Survey drawings

The scale of a survey drawing must be appropriate to the level of recording, the nature and extent of the site, the amount of detail that is available and the use that will be made of the survey. A Level 1 survey will require little more than a location symbol on a map or a delineated area showing the approximate extent of the site. Level 2 surveys will normally be drawn or designed at scales of up to 1:2 500, whereas surveys at Level 3 will require plans at 1:1 250 scale or larger. The same scale should, so far as is possible, be adhered to throughout a project (especially a thematic one) in order to facilitate the comparison of different examples. To help make complicated remains comprehensible, interpretive diagrams or phase plans should be provided. Terrain modelling can be used very effectively to illustrate and explain the relationship between the site and its topography: in certain circumstances this may be preferable to contour modelling which is less easy to understand.

Particularly complex relationships within a site may need to be drawn at a larger scale than the rest of the survey; these may be shown as an insert or window. Profiles should be drawn where it is necessary or helpful to show the ground surface, especially that of a bank or ditch in section; these will normally be drawn at a much larger scale (eg 1:1 250) as appropriate. As a general rule, exaggeration of the vertical axis is to be discouraged, but is sometimes necessary. For both profiles and for detailed windows, the scale, position and orientation of the supplementary drawing must be shown clearly.

All drawings must include a north point and a metric scale bar. There may be occasions when the inclusion of an imperial scale is necessary. This may be particularly appropriate in the case of a new survey of a site with a history of investigation prior to the introduction of metrification. All drawings (except those for publication) must be clearly labelled with the name of the site, the surveyor and the date of the survey. Drawings in a set must be cross-referenced to each other.

Drawings may be executed by hand, or computer generated: hand-drawn plans can be scanned into the digital environment to allow further manipulation. The growth and development of digital archives have led to an increasing requirement for the provision of survey information in an electronic format to allow manipulation and interrogation within GIS. Survey data are captured using EDM and GPS equipment. These developments have prompted the increasing use of CAD and Desktop Publishing software in the processing and presentation of survey data. This has made survey data more flexible and easier to manipulate into different formats than when drafted in traditional hand-drawn format.

The drawing conventions at each Level should follow standard EH practice as laid out in the archaeological drawing conventions below. Surveys should also contain the appropriate corporate logo. In order to record this, and other pertinent information, EH has devised a standardised information block, which must be included and completed on all survey drawings prepared for the NMR.

A set of drawings may include the following Items:

13 A diagrammatic plan showing the location or extent of the monument or landscape.

14 A metrically accurate site plan, typically at 1:1 000 or 1:2 500, showing the form of the site or landscape. The plan should be related to topographical features and to modern detail (field boundaries etc), whether or not they are depicted on OS maps. The use of larger scales (e.g. 1:500 or 1:250) may occasionally be justified, where relatively intricate detail needs to be shown. The scale 1:1 250 may be justified in urban areas where this is the OS basic scale. (Note. As cartographic information in digital form is now the norm, the concept of basic scale weakens as the reproduction of maps at a greater range of scales becomes possible; however, the traditional suite of mapping scales remains a useful benchmark.)

15 Profiles illustrating salient vertical and horizontal differences in the ground surface. Their position must be marked on the site plan and their orientation distinguished by means of a reference letter and arrow at each end of the section line.

16 Interpretive diagram(s) showing successive phases of development; phase plans must be accompanied by an unaltered copy of the survey from which the interpretation has been devised. Full cross-referencing must be included.

17 Reconstruction drawings may be particularly relevant. Such drawings must always be fully cross-referenced and must be accompanied in the record by copies of the survey plans on which they are based.

18 Copies of transcriptions of aerial photographs, either undertaken as part of the National Mapping Programme (1:10 000) or as specific larger-scale exercises.

19 Copies of plans that throw light on the history and interpretation of the monument. This includes any excavation plans which contribute to an understanding of the visible remains. The location of excavation trenches should be clearly shown on the new survey, with some indication of their accuracy. If a report is to be published, the copyright of any plan or photograph must be taken into account.

20 Copies of any plans derived from geophysical or geochemical investigation. The limits of survey or common points must be shown. An accessible presentation of the data should be superimposed on a second copy of the new survey.

21 Copies of gridded plans showing the location of archaeological objects and the extent of artefact spreads found by 'field-walking'.

Records are now often produced wholly or partly in digital form, whether as a word-processed computer file, an EDM or GPS survey of a site, a CAD drawing or a digital photographic image. Detailed guidance on this and a range of digital archiving issues are available from EH: **http://www.englishheritage.org.uk/upload/pdf/M0RPHE_Technical_Guide_1_Digital_Archiving_and_Dissemination.pdf**

While in theory it is possible to store all such material in digital form in perpetuity, experience has shown already that even the storage media themselves can be rapidly superseded by technical developments. Additionally, the long-term stability of magnetic and digital data is currently unproven.

It is necessary to distinguish in this area between data that is stored in an active computer system (on-line) and data that is stored on other media, such as floppy discs, CDs or DVDs (off-line). In the case of on-line data, curation problems are reduced if the system is backed up regularly and the data adequately migrated when the system

is itself upgraded, but it is important to appreciate that the advent of new software and hardware platforms may result in restricted access or functionality.

Where digital data is to be deposited as part of the archive record it is imperative that the intended repository is contacted as early in the recording process as possible. This will help to ensure that the repository is willing and able to accept and access the data in the hardware and software configurations used. While some national archive repositories can store data in on-line systems, most local repositories are likely to store material in off-line formats, at least in the short term.

Where records are written to off-line storage media it is recommended that at least two copies are created, preferably on different types of storage media, and that these are stored in different locations. The long-term storage of off-line data presents a number of problems in maintenance and curation. It requires stable storage conditions, regular copying to ensure that magnetic-based information is not lost, and regular up-grading to keep it accessible as software changes. Additionally, the pace of change in computer hardware means that some early storage formats have already become obsolete, and it may be necessary to transfer data between different types of media to ensure continued use.

At present, therefore, it is always advisable to hold a hard copy of all data deposited in digital form. While the digital record can provide information not susceptible of reproduction on paper (eg three-dimensional views, or the ability to examine minute areas of a drawing in close detail) the paper archive at least ensures the currency and accessibility of most of the information. Further guidance on digital data issues can be obtained from the Archaeology Data Service (**http://ads.ahds.ac.uk/**).

Case Study 11

Chester amphitheatre: a Level 3 survey of an urban landscape

In 2004, EH in partnership with Chester City Council commenced a programme of excavation and non-invasive survey at the site of the Roman amphitheatre, close to the city centre. The aim of project on this internationally important monument was to provide both organisations with up to date and well-researched information about the site and its role in the development of the urban landscape of Chester. The results of the investigation were intended to inform the future management, conservation and display of the monument, as well as underpinning the excavation recording process and providing context for its results.

Although approximately half of the site had been extensively excavated in the 1960s, little of the site's post-Roman context had been recorded, or even acknowledged. There was, therefore, a massive gap in the contextualisation of the excavation findings as well as in the overall understanding of the historic landscape. To formulate sensible management and conservation plans for the future of the site and its landscape character it was necessary to address this imbalance of understanding through non-invasive survey.

One of the problems of studying the development of a part of an urban landscape is defining the physical limits of survey, and in this case a rapid desk-top study of historical cartography, published history and previous excavation was made to establish sensible boundaries to the study area. This initial rapid survey provided sufficient background information to define the limits of a wide enough landscape area to provide context and understanding, but without diluting the primary aims of the project.

A number of survey methodologies were then identified that were appropriate to that area and the project aims. As existing OS digital urban mapping at 1:1 250 scale was insufficiently detailed to act as a base-map, the first stage was to undertake a new detailed topographic survey of the study area at a scale of 1:500; this was commissioned from an external contractor. This provided a highly accurate plan of all structures and features in the area. The data was captured electronically using a total-station EDM and the results were presented as computer-based AutoCAD® drawing files to ensure file exchange compatibility between the various non-invasive surveys and client organisations. Because future management of the area was an issue, it was necessary to include even small details such as wall thicknesses, trees, shrubs and street furniture, and all ground points were recorded in plan and height to permit production of computerised 3D ground models and allow inclusion of depth data derived from excavation. This was tied into OS National Grid using differential survey-grade GPS.

Even though this was an urban area, there were sufficient open spaces to allow geophysical survey to be used to clarify the existence of buried structures. Resistivity, magnetometry and ground-probing radar were commissioned from an external contractor, and applied as appropriate. The resulting data was provided in an electronic form compatible with the base dataset, and as an analytical report (Geophyisical Surveys of Bradford [GSB] 2004). More building blocks for the study were established by the capture of up-to-date oblique aerial photography, using fixed-wing aircraft for general context coverage and tethered balloon for low level capture. Ground photogrammetry was used to record standing fabric of the amphitheatre and laser-scanning of the previously excavated area was also undertaken to provide a 3D record of the site and form the basis for computer-based reconstruction models.

All these surveys provided the building blocks from which the understanding of the historic components and development of the landscape could be formulated, as well as forming a metrically accurate record. In addition, Architectural Investigators from EH undertook a rapid survey of the standing buildings, which was made available in report form (Menuge *et al* 2004). This was then followed by a detailed ground survey and study of the historical mapping by archaeologists from EH. This involved researching and acquiring historic cartography from the County Records Office, museums and other library sources. All the survey data and historic map data was converted into a common electronic format for comparative use with the other datasets. A similar trawl and analysis of historic topographic prints, paintings, illustrations and vertical aerial photography was undertaken. A specialist researcher with knowledge of local records was commissioned to examine documentary sources. The modern history of the site was pursued through a community involvement programme to acquire memories and photographic images.

Armed with this material, and by using observation and analytical skills, ground survey was undertaken using the metrically accurate base-map against which to record and analyse the historic development of the landscape. The area was divided into 16 map sheets each covering an area of 80m^2, which were plotted on polyester at a scale of 1:200. Various historic plans

Extract from OS 1:500 scale map of 1874 of the study area using colour to convey interpretation of mapped features and correlation with the modern road layout and buried archaeological remains (© and database Crown Copyright and Landmark Information Group Ltd (All rights reserved 2006). Licence numbers 000394 and TP0024). Map regression forms an integral part of urban studies, and computer software makes the process of the comparison of different editions, scaling, adjustment and presentation simple. GIS can also be used to enhance the value of the collected information. The inset shows the same area as mapped in 1791 (© Grosvenor Museum, Chester City Council).

Archaeological drawing conventions

Background considerations

The purpose of a set of drawing conventions is to provide consistency and clarity in the production of archive or publication plans, regardless of whether they are hand-drawn or produced digitally on a computer. As well as the employment of a standard scale bar, north arrow and style of lettering, consistency is achieved through standardisation of symbols for the depiction of archaeological features (eg earthworks, cairns, ruined walls) and non-archaeological features (eg modern fences, roads and tracks). Clarity is achieved by adapting the conventions to the scale of the finished plan; by the selective use of annotation and by the provision of a key explaining the conventions used. As a minimum standard, all the plans within a project or publication must use the same conventions but the ultimate aim for an organisation is to have a single set of conventions for all its mapping output. This aim towards consistency should also extend to the naming of computer files and to layers and blocks within files where maps or plans are to be stored digitally.

Computer drawing packages help in the setting up of mapping conventions by enabling the user to design a library of symbols and line-types that are easily transferred between drawing files across a range of projects. Computer technology also gives access to colour although care should be taken to use coloured conventions sympathetically, to avoid a garish image that is difficult to read, and therefore ends up masking information. The use of colour is unrestricted when it comes to preparing maps and plans for digital, on-screen presentations and for inclusion in office reports produced on desk-top colour printers. Colour is less widely available for published illustrations due to the increased production costs. Where a map or plan is for publication it is important to ascertain at the outset if it is going to appear in black and white or colour in order to design the conventions accordingly.

Objectives

EH uses a standard set of mapping conventions for the depiction of archaeological sites and landscapes. (It is acknowledged that special circumstances sometimes require additional or alternative conventions.) The aim in issuing the EH conventions is:

- to promote the use of a set of conventions across the profession adapted to the recording and interpretation of archaeological sites and landscapes;
- to facilitate the comparison of plans of different archaeological sites and landscapes through the use of a standard set of conventions;
- to facilitate the comparison of plans produced by different archaeological organisations by promoting the use of a standard set of conventions;
- to provide guidance on the level of information and the preferred conventions for drawings acceptable to the NMR archive;
- and to indicate a minimum level of information that should be included in archive and publication drawings.

General points

As a minimum standard, all plans should include:

- a metric scale bar, and if appropriate, an imperial bar
- a north point. This should be annotated with MN to indicate that the direction relates to magnetic north (in which case the date should also be included); with GN to indicate direction related to the orientation of the national grid; or with TN to indicate direction to True North calculated by reference to information on local OS map sheets.
- a key to illustrate the conventions used. To avoid repeating the key on each map or plan in a publication, the conventions used could form a separate figure that appears before the first of the illustrations to which it relates.

All archive plans should include an information block containing:

- site name
- District
- scale of survey
- surveyor(s)
- associated plans
- project name
- NGR
- County
- Parish
- date of survey
- survey method
- office of origin
- document status
- any unique identifying number (eg SAM number, NMR, SMR or HER)

Where the plan is to be stored digitally, the information block need not appear on the drawing but could be embedded in the file as metadata.

All archive plans should have a grid, preferably depicted by means of marginal ticks, with numeric values qualified by a statement as to whether it is a local grid (ie a site grid) or related to the National Grid. There is no need for a drawn grid on digital maps and plans where the base co-ordinates of the drawing relate either to a local grid or to the National Grid. However, the statement as to the origin of the grid still needs to appear as text on the drawing or stored as metadata.

Case Study 12

Spadeadam Rocket Establishment, Cumbria: a Level 3 survey of a technological landscape

Spadeadam Waste lies between the border towns of Brampton, Cumbria and Haltwhistle, Northumberland. In the late 1950s this high desolate moorland was chosen as the site for the testing of Britain's indigenous, intermediate range ballistic missile Blue Streak. The construction of the rocket establishment transformed the moorland into a complex technological landscape, inter-connected by roads, electric transmission lines, water pipes and more specialised linkages, such as high pressure nitrogen pipe lines, and command and control cables. Since 1976 this 3,000ha range has been used by the RAF as an electronic warfare tactics range.

Greymare Missile Test Area, low level oblique air photographs enable the relationships between the natural landscape and manmade features to be quickly appreciated. © English Heritage NMR 17819/05

As part of continuing improvements to the management of its estate the Ministry of Defence, through the RAF and Defence Estates, is producing Integrated Rural Management Plans (IRMPs). The primary aim of the investigation was to identify and record the remains of the rocket establishment to aid their future management.

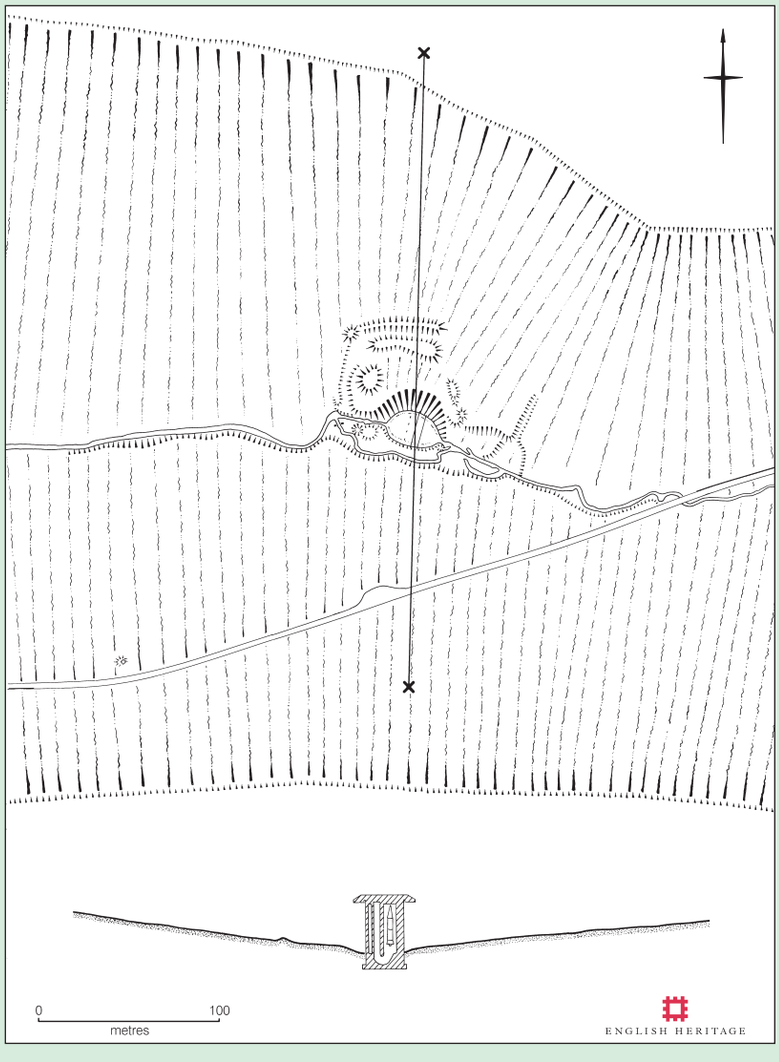
The starting point for the investigation was a topographic survey of the main rocket test areas. These were open and ideally suited to recording using differential survey-grade GPS equipment. The use of GPS equipment allowed widely-spaced locations to be easily positioned on the same grid and produced an electronic data set that could be plotted at a variety of scales.

Some original site drawings did survive but their coverage was patchy and for some areas non-existent. They also often represented the engineers' intentions (rather than as-built plans) and in some locations omitted modifications made during construction. They also did not show many significant features associated with the site's construction, including a temporary navvy camp, building workers' huts and the foundations of a concrete mixing plant. Also absent from the original drawings were features associated with the site's use in the 1960s by the European Launcher Development Organisation (ELDO) and later by the RAF.

The new survey provided a point in time record that could be used to produce a detailed analysis of the development sequence of each area, but also provided the estate's managers with precise identifications of all the Rocket Establishment's buildings and ancillary features.

Architectural drawings were also prepared for some of the key installations, including the main rocket stands and the heavily protected block houses from where the tests were controlled and monitored. These were recorded by a combination of a total-station EDM, hand measuring and booking techniques. The resulting drawings were prepared using AutoCAD® software. In addition to the drawn record an inventory was made of all the Rocket Establishment's buildings and key features, using a standardised form and cross-referenced by number to the drawings. Information on the sheets included grid references, and notes of documentary sources confirming construction dates and former functions. In nearly all instances a photograph was attached to the forms.

The forms provide a record of the different features and are an important source of data for the management of the range's historic assets. They allow the significance of different structures to be quickly appreciated, so that, for example, training activities may be modified to avoid damage.



Survey of the earthworks associated with the abandoned 1959 underground launching facility project. This drawing was produced using traditional pen and ink techniques.

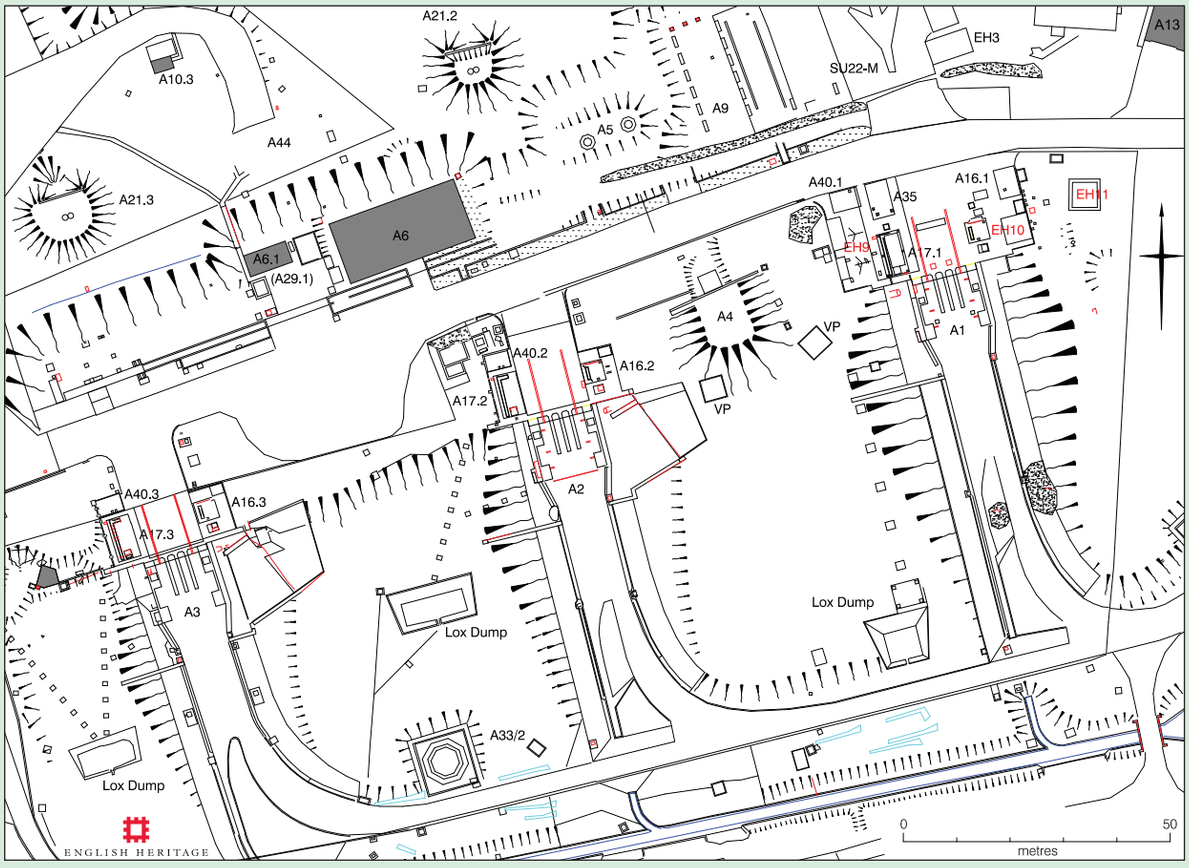
Even on a recent site as comparatively well-documented as Spadeadam, aspects of the site's history remained poorly understood and the archaeological remains of those activities are the only substantial confirmation of their existence. One persistent rumour was that work had started on an experimental underground launcher facility, or silo, for the Blue Streak missile.

Contemporary air photographs revealed disturbed ground in an area where it was suggested that the silo excavation might lie. Earthworks in the area revealed a roughly circular hole with traces of a concrete lining around its lip and a by-pass channel with sluices to divert water around the excavations (Cocroft 2006).

An important aspect of this project was the collaboration with an oral history project run by Tullie House Art Gallery and Museum, Carlisle, and the video installation artist Louise K Wilson. The oral history project had many benefits: the stories told by the veterans were a significant contribution to the social history of the establishment and helped to clarify aspects of the site's operation and history. Another valuable gain was the unearthing of many contemporary photographs. Louise's film was important in exploring the character of the range and what it meant to different groups of people.

The archaeological survey was presented as an illustrated, hardcopy report setting the site in its historical context and describing its development. This was supported by drawings and a separate volume containing the forms with the descriptions of the individual features. It was also converted to pdf format for supply on compact disc. The work of the oral history project was presented by an exhibition of images and artefacts, supported by an archive of recordings, photographs and other documents. Louise K Wilson's film was shown at exhibitions and conferences elsewhere. Less tangible is the increased local awareness of the work that had gone at Spadeadam. In the future modern technology not only offers the possibilities of presenting such projects on a single CD, but also offers a means for the electronic interactive exploration of an historic environment and what it means to different groups of people.

This project illustrates how an archaeological survey of a recent defence site may act as a catalyst for other forms of research and activities, and through which a local community can appreciate the significance of historic landscapes where physical access may be barred. The survey archive has been deposited in the NMR, Swindon.



An extract of the survey of the Priorlancy Engine Test Area. The numbers on the diagram are cross referenced to individual recording forms. The drawing was produced using AutoCAD® software.

Conventions for large-scale drawings (1:1 250; 1:1 000 and 1:500)

Natural Features

Contours

Contours depicting the natural terrain should be unobtrusive in the drawing. This can be achieved by means of a thin, dashed or dotted line, with slightly thicker lines to emphasise major contours (for example every 25m where contours are at 5m intervals). To preserve clarity, contour lines should not cross other drawn features, such as earthworks. Contours should be labelled selectively so as to make the direction of the natural slope intelligible without cluttering the drawing. Make it clear that the contours are in either feet or metres by adding "ft" or "m" after each contour label in the drawing, or by a statement in the key or caption.

Natural hachures

Natural hachures can be used instead of contours where it is necessary to emphasise or precisely depict the shape of a particular slope. Natural hachures

are drawn with thin heads and broken, wavy tails to distinguish them from hachures representing artificial slopes (*see below*).

Water features
The edges of wide stretches of water, such as a pond or a river, are shown by a continuous line, paralleled by a wavy broken line simulating water. A stream may be too narrow to show both sides, in which case it is shown by a single line representing the centre of the watercourse. Use an arrow to indicate the direction of flow for all types of watercourse.

Rock exposures and boulders
Outcrops are shown by a combination of long and short lines at right angles to the rock edge, with the length of the longest lines determined by the width of the exposed face. Reference should be made to large-scale OS mapping for examples of this convention. Surface exposures of bedrock are depicted by hatching.

Large rocks and boulders are shown in outline, but where they form part of a structure they can be filled in for emphasis (*see below*). Spreads of rocks, such as scree, are shown by stippling. Use a varied dot size to suggest a mixture of rock and smaller stones (*see* Conventions 1, page 11 and Conventions 2)

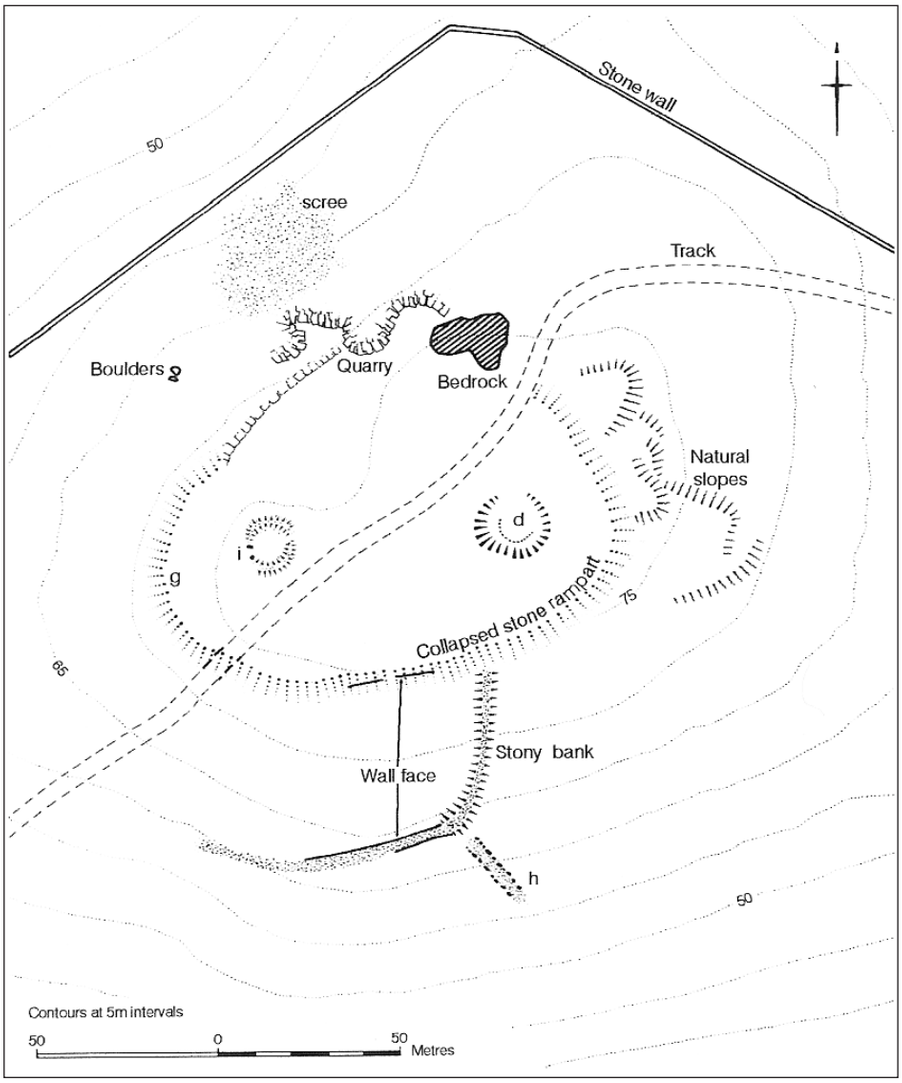
Archaeological features

Artificial slopes
Hachures are used to depict artificial slopes. They are an extremely versatile method of depicting the wide range of slopes encountered on an earthwork site (*see* Conventions 1, page 11 and Conventions 2); *see also* Bowden 2002, fig 20). Used with care, they can show a wide variety of earthworks ranging from very slight slopes shown by small-headed hachures with broken tails (a) to very steep, wide slopes shown by thick-headed hachures (b). For, as well as the shape of the hachure, the spacing along an earthwork also conveys much about the type of slope. Narrowly spaced hachures indicate a steeper slope than where they are drawn widely apart. Care is needed not to place hachures too closely together as there is danger that the heads will coalesce into an unintelligible mass. Equally, if the hachures are too far apart they will not define either the shape or the alignment of an earthwork adequately. The most difficult slopes to define by hachures are those on tight curves, such as the edge of a circular pit or mound. In these cases, particular care has to be taken over the alignment and spacing of the hachures to get an accurate depiction. This sometimes necessitates adding short lines in between the tails of hachures to maintain the uniform representation of a slope (c). Where a feature is too narrow to be shown by hachures, such as the groove left by a timber roundhouse (d), a single dashed line can be used

Ploughing
Irrespective of age, it is not usual to depict the earthwork remains left by ploughing as hachured slopes. A line convention is generally used as an alternative to hachures, with the line following the furrow rather than the ridge. Narrow ridge-and-furrow ploughing (which typically results in straight, closely-spaced furrows) is shown by short dashes (e), while long dashes are used to show broad ridge-and-furrow (f).

Stony features
Stipple can be used in among hachures to indicate earthworks with a high stone content, such as stony banks, or used without hachures where the feature is comparatively flat. Where major slopes are formed entirely of stone, such as the collapsed stone rampart of a prehistoric hillfort, the hachures are drawn as strings of dots with larger dots used to define the head of the hachure (g). Wall faces are indicated by a continuous solid line or, if the scale allows, by showing the individual stones as filled shapes (h). Standing stones and orthostats are also shown in this way (i).

Quarrying
Quarried faces are depicted in the same way as natural rock edges. Annotation should be used to distinguish quarries from natural rock exposures when both occur on the same plan. Dumps of quarry spoil are shown by hachures with stippling to indicate stony material.



Conventions 2

The modern landscape

Standing buildings

Standing buildings are shown with diagonal hatching. Where individual buildings abut, the party wall is shown. Cross-hatching is used to show glass structures. Roofless buildings are shown in outline. Free-standing walls are shown in outline or can be emphasised with a solid fill where of archaeological significance (j).

Walls, hedges and fences

Stone walls are shown by two parallel lines, while fences are shown by a single continuous line. Hedges are shown by a double wavy line to give the impression of vegetation.

Road, tracks and paths

The sides of a metalled road are shown by a solid line, with a dashed line to indicate the edge of the metalling. The edges of an un-metalled track are shown by a dashed line.

Conventions for small-scale drawings (1:2 500 and 1:5 000)

Archaeological features

The capacity to show small detail is restricted on maps at these scales (*but see* Case Study 4). Instead, greater use can be made of symbols, tone and (where possible) colour to construct the map allowing the freedom to develop conventions specific to a particular map or project (*see*, eg, Oswald *et al* 2007).

Natural features and the modern landscape

The conventions used are based on the large-scale mapping conventions described above, but simplified to accommodate the reduced scale. For example, stone walls should be shown by single, rather than double lines, while cross-hatching to denote buildings can be replaced by a solid fill.

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Landscape of former lead mining, Scordale, Cumbria (photograph by Bob Skingle) © English Heritage. (NMR DP 028633)

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