consulted about applications affecting registered parks and gardens.

Large scale quarries can have a significant impact on the landscape (© English Heritage).

Environmental Impact Assessment and Pre-Determination Measures

41. If the scoping process has identified archaeological issues, it is typical for archaeological measures to be included as part of an Environmental Impact Assessment (EIA) in order to assess what impacts need to be addressed and how they can be mitigated. The historic environment is an important consideration in any EIA. The basic structure of the EIA and Strategic Environmental Assessment processes as defined by the two European Union Directives (85/337/EC updated 1997 and 2001/42/EC) are essentially the same, and have been incorporated very closely into UK legislation through a series of regulations or 'statutory instruments'. Environmental Impact Assessment (EIA) is a procedure which ensures that the environmental consequences of certain projects are identified and assessed before any authorization, such as a planning permission, is given. Proposals which must be subject to EIA are those which are likely to have significant effects on the environment by virtue of their nature, size or location. In practice most planning applications for mineral extraction will include an EIA. The term "Environmental Statement" is often used for the statement of the results of an EIA process.

42. The following principles are quoted from 'PLANARCH 2[10]. PLANARCH is a partnership established to further the integration of archaeology within the planning process in North West Europe. PLANARCH 2 identified good archaeological practice based on experience of EIA implementation across the EU.

PLANARCH 2 Guiding Principles

The operational principles set out below are intended to provide a rigorous, robust and reasonable framework for ensuring that the historic environment is appropriately treated in the EIA process. They have been arrived at following a review of current practice across parts of England and North-West Europe as part of the 'PLANARCH' project.

1. Cover all aspects of the historic environment.
2. Integrate historic environment expertise into all stages of EIA, from screening through to implementation.
3. Describe the project requiring assessment clearly and in sufficient detail to allow identification of all impacts that could affect the historic environment.
4. Define a suitable large study area to allow a clear understanding of the historic environment and the extent of potential impacts upon it.
5. Undertake all historic environment surveys and investigations to a high standard so as to ensure a full understanding of the nature and significance of the resource and to allow informed decisions to be taken.
6. Assess all beneficial and adverse impacts on the historic environment, including direct, indirect, temporary, permanent and cumulative effects.
7. Evaluate the significance of any impacts on the historic environment resource to take account of both the intrinsic value of the resource and how much it will be changed. Use relevant international, national and local legislation and policy to explain the significance, and make explicit the basis for any statements concerning value or importance.
8. Consider the likely effects on historic environment assets of alternative scenarios, including doing nothing.
9. Consider a variety of approaches to mitigation, including design modification, appropriate investigation and recording measures. Make provision for unforeseen effects. Propose realistically achievable mitigation measures and fully monitor and document any agreed actions, including responsibility for their implementation.
10. Ensure all communication relating to the historic environment in EIAs is clear, focused and accessible to the non-specialist. Archive and index all documentation in a clearly traceable manner.

Priniciples for the historic environment component of EIAs developed by the PLANARCH project.

43. There is a range of established techniques that is used to evaluate and record archaeological and palaeoenvironmental deposits. Some of the techniques are geared towards site detection (e.g. aerial photography, fieldwalking, geophysics) while others are geared towards recording structures and deposits (e.g. surveying and excavation). No single technique exists that can identify all archaeological remains. Evaluating any given area that is deemed to be archaeologically sensitive therefore usually requires a combination of techniques that are directly appropriate to the type of landform and potential archaeology that may be encountered. For example, linear evaluation trenches are generally effective for finding contiguous features such as field systems, enclosures, forts or large ring ditches. Conversely, they are poorly suited to finding dispersed or non-contiguous remains such as post-built buildings, pits or hearths. In the following sections the various techniques are described according to the circumstances in which they can best be applied, as well as broad indications of relative cost.

44. Evaluation of the historic environment component of a proposed development site is undertaken via an incremental process based on the stages set out in Table 1. The first piece of work in the pre-determination stage is usually the desk-based assessment. This is a crucial stage of the process and it is in the interests of the mineral operator and local authority that an appropriately qualified, skilled and experienced archaeologist undertakes this work. A good desk-based assessment is a cost-effective investment that will reduce risk, whereas a poor desk-based assessment can lead to unexpected costs and delay. For certain types of mineral workings it is also important to consider the potential for subterranean remains.

The restored Hilton gravel pits, Derbyshire, now open to the public as a nature reserve (© Tim Cooper).

Desk-Based Assessment

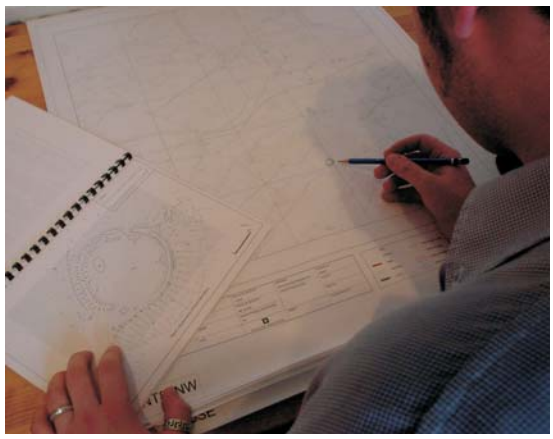
45. A desk-based assessment (DBA) is defined by the Institute of Field Archaeologists (IFA) as "A programme of assessment of the known or potential archaeological resource within a specified area or site"[18]. This involves a detailed and comprehensive assessment of all the documentary evidence that can be accessed for the development site and its immediate environs in order to allow the best informed decision possible to be made as to the archaeological potential of the site.

46. A DBA will be used frequently by the planning authority in order to determine the need for further archaeological investigation. The archaeological importance of a site is assessed against other comparable examples and is guided principally by the criteria set out in PPG 15[2] and 16[11] and English Heritage guidance.

Old documents such as this 1825 print of the Haytor Granite Quarry in Devon are useful tools in the analysis of changing landscapes (Devon Library Services).

47. A DBA will typically include information from maps and plans of the area, both modern and historical, all relevant data from the Historic Environment Record, the National Monuments Record (NMR), aerial photograph evidence, geological information, place-name evidence and any archaeological literature relating to previous investigations on or near the site. If the site has been used in more recent historic times, the DBA might include an assessment of more modern documentary sources such as parish registers, trade directories or military records. The DBA will also consider the potential impact that a proposed development will have on the area under study.

48. Desk-based assessments are relatively inexpensive as they do not include fieldwork other than perhaps a site visit that may include a walkover survey. It is undertaken during the pre-determination phase of the planning application.

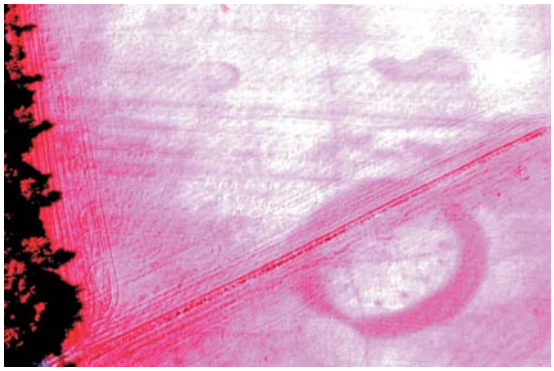


A desk-based assessment will involve careful analysis of any previous archaeological work undertaken in the area.

Aerial Photography

49. Throughout the 20th and early 21st centuries , aerial photography has proved to be the single most effective method for discovering new archaeological sites. With the ability to photograph and analyse huge areas in a short space of time it provides an efficient means of observing the landscape and detecting discolourations in soils and crops, as well as upstanding remains which may be difficult to see at ground level. Aerial photography is most productive in dry conditions when there is a high soil moisture deficit. Crop marks, parch marks and soil marks show best under these conditions and the hot summers of 1976 and 1994 were spectacularly productive for this reason.

50. Archaeological features show as a result of differential crop ripening or moisture content in the overlying soil. Using good quality oblique photographs of archaeological sites, specialists can transcribe archaeological remains as corrected plots on to Ordnance Survey base maps. Once the existence of a site has been fixed in a particular location, sensitive areas can be defined.



Infrared aerial photograph revealing a henge monument at Akeld with other ring ditch and boundary features. This site lies next to a quarry area that had no sites visible from the air but on excavation produced lots of small dispersed features that did not show as cropmarks. © Newcastle University

51. Different types of archaeological site have characteristic shapes allowing buried sites to be classified according to type and general date. Aerial photography is less responsive to small features such as post holes, stake holes and small pits, but will generally show large sites well unless blanketed by deposits of alluvial or colluvial sediments.

Aerial photography reveals cropmarks of an Iron Age fort on a gravel bluff overlooking the river Tweed. Previous extraction has removed part of the interior (© Tim Gates).

52. Aerial photography is a mid-range expense, but highly cost-effective given the huge return for the short periods of flying time, photography and transcription involved. In order to be most cost-effective, it is useful to target flying during specific times of the year when the soil moisture deficit is at its maximum. Checking aerial photographs and transcribing archaeological sites on to maps can be undertaken to inform the Local Development Framework or as part of the pre-determination phase of the planning application. Dry summers resulting from climate change provide greater opportunities than ever for identifying new sites from the air.

Fieldwalking

53. This is an important technique that should be considered for all potential quarry sites where removal of topsoil will occur. This is because fieldwalking allows two processes to be undertaken at the same time. Firstly, by collecting a sample of the surviving artefacts from the topsoil, a record of the archaeological resource in the topsoil is made before it is removed. Secondly, the plotting of artefacts allows for the location of potential sub-surface remains to be identified. Although this method is relatively inexpensive it can yield good quality, informative data. It is worth considering having an area of land specially ploughed in order to facilitate this technique.

Fieldwalking over the site of a proposed gravel quarry. Walking at intervals of 2m maximises artefact recovery and provides a method of recording the archaeology of the topsoil before its removal.

54. Fieldwalking involves walking in a straight line across ploughed fields observing the ground for artefacts. The closer together the walkers are placed the more accurate the survey will be and the greater the potential to identify sites and assess potential risk. In northern England intervals of 2-5 metres have been found to be most effective whereas in other areas, where flint is more common, wider spacings of perhaps 10m may be better suited. Finds are bagged, numbered and surveyed in so that each find can be accurately located on a map.

55. The most common finds are stone tools and pottery. Therefore, it is particularly useful for identifying Stone Age (Palaeolithic, Mesolithic, Neolithic) and Early to Middle Bronze Age sites, as well as Roman, medieval and post-medieval sites that sometimes produce large quantities of well-fired pottery. Where sites are identified by aerial photography or geophysics, fieldwalking can be used to assess their date as well as to retrieve important artefactual evidence that may not survive in the buried deposits.

56. Fieldwalking is a rapid, cost-effective and relatively inexpensive technique which allows for 'broad-brush' archaeological prospection and landscape characterisation over large areas. It is most commonly employed in the pre-determination phase of the planning application but the results from earlier surveys can usefully feed into the LDF. It is particularly effective for locating Stone Age archaeology when undertaken at closely-spaced intervals.

To ensure that accurate interpretations can be drawn from fieldwalking data the positions of all finds are recorded using precision survey equipment.

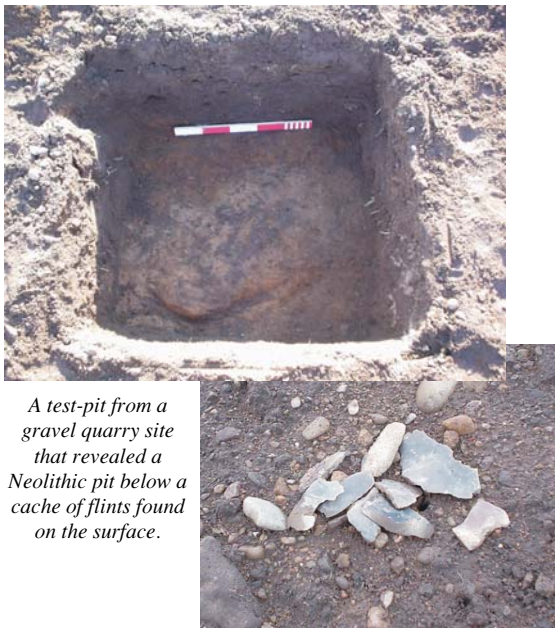
Test-Pits

57. Test-pitting is often used in conjunction with other forms of archaeological investigation to test for the presence of sub-surface archaeology. In areas where it is not possible to fieldwalk, such as fields under permanent pasture, regularly spaced test-pits allow the ploughsoil to be sampled for the presence/absence of artefacts, while also allowing for the identification of buried deposits. Test-pitting is different to evaluation trenches as test-pits are usually hand dug and are much smaller.

Test-pitting being used to examine an area that produced a large quantity of Mesolithic flints as a consequence of fieldwalking and to investigate buried features visible on aerial photographs as crop marks.

58. Test-pits can vary in size from 1m and 2m squares to 5m squares. They are often excavated in a grid pattern and the contents of each pit are usually sieved to maximise finds recovery. For example, test-pitting has been successfully used during pre-determination evaluation for a quarry site in Northumberland to test whether artefact scatters identified on the surface during fieldwalking had buried remains surviving below them. A pit feature was discovered below an area where a marked concentration of stone tools was noted during the fieldwalking of the site.

59. Test-pitting provides a way of sampling non-ploughed areas, such as pasture or woodland as well as testing fieldwalking data for the presence of sub-surface remains. It is an inexpensive-medium expense technique that demands a significant investment of labour depending on the size of the area being investigated and the sample interval required. Test-pits also provide a section through sediments and this additional information can be helpful in understanding whether or not remains will survive in the area, as well as how the landform and soil cover has formed and developed. They are typically employed as part of the pre-determination phase of the planning application.



A test-pit from a gravel quarry site that revealed a Neolithic pit below a cache of flints found on the surface.

Geophysical Survey and Remote Sensing

60. Geophysical survey offers a non-intrusive method of archaeological prospection that can aid the discovery of sub-surface archaeological remains. The main methods of geophysical survey are magnetometry and resistivity. Ground Penetrating Radar (GPR) is being used with increasing regularity, but usually in a more targeted fashion than the two former techniques. Although GPR is expensive, on some sites it may be the only method that can be used because of its ability to give linear profiles, or 'slices', through buried sediments. If sufficient profiles are taken, this technique can provide three-dimensional images of sub-surface features. There may be opportunities for integrating minerals and archaeological prospection techniques.

Captain's Pingle, Barrow-upon-Trent, Derbyshire: magnetometer survey plan showing a curvilinear Romano-British ditched enclosure. Linear anomalies running obliquely across the enclosure correspond to the furrows associated with medieval ridge and furrow cultivation (Survey for Trent & Peak Archaeology by Adrian Butler; reproduced by permission of University of Leicester Archaeological Services, Lafarge Aggregates Ltd and Trent &Peak Archaeology).

61. Airborne 'Light Detection and Ranging' (Lidar) measures the height of the ground surface and other features in large areas of landscape with a resolution and accuracy hitherto unavailable, except through labour-intensive field survey or photogrammetry. It provides highly detailed models of the land surface at sub-metre resolution. Lidar operates by using a pulsed laser beam which is scanned from side to side as the aircraft flies over the survey area, measuring between 20,000 to 100,000 points per second to build an accurate, high resolution model of the ground and the features upon it. In England the Environment Agency has for several years used Lidar for the production of cost-effective terrain maps suitable for assessing flood risk. They have data for large areas of the country, concentrating on the coasts and river valleys and this is available for use by legitimate researchers subject to strict licensing agreements.

62. With risk reduction a key concern for most developers, geophysical survey can offer a relatively inexpensive and cost-effective way of testing large areas for the presence of sub-surface remains. However, geophysical survey can work with varying degrees of success depending on the type of geology, thickness of overlying sediments, soil-moisture conditions present, and whether results are hindered by the presence of services, underground pipes and other modern disturbance. Surveys on sandy soils, clays and alluvium can all deliver useful results, but their effectiveness is also dependent on the size and type of fill of archaeological features. Small features such as post holes and small pits are unlikely to be revealed and recognition is also hindered for those features with fills similar to their surrounding host soils and geology.

63. Geophysical surveys work very well in some situations and less well in others. To maximise the benefit of geophysics, it is best to employ a range of techniques, usually starting with magnetometry, as different techniques reveal different information about buried deposits. It is an inexpensive-medium expense technique that does not require large amounts of labour, but it does require the use of specialist equipment and staff. It is typically employed as part of the pre-determination phase of the planning application, although Lidar surveys already undertaken for many parts of England by the Environment Agency can also provide important information for the LDF.

Evaluation Trenching

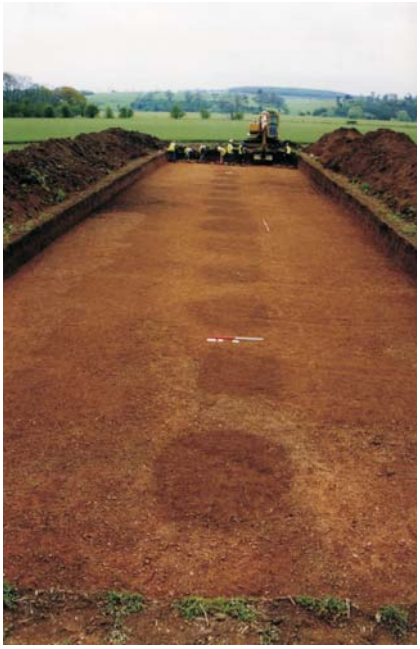
64. Evaluation trenching is a limited programme of fieldwork that is designed to determine the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site.

A programme of evaluation trenching samples a 47 ha site in advance of coal extraction in County Durham.

65. This technique involves stripping the topsoil from a specified area in order to evaluate the nature, extent and condition of archaeological remains on a site. Each site should be considered on its specific merits and the design of trenching should follow a question-led approach that draws on the expectations of what type of archaeology may be reasonably encountered and its likely location. The planning authority may request a sample of the area to be affected to be evaluated. The sample size should be reasonable and appropriate (see the CBI Code of Practice[4] and commentary in Hey and Lacey 2001[19]) as the purpose of evaluation trenching is to identify the potential of an area and not to sample excavate it. Before permission is granted the mineral planning authority should be able to demonstrate that all reasonable steps have been taken to ascertain that no remains worthy of preservation *in situ* will be disturbed by the proposed development.

66. Although evaluation trenching has become a very common technique it can be more effective at finding certain types of archaeological remains than others. Depending on the results of an evaluation, the archaeological curator may decide that further archaeological investigation is necessary. Trenching is particularly effective at finding large features, or linear features, such as ditches, pit alignments, enclosed sites, field systems, Roman roads and so forth. It is less sensitive to archaeological sites that comprise small features with a dispersed distribution. The latter sites include pit clusters, small post-built buildings, or isolated monuments such as some prehistoric burials. If these types of archaeological remains are expected then other techniques should be considered. Evaluation trenching can often be combined with other evaluation techniques to produce the most accurate, speedy and cost-effective means of finding remains that merit preservation *in situ* and identifying other necessary mitigation measures.

67. Trenching is a medium expense technique that can be very effective for locating and evaluating large sites, linear features or sites where certain types of buried archaeological remains are anticipated. It requires a combination of mechanical excavation and limited archaeological investigation to assess the nature, extent and condition of the remains. It is used as part of the pre-determination phase of the planning application.



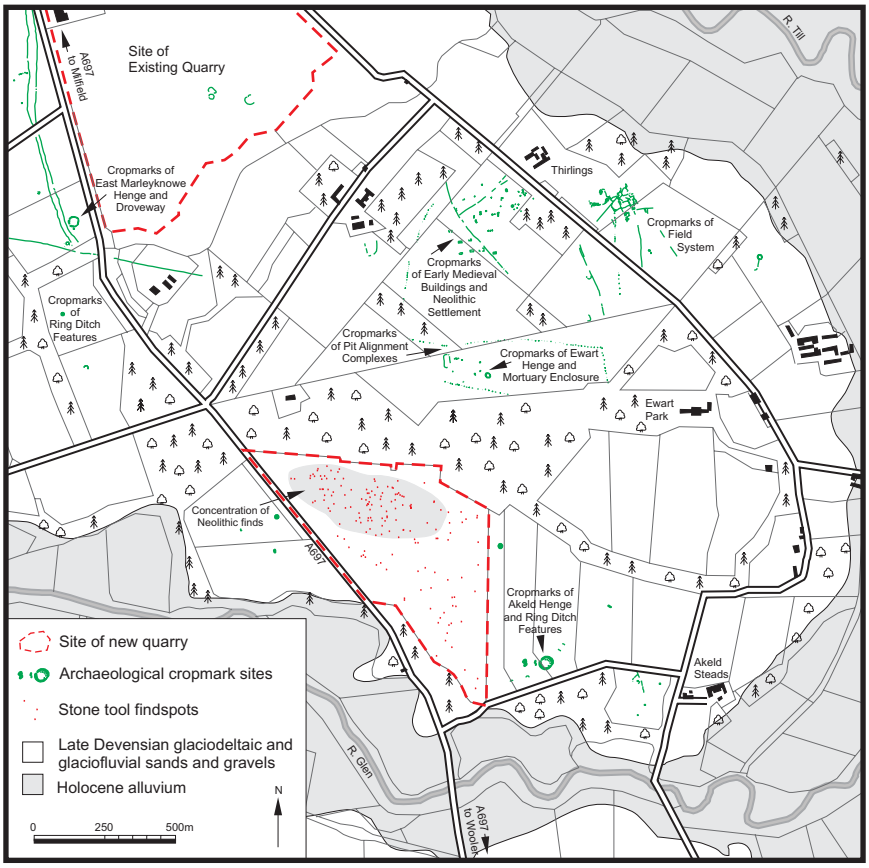
An evaluation trench containing a prehistoric pit alignment at Barrow upon Trent, Derbyshire (©D. Knight, Trent & Peak Archaeology).

Geomorphological Mapping

68. Geomorphological mapping is often the first step in designing evaluation programmes and assessing the palaeoenvironmental potential of sites. This can help understand how the landscape has formed and has been modified through time and in so doing determine not only the potential for survival of remains of different periods, but also their potential state of preservation and the type of techniques required for their evaluation.

69. Geomorphological mapping usually requires a programme of fieldwork and survey by appropriate specialists, supported by desk-based analysis of Ordnance Survey maps, geological maps, aerial photographs and various remote sensing techniques. Geomorphological maps have been used as the basis for landform classification and these can be used to inform archaeological expectations for an area and subsequent decision-making.

70. Field-based geomorphological mapping is a rapid, cost-effective and relatively inexpensive technique which provides the basis for analysis of environmental change and the platform for other evaluation work. Ideally, to maximise cost effectiveness, industry required geotechnical assessments and archaeological geomorphological mapping should be integrated. It can provide important information on past land-use by human populations as well as generate data on past farming practices. Detailed mapping of extensive areas can be greatly facilitated by high-resolution remote sensing techniques such as Lidar, although these may add to the cost of survey. It is typically employed as part of the pre-determination phase of the planning application although prior work can provide important information to the LDF.



Example of a plan which combines pre-determination archaeological field data and geomorphological mapping in the vicinity of a new quarry site in Northumberland. This kind of detailed mapping that contains accurate data from aerial photographs and previous work allows targeted and appropriate schemes of archaeological mitigation to be identified and agreed.

Sediment Analysis

71. Analysis of the depth, nature and age of sediments lying beneath the surface is an important means of understanding landforming processes and environmental history, and should complement geomorphological mapping in palaeoenvironmental investigations. Sedimentary sequences may be well-exposed in eroding river banks, aggregate quarries and drainage ditches. However, these sections may only expose the upper part of sediment bodies and in these cases, as well as in areas that lack any such exposure, it is usually necessary to extract sediment cores using hand-operated or powered augers.

72. Of particular interest to low-lying sand and gravel sites are palaeochannels that reflect changes in the course of past river channels. These former ox-bow lakes and floodplain wetlands are the most likely areas for deposition of peat and organic-rich sediments that are suitable for radiocarbon dating and the preservation of pollen, plant and insect remains. These fossil materials can reveal much about former environments and human land-use and change over time.

A sedimentologist examines a quarry face, and below, an extracted sediment core in the field.

Sediment coring into a kettle hole on a gravel terrace using a percussion corer. Such cores can provide information on past human activity and land-use.

73. Sediment coring and analysis is an inexpensive-medium expense technique which, in association with geomorphological mapping, provides the basis for analysis of environmental change and a means of accessing material for radiocarbon and palaeoecological analysis. It requires the use of specialist equipment and staff and can be employed as part of the pre-determination phase of the planning application or as a post-permission measure.

Determination

74. Following one or more stages of pre-determination works, appropriately informed decisions are taken by the planning authority upon the granting or refusal of planning permission, and if permission is granted, upon appropriate planning conditions or obligations Permission may be granted subject to further evaluation work or full archaeological recording, or, on some occasions, on condition that nationally important remains identified during the pre-determination evaluation stage are 'preserved in situ', or no further action may be required other than the analysis and dissemination of results to date (for an example of a model condition see PPG 16 paragraph 30)[3]. Preservation *in situ* is required when the remains are considered to be sufficiently important (PPG 16 annex 4)[3]. In some cases this may be beneficial for both the protection of the archaeology and the developer, as the latter does not have to bear the cost of full excavation. The key underlying principle behind PPG 16 is a presumption in favour of preservation in situ of nationally important remains and their settings whether scheduled or not. Consideration must also be given to the historic landscape character of the surrounding area and any impacts on historic buildings.

75. The criteria for assessing whether archaeological remains are considered to be of national importance are set out in Annex 4 of PPG 16[3] together with an additional criterion identified by English Heritage as 'amenity value'. The amenity value of a monument may be assessed according to the degree to which it is visible and physically and intellectually accessible. These criteria are currently under review and further guidance can be expected.

Post-Permission Mitigation Measures

76. Guidance for all planning conditions, applicable to post-premission archaeological measures, state that conditions should only be imposed where they satisfy all of the following tests. In brief, all archaeological conditions at any stage in the planning process should be:

1. necessary
2. relevant to planning
3. relevant to the development to be permitted
4. enforceable
5. precise
6. reasonable in all other respects

77. Mitigation measures range from no further work, to full excavation to preservation *in situ* of archaeological remains. Typically mitigation measures may lie somewhere between two ends of the spectrum with a combination of preservation and excavation (i.e. recording). As the choice of mitigation measures requires a long term perspective, due consideration should be given to ensuring that mitigation solutions are sustainable over the long term. This means that in some cases archaeological remains will be protected through 'preservation by design'. This means, for example, that if ground water levels are to be altered, the design of these works is undertaken so as to ensure that archaeological remains do not dry out or suffer from destruction or dessication as a result of such measures. Consequently, some archaeological mitigation can be achieved through appropriate design in relation to working of the extraction site and subsequent restoration.

78. Restoration is a key element of mineral extraction and one that has been carried out to good effect on many sites, thereby improving the landscape and quality of life for local communities. It is important that plans for quarry restoration are in keeping with the landscape character and setting of archaeological sites. In practice this has to be reconciled with a range of interests that may also include biodiversity, geodiversity and recreation.

Watching Brief

79. A 'watching brief' sometimes also referred to as 'archaeological control and supervision' - is defined by the IFA as "A formal programme of observation and investigation conducted during any operation carried out for non-archaeological reasons"[20].

An archaeological watching brief at a whinstone quarry on the North-East coast.

During a watching brief the topsoil stripping is supervised by an archaeologist to ensure that all features and deposits are recorded.

80. Watching briefs are employed when other evaluation techniques have not detected significant archaeological or palaeoenvironmental remains but there is still considered to be some potential for them to survive, or where the presence and nature of remains could not be accurately established in advance of development.

81. A watching brief involves the presence of archaeologists and/or palaeoenvironmental specialists on site who supervise, observe and record any remains exposed during the groundworks. Watching briefs are usually specified by a planning authority as part of a planning condition in order to record any archaeological remains as topsoil stripping progresses.

82. A watching brief is a relatively inexpensive technique as it requires few people to be on site, and if little is identified the results will only require reporting. However, if archaeological remains are found then developers are usually expected to pay for full excavation and recording of the deposits if the development is to continue. For this reason archaeologists usually advise developers to budget for a contingency sum in case archaeological or palaeoenvironmental remains are found.

Excavation

83. An excavation is defined by the IFA as "A programme of controlled, intrusive fieldwork with defined research objectives which examines, records and interprets archaeological deposits, features and structures and, as appropriate, retrieves artefacts, ecofacts and other remains within a specified area or site"[21].

Excavations of an Iron Age roundhouse at Hoveringham Quarry, Nottinghamshire (© D. Knight, Trent & Peak Archaeology).

84. Full archaeological excavation of a site is traditionally thought to be the main activity of archaeologists. Although destructive, excavation is often the most informative field technique and imperative when archaeological remains would otherwise be destroyed. The excavation process follows a typical sequence:

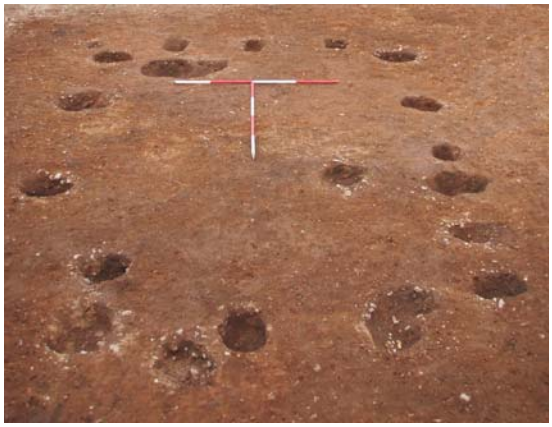
- Once the overburden has been stripped from a site, all features are hand cleaned and planned.
- Each archaeological deposit and feature is usually either fully excavated or sampled and a section drawn, levelled, photographed and surveyed. The fill of a feature is often sieved to assist with obtaining small finds and charred wood and other organic samples for dating and a sample is sometimes kept for further environmental analysis. A record sheet for each feature and deposit is completed.
- Once excavation is complete the field archive is digitised and illustrations drawn up for inclusion in a report and publication.
- Following their assessment any specialist analyses, such as pottery, flint, bone, environmental and dating work are undertaken and reports produced.
- A report is produced that describes the excavation and all the features discovered.
- Photographs, slides and digital pictures are developed, catalogued and mounted.
- A report is then prepared for publication that brings together and interprets all the information, and the site archive is deposited with the regional collections museum.

85. As full excavation is labour-intensive and generates more post-fieldwork analysis than other techniques, it tends to be the most expensive type of archaeological work. It is employed as part of the post-determination phase of the planning application.

Excavation of a Bronze Age house at Milfield, Northumberland, in advance of gravel extraction.

Strip and Record

86. The 'strip and record' method, sometimes referred to as 'strip, map and sample', is different to full excavation as it is primarily aimed at large open area excavation where the intention is not to excavate all the archaeological remains exposed, but rather to plan them in full and selectively sample them to answer specific questions in relation to date, sequence, function and so forth. Firstly the overburden is systematically stripped by machine to expose the top of the archaeological horizons. Archaeological remains within the stripped area are then cleaned, mapped and photographed. Following on from this a process of systematic sampling of deposits is undertaken, the intensity of which is usually decided once it has been established what archaeological remains exist.



An example of an Anglo-Saxon house found under a strip and record condition and which may well have been lost if evaluation trenching missed it and the area was written off as being archaeologically sterile.

87. In certain circumstances this approach has considerable appeal. Firstly, it allows for all archaeological remains to be recorded in plan. This allows for a much fuller understanding of site layout and organisation and the relationship between groups of features and their wider setting, as well as the preservation by record of all remains that will eventually be removed. Secondly, the adoption of this approach may mean that less costly work is required in the pre-determination stage as its adoption as a post-determination measure will ensure that all archaeology on a site is recorded at that stage. Thirdly, resources can be targeted to maximise the information gain rather than excavation of all deposits. This also encourages a question-led, research focused, approach which helps archaeologists to think through what it is the site can tell us.

88. Some of the most important gains in archaeological knowledge in recent years have occurred through the use of the strip and record approach. These have included the discovery of sites that are virtually impossible to prospect for, such as the Dark Age houses and late Bronze Age settlement discovered at Cheviot Quarry, which have plugged important gaps in the settlement history of North East England. Similarly, ephemeral remains have come to light unexpectedly as a result of this approach and these can add significantly to our understanding of the past, the Neolithic 'long house' at Yarnton and the eight Neolithic buildings at Lanton being good examples.

89. Strip and record can be expensive but it can be more cost-effective and less expensive than full excavation. The drawback is that the exact costs are not known until the area has been stripped, cleaned and mapped. However, as subsequent excavation is targeted this does mean that resources can be allocated to best effect. The adoption of this approach can, in some cases, reduce the quantity and therefore the cost, of pre-determination measures. For further information about this technique and its implications within the context of the planning process see the publication by Hey and Lacey (2001)[19].

A strip and record approach on this 10ha quarry site allowed for targeted excavation and a full record of the archaeological remains in plan.

Archaeological Survey

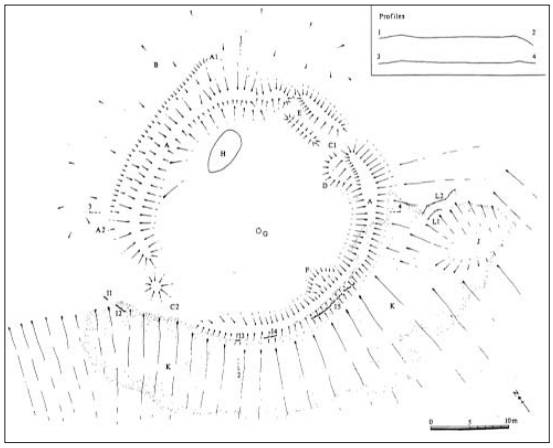
90. Survey is a non-intrusive method for recording upstanding archaeological remains. It is particularly useful for understanding constructional relationships and is used on earthwork sites and those with standing buildings or masonry. Surveys can take a variety of forms; the recording of upstanding features, landscape topography and contour surveys. If upstanding remains are to be excavated it is standard practice to accurately survey the site in advance of excavation. In addition, if the setting of a site or landscape character may be disturbed by a development, then a survey of the surrounding area may be required.

91. Surveys can often be enhanced by reference to aerial photographs which help show large features more clearly, as well as the presence of buried features.

92. A rapid means for assessing the upstanding archaeology and standing structures of large or inaccessible areas, such as woodland, is by the use of a walkover survey. This comprises systematically walking over a given area plotting all features onto a base map.

Survey can reveal relationships between upstanding remains without the destructive impact of excavation, such as this circular structure that postdates the prehistoric fort rampart running below its far edge.

93. Survey is a recording technique that can be employed either pre or post-determination. It is a medium expense cost that requires time in the field by a team of usually two or more people depending on the size of the site. It involves the use of specialist survey equipment, GPS instruments and specialist surveying software and drawing packages to produce scale drawings from digital output.



A survey of an upstanding Iron Age hillfort that stands adjacent to a Whinstone quarry at Howick close to the Northumberland coast.

Palaeoenvironmental Analysis

94. If it is known that development will remove deposits of high palaeoenvironmental potential planning conditions/obligations may require the analysis of those sediments.

95. Finer-grained sediments accumulating in ox-bow lakes and peat bogs trap and preserve pollen grains and fragments of plants and insects that existed at the time of deposition. These fossil remains can be extracted from sediment samples and identified in the laboratory. When combined with radiocarbon dates from their associated sediments (or the fossils themselves) these records help to build a picture of the plant and insect communities contemporary with past landscapes and their inhabitants.

Sediment samples are taken from a trench section using monolith tins for analysis in the laboratory.

96. The palaeoenvironmental record may contain evidence for human activity such as deforestation, pastoralism and cereal cultivation and hence it forms part of the archaeological record. Furthermore, in areas where the archaeological record is disturbed or absent, palaeoecological techniques may assume particular importance as the primary means of evaluating the presence and activities of past societies.

The samples are analysed to determine what kind of vegetation grew and how the landscape changed through time.

97. Palaeoenvironmental techniques can provide evidence for environmental setting and land-use during earlier periods and, in areas where other archaeological materials are disturbed or absent, and it may constitute the sole record of former human activities. This record is therefore an important component of the historic environment. Palaeoenvironmental analysis is a medium cost technique depending on the scale of assessment, and requires the use of specialist facilities and staff.

CONCLUSION

98. The historic environment and mineral resources are finite and irreplaceable and it is incumbent on all stakeholders to value these resources and, wherever possible, manage them in a balanced way. The recent Government statement "The Historic Environment: A Force For Our Future"[22] identifies how the historic environment contributes to people's quality of life and its place in relation to development. This is reflected in the core values of the Quarry Products Association which includes the statement, "QPA members recognise the importance of our national heritage and the contribution that industry can make to furthering knowledge of our heritage through archaeological exploration, including where appropriate, preservation *in situ*."

99. Sustainable management of the historic environment is vital as it underpins the character, history and enjoyment of the countryside as well as attracting important tourist spend, all of which can be important considerations for communities where mineral development takes place. The important archaeological work contributed by mineral operators in England merits significant appreciation and should form one of the key indicators of successful sustainable development, both for the minerals industry and planning authorities.

An attractively restored area of a Whinstone quarry in Northumberland which it is hoped to open up for public access and interpretation.

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Web Sites

Relevant Organisations

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British Aggregates Association www.british-aggregates.com
English Heritage www.english-heritage.org.uk
Institute of Field Archaeologists (IFA) www.archaeologists.net/
Quarry Products Association (QPA) www.qpa.org.uk/

Sources of Information and Advice

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Archaeological Research Services Ltd - www.archaeologicalresearchservices.com
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English Heritage Historic Environment Advice Pages - www.helm.org.uk
Mineral Industry Research Organisation - www.goodquarry.com
PPG 15 - http://www.communities.gov.uk/index.asp?id=1144041
PPG 16 - http://www.communities.gov.uk/index.asp?id=1144057
Till-Tweed Project -http:// www.ncl.ac.uk/till-tweed/
Regional Research Frameworks for the Historic Environment.

Each of the English government regions has devised its own regional research framework, some of which have been published as books and others are available on-line. The local authority archaeological curator will have the reference for their given area.

Minerals and Historic Environment Forum: Constituent Representatives

Association of Local Government Archaeological Officers: UK
Archaeological Research Services Ltd
British Aggregates Association
Confederation of British Industry Minerals Group
English Heritage
Institute of Field Archaeologists
Mining Association UK
Planning Officers Society
Quarry Products Association
Standing Committee of Archaeological Unit Managers