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Summary

Gloucestershire County Council Archaeology Service was commissioned in March 2004 to undertake an assessment of the archaeological resource threatened by the extraction of aggregate minerals within Gloucestershire. This project consisted of a consideration of the archaeology within the aggregate producing areas of the county and the formulation of a Resource Assessment and Research Framework for those areas. This report presents the results of this survey and suggests areas where further work should be targeted in order to better understand the archaeology of areas potentially under threat from aggregate extraction.

Summaries of the methodologies used and an outline of the results of the project can be found on the project website at:
http://www.gloucestershire.gov.uk/index.cfm?articleid=7795

Since this report was produced, the planning system has undergone a number of significant changes following the introduction of the Planning & Compulsory Purchase Act 2004. As a result, some of the information included in Section 1.3 of the report is now out of date. For further information on the new Act, please see:
http://www.planningportal.gov.uk/england/professionals/en/1085083698055.html
and for details of how this affects Gloucestershire see:
http://www.gloucestershire.gov.uk/index.cfm?articleid=1405

Further archaeological developments have also occurred since the drafting of this report, most notably the preparation of the South West Archaeological Research Framework which prepared both a resource assessment and research framework for the South West region. Copies can be found at :
http://www.somerset.gov.uk/somerset/cultureheritage/heritage/swarf/

1. Introduction

1.1 Background to the project

1.1.1 Gloucestershire has a range of geological resources used as aggregates. These consist of two groups of limestone (one in the Forest of Dean and one in the Cotswolds) and the sand and gravel deposits of the river valleys. Roughly 2 million tonnes of crushed rock and c.800,000 tonnes of sand and gravel are produced annually in the county.

1.1.2 The main aim of the project was to improve the amount and quality of archaeological information available regarding the aggregate producing areas, and thus allow more informed advice regarding the archaeological impact of aggregates extraction to be given at:

- Future Minerals Local Plan reviews
- Reviews of existing minerals planning permissions
- Assessment of new applications for minerals planning permission

1.1.3 A countywide Minerals Local Plan has been adopted by Gloucestershire County Council, which identifies ten sites or areas of search for minerals extraction including the supply of aggregates. The identification of sites for inclusion in the plan has provoked widespread public debate, and considerable opposition, especially to the limestone sites in the Forest of Dean and the Cotswolds, where most of these reserves lie within Areas of Outstanding Natural Beauty.

1.1.4 Consideration of the archaeological implications of site allocation is difficult at this strategic planning stage since it is often hampered by insufficient archaeological information to enable judgements to be made between sites. In contrast, once the allocations have been made and the strategic plan adopted, reasonably efficient procedures exist to allow the archaeological implications to be investigated within the planning policy guidance framework. These mechanisms do not exist at the strategic planning stage. The majority of the strategic decisions about land allocation are therefore made on the basis of inadequate knowledge.

1.1.5 Old planning permissions for aggregate extraction (given prior to the introduction of the current archaeology and planning guidance and legislation) exist within each area of aggregates resources. Some progress has been made in addressing the archaeological implications of these permissions through their review by the minerals planning authority. There has, however, been no systematic review of the issue in an archaeological context.

1.1.6 This project has provided an opportunity to construct a strategic overview of both the extent and character of the aggregate deposits in the county, and the archaeological resource in these areas. The enhanced understanding will inform future decision making on priorities for the preservation of nationally important archaeological sites through designation and the management of archaeological sites through the minerals planning process. Other project outputs include a research framework that will inform decision making, and an opportunity to develop a better awareness of archaeological issues within the minerals industry and the general public.

1.1.17 This report was originally compiled in 2005. Minor edits have been made based on comments received during and after a conference held in December 2006 at which Aggregate Archaeology Surveys for Gloucestershire, Warwickshire and

Worcestershire were presented and discussed. Changes have been made to the text to reflect errors of fact or emphasis and where greater clarity was requested. The revised report does not take into account work undertaken or published since March 2005, including the South West Archaeological Research Framework.

1.2 Aims and objectives of the project

1.2.1 Aims and objectives of the project were formulated with reference to the criteria published by English Heritage for Aggregate Levy Sustainability Fund (ALSF) projects. The project was designed to fulfil two of the three main criteria set out by English Heritage. These were:

> *A. Projects to increase the understanding and dissemination of knowledge gained from previous work undertaken on aggregate extraction landscapes: both to the local communities and the wider academic and public. This work will also improve our ability to predict future impacts in such environments (see B).*
>
> *B. Projects aimed at developing the capacity to manage the impact of aggregate extraction on historic landscapes in the future. To develop reliable predictive information to enable curators, planners and the industry to better manage the impact of future extraction on the historic environment.*

1.2.2 The project was commissioned by English Heritage on the basis of a project outline submitted in November 2002, and accepted by English Heritage in March 2004. A Project Design was subsequently submitted to English Heritage, in support of an application for the funding of the project under the Aggregates Levy Sustainability Fund (project number 3346). The Project Design outlined seven aims for the project. These were:

> *To facilitate decisions regarding strategic planning, management and preservation of archaeological sites and historic landscapes in the aggregate producing areas.*
>
> *To define the aggregates resource in Gloucestershire.*
>
> *To identify the areas of past, present and future aggregate extraction.*
>
> *To undertake limited data capture to facilitate the other aims*.
>
> *To assess the state of knowledge regarding the archaeology of the aggregate areas.*
>
> *To develop a draft archaeological research agenda for the aggregate areas.*
>
> *To increase public and industry awareness of the archaeology of the aggregate producing areas.*

1.2.3 To meet these objectives a project methodology was formulated (see Methodology, Section 2). The main points of the methodology were the definition of the aggregate minerals producing deposits and the collection of data regarding all aggregate minerals planning permissions. Archaeological data for these areas was then collected from the county Sites and Monuments Record to assess the nature, date and extent of archaeological material within the aggregates producing areas. This allowed the formulation of an archaeological research agenda to address the current gaps in knowledge of the archaeology of these areas.

1.3 Minerals Planning Guidance and Legislation

1.3.1 Minerals planning is controlled by legislation and guidance at both local and national level. Underpinning this legislation is the understanding that minerals working has a number of special characteristics which set it apart from other forms of development. For example, extraction sites are limited as minerals can only be worked where they naturally occur and, although working often takes place over a long period of time, it should not be regarded as a permanent land use. Minerals working often has adverse effects, for example local disruption to the community, and all costs and benefits need to be considered and adverse environmental impacts mitigated or controlled during the process of extraction. When work stops at an extraction site, the land requires treatment to make it suitable for beneficial after-use and to avoid dereliction.

1.3.2 *National Legislation*

Minerals extraction is controlled at a national level by Town and Country Planning legislation with the Office of the Deputy Prime Minister responsible for developing national planning policy guidance, including that for mineral development. The Town and Country Planning Act 1990 was an attempt to consolidate much of the existing planning legislation. It has since been amended by the Planning and Compensation Act 1991 and by the minerals provisions of the Environment Act 1995. The 1990, 1991 and 1995 Acts provide the basis for the control of mineral development.

1.3.3 The *Planning and Compensation Act* 1991 introduced new provisions for dealing with permissions for the winning and working of minerals originally granted under Interim Development Orders (IDOs). These were permissions granted after 21 July 1943 and before 1 July 1948, which have been preserved by successive planning acts as valid planning permissions and are referred to in the 1991 Act as "old mining permissions". The Act requires holders of such permissions to apply to the Mineral Planning Authority for registration of the permission and subsequently to apply for determination of the conditions to which the permission is to be subject, if they wish the permission to continue to have effect.

1.3.4 The duty of all Minerals Planning Authorities (MPAs) to prepare a Minerals Local Plan (MLP) was set out in the Town and Country Planning Act 1990, as amended by the Planning and Compensation Act 1991.

1.3.5 Having dealt with "old permissions" from the 1940s, the *Environment Act* 1995 was designed to review and update minerals permissions granted in the 1950s, 60s and 70s and to provide for periodic review of permissions granted thereafter. The Act made the distinction between "active" and "dormant" sites and obligated Minerals Planning Authorities to compile lists of all dormant and active sites in their areas. MPAs were also obliged to periodically review all minerals permissions on a regular basis.

1.3.6 *Minerals Planning Guidance (MPGs)*

The minerals industry is guided by Minerals Planning Guidance and those relevant to aggregates are outlined below.

MPG1 '*General Considerations and the Development Plan System'* sets out the Government's policies on minerals and planning issues and provides advice on the operation of the development plan system with regard to minerals.

MPG 2 *'Applications, Permissions and Conditions'* provides advice on those aspects of the development control system of particular relevance to minerals and on the preparation and determination of individual planning applications.

MPG 4 gives guidance for local authorities over their use of powers granted in the 1995 Environment Act.

MPG 6 *'Guidelines for Aggregates Provision in England'* aims to provide a framework within which local authorities could develop policies relating to aggregates and encouraged the formulation of Development Plans by Minerals Planning Authorities. The Regional Guidelines annexed to MPG6 identify the forecast demand broken down for each planning region. The Guidelines identify that approximately 715 million tonnes (mt) of aggregates will be required from the Southwest Region.

MPG 8 gives guidance for dealing with old permissions, granted under Interim Development Orders (IDOs) and revised under the Planning and Compensation Act 1991. MPG 9 gives advice on the considerations to be taken into account by applicants and Minerals Planning Authorities in preparing and determining the conditions to which any new permissions should be subject.

1.3.7 The *Environment Act 1995* introduced new requirements for an initial review and updating of old mineral planning permissions and the periodic review of all mineral permissions thereafter. MPG 14 *'Review of Minerals Planning Permissions'* gives advice to Mineral Planning Authorities and the minerals industry on the statutory procedures to be followed and the approach to be adopted for the preparation and consideration of updated planning conditions in the review process.

1.3.8 The exploitation of marine aggregates is covered by Marine Mineral Guidance 1 *Extraction by Dredging from the English Seabed*. The Note provides a statement of the Government's policies on the extraction of marine sand and gravel and other minerals from the English seabed. Currently, dredging licences are issued by the Crown Estate although a non-statutory "Government View" (GV) procedure was introduced in 1968, under which a licence is only issued if the Government has indicated that it is content that the impacts on the environment of the proposed dredging activity are acceptable. The GV procedure was amended in 1998 with the introduction of 'Interim Procedures', to make the application and determination process faster and more transparent.

1.3.9 *Regional Planning*

Within England nine economic planning regions are defined, each having a regional development agency and a regional planning body which is responsible for preparing regional planning guidance. Gloucestershire is included within the South West Regional Assembly, which is responsible for the preparation, monitoring and reviewing of *Regional Planning Guidance for the South West* (RPG10). Policy RE3 of RPG10 deals with minerals planning for the region and outlines the sub-regional apportionment of aggregate production to 2009. This is due to be superceded by the Regional Spatial Strategy, currently in preparation, which will replace the Minerals Local Plan with a Minerals and Waste Development Framework by 2007.

1.3.10 The South West Regional Aggregates Working Party (SWRAWP) is a technical working group whose role is to provide regional information and technical advice to Central Government on the supply and demand for primary and secondary aggregates in the region. The Working Party, in addition, monitors the supply of and demand for aggregates, and provides a forum for facilitating the apportionment to individual counties of the regional guidelines of MPG6.

1.3.11 *Local Policy and Guidance*
At a local authority level, Mineral Planning Authorities are required to prepare development plans for minerals which set out the policies and proposals against which planning applications are determined. Development Plans, which have to take into account Government guidance as set out in *Planning Policy Guidance Notes* and *Minerals Planning Guidance Notes*, provide the basis for rational and consistent planning decisions.

1.3.12 Within Gloucestershire, the *Gloucestershire Structure Plan* was adopted in December 1999 and the mineral policies contained within it provide the strategic basis for the preparation of the Gloucestershire *Minerals Local Plan***.** This was the first county-wide minerals plan and replaced the non-statutory *Upper Thames Policy Review* (1993) that had been adopted by the County Council for development control purposes pending the preparation of an MLP.

1.3.13 *District Local Plans* are prepared by the six District Councils in Gloucestershire. These set out detailed policies on specific proposals for development and land-use and guide day-today planning decisions. The timescale for the preparation and adoption of these plans varies according to the individual district authorities.

1.3.14 *Environmental Constraints*
The extraction of minerals can have significant impact on the local environment and the MPA has a responsibility to strike a balance between the need for mineral products and the environmental impact of minerals development. A hierarchy of protection for the natural environment exists at International, European, National, Regional and Local levels, with Gloucestershire containing sites which fall into all of these categories. Policy E1 of the MLP states that minerals development will not be allowed where it is likely to have significant adverse effects on International or European designated sites. Policy E2 states that development will only be allowed in Areas of Outstanding Natural Beauty in “exceptional” circumstances and Policy E3 deals with the circumstances of development close to Sites of Special Scientific Interest and/or National Nature Reserves and their settings. The natural environment is covered at a national level by PPG 7, which deals with the countryside and PPG 9 *Nature Conservation*. The MPA requires that an environmental impact assessment (EIA) is prepared for proposals for mineral development in accordance with the *Town and Country Planning (Environmental Impact Assessment) Regulations* 1999.

1.3.15 Scheduled Monuments are protected under the 1979 *Ancient Monuments and Archaeological Areas Act* and listed buildings under the *Planning (Listed Buildings and Conservation Areas) Act 1990*. Archaeology is also covered under the *Archaeological Investigation Code of Practice for Minerals Operators* formulated by the Council for British Industry to ‘promote co-operative and effective working relationships between mineral operators, planners and archaeologists’. Article 7 of the *Town and Country Planning (General Permitted Development) Order* 1995 also restricts rights to prospect for minerals where the land is a Scheduled Monument, in an area of archaeological importance or registered on the county Sites and Monuments Record (SMR). Policies E4, E5, E6 and E8 of the MLP deal with the impact of minerals extraction on aspects of the historic environment, within the national guidance framework of PPGs 15 and 16.

1.3.16 Gloucestershire County Council operates a database of archaeological information, the County Sites and Monuments Record (SMR) which lists sites of national, regional and local importance, as well as details of archaeological interventions, such as excavations or desk-based work. This database has a role in

planning control and is used in conjunction with the County Council Geographical Information System, which enables it to be interrogated on a variety of criteria including location, geology and monument or object type and date.

1.3.17 Although the legislative framework is aimed at providing protection for archaeological deposits threatened by quarrying, this protection is threat-based and there is no general provision for strategic overviews of the impact of quarrying on the archaeological resource. One of the project aims was, therefore, to provide good quality baseline data to facilitate such strategic decisions. As such, the study was not limited to current extraction areas, or those identified in the MLP with potential for future extraction, but at whole landscapes, identified in the Methodology (Section 2).

1.4 Report Structure

1.4.1 This report is divided into five linked sections. Section 1, *Introduction*, gives the background and context for the project as a whole. Section 2 *Methodology* outlines the approach used to capture data and describes the ways in which this data was categorised and interrogated by this project. Part of this methodology involved the definition of sub-units for further analysis. An assessment of the methodology and recommendations for future projects follows. Section 3 describes the aggregates resource within each sub-unit as well as the areas preferred for mineral extraction. Sections 4 and 5 contain a *Resource Assessment* and *Research Agenda* for the aggregate areas defined previously. The Resource Assessment collates data available from the SMR and presents it by period for each of the three major aggregates areas defined. An attempt is made to assess the level of archaeological intervention before extraction, where this is known, and the results are discussed. The Research Agenda identifies previous research which has taken place in the county before moving on to discuss potential areas for future research and identifying future research themes, based on the Resource Assessment. Further projects which address these themes are also identified. Two appendices detail a simplified methodology for the project as a whole and a detailed methodology for the integration of the Upper Thames NMP data with the SMR. Tabulated data and maps are presented at the end of the volume. Gazetteers are retained in digital format.

1.5 Acknowledgements

The project was managed by Toby Catchpole and overseen by Jan Wills, County Archaeologist. Buzz Busby monitored the project on behalf of English Heritage.

Robin Drake, Brenda Powell and Kevin Phillips of the Minerals and Waste Planning department at Gloucestershire County Council provided much useful information about the active and inactive quarries in the county, as well as advise on the Minerals Local Plan. Gloucester Harbour Trustees provided data about marine aggregates in the county.

Gloucestershire County SMR provided SMR data and access to files and the SMR library.

Duncan Brown, Project Manager, Listed Buildings Online, provided data about listed buildings in the county.

The staff of the Gloucestershire County Council Archaeology Service provided help with various aspects of the project. In particular Graham Tait provided GIS and website advice and Jon Hoyle answered many questions on the archaeology of the Forest of Dean. The Research Agenda was circulated to Toby Catchpole, Tim Grubb, Paul Nichols, Charles Parry, Jo Vallender, Jan Wills and Peter Buzby, who provided comments which were incorporated into the final text.

2. Methodology

2.1 Introduction

2.1.1 To achieve the project aims of identifying the past, present and future aggregates producing areas within Gloucestershire and the impact that extraction has had on archaeological remains and deposits a clearly defined methodology was required. This methodology could be broken down into three parts:

i) identification of the aggregate producing geology within the county
ii) identification of geology within these areas which is currently and has been historically worked
iii) identification of the known archaeological deposits located on this geology

2.1.2 A detailed methodology is given below, but during the course of the project a request was made for a simplified methodology to be supplied to English Heritage for dissemination to other bodies interested in carrying out similar projects. This is contained in Appendix 1.

2.1.3 The SMR was exclusively used to capture data for the project (see Section 2.3, below). Limited data capture was undertaken to facilitate the aims of the project, which took the form of integrating the results of the Upper Thames Valley section of the National Mapping Programme, undertaken by English Heritage, into the SMR (for a detailed methodology, see Appendix 2). No attempt was made to verify SMR data, beyond the correction of obviously incorrect information.

2.1.4 During analysis of the data for the Research Framework and Strategy a decision was taken to focus on research-led projects, with developer funded or "rescue" work included only when it has significantly contributed to the knowledge of a specific period or area. Similarly, large-scale industrial landscapes, and Post-Medieval sites in general, were only considered from an archaeological perspective.

2.2 Identification of aggregate minerals producing deposits and collection of data regarding all aggregate minerals planning permissions

2.2.1 Gloucestershire County Council (GCC) holds digital geology maps supplied by British Geological Survey on its corporate GIS system. This data is digitally "tagged" at varying levels with data from the BGS *Lexicon of Named Rock Units*. The data include general geological rock types (limestone, gravel), identified as ROCK type and specific lithologies within these (Crease limestone, Mathon sand and gravel), identified as a LEX type. This data is searchable at both levels and the results can be plotted on a background map of the county. SMR data is similarly tagged with BGS data allowing the two data sets to be interrogated and combined.

2.2.2 The first step was to identify all of the potential aggregate producing geology within Gloucestershire, whether there are future plans to extract it or not (see Section 3). A plan of the limestone and sand and gravel geologies within the county, at a broad level, was produced from BGS digital data (figures 1 and 2). As this covered most of the county, the area of study was reduced by identifying the deposits and beds which had been historically exploited.

2.2.3 To allow this assessment, information was obtained from the Minerals and Waste Planning Officers at GCC. This consisted of paper maps showing the location of all historic quarries with planning permission since 1947, supported by paper files containing planning permissions and further detail. The results of the analysis of this data was tabulated and plotted onto the GIS (see Table 1 and figure 3). The geology on which each quarry is located was then analysed and tabulated. A list of 62

"lapsed" permissions under the Environment Act 1995 was also compiled from Minerals and Waste Planning Officers data, although it was impossible from the information available to assess if these ever produced aggregates. As a result these were tabulated (see below), but excluded from this study. Likewise a list of 14 quarries currently used for waste disposal, but with no known planning history, were listed but excluded from this study. One result of this is that there appears to be a higher proportion of dormant sand and gravel quarries in the county when compared to hard stone quarries than is actually the case.

2.2.4 In the Forest of Dean two limestone horizons were identified as having potential for future aggregate production: the Lower Limestone Shales and the Lower Dolomite. The former is less favoured as it is more difficult to work, with the Lower Dolomite forming a more significant resource. These areas are tagged by the BGS as LSH-LMST and LD-DOLO respectively. Dolomotised limestones of the Black Rock Group (tagged BPGP-DLDO), such as Black Rock Limestone (tagged BRL-DLDO), are also potential aggregates sources and were included in this study.

2.2.5 Although the geological occurrence of limestone in the Cotswolds is reasonably well understood, there is no technical resource analysis to enable identification of the best source of future aggregate reserves, with the variability of individual limestone beds mitigating against wider resource identification. For the Cotswold area this project identified all of the limestone resource in the area, then narrowed the selection to those geologies which are actively being quarried for aggregates. These are tabulated below.

Description	**BGS Tag**
Great Oolite Group	GOG-OOLM
Inferior Oolite	INO-LMST
Chipping Norton Limestone	CNL-LMST
White Limestone	WHL-LMST
Birdlip Limestone	BLPL-LMST
Eyford Member	EYF-LMST
Notgrove Member	NGRV-LMST

Table 1: quarried geologies in the Cotswold Limestone area

2.2.6 The drift deposits which may contain sand and gravel are mainly associated with the county's major river systems and their geological occurrence is reasonably well understood. Their potential for aggregates production is less well known, however, and production is at present mainly focused in the Upper Thames Valley, with some former workings in the Severn, Evenlode and Windrush valleys. The mapping of drift deposits is more difficult than with solid geology and as a result the areas considered by this study are relatively poorly defined. Geologies which have been actively exploited are tabulated below.

Description	BGS Tag
Spring Hill Member	SPHT-SAGR
Holt Heath Member	HHTD-SAGR
Northmoor Member	NO-GRSS
Sherborne Member	SHE-GRAV
Rissington Member	RIN-GRAV
Paxford Member	PA-GRAV
Wolford Heath Member	WOHE-SAGR
Third Terrace of the River Frome	FR3-GRAV
Cropthorne Terrace Deposit	CRTD-SAGR
Wasperton Terrace Deposit	WAT-SAGR
Cheltenham Sand and Gravel	CHSG-GRAV
Mathon Sand and Gravel	MASG-SAGR

Table 2: quarried geologies in the sand and gravel areas

2.2.7 Areas of peri-glacial "head" occur throughout the sand and gravel deposits in the county. This is considered unsuitable for use as an aggregate and so has been excluded from the consideration of the resource.

2.2.8 Potential aggregate producing marine deposits exist within the channel of the River Severn and have been subject to an extensive survey (Posford Duvivier 2000). There are, at present, no permissions to extract this material within Gloucestershire, however, and as the SMR and land-based planning guidance such as PPG16 does not extend below low water, there is no means of easily assessing the archaeological resource within the river channel.

2.2.9 As the geologies identified from BGS data covered most of the county, the next stage of the project aimed to reduce the areas further by identifying sub-units for study (see figures 4 and 5). Two of these sub-units (the Cotswold Limestone and the Forest of Dean) were hard rock areas (figure 5), whilst the remaining five (the Severn Vale, the Windrush, Evenlode, Leadon and Upper Thames Valleys) were in areas of drift deposits (figure 4). The methodology within each sub-unit differed slightly due to their varying geographical areas and sizes, and differential levels of past and present extraction (Sections 2.3.5 to 2.3.10, below).

2.2.10 Although formulated to assess the aggregate producing minerals present within the county, this methodology was not designed to take into account constraints on the extraction of this resource, such as the presence of major roads, Areas of Outstanding Natural Beauty, agricultural or other designations. Throughout the project the major urban areas of Gloucester, Cheltenham, Tewkesbury, Cirencester, Stroud and Nailsworth were excluded from any searches, as mineral extraction is prohibited within such areas by Minerals Planning Guidance and legislation (see Section 1.3). However, it was not possible to exclude smaller built-up areas such as villages (Blockley, Guiting Power etc) and small towns (Stow-on-the-Wold, Bourton-on-the-Water, Coleford etc). Although these areas have not been excluded from the study, it should be stressed that this does not imply that they are under threat from quarrying.

2.2.11 The exclusion of urban areas leads to the following quarries being removed from the dataset: Arle Road, Bouncers Lane, Hucclecote A and B, Innsworth Lane, Naas Lane, Swindon Lane/Road, Tewkesbury Road, Violet Villa. All of these quarries are dormant and located on sands and gravels.

Area	Total	Active	Dormant	% active	% dormant
Severn Valley	**26**	2	24	8	92
Cotswold Limestone	**18**	9	9	50	50
Upper Thames Valley	**13**	7	6	54	46
Forest of Dean	**9**	3	6	33	67
Windrush Valley	**5**	0	5	0	100
Leadon Valley	**2**	1	1	50	50
Evenlode Valley	**4**	0	4	0	100
Total	**77**	**22**	**55**	**29**	**71**

Table 3: Dormant and active quarries by area

Table 4: Permissions Lapsed under Environment Act 1995:
(Jurassic and Carboniferous Limestone only)

Bearse	SO 572 051
Bluestone (Probert's Barn)	SO 590 166
Boatwood	ST 554 984
Clearwell	SO 571 084
English Bicknor	SO 577 160
Edge Hill	SO 661 167
Galders Wood	SO 567 098
Hawthorns	SO 644 179
Little Drybrook	SO 594 072
Plump Hill	SO 661 172
Staunton	SO 552 123
Stowfield Farm	SO 588 168
Tidenham Chase	ST 555 985
Whitecliff	SO 567 099
Woodcroft (Lancaut)	ST 540 959
Worells	SO 565 046
Bath Road	ST 888 928
Bourton	SP 157 197
Breakheart	ST 755 966
Burleigh	SO 863 014
Broadfield Farm	SP 135 118
Cats Abbey	SP 175 134
Cats Brain	SO 867 114
Cirencester Road	SO 894 012
Coln Lane Ground	SP 181 066
Coates	ST 995 999
Coopers Hill	SO 885 140
Cotstone	SP 125 384
Dean (Chedworth)	SP 065 105
Edge	SO 848 094
Fish Inn	SP 119 269
Forest Green	SO 841 000
Foss Cross	SO 105 092
Gawcombe	SP 206 209
Hampen Farm	SP 060 198
Harveys Grave	ST 844 957
Hillbarn	SP 107 339
Honeycombe Leaze	SP 112 025
Ilsom Farm	ST 904 941
Jackdaw	SP 077 310
Killkenny	SP 005 186
Leckhampton (New Quarry/Waggon Quarry)	SO 946 177
Kineton Thorns	SP 120 363
New Park	SP 175 281
Orchard Farm	SP 080 345
Oxleaze	ST 886 938
Pyke	ST 812 980
Ready Token	SP 118 031
Salperton	SP 080 214
Sheepbridge	SP 191 072
Slade	SP 070 214
Smiths Cross	SO 961 116
Snowshill	SP 118 326
Soundborough	SP 048 218
Station Road	ST 893 928
Stratton	SP 018 038
Sunhill	SP 117 025
Welsh Way	SP 115 029
Vatch Lane	SO 885 039
Westington	SP 140 367
Winterwell	SP 108 134

Table 5: Miscellaneous quarries used for waste disposal with no known planning history

Old Airfield, Moreton Vallance	SO 790 100
Bevans	SO 109 287
Court Farm	SO 795 007
Crickley Hill	SO 927 162
Clays Wood	SO 584 073
Devonport Wood	SP 112 271
Hampton Fields	ST 886 999
Ozleworth	ST 791 945
Picket Piece	ST 881 971
Quarry Farm	SP 099 020
Saltdown Barn	SP 062 072
Sunhill	SP 117 025
Taits Hill	ST 735 995
Wickley Wood	ST 838 971

2.3 Data collation and cross referencing

2.3.1 The archaeological data used in this project was exclusively derived from the county SMR, with the exception of the Upper Thames Valley NMP, which was added to the SMR as part of this project (see Appendix 2). Data collection for the project involved period based searches of the SMR, based on the specific period for sites and artefacts recorded in the SMR for the county. It was not possible to include data collected as part of the Portable Antiquities Scheme as this data has not yet been made available to the SMR. Radiocarbon dates and environmental data are not visible on the SMR at the level at which it was searched for this project. As an alternative, the Arts and Humanities Data Service *Index of Radiocarbon Dates* and the English Heritage *Environmental Archaeology Index* (both available online via the AHDS) were used to assess known data.

2.3.2 To keep database sizes manageable, only data under the following headings were extracted from the SMR (for a detailed overview of the data structure of the SMR see p.100-101):

Site ID
Area Number
General Type
Specific Type
Specific Period
Easting
Northing
Description

2.3.3 Initially data was collected by period for the whole county, and subsequently more closely analysed at sub-unit level (see Section 2.2.9, above). This allowed the data from the sub-units to be compared with the broader pattern and an assessment made of how representative the archaeology of the sub-units is of the broader county.

2.3.4 Due to the varying nature of the aggregates resource, and how it is extracted within the sub-units, a slightly different methodology was adopted for each sub-unit. The major difference in methodology was between the hard rock area of the Cotswolds and the other sub-units.

2.3.5 *The Cotswold Limestone*
Due to the extensive occurrence of limestone and the poor knowledge of its suitability as aggregate producing material, working and dormant quarries were identified from material held by Gloucestershire County Council Minerals and Waste Planning Officers. Each quarry which has produced aggregate was then plotted onto the GIS and a search of the SMR carried out over a 2km radius of each site (figures 69-85). This radius was used in order to take in the preferred areas identified in the MLP at Daglingworth and Huntsmans Quarries and included all geologies which had the potential or have been known to produce aggregates.

2.3.6 *Forest of Dean*
Although there are two preferred areas identified in the MPL, all the areas of Lower Limestone Shales and Lower Dolomite, as well as other dolomitised limestone such as Black Rock Limestone, were identified and a search of the Sites and Monuments Record undertaken at this level. All sites on these geologies were extracted from the SMR and incorporated into the project database (figures 59-68).

2.3.7 *The Upper Thames Valley*
Areas of working in this sub-unit are closely defined by the Upper Thames Plan and the Upper Thames Plan Review. Areas of potential resource lie outside this area, however, and an SMR search was therefore undertaken based on all sand and gravel deposits within the valley, whether included in the MLP and UTPR or not (figures 49-58).

2.3.8 *The Severn Vale*
Although there is a high number of dormant quarries on the Severn gravels, there are currently few active quarries in this sub-unit. A further problem is the extent to which sands and gravels (and their associated archaeology) have been masked by the development of riverine alluvium. The major urban centres of Gloucester, Cheltenham and Tewkesbury are located in this sub-unit, which also introduces a bias into the nature of archaeological recording in this area. The most productive geology in this valley has been the Cheltenham Sands and Gravels, although a diversity of materials has historically been exploited. As a result the whole of the sand and gravel resource within the Severn Valley was treated as a unit of analysis (figures 16-25). The River Avon joins the Severn at Tewkesbury and the short section of this river which lies within the county has been considered with the Severn.

2.3.9 *The Windrush and Evenlode Valleys*
Extraction of sand and gravel has occurred in these areas, although there are no active quarries at present. The gravel deposits have been extensively exploited, in particular the Sherborne and Rissington Members of the sand and gravels. In the Evenlode valley (figures 41-48) four quarries have historically exploited the deposits of Wolford Heath Member and Paxford sand and gravels. The sand and gravel resource of both valley systems were considered to be suitable units of analysis for these areas.

2.3.10 *The Leadon Valley*
Sand and gravel deposits occur in the north west part of the county in the valley of the River Leadon. The resource has been lightly exploited in the area with quarries at Bromsberrow utilizing the Mathon Sand and Gravel deposits. All of the sand and gravel deposits in this area were used as a unit of analysis (figures 26-30).

2.3.11 Underlying the methodology was a recognition that the archaeological data between different regions of the county was of varying quality. The Forest of Dean has recently been subject to intensive survey and for both the Forest of Dean and the Upper Thames Valley NMP data has recently been acquired by the SMR. In addition, urban areas such as Cheltenham, Gloucester and Tewkesbury tend to have higher levels of urban development than rural areas and thus higher levels of archaeological intervention. Urban areas also tend to have higher numbers of listed buildings. Consequently the SMR data for all of these areas is much richer. Similarly, geological data is of variable quality with superficial deposits being more difficult to map than solid geology.

2.3.12 It should be remembered that the information collected from the SMR represents only a “snapshot” of the data in the record at the time that it was collected for this project (September 2004) and that very little data verification has been carried out as part of this project.

2.4 Archaeological Resource Assessment

2.4.1 *Frameworks for our Past* (Olivier 1996) introduced the concept of a *Research Framework* which comprises a *Resource Assessment* summarising the current state of knowledge and understanding and a *Research Agenda* highlighting gaps in knowledge, the potential of the resource and possible research topics. Regional Research Frameworks have been completed or are underway for much of England and that for the south west region is in its early stages.

2.4.2 The Resource Assessment in this report is based on a search of the SMR for the seven aggregate producing areas. This data was subsequently exported to an Excel database which allowed it to be summarised by period and analysed at this level on GIS. For the purposes of the assessment the chronological periods used were:

Palaeolithic to Neolithic
Bronze Age to Iron Age
Prehistoric (general/unknown specific date)
Roman
Early Medieval (5th to 11th Centuries)
Medieval (11th to 16th Centuries)
Post-Medieval (16th to 21st Centuries)
Undated/unknown

Designated sites (Scheduled Monuments and Listed Buildings) are also listed.

2.4.3 Due to the way in which the SMR data are categorised, sites spanning chronological boundaries such as Late Bronze Age/Early Iron Age were included in both the Bronze Age and Iron Age periods. Likewise Late Iron Age/Roman sites were included in both the Iron Age and Roman period assessments. For the Early Medieval period records with a specific period of 5th to 11th centuries were considered. Sites of 11th to 16th centuries were categorised as belonging to the Medieval period. Due to the way in which data has been recorded, it was necessary to record sites and artefacts of Medieval or Post-Medieval periods in both assessments, as some data had been assigned specific periods of 11th to 19th centuries or 15th to 21st.

2.4.4 A further bias was added to the collection of the data from the SMR in that variable standards have been used to record finds and features from excavated sites. No attempt has been made in this study to reduce finds and features from excavated sites to a single record for that site. In some cases, such as multi-period settlements in the Upper Thames Valley, this has allowed these sites to be considered in more than one chronological period assessment. In other cases, such as excavations at Roman villas, multiple finds from a single site can lead to an over representation material for that period.

2.4.5 The results of these searches were tabulated and quantified and statistics produced based on location, period, site type and the nature of the archaeology. Period maps of the sub-units were also produced. When quantifying the results from the assessment, the varying sizes of the sub-units should also be taken into account (see Table 6). An attempt has been made to assess areas in terms of raw numbers of sites and findspots, to quantify this as a percentage of the total of the known sites and findspots and also to quantify this in terms of SMR record density (Tables 33 and 34). It was not possible to assess the total number of sites and monuments in these areas, merely the record made of them on the SMR. Single sites may have multiple

records and, although this does not reflect an absolute distribution, it does allow an understanding of how well known and recorded sites are within a sub-unit.

2.4.6 The diversity of total sizes of the sub-units within the sands and gravels can be understood from the following table:

Sub-Unit	Area (km^2)
Severn Vale	116
Upper Thames Valley	69
Evenlode Valley	24
Leadon Valley	6
Windrush Valley	3

Table 6: sub-unit areas

2.4.7 No primary fieldwork or intensive documentary research into the sites included in the Resource Assessment was undertaken, but a certain amount of verification of data was necessary. This involved the consultation of SMR site files and/or published site reports to clarify data, if necessary. Where it was possible, the nature of the archaeological intervention and recording of sites destroyed by quarrying was listed to enable an understanding of the level of archaeological work undertaken in aggregate producing areas.

2.5 Archaeological Research Agenda

2.5.1 The Resource Assessment summarises the current state of knowledge and understanding of the archaeology of the aggregate producing areas and includes information on the fragility and rarity of the resource identified. Data collected from the SMR and from the English Heritage Monument Class Descriptions/Monument Protection Programme was utilised to assess the relative importance of sites in the study areas, both on a regional and national scale. Resource Assessments produced for other regions were utilised as templates and for background information.

2.5.2 Although not intended to be a Resource Assessment/Research Agenda for the county as a whole, a need was recognised for the project to fit into a wider framework. The Regional Research Framework for South West England was on-going during the project, with discussion and liaison between the two. The Research Agenda also utilised existing synthetic publications covering the archaeology of the region to provide the background information against which the Assessment for the study areas could be compared. Account was also taken of past and current research projects undertaken in the county, their aims and objectives and their level of success. One of the primary objectives of the Agenda was to identify gaps in the knowledge of the archaeology of the aggregate producing areas, how these relate to the knowledge of the period generally for the county and the ways in which these gaps could be closed. Further work was also suggested, based on the results of the Agenda and covering issues not addressed under normal planning-led investigation. Academic themes for further research were identified, as were geographical areas with the potential to yield good quality data to answer research questions.

2.6 Appraisal and recommendations

2.6.1 The methodology used in this report has proved to be robust, within the constraints of the data available. Problems with the general nature of data categorised by the SMR are outlined above (see Section 2.4.3 and 2.4.5), as are issues with the recording and availability of Portable Antiquities Scheme, environmental and chronometric data (Section 2.3.1).

2.6.2 A general need for baseline archaeological data has been identified (see Section 1.2.2) and one success of the current project is that it has produced a methodology which could be used for similar projects in other parts of the country. A simplified methodology has been prepared (Appendix 2) and has been circulated both within English Heritage and to other curators within the region and nationally.

2.6.3 Another success of the project resulted from discussions with the Minerals and Waste Planning Officers at Gloucestershire County Council. The sharing of data encouraged greater understanding of the archaeological implications in aggregate areas and a different perspective on the nature of the data used. GIS layers produced for the project have improved the information easily available to both archaeological and minerals teams at the authority. Discussions at an early stage of such projects are to be recommended.

2.6.4 Of the nine objectives identified in the Project Design it was possible to achieve all but one, Objective 6.6. Due to the limitations of the data available, it was not possible to fully consider the impact which past aggregate extraction has had on archaeological sites and deposits. It was not possible to identify the location, type and period of each recorded element of the historic landscape or the nature of archaeological intervention (and subsequent report) which produced the record. A limited attempt was made (see Section 4.5), but extensive assessment proved impractical due to the structure of the source data.

2.6.5 Similarly, it was not practical to identify underlying trends in the distribution of archaeological sites and findspots, as the major factor (geology) was predetermined by the areas examined. Cross comparisons between different geologies were attempted in this study (Resource Assessment, Section 4), but the significance of these differences and similarities could not be fully understood.

2.6.6 Due to the time over which this project ran, it was not possible to exploit the results of the South West Archaeological Research Framework, which started as the current project was drawing to an end. Similarly, a Resource Assessment and Research Framework was being compiled for the Forest of Dean during the course of this project, but the final report was not available at the time of completion (Hoyle *et al* forthcoming). Wider discussion with the academic community may also have produced useful results, but was not possible. Although general synthetic material is available for the county, many are more than 20 years old, making it difficult to form a general overview of the archaeology of the county and region, and how the aggregate areas related to this. The specialist knowledge of the staff of the County Archaeology Service and SMR was therefore crucial to the formulation of the Research Framework and consultation formed a major element of this phase of the project. The widest possible discussion during the formulation of Research Frameworks and Strategies is desirable and recommended. Familiarity with the formulation of research designs and methodologies by staff undertaking the project is also recommended.

3. Description of the Aggregates Resource within Gloucestershire

3.1 The British Geological Survey identify the fact that information about the minerals resource is unevenly distributed throughout the country and is of variable quality (Ellison & Smith 1998). The identification of the minerals resource is both imprecise and limited by the quality of the information available. Further, a view has to be taken, when considering the resource, over what may or may not become economically viable to work in the future. As a result of the imprecision involved, the BGS use a tripartite system of classification, dividing the resource into inferred, indicated and measured categories.

- Inferred resources are defined from existing geological data and the BGS is in the process of compiling detailed interpretations of this information on a regional basis. This will be in the form of a series of 1:100 000 scale resource maps and accompanying reports covering the whole of England and Wales. Work is currently underway for the resource map of Gloucestershire, although it is not expected to be published until 2005.

- Indicated resources have been defined by drilling and sampling and have had their technical properties characterised. These reports are on the assessment of bulk mineral resources of areas within the UK and over 140 reports were produced between 1971 and 1990 as part of a national stock-take of the minerals resource, funded by the (then) Department of the Environment. The minerals covered were sand and gravel, hard rock aggregates, limestone, conglomerate and celestite (one report). The sand and gravel resource within Gloucestershire was included in this survey programme.

- Measured resources are defined by closely spaced drilling, an evaluation of the quality of the material, its market suitability and general economic viability.

3.2 The BGS also maintains a database of active quarries (termed “Britpits”) and publishes a *Directory of Mines and Quarries* as well as maintaining a GIS-based minerals information system (called MINGOL) including physical and chemical characteristics of the minerals surveyed.

3.3 The data generated by the BGS, including digital geological data, was used in conjunction with information supplied by Gloucestershire County Council Minerals and Waste planners to produce a description of the aggregate resource within the county. The MLP identified nine broad geological areas which were termed “*Areas of Investigation*” on the basis that they were the first stage in the process of future mineral resource appraisal. These areas were found to be far too broad for future minerals planning and areas of potentially workable limestone resource areas, termed “*Preferred Areas*”, were identified in the adopted MLP. These areas were guided by MPG 1 and MPG 6 and are largely extensions to existing quarries in the Forest of Dean and the Cotswolds. For the purposes of this description, however, it was necessary to consider *all* of the areas in which potential aggregate resources occur, regardless of any future intention to exploit such reserves. For this purpose the county has been divided into three major geographical areas: the Forest of Dean, the Cotswolds and the major river valleys. Each is described separately below.

3.4 *Forest of Dean*

Three main resources have been identified in the Forest of Dean. These are the Lower Limestone Shales, Lower Dolomite and members of the Black Rock limestone group. Lower Limestone Shales occur in a broad band to the west of the River

Severn in the vicinity of Clearwell, covering an area of roughly 11km^2. Narrow bands of this lithology run south west towards Woolaston and also occur to the north and south of Cinderford and to the north and south of Redbrook. The Lower Dolomite is a more significant resource in terms of aggregates production and occurs around the periphery of the Forest of Dean coalfield, especially to the west of Coleford and along the eastern flank of the Wye valley. This is a distribution largely shared by the Black Rock limestone group.

3.5 At present three quarries exploit the aggregates resource in the Forest of Dean (Drybrook, Stowfield and Stowe Hill) with a further six known dormant sites. Roger's quarry is inactive but contains potentially workable reserves. Potentially workable resources of Lower Limestone Shales have been located adjacent to Stowe Hill and Clearwell Quarries and reserves of Lower Dolomite exist at four quarries, two of which are active (Drybrook and Stowfield) and a further two are inactive (Bream and Roger's), but contain potentially workable reserves. A third inactive quarry at Tintern no longer has an extant permission.

3.6 Preferred Areas identified by the MLP are:

- to the east of Stowe Hill/Clearwell Quarry,
- west of Drybrook Quarry,
- north and east of Stowfield Quarry.

3.7 Forest of Dean sandstone is not quarried specifically as an aggregate resource the area where it outcrops was not included within this project. It is primarily a building stone, although Wilderness Quarry crushes some waste stone for aggregate.

3.8 *Cotswold Limestone*

The Cotswolds are by far the largest limestone resource in the county, although the potential of the various geologies for aggregate extraction is relatively poorly understood. The principle geologies which currently produce aggregates belong to the Great Oolite and Inferior Oolite Groups with Fullers Earth Clay, Cornbrash and Cotswold Slates (Eyford Member) also being exploited. The most extensively quarried member of the Great Oolite series is the White Limestone, which occurs widely across the Cotswold plateau between Minchinhampton and Burford.

3.9 Currently the bulk of limestone aggregates are produced from three quarries in the Cotswolds (Daglingworth, Huntsmans and Guiting), with Cornbrash being worked concurrently with the overlying sand and gravel at Shorncote in the Upper Thames Valley. There are a further six active aggregate producing quarries on the Cotswolds, including building stone quarries which crush waste rock for sale as aggregate (Oathill, Oxleaze, Stanleys, Swellwold and Veizeys). A total of nine quarries are recorded as not currently being worked, but with potential reserves of aggregate resource. It is likely that reserves at Guiting Quarry will be exhausted by 2006, but expansion at Daglingworth and Huntsmans is anticipated to compensate for this.

3.10 The Preferred Areas identified by the MLP for the Cotswolds are:

- to the north west of Daglingworth Quarry,
- west, north and east of Huntsman's Quarry.

3.11 *River Valleys*

The sand and gravel resource is mainly associated with the county's river systems, with investigation by the British Geological Survey indicating that the river terrace deposits flanking the rivers Thames, Severn and Avon, and to a lesser extent their tributaries, appear to provide the greatest potential for workable sand and gravel. For the purposes of this survey, all sand and gravel deposits were considered as potentially exploitable, with the exception of those mapped as "head", which is generally poor quality. Historic working has been located within the Severn Vale at Frampton-on-Severn and Twyning; within the Windrush and Dikler Valleys close to Bourton-on-the-Water and within the Evenlode Valley close to Moreton in Marsh. Current production is almost entirely focused in the Upper Thames Valley, however, with some 97% of production coming from seven quarries. Four of these are located in the Fairford/Lechlade area and three in the South Cerney/Somerford Keynes area. In addition a further four sites contain reserves but are not being worked at present. The remainder of production (mainly as sand) comes from two small quarries in the Severn Vale (at Frampton-on-Severn and Bishop's Cleeve) and from one at Bromsberrow in the Leadon Valley, where there is also a dormant site. Two sites in the Upper Thames Valley have been identified as having reserves of aggregate minerals as has the quarry at Shurdington in the Severn Vale.

3.12 The four Preferred Areas are identified in the MLP, all in the Upper Thames Valley, are:

- an area of c.37 ha to the north of Shorncote quarry at Dryleaze Farm,
- an area of c.16.5 ha to the south of Cerney Wick,
- 100 ha at Lady Lamb Farm, Horcott,
- 185 ha in the Kempsford/Whelford area.

3.13 In contrast to the hard rock aggregates resource, sand and gravel are superficial deposits and occur at a shallow depth over extensive areas. The land-grab associated with such extraction is therefore greater than that associated with hard rock, which can be exploited to greater depth.

3.14 Although current exploitation is focussed in the Upper Thames Valley, Policy RE3 of Regional Planning Guidance 10 identifies the need to supplement the sand and gravel produced from the Upper Thames Valley with material from elsewhere in the south west, due to increasing environmental constraints within the Valley. Reserves of sands and gravels which have historically been exploited exist in the north east of the county in the area of Moreton in Marsh and the Evenlode Valley where sand and gravel deposits cover an area of c.26km^2. Further deposits occur in the Windrush Valley in the vicinity of Bourton on the Water; around Cheltenham and Gloucester and in the area of Cam and Frampton-on-Severn. Reserves of unexploited sand and gravels occur on the west bank of the River Severn in the region of Highnam, to the south of Forthampton and in the vicinity of Lydney. Extensive deposits also occur to the north of Tewkesbury, continuing along the Severn into Worcestershire. Small areas of sand and gravel deposits occur in the Leadon Valley in the north west of the county although these are overlain by deposits of alluvium and "head". Head deposits also occur in the eastern part of the Forest of Dean. Areas of such peri-glacial deposits occur throughout the sand and gravels of the county, but are considered unsuitable for use as an aggregate and so have been excluded from this consideration of the resource.

3.15 Marine and riverine deposits of sand and gravel occur in the River Severn downstream of Gloucester and these have been subject to intensive survey (Posford Duvivier 2000). No current permissions or future plans exist for extraction of the

marine resource within Gloucestershire at the present time and the economic viability of the deposits within the Severn remains unquantified.

4. Archaeological Resource Assessment

4.1 SMR data by period for the county

4.1.1 Initially data from the SMR was extracted by period for the entire county. The results are tabulated below.

Period	No of Sites	% of total	ranking
Palaeolithic	32	0.1	13
Mesolithic	81	0.2	12
Neolithic	444	1	10
EARLIER PREHISTORIC (subtotal)	*557*	*n/a*	*n/a*
Bronze Age	1,176	2.6	6
Iron Age	883	2	8=
LATER PREHISTORIC (subtotal)	*2059*	*n/a*	*n/a*
Prehistoric	893	2	8=
Roman	6,512	14.2	4
Early Medieval	993	2.1	7
Medieval	6,801	15	3
Post-Medieval	18,442	40.4	1
Modern	185	0.4	11
Multi-Period	2,167	4.8	5
Unknown	6,945	15.2	2
TOTAL	**45,554**	100	n/a

Table 7: SMR data by period for the county

4.1.2 *Listed Buildings*

A total of 4,594 listed buildings are recorded by the SMR for the county, only 655 of these have been digitised onto GIS, however. The English Heritage Listed Buildings online database contains 14,858 entries for the county, although this total includes the unitary authority of South Gloucestershire, not considered here.

4.1.3 *Scheduled Monuments*

853 Scheduled Monuments are listed in the county SMR, giving an average density of 0.3 Scheduled Monuments per km^2.

4.1.4 The Monuments at Risk Survey (Darvill and Fulton 1998, 67) suggested that the average archaeological site density for England as a whole was 5.04 per km^2, although Gloucestershire had more than 7 records per km^2 at that time. With an average of 16 records per km^2 in the county identified here (Table 34), Gloucestershire would seem to have an unusually high incidence of records. The high number of records may not necessarily reflect actual density of archaeological sites across the county, however, with more sites occurring in urban areas. More importantly, the Monuments at Risk Survey excluded domestic buildings constructed after 1700 and all buildings of post 1900 date. Stray finds (which represent c.22% of all records in SMRs) and place names were also excluded. The MARS survey and the one presented here are not directly comparable, therefore.

4.1.5 Finds and sites of Post-Medieval date are the most common records on the SMR, followed by those of Unknown and Medieval date. Roman sites and finds are fourth most common, but have a similar number of records as Medieval period sites

and finds. Mesolithic and Palaeolithic sites and finds are particularly under-represented, as are those of a modern date.

4.1.6 The area identified here as the potential aggregate resource covers c.18% of the county. This includes roughly equal areas of sand and gravel deposits and hard rock limestone. It is therefore possible to compare numbers and densities of records across these different geologies. In the following Resource Assessment three aggregate producing areas, identified in the Methodology (Section 2) as the Cotswold Limestone, the Forest of Dean and the sand and gravel producing areas, will be used as units for analysis. The gravel producing areas are further sub-divided into the geographical units of the Upper Thames Valley, The Evenlode Valley, the Windrush Valley, the Severn Vale and the Leadon Valley (figures 4 and 5).

4.1.7 In the following section the SMR data for each of these areas is presented. This takes the form of tables with raw numbers of SMR records for each area, followed by the percentage of the total number of records for the county this represents. A summary of interventions listed by the SMR follows, as well as tabulated data giving record numbers and densities for each aggregate area and sub-unit. The data is discussed and an overview is presented.

4.2 SMR data by period and geology: Sand and gravel areas

4.2.1 *Early Prehistoric (Palaeolithic to Neolithic)*
For the sands and gravels within the study area there is a total of 53 early prehistoric records (figure 6). Nine of these date to the Palaeolithic period, 5 to the Mesolithic and 39 to the Neolithic. 10% of the county's Early Prehistoric sites occur in this area.

Sub Unit	No	Palaeolithic	Mesolithic	Neolithic
Upper Thames Valley	41	4	3	34
Windrush Valley	6	1	0	5
Severn Vale	5	3	2	0
Leadon Valley	1	1	0	0
Evenlode Valley	0	0	0	0
TOTAL	**53**	**9**	**5**	**39**
% of county	**10**	**28**	**6**	**9**

Table 8: Early Prehistoric records for sand and gravel areas

4.2.2 *Later Prehistoric (Bronze to Iron Age)*

A total of 648 later prehistoric sites and artefact records occur on the sands and gravels within the study area. 328 of these belong to the Bronze Age and 320 to the Iron Age (figure 7). 31% of the county's Later Prehistoric sites occur in this area.

Sub Unit	No	Bronze Age	Iron Age
Upper Thames Valley	534	306	228
Windrush Valley	67	8	59
Severn Vale	42	12	30
Evenlode Valley	5	2	3
Leadon Valley	0	0	0
TOTAL	**648**	**328**	**320**
% of county	**31**	**28**	**36**

Table 9: Later Prehistoric records for sand and gravel areas

4.2.3 *General Prehistoric (Specific Period Unknown)*

74 records of unassigned prehistoric date are present within the SMR on the sands and gravels within the study area (figure 8).

Sub Unit	No	% of county
Upper Thames Valley	43	5
Windrush Valley	15	2
Severn Vale	15	2
Evenlode Valley	1	0.1
Leadon Valley	0	0
TOTAL	**74**	**9.1**

Table 10: General Prehistoric records for sand and gravel areas

4.2.4 *Roman*

SMR records for the Roman period total 6,512. Of these 1,058 occur on the sands and gravels, representing 16% of the total for the county (figure 9).

Sub Unit	No	% of county
Upper Thames Valley	564	9
Severn Vale	317	5
Windrush Valley	146	2
Evenlode Valley	24	0.2
Leadon Valley	7	0.1
TOTAL	**1,058**	**16.3**

Table 11: Roman records for sand and gravel areas

4.2.5 *Early Medieval*

A total of 993 sites and artefacts are recorded on the SMR. Of these 179 occur on the sands and gravels within the study area, representing 18% of the recorded sites for this period (figure 10).

Sub Unit	No	% of county
Upper Thames Valley	104	11
Severn Vale	44	4
Windrush Valley	25	2
Evenlode Valley	6	1
Leadon Valley	0	0
TOTAL	**179**	**18**

Table 12: Early Medieval records for sand and gravel areas

4.2.6 *Medieval*

SMR records for the Medieval period total 6,801. 785 of these occur on the sands and gravels, representing 11% of the total for the county (figure 11).

Sub Unit	No	% of county
Severn Vale	469	7
Upper Thames Valley	225	3
Evenlode Valley	46	0.4
Windrush Valley	22	0.3
Leadon Valley	23	0.3
TOTAL	**785**	**11**

Table 13: Medieval records for sand and gravel areas

4.2.7 *Post-Medieval*

18,442 records of Post-Medieval date are held by the SMR. 1,228 of these lie within the sand and gravel area, a total of 7% of those recorded for the county (figure 12).

Sub Unit	No	% of county
Severn Vale	603	3
Upper Thames Valley	332	2
Evenlode Valley	179	1
Windrush Valley	90	0.7
Leadon Valley	24	0.3
TOTAL	**1,228**	**7**

Table 14: Post-Medieval records for sand and gravel areas

4.2.8 *Modern*

Of the 185 modern records within the county SMR, 158 occur in the sand and gravel aggregate area, some 7.2% of the total (figure 13).

Sub Unit	No	% of county
Severn Vale	64	2.9
Upper Thames Valley	53	2.4
Evenlode Valley	27	1.3
Windrush Valley	14	0.6
Leadon Valley	0	0
TOTAL	**158**	**7.2**

Table 15: Modern records for sand and gravel areas

4.2.9 *Multi-Period*

2,167 Multi-Period records occur in the county SMR. 79 of these occur within the sand and gravel area, representing c.4% of the total (figure 15).

Sub Unit	No	% of county
Upper Thames Valley	75	3.6
Severn Vale	3	0.3
Evenlode Valley	0	0
Windrush Valley	1	0.1
Leadon Valley	0	0
TOTAL	**79**	**4**

Table 16: Multi-Period records for sand and gravel areas

4.2.10 *Unknown*

4.2.10.1 A total of 6,945 records within the county are of unknown date. 16% of these occur within the sand and gravel sub-units (figure 14).

Sub Unit	No	% of county
Upper Thames Valley	681	10
Severn Vale	289	4
Windrush Valley	71	1
Evenlode Valley	32	0.9
Leadon Valley	6	0.1
TOTAL	**1,079**	**16**

Table 17: Unknown period records for sand and gravel areas

4.2.11 *Listed Buildings*

Sub Unit	No	% of county
Upper Thames Valley	97	2
Severn Vale	167	3
Windrush Valley	25	0.5
Evenlode Valley	86	2
Leadon Valley	17	0.5
TOTAL	**48**	**8%**

Table 18: Listed Buildings in the sand and gravel areas

4.2.12 *Scheduled Monuments*

Sub Unit	No	% of county
Upper Thames Valley	25	3
Severn Vale	13	2
Windrush Valley	23	3
Evenlode Valley	5	1
Leadon Valley	1	0.2
TOTAL	**48**	**9.2%**

Table 19: Scheduled Monuments in the sand and gravel areas

4.3 SMR data by period and geology: Forest of Dean (Hard Rock Resource Area)

4.3.1 *Early Prehistoric (Palaeolithic to Neolithic)*
50 records dating to this period are held by the county SMR, representing c.9% of the total for this period within Gloucestershire. Of these, two date to the Palaeolithic period, 22 to the Mesolithic and 26 to the Neolithic (figure 59). The area contains almost a third of the known Mesolithic sites for the county, although the Neolithic and Palaeolithic periods appear to be under represented. The Forest of Dean has a higher than average record density for the Early Prehistoric period and has the highest density of records for any sub-unit apart from the Windrush Valley (Table 34).

4.3.2 *Later Prehistoric (Bronze to Iron Age)*
20 records of this period are on the county SMR. This represents less than 1% of the total for the county with the Iron Age being particularly under represented. Sites and artefacts recorded in the study area by the SMR consist of 18 recorded as Bronze Age and 2 Iron Age enclosures. The sub-unit has a lower than average record density for this period (figure 60, Table 34).

4.3.3 *General Prehistoric (Specific Period Unknown)*
A total of 27 prehistoric records were retrieved from the county SMR, mainly consisting of multi-period sites or findspots of undiagnostic artefacts. These represent c.3% of general prehistoric sites in the county, although the record density is relatively high and matches that of the Upper Thames Valley (figure 61, Table 34).

4.3.4 *Roman*
A total of 35 records of Roman date are recorded in the aggregates resource area of the Forest of Dean. This is the lowest record density for the period from the county although records again contain a high proportion of findspots (figure 62, Table 34).

4.3.5 *Early Medieval*
55 Early Medieval records are held by the county SMR for the Forest of Dean resource area (figure 63, Table 34). The majority of these relate to the Offa's Dyke project, which was extensively surveyed during 1995/6 (Hoyle & Vallender 1997).

4.3.6 *Medieval*
There are a total of 136 records in the Gloucestershire SMR for the Medieval period in the Forest of Dean resource area (figure 64, Table 34).

4.3.7 *Post-Medieval*
639 records of this period are held by the SMR in the Forest of Dean aggregate resource area (figure 65, Table 34). A high proportion of these relate to fieldnames and placenames, although significant numbers of limekilns and quarries are also recorded.

4.3.8 *Modern*
The SMR holds 78 records of this period, which is mainly represented by the recording of land parcels and footpaths from First Edition Ordnance Survey maps (figure 66, Table 34). Few of the records for this period are for upstanding earthworks or buildings.

4.3.9 *Multi-Period*
Only 3 Multi-Period sites are recorded from the Forest of Dean, all of which appear to be multi-phase medieval landscapes (figure 68, Table 34).

4.3.10 *Unknown*
A total of 594 records are assigned an Unknown date by the SMR. The majority of these are quarries and scowles which cannot be assigned an accurate date (figure 67, Table 34).

4.3.11 *Scheduled Monuments*
The county SMR records 23 Scheduled Monuments in this sub-unit. This is 3% of the county total.

4.3.12 *Listed Buildings*
A total of 59 listed buildings are recorded in the Forest of Dean resource area, representing 1% of the county total.

4.3.13 An obvious bias in the data collected here is that is, by definition, only the limestone areas of the Forest of Dean were examined. These areas are also those predominantly used for agriculture and therefore the archaeology is more visible than within the areas of sandstone and coal measure geology. Indeed, the distribution of prehistoric material from the Forest is entirely from this area. This appears to reflect collection bias, rather than actual archaeological patterning, although the central, wooded area of the Forest of Dean remains poorly understood (J. Hoyle, *pers comm*.).

4.4 SMR data by period and geology: Cotswold Limestone

4.4.1 The different methodology adopted for this area means that it is slightly different to that for the sands and gravels (see Methodology, Section 2). Record density for this sub-unit is reflected in the raw number of records for a site, as the data was collected from a 2km radius of each quarry site. To calculate a comparable record density to that recorded for the sands and gravels, the total number of records for each quarry area needs to be divided by the sum of each of the 18 areas searched. The total for each period, therefore should be divided by 226 to arrive at a figure for record per km^2.

4.4.2 The methodology adopted here reflects the less extensive nature of limestone quarrying, but is formulated to take into account the maximum extent of *Preferred Areas* identified in the Minerals Local Plan (see Section 3.10). The sum of the resulting areas is roughly equal to that within the sand and gravel areas and thus allows a cross comparison between record densities in these areas. The proportion of the sites on limestone geologies which occur within 2km of a quarry is also given in the following tables, expressed as a percentage.

4.4.3 Figures for each 2km area around each quarry considered here are presented as figures 69 to 85. Each figure also shows contours at 50m intervals.

4.4.4 *Early Prehistoric (Palaeolithic to Neolithic)*
A total of 312 Earlier Prehistoric records are held by the SMR from the limestone areas of the Cotswolds. These consist of 32 Palaeolithic, 39 Mesolithic and 270 Neolithic records.

Quarry	No	Palaeolithic	Mesolithic	Neolithic
Benns Hill	2	1	0	1
Birdlip	9	0	3	6
Bishops Cleeve (Wingmoor Farm)	3	3	0	1
Brockhill	1	0	0	1
Cotswold Hill	0	0	0	0
Daglingworth	10	0	3	7
Guiting	1	0	0	1
Happylands	0	0	0	0
Hornleasow	2	0	0	2
Huntsmans	14	0	0	14
Oathill	1	0	0	1
Oxleaze	1	0	0	1
Shenberrow	4	0	0	4
Soundborough	2	0	0	2
Stanleys	0	0	0	0
Swellwold	15	0	0	15
Three Gates	0	0	0	0
Veizeys	2	0	1	1
TOTAL	**67**	**4**	**7**	**57**
% of County	**12**	**13**	**9**	**13**
% of limestone	**22**	**100**	**18**	**21**

Table 20: Early Prehistoric records for the Cotswold Limestone area

4.4.5 *Later Prehistoric (Bronze to Iron Age)*

A total of 974 Later Prehistoric records from the limestone areas are held by the SMR. These consist of 689 Bronze Age and 285 Iron Age sites.

Quarry	No	Bronze Age	Iron Age
Benns Hill	4	4	0
Birdlip	32	14	18
Bishops Cleeve (Wingmoor Farm)	13	2	11
Brockhill	8	8	0
Cotswold Hill	15	14	1
Daglingworth	48	10	38
Guiting	14	13	1
Happylands	0	0	0
Hornleasow	1	1	0
Huntsmans	77	46	31
Oathill	23	15	8
Oxleaze	9	8	1
Shenberrow	16	13	3
Soundborough	9	9	0
Stanleys	1	1	0
Swellwold	50	49	1
Three Gates	14	13	1
Veizeys	15	12	3
TOTAL	**349**	**232**	**117**
% of County	**17**	**20**	**13**
% of limestone	**36**	**34**	**41**

Table 21 Later Prehistoric records for the Cotswold Limestone area

4.4.6 *General Prehistoric (Specific Period Unknown)*

The SMR records 531 prehistoric finds and sites from the Cotswold Limestone areas. 23% of these occur within 2km of a quarry.

Quarry	No
Benns Hill	4
Birdlip	12
Bishops Cleeve (Wingmoor Farm)	3
Brockhill	4
Cotswold Hill	7
Daglingworth	21
Guiting	7
Happylands	0
Hornleasow	3
Huntsmans	12
Oathill	3
Oxleaze	11
Shenberrow	4
Soundborough	12
Stanleys	0
Swellwold	9
Three Gates	6
Veizeys	6
TOTAL	**124**
% of County	**14**
% of limestone	**23**

Table 22: General Prehistoric records for the Cotswold Limestone area

4.4.7 *Roman*

1,803 Roman sites and finds are recorded on the SMR as lying on the Cotswold Limestone. 21% of these occur within 2km of a quarry.

Quarry	No
Benns Hill	13
Birdlip	42
Bishops Cleeve (Wingmoor Farm)	101
Brockhill	18
Cotswold Hill	7
Daglingworth	62
Guiting	5
Happylands	5
Hornleasow	6
Huntsmans	56
Oathill	4
Oxleaze	10
Shenberrow	6
Soundborough	7
Stanleys	6
Swellwold	15
Three Gates	7
Veizeys	16
TOTAL	**386**
% of County	**6**
% of limestone	**21**

Table 23: Roman records for the Cotswold Limestone area

4.4.8 *Early Medieval*

The county SMR records 197 Early Medieval sites on the Cotswold Limestone, 21% of which lie within 2km of a quarry.

Quarry	No
Benns Hill	2
Birdlip	0
Bishops Cleeve (Wingmoor Farm)	16
Brockhill	2
Cotswold Hill	1
Daglingworth	4
Guiting	0
Happylands	0
Hornleasow	0
Huntsmans	0
Oathill	3
Oxleaze	1
Shenberrow	0
Soundborough	4
Stanleys	5
Swellwold	0
Three Gates	1
Veizeys	3
TOTAL	**42**
% of County	**4**
% of limestone	**21**

Table 24: Early Medieval records for the Cotswold Limestone area

4.4.9 *Medieval*

A total of 1,399 Medieval records from the Cotswold Limestone area occur on the SMR. 33% of these sites are located within 2km of a quarry.

Quarry	No
Benns Hill	10
Birdlip	73
Bishops Cleeve (Wingmoor Farm)	88
Brockhill	12
Cotswold Hill	23
Daglingworth	30
Guiting	16
Happylands	10
Hornleasow	2
Huntsmans	7
Oathill	9
Oxleaze	11
Shenberrow	49
Soundborough	8
Stanleys	33
Swellwold	8
Three Gates	31
Veizeys	44
TOTAL	**464**
% of County	**7**
% of limestone	**33**

Table 25: Medieval records for the Cotswold Limestone area

4.4.10 *Post-Medieval*

A total of 4,288 Post-Medieval records are held by the SMR for the Cotswold Limestone areas. 18% of these sites are located within 2km of a quarry.

Quarry	No
Benns Hill	13
Birdlip	48
Bishops Cleeve (Wingmoor Farm)	51
Brockhill	10
Cotswold Hill	14
Daglingworth	40
Guiting	17
Happylands	13
Hornleasow	7
Huntsmans	5
Oathill	8
Oxleaze	5
Shenberrow	12
Soundborough	17
Stanleys	113
Swellwold	9
Three Gates	15
Veizeys	385
TOTAL	**782**
% of County	**4**
% of limestone	**18**

Table 26: Post-Medieval records for the Cotswold Limestone area

4.4.11 *Modern*

The county SMR holds 714 records for modern sites from the Cotswold Limestone. Although 6.1% of the sites assigned to this period by the county SMR are located within 2km of a quarry, this represents 19% of the total recorded from the limestone areas.

Quarry	No
Benns Hill	4
Birdlip	16
Bishops Cleeve (Wingmoor Farm)	15
Brockhill	2
Cotswold Hill	2
Daglingworth	6
Guiting	2
Happylands	5
Hornleasow	2
Huntsmans	2
Oathill	0
Oxleaze	1
Shenberrow	1
Soundborough	1
Stanleys	7
Swellwold	2
Three Gates	2
Veizeys	64
TOTAL	**134**
% of County	**6.1**
% of limestone	**19**

Table 27: Modern records for the Cotswold Limestone area

4.4.12 *Multi-Period*

A total of 52 records for Multi-Period sites are recorded by the SMR from the Cotswold Limestone areas. 4% of these lie within 2km of a quarry

Quarry	No
Benns Hill	0
Birdlip	2
Bishops Cleeve (Wingmoor Farm)	0
Brockhill	0
Cotswold Hill	0
Daglingworth	0
Guiting	0
Happylands	0
Hornleasow	0
Huntsmans	0
Oathill	0
Oxleaze	0
Shenberrow	0
Soundborough	0
Stanleys	0
Swellwold	0
Three Gates	0
Veizeys	0
TOTAL	**2**
% of County	**0.1**
% of limestone	**4**

Table 28: Multi-Period records for the Cotswold Limestone area

4.4.13 *Unknown*

A total of 2,557 records of unknown period are recorded in the Cotswold Limestone areas by the SMR. 15% of these lie within 2km of a quarry.

Quarry	No
Benns Hill	16
Birdlip	70
Bishops Cleeve (Wingmoor Farm)	34
Brockhill	16
Cotswold Hill	12
Daglingworth	73
Guiting	12
Happylands	14
Hornleasow	5
Huntsmans	19
Oathill	18
Oxleaze	15
Shenberrow	25
Soundborough	15
Stanleys	10
Swellwold	4
Three Gates	15
Veizeys	0
TOTAL	**373**
% of County	**5**
% of limestone	**15**

Table 29: Unknown period records for the Cotswold Limestone area

4.4.14 *Listed Buildings*
A total of 279 listed buildings are listed by the SMR as occurring within 2km of the hard rock quarries on the Cotswolds identified in this study. The majority of these occur in Tetbury (close to Veisey's Quarry) and in and around Blockley and Bishop's Cleeve.

4.4.15 *Scheduled Monuments*
In total 76 Scheduled Monuments occur within 2km of the hard rock quarries on the Cotswolds. This represents 9% of those recorded for the county, a roughly equal amount to those located on the sands and gravels. The main concentration of Scheduled Monuments identified here is in the rich prehistoric landscape at the head of the Windrush Valley.

4.5 Interventions recorded by the SMR

4.5.1 The interventions recorded here, except where noted, are directly related to the operation and expansion of the quarries identified within this study. The list was complied from the Gloucestershire County SMR and from planning records held by Gloucestershire County Council.

Quarry	SMR No	Description
Birdlip	n/a	A417 road improvements, not related to quarry.
Bishops Cleeve	15918	Desk Based Assessment
	9901	Evaluation
Brockhill	17032	Watching brief
Daglingworth	4783	A417 road improvements, not related to quarry.
Guiting	16291	Evaluation
Hornleasowe	11129	Excavation (dinosaur)
Huntsmans	9890	Geophysical survey, Evaluation, Excavation, Watching Brief
	11376	Desk Based Assessment, Evaluation of Buckle Street
	22106	Fieldwalking, Evaluation, Excavation
	22107	Fieldwalking, Evaluation, Excavation
Soundborough	27070	Desk Based Assessment
Stanleys	20689	Evaluation

Table 30: Interventions recorded by the SMR in the Cotswold Limestone area

Quarry	SMR No	Description
Drybrook	4371	Evaluation, Watching brief
Rogers	n/a	Desk Based Assessment
Stowfield	20360	Desk Based Assessment
	13920	Desk Based Assessment, Evaluation, Watching Briefs
Stowe Hill	21477	Desk Based Assessment, Geophysical Survey, Evaluation

Table 31: Interventions recorded by the SMR in the Forest of Dean

Quarry	SMR No	Description
Cerney Wick Farm	n/a	Desk Based Assessment, Evaluation
Coln Gravel	21065	EIA
Cotswold Community	3121	Evaluation, Excavation
Dryleaze	21130	Desk Based Assessment, Geophysics, Evaluation
Horcott	21783	Evaluation, Excavation
Lady Lamb Farm	2505	Evaluation
Manor Farm, Kempsford	14656	Evaluation, Excavation
Milestone House	20239	Evaluation, Excavation
Spratsgate Lane	2361	Evaluation, Excavation
Shorncote	15477	Evaluation, Excavation
Stubbs Farm, Kempsford	3156	Desk Based Assessment, Excavation, Evaluation
	14655	Evaluation
Thornhill Farm	4871	Desk Based Assessment
	324	Excavation
Totterdown Lane	15370	Evaluation, Excavation

Table 32: Interventions recorded by the SMR in the sand and gravel area

Number Of Records Per Aggregate Area

Sub Unit	Early Prehistoric	Late Prehistoric	Prehistoric	Roman	Early Medieval	Medieval	Post-Medieval	Modern	Multi-Period	Unknown
County	*557*	*2,059*	*893*	*6,512*	*993*	*6,801*	*18,442*	*2,167*	*185*	*6,945*
Limestone (county)	*312 (56%)*	*974 (47%)*	*531 (59%)*	*1,803 (28%)*	*197 (20%)*	*1,399 (21%)*	*4,288 (23%)*	*714 (33%)*	*52 (28%)*	*2,557 (38%)*
Sands and Gravels (County)	*91 (16%)*	*693 (34%)*	*98 (11%)*	*2,348 (36%)*	*245 (25%)*	*1,338 (19%)*	*2,634 (14%)*	*240 (11%)*	*88 (48%)*	*1,217 (17%)*
Other (County)	*154 (28%)*	*392 (19%)*	*264 (30%)*	*2,361 (37%)*	*551 (55%)*	*4,064 (60%)*	*11,520 (62%)*	*1,213 (56%)*	*45 (24%)*	*3,171 (46%)*
Cotswold Limestone	67	349	124	386	42	464	782	134	2	373
FoD	50	20	27	35	55	136	639	78	3	594
Sands and Gravels	53	648	74	1,058	179	785	1,228	158	1,079	79

Table 33: Number of records per aggregate area

The majority of Early Medieval to Modern sites do not occur on either the sands and gravels or the limestone. These sites are found on drift geologies of alluvium, head, clay and silt and solid geologies of mudstone, siltstone and sandstone.

SMR Record Density By Sub-Unit:
(records per km^2)

Sub Unit	Area (km^2)	Early Prehistoric	Late Prehistoric	Prehistoric	Roman	Early Medieval	Medieval	Post-Medieval	Modern	Unknown	Multi-Period
Severn	116	0.1	0.4	0.1	2.7	0.4	4	5.2	0.5	2.5	0.1
UTV	69	0.4	7.7	0.6	4.9	1.5	3.3	4.8	0.8	9.9	1.1
Evenlode	24	0	0.2	0.1	1	0.25	1.9	7.5	1.1	1.3	0
Leadon	6	0.2	0	0	1.2	0	3.8	4	0	1	0
Windrush	3	2	22.3	5	48.7	8.4	7.3	30	4.7	23.7	0.4
Cotswold Limestone	226	0.3	1.5	0.5	1.7	0.2	2.0	3.5	0.6	1.6	0.1
FoD	46	1.1	0.4	0.6	0.8	1.2	2.9	13.9	1.7	11.9	0.1
County	**2705**	**0.2**	**0.8**	**0.3**	**2.4**	**0.4**	**2.5**	**6.8**	**0.1**	**2.6**	**0.8**

Table 34: SMR record density by sub-unit

4.6 Discussion

4.6.1 *Early Prehistory*

4.6.1.1 There are very few records for this period in general, c.1% of the total for the county. Neolithic sites have the highest frequency, although this is probably a product of the higher number of visible earthworks (in particular long barrows) dating to this period. Previous research has also mainly focussed on the period, with Crawford (1925) and O'Neil and Grinsell (1960) cataloguing the long barrows of the county and research excavations at Hazleton North (Saville 1990), Crickley Hill (Dixon 1994) and Peak Camp (Darvill 1981). The English Rivers Palaeolithic Project (Wessex Archaeology 1996) also covered the county, although this did not record new sites. With the exception of Alistair Marshall's survey (Marshall 1985), there has been little systematic fieldwalking and few attempts to explain what prehistoric lithic scatters may represent (Snashall 2002).

4.6.1.2 This period is relatively well represented by radiocarbon dates (the AHDS database lists 40 for this period), but these represent only a few sites (Hazleton North and Peak Camp), predominately of Neolithic date. Environmental data is poor and monument specific (although Brown & Barber (1985) did examine a site close to the county boundary), with no general overview available for the period from the available data.

4.6.1.3 *Sands and Gravels*: 10% of the county's Early Prehistoric resource occurs on the sands and gravels, with a high proportion of Palaeolithic records (over a quarter of the county total) from this geology (Table 34). Relatively few Mesolithic records exist for these areas, however. The Windrush Valley has the highest record density for the Early Prehistoric period with the Upper Thames and Leadon Valleys having higher than average densities. The Severn Vale has below average record density and the Evenlode Valley has no records from the period.

4.6.1.4 *Forest of Dean*: There is a fairly even split in frequencies of Mesolithic and Neolithic sites within the Forest of Dean, although the Mesolithic sites represent a higher percentage of the county total (Table 34). This sub-unit has a higher than average record density for the Early Prehistoric period.

4.6.1.5 *Cotswold Limestone*: All of the Palaeolithic sites on the limestone occur within 2km of a quarry, although these only total four (Tables 33 and 34). Nearly a quarter of the county's Neolithic sites occur in this sub-unit. Despite these relatively high numbers of records, the density for the sub-unit as a whole is only very slightly higher than the county average. More than half of the Early Prehistoric sites in the county occur within areas of limestone, however.

4.6.2 *Later Prehistory*

4.6.2.1 4.5% of the total records for the county can be attributed to the Later Prehistoric period (Table 34). There are slightly higher numbers of Bronze Age sites, although this probably reflects the high number of Early Bronze Age round barrows in the county (a total of 638, or 54% of the total Bronze Age sites). These barrow sites have been catalogued by Grinsell, but very little modern, good quality work has been carried out on their chronology and construction.

4.6.2.2 The Iron Age data is dominated by results from extensive excavations, especially in the Upper Thames Valley, with little work having been undertaken, despite an inventory published by the RCHME (1976), on the hillforts and settlements on the Cotswold Limestone. No modern, large scale excavation has been published

for a hillfort in the county and the non-hillfort occupation of the Cotswolds is generally poorly understood.

4.6.2.3 The AHDS radiocarbon database lists a total of 31 radiocarbon dates for this period, with twice as many Iron Age dates than Bronze Age. Environmental evidence is somewhat better, although this reflects the higher number of interventions at sites of this date.

4.6.2.4 *Sands and Gravels*: 30% of the county's Later Prehistoric sites are located on the sands and gravels, with an over-representation of sites in the Windrush and Upper Thames Valleys (Table 34). This can be accounted for by the visibility of these sites as cropmarks, the acquisition of this data by the SMR for the Upper Thames Valley and extensive archaeological evaluation and excavation in advance of quarrying. The Windrush Valley has also been subject to intensive work at Salmonsbury Camp, Bourton Bridge and Bourton on the Water. The Upper Thames Valley has the highest number of Bronze and Iron Age sites with the Leadon Valley having no records for either period. The Evenlode and Severn valleys have lower than average record densities for the Later Prehistoric period.

4.6.2.5 *Forest of Dean*: The limestone resource area in the Forest of Dean contains less than 1% of the county's Iron Age sites (Table 33). The Forest in general has very few recorded Iron Age sites, with half of the average number of records per km found in the rest of the county.

4.6.2.6 *Cotswold Limestone*: 20% of the county's Bronze Age sites occur within this sub-unit with concentrations around Huntsmans and Swellwold quarries in particular (figure 69). This partially represents the higher density of Later Prehistoric sites on the limestone uplands generally (Table 34), but also reflects archaeological work undertaken in advance of quarrying. Swellwold is also located within a concentration of round barrows in the area around Condicote henge.

4.6.3 *Prehistoric*

4.6.3.1 Only 2% of the records for the county are described as generally prehistoric, many relating to findspots of flint artefacts (Table 33).

4.6.3.2 *Sands and Gravels*: 9% of the county total of prehistoric monuments occur within the sands and gravels sub-unit (Table 33). There is a significantly higher than average record density in the Windrush Valley, with the Severn and Evenlode scoring lower than average (Table 34). No sites of this period are recorded in the Leadon Valley. The Upper Thames Valley has the highest frequency of prehistoric sites, almost certainly due to the higher level of excavation of undated, but still prehistoric, features from this area.

4.6.3.3 *Forest of Dean*: This sub-unit has a lower than average record density, but has a relatively high number of findspots of this date (Table 34). This might relate to unsystematic fieldwalking undertaken by members of DAG and reported to the SMR.

4.6.3.4 *Cotswold Limestone*: 14% of the county's prehistoric sites occur within 2km of a quarry on the limestone and this represents nearly a quarter of all the sites of this period on the limestone (Table 33). Daglingworth Quarry has a high frequency of sites as a result of excavations along the A417. There is a higher than average record density for this period, although Stanleys and Happylands quarries have no recorded sites of this period.

4.6.4 *Prehistoric Period Discussion*

4.6.4.1 Excluding data for urban areas skews the data somewhat: in the Severn Vale a total of 7 Palaeolithic, 2 Mesolithic and 19 Neolithic sites and artefacts are recorded in the SMR and, although the Mesolithic sites lie outside urban areas, all of the Neolithic and half of the Palaeolithic sites and artefacts recorded in the Vale occur within urban areas. There are likewise 53 Iron Age and 25 Bronze Age sites in the Severn Vale, half of which are now in urban areas.

4.6.4.2 The high number of Early Bronze Age burial monuments from the county also skew the data. These tend to occur on the Cotswolds and are under-represented on the sands and gravels. The Neolithic and Bronze Ages in particular have an over-representation of visible earthwork sites, whereas later prehistoric sites have been identified from aerial photography or excavation in advance of development. An attempt to quantify this is provided below (Table 35) where findspots and upstanding earthworks identified in the SMR for the county are compared to the presence of excavated features such as pits, postholes and burials. Although this is a rather coarse quantification (due in part to events such as evaluation and excavation not being recorded separately by the county SMR), it is clear that Iron Age excavated features are more common than those dating to the Palaeolithic and Mesolithic periods.

Period	Findspots	Earthworks	Excavated Features
Palaeolithic/Mesolithic	99 (88%)	0 (0%)	9 (8%)
Neolithic	216 (49%)	118 (27%)	20 (5%)
Bronze Age	126 (11%)	503 (43%)	178 (15%)
Iron Age	63 (7%)	64 (7%)	357 (40%)

Table 35: Comparative visibility of prehistoric features

4.6.4.3 On the sands and gravels, the Upper Thames Valley consistently has the highest number of sites throughout all of the prehistoric period (Table 33). Indeed, the proportion of sites per sub-unit is consistent throughout the period with the Windrush and Severn valleys having the next highest concentration of sites and the Leadon and Evenlode valleys having consistently the fewest sites. Both the Cotswold and Forest of Dean Limestone sub-units have higher frequencies of Early Prehistoric sites than the Upper Thames Valley, although when record density is taken into consideration, the Windrush Valley has better recorded archaeology from this period. Conversely, there are no records for this period from the Evenlode Valley, which seems to be particularly under-represented throughout the prehistoric period.

4.6.4.4 For the Later Prehistoric period, the Upper Thames Valley has a significantly higher number of records than the other sub-units, indeed it has a higher frequency of sites from this period than the sum of those from all of the other sub-units (Table 33). In terms of record density, the Upper Thames Valley comes second only to the Windrush Valley, reflecting the intensity of both prehistoric occupation and archaeological activity around Bourton on the Water. The Leadon Valley has no records for Late Prehistoric period sites, with the Evenlode Valley and Forest of Dean scoring lower than average.

4.6.4.5 Throughout the Early, Late and general Prehistoric periods, the Windrush and Upper Thames Valleys have consistently high record densities and numbers of sites (Table 34). The limestone areas of the Cotswolds and Forest of Dean have a generally higher than average density of sites with the Severn, Evenlode and Leadon Valleys in particular having relatively few sites. The Leadon Valley scores a zero for

two of the three divisions of the prehistoric period made here, with the Evenlode Valley being the only other sub-unit to score a zero.

4.6.4.6 There is an interesting contrast between the densities of Earlier Prehistoric and Later Prehistoric sites in the Forest of Dean, when compared to the sand and gravel areas (Table 34). The preponderance of Later Prehistoric sites on the sands and gravels has been highlighted above. In the Forest of Dean, however, Earlier Prehistoric sites dominate. Similar methodologies were used in these sub-units, so this does not appear to represent a methodological bias.

4.6.4.7 In terms of understanding the prehistoric landscape of the aggregate producing areas, there are obvious gaps in knowledge for the period in the Leadon and Evenlode Valleys, with the Severn Vale coming a close third. Caveats about the exclusion of urban areas should be taken into account when considering the latter, however. The Windrush Valley is consistently the best recorded prehistoric landscape, although this is probably artificially skewed by the very small area of this sub-unit (at 3km^2 it is the smallest). The sands and gravels, and the Upper Thames Valley in particular, have the highest number of records per sub-unit and the highest record density (Table 34). This is in general agreement with the picture from the whole county, with limestone areas returning 1.2 records per km^2 and the sand and gravel areas 2.1 per km^2. An obvious gap in knowledge for the Forest of Dean includes the apparent lack of Earlier Prehistoric burial and ceremonial monuments. Although the Earlier Prehistoric period is apparently well represented, these records nearly all relate to finds from fieldwalking and stray finds, with a complete lack of upstanding earthworks recorded. This is similar for the Later Prehistoric period, although two extant Iron Age earthworks are recorded from the resource area. One potential major factor in the low monument density in the Forest is the presence of tree cover, making both aerial and ground-based survey difficult, resulting in a low record density.

4.6.4.8 Although there is a good chronological spread of prehistoric radiocarbon dates from the county, these are derived from approximately ten sites. Chronology remains poorly understood throughout the prehistoric period.

4.6.5 *Roman*

4.6.5.1 *Sands and Gravels*: Although there is a roughly equal division of Roman sites across the sands and gravels, limestone and other geologies of the county, the record density is far higher for the sand and gravel areas (Table 34). The Windrush Valley in particular has an extremely dense cluster of records, dominated by finds from sites in Bourton on the Water such as Salmonsbury Camp and Bourton Bridge. The Leadon Valley has a particularly low number of records for this period with all of the records relating to Roman roads. Within the Evenlode valley, which has the lowest record density for this sub-unit, records mainly represent finds from the small Roman town at Dorn.

4.6.5.2 *Forest of Dean*: This sub-unit has the lowest number of Roman period finds in this study, with a lower than average record density (Table 34).

4.6.5.3 *Cotswold Limestone*: The Cotswold Limestone sub-unit has a higher record density when compared to the Forest of Dean, with nearly a quarter of all the Roman sites on the limestone occurring within 2km of a quarry (Table 33). Sites with high numbers of records tend to reflect the amount of archaeological work carried out close to these sites, which has not always been related to the extraction of aggregates (the construction of a Tescos at Bishop's Cleeve and improvements to

the A417, for example). This data does give an impression of the likely site density in these areas, however.

4.6.5.4 As less than a quarter of all the Roman sites in the county are assigned to a specific century within the Roman period by the SMR, it is not feasible to analyse the data by century therefore.

4.6.5.5 With the exception of the Windrush Valley, the Upper Thames Valley and the Severn Vale, all of the sub-units in this study have lower than average record densities (Table 34). The exclusion of urban areas from the study skews the data, however, as a total of 2,185 Roman sites occur in the major settlements in the county. The visibility of sites is also a factor and, as outlined in the methodology (Section 2), finds from excavated sites dominate the data. To give an idea of how this affects the data, c.6,000 records in the SMR relate to excavated features such as pits and postholes, whereas c.1,500 relate to findspots and upstanding monuments such as roads and town defences. Areas where little archaeological work has been undertaken will therefore appear to have more sparse record densities.

4.6.5.6 Despite the high number of Roman records for the county, relatively little synthetic work has been carried out. Rather, attention has focussed on excavation, both within towns such as Gloucester and Cirencester, at villa sites (Woodchester, Chedworth, Spoonley Wood, for example) and settlement sites (Frocester in particular). The relationships between these sites, the towns and the countryside and settlement hierarchy generally are relatively poorly understood. The process of "Romanisation" and how this is reflected in the archaeology within the county is also relatively under explored. The Forest of Dean is particularly under represented during this period and is an obvious area in need of more work.

4.6.5.7 A total of 7 radiocarbon dates for this period are recorded in the AHDS database, although this may reflect a general dependence on pottery and coins for chronological resolution during this period. Dates are exclusively from the towns of Cirencester and Gloucester.

4.6.6 *Early Medieval*

4.6.6.1 Less than half of the records for the Early Medieval period occur either on limestone or sand and gravels with the period generally having a low record density across the county (Tables 33 and 34).

4.6.6.2 *Sands and Gravels*: The Upper Thames Valley has the highest number of records for this period, although many of these relate to work at relatively few, large sites such as Cotswold Community, Shorncote, Coln House School and Butler's Court. The Windrush Valley has the highest record density but the Evenlode and Leadon valleys are particularly under represented, the Leadon Valley being the only sub-unit to return no records for the period.

4.6.6.3 *Forest of Dean*: This sub-unit has an above average record density, although nearly all of these records relate to a single piece of work: the Offa's Dyke Management Survey (Hoyle & Vallender 1997).

4.6.6.4 *Cotswold Limestone*: Early Medieval sites are poorly represented in this sub-unit, which has the second lowest record density after the Leadon Valley (which has none: Table 34). Nearly a quarter of the quarry sites have no recorded Early Medieval sites within 2km, with Bishop's Cleeve being the only site with a significant number of records, relating to excavations at the Tesco and Stoke Road sites. Although only 4% of the county's Early Medieval sites occur in this sub-unit, nearly a

quarter of all the sites from this period which are located on the limestone occur within 2km of a quarry.

4.6.6.5 Due to the coarse chronology used by the SMR it is impossible to break Early Medieval sites down by century, although 5th to 6th century sites have only been identified in the Windrush and Upper Thames valleys.

4.6.7 *Medieval*

4.6.7.1 In common with the Early Medieval period, less than half of the sites for this period in the county occur within the study area. Record density is, however, much higher for this period (Tables 33 and 34).

4.6.7.2 *Sands and Gravels*: In terms of frequency of records, the Severn Vale dominates this period and has higher numbers of most monument types recorded by the SMR (Table 34). The Windrush Valley, however, has the highest density of records, although the Severn Vale does have a higher than average monument density for this period. The Early Medieval period is the only one for which the Leadon Valley has a higher than average record density.

4.6.7.3 *Forest of Dean*: This sub-unit has a relatively high record density for this period, many of the records relating to the Forest of Dean NMP survey (Table 34).

4.6.7.4 *Cotswold Limestone*: Although this sub-unit has a below average record density, a third of the Medieval sites recorded on the limestone in the county occur within 2km of a quarry. As well as the high numbers of sites from quarries where archaeological work has been undertaken (Birdlip, Bishop's Cleeve and Daglingworth), Shenberrow Quarry is located in the area covered by the Cotswold NMP pilot study and therefore has a higher than average number of sites recorded.

4.6.8 *Medieval Period Discussion*

4.6.8.1 The exclusion of urban areas from the study has skewed the data, especially in the Severn Vale. The sands and gravels of the Vale contain 21 recorded medieval churches and 7 deserted villages, in comparison to the Upper Thames Valley's 5 churches and 1 deserted village. The SMR, however, records a total of 888 medieval sites in the Severn Valley, half of which are located in urban areas. Nearly half of the churches recorded by the SMR in the Severn Vale also occur within urban areas.

4.6.8.2 Throughout the Early Medieval and Medieval periods, the Windrush Valley and the Forest of Dean return the highest record densities (Table 34). The record density for the Forest of Dean is somewhat illusory, however, and reflects records generated during the Offa's Dyke survey. When the over-representation of the Early Medieval Period due to the Offa's Dyke survey is taken into account, the period is under represented in this sub-unit with very little apparent contemporary settlement. The Medieval period is generally better recorded, with the majority of the sub-units having higher than average record densities. This is in contrast to the Early Medieval period, where more sub-units have below average record densities, with the Leadon Valley returning no records.

4.6.8.3 Both the Deserted Medieval Villages (DMVs) and moated sites of the county have been catalogued (Aston & Viner 1981, Rawes 1978) and the origins and development of historic towns have been considered (Douthwaite & Devine 1998, Bassett 1977). Aston & Viner (1981) pointed out the lack of general work on DMVs in the county, despite several sites having been excavated. Rawes (1978) also suggested that more work was needed on moated sites and suggested more intensive work, survey and excavation was needed. The list published in 1978

contained 114 sites but that number has now more than doubled, with the SMR recording a total of 238.

4.6.8.4 Although the Gloucestershire section of Offa's Dyke has been surveyed (Hoyle & Vallender 1997), it is still unclear if this section is indeed part of the Dyke. Hoyle and Vallender (1997) proposed recommendations for future archaeological work, including the investigation of the large gap between Redbrook and English Bicknor, as well as trial excavation to assess the nature and date of the monument.

4.6.8.5 A total of 15 radiocarbon dates are recorded by the AHDS database, with 8 of these relating to a dating programme for the tithe barn at Frocester. Two dates from North Street, Winchcombe (Saville 1985), are not listed in the database, however. The Vernacular Architecture Group Dendrochronology Database lists a total of 12 Medieval dendrochronological dates for the county, from a variety of churches, barns and houses.

4.6.9 *Post-Medieval*

4.6.9.1 The Post-Medieval period has the highest density of records for any chronological period, with particular concentrations of records in the Forest of Dean (Table 34).

4.6.9.2 *Sands and Gravels*: Although the Severn Vale has the highest frequency of Post-Medieval records, the density of these records is less than average, with the Windrush Valley having the densest distribution for this period in the county (Table 34).

4.6.9.3 *Forest of Dean*: This sub-unit has the second highest record density for the Post-Medieval period (Table 34). There is a genuine presence of early industrial sites within the Forest, in contrast to other parts of the county.

4.6.9.4 *Cotswold Limestone*: The density of Post-Medieval records in this sub-unit is below average (Table 34), although relatively high numbers of records occur at Stanleys and Veizeys quarries (figure 82). This is due to the presence of villages within 2km of these quarries (Blockley and Tetbury), giving an artificially high number of records. Birdlip, Daglingworth and Bishop's Cleeve, again, have high numbers of records due to recent archaeological work in their vicinity (figure 74)

4.6.9.5 Although there are no available Post-Medieval radiocarbon dates for the county, the Vernacular Architecture Group Dendrochronology Database lists a total of 15 Post-Medieval dendrochronological dates for the county, predominantly from houses.

4.6.10 *Modern*

4.6.10.1 The Modern period has the lowest record density for any period considered here, although the frequency is higher than either the Early Medieval or Multi-Period records (Table 34).

4.6.10.2 *Sands and Gravels*: 86% of the total records for this period are from the sand and gravel sub-unit, although this represents only 158 records (Tables 33 and 34). The Windrush Valley has the highest density of records although the Leadon Valley has no records for this period.

4.6.10.3 *Forest of Dean*: This sub-unit has the second highest record density for the Modern period (Table 34).

4.6.10.4 *Cotswold Limestone*: The record density from the limestone sub-unit is low, possibly reflecting the nature of the settlement pattern on the Cotswolds, with very few modern developments in that area. There are a high number of modern sites and finds from within 2km of Veizey's quarry, due to the location of the site close to the town of Tetbury. The relatively high number of records from Bishop's Cleeve are almost entirely from the airfield at Stoke Orchard.

4.6.11 *Post-Medieval and Modern Periods Discussion*
4.6.11.1 The data for both the Post-Medieval and Modern periods includes a large number of houses and other built structures, with below ground archaeological features under represented. All of the records for the Post-Medieval Leadon Valley are for buildings and up to a third of those in the Upper Thames Valley for this period are for houses.

4.6.11.2 An obvious skew in the data is that many Post-Medieval and Modern sites occur in urban areas, which have been excluded from this study. Although a survey currently underway in the Forest of Dean, has identified a genuine concentration of Post-Medieval and Modern sites in this sub-unit, largely due to the presence and exploitation of the mineral resource.

4.6.12 *Unknown*
4.6.12.1 *Sands and Gravels*: The Upper Thames Valley has the highest frequency of Unknown date records, although the density of these records is second to those from the Windrush Valley (Table 34). Both of these sub-units have very high densities of records. The high proportion of sites of unknown date can be assigned to the presence of cropmark data in the Upper Thames Valley, along with the large scale excavations in this region producing a relatively high number of undated features.

4.6.12.2 *Forest of Dean*: This sub-unit has the highest number of Unknown period sites, and the second highest density of records (Table 34).

4.6.12.3 *Cotswold Limestone*: There is a below average density of Unknown date records in this sub-unit (Table 34), partly as fewer large scale evaluations or excavations have been carried out in comparison to the sands and gravels and partially due to the less extensive nature of extraction of limestone. Indeed, those sites with higher numbers of records of unknown date are those which have seen archaeological work in their environs, such as Birdlip, Bishop's Cleeve and Daglingworth.

4.6.13 *Multi-Period*
4.6.13.1 *Sands and Gravels*: Compared to the other sub-units, the sands and gravels have a high proportion of Multi-Period sites (Table 34). A major contributing factor is the susceptibility of the gravels to cropmark formation and a subsequent focus on this area for aerial reconnaissance. The Upper Thames Valley is the only area to have been subject to NMP survey (Table 34), creating further bias in the number of records within this sub-unit, which has the highest density of records (Table 34). The Leadon and the Evenlode Valleys, by contrast, have no recorded Multi-Period sites.

4.6.13.2 *Forest of Dean*: In common with all of the sub-units outside the Upper Thames Valley, the Forest of Dean has a below average density of Multi-Period records (Table 34). This may relate to better site recognition as a product of the Forest of Dean survey but could also represent the lack of cropmark sites from this sub-unit, partially due to woodland cover.

4.6.13.3 *Cotswold Limestone*: The general lack of Multi-Period sites from the limestone areas is probably due to the lack of aerial photographic coverage and focus of such work on the Upper Thames Valley, which is more prone to crop mark formation. Indeed, the two records for this period occur within 2km of Birdlip Quarry, were identified as a result of the NMP pilot study for the Cotswolds.

4.6.14 *Unknown and Multi-Period Discussion*
4.6.14.1 Multi-Period records form the smallest component of records retrieved from the SMR for this project. The majority of these sites occur within the sand and gravel sub-units, especially the Upper Thames Valley (Table 34). This is almost certainly a product of the long history of research into the cropmarks of the Upper Thames Valley, as well as work in advance of quarrying. A notable exception to this general trend is the Evenlode Valley, a tributary of the Thames, which has no Multi-Period records.

4.6.14.2 The Forest of Dean is the sub-unit with the highest number of sites of Unknown date, with the second densest concentration of records after the Windrush Valley (Table 34). This is almost entirely a product of the recording of scowles and quarries as of unknown date.

4.6.15 *Scheduled Monuments*
4.6.15.1 *Sands and Gravels*: A low proportion of the county's Scheduled Monuments occur in the sand and gravel sub-units, although the highest proportion of these are located within the Upper Thames Valley and Windrush Valley. The Windrush has a remarkably high density of Scheduled Monuments (7.6 per km^2) with the remaining areas having an average or slightly below average density. The Leadon Valley has the lowest representation, the single record being for a moated site at Hartpury Court.

4.6.15.2 *Forest of Dean*: Around 4% of the county's total of Scheduled Monuments occur in the Forest of Dean resource area. The density (0.5 per km^2) is only slightly higher than that for the county, however.

4.6.15.3 *Cotswold Limestone*: There is a similar density of Scheduled Monuments within the Cotswold Limestone sub-unit (0.3 per km^2), although a higher proportion of those occurring in the county are located here.

4.6.16 *Listed Buildings*
4.6.16.1 Not all of the listed buildings in the county have been recorded on the SMR, the data given here is therefore based only on a partial sample and should be treated with caution.

4.6.16.2 *Sands and Gravels*: The highest density of listed buildings occurs in the Severn Vale, although the numbers are relatively low as a whole. The areas with fewest listed buildings are the Windrush and Evenlode Valleys, although these are the two areas with the highest density of listed buildings. The Severn Vale and Upper Thames Valley have the least dense distributions, despite high frequencies of listed buildings.

4.6.16.3 *Forest of Dean*: This sub-unit has a low frequency of listed buildings with a density of 1.2 per km^2. This is only slightly below the average for the county of 1.6.

4.6.13.4 *Cotswold Limestone*: 279 listed buildings occur within 2km of quarries on the limestone, the majority of those located in Tetbury, Blockley and Bishop's Cleeve. The density of records is again only slightly lower than the average for the county.

4.6.17 *Designated Sites Discussion*
4.6.17.1 It is notable that all of the sub-units, with the exception of listed buildings in the Forest of Dean, contain roughly the average density for the county's protected sites (0.3 per km^2).

4.6.18 *Interventions*
4.6.18.1 An impression of the level of archaeological intervention carried out within the sub-units in advance of quarrying can be gained from Section 4.5 and Tables 30-32, above. It can be seen that more quarries on the sands and gravels have had more extensive archaeological work undertaken than those located elsewhere. Indeed, Huntsmans Quarry appears to be the only quarry located on the Cotswold Limestone to have undergone an extensive archaeological programme of works (Patrick Foster Associates 2000). Although the Forest of Dean appears to have had a low level of archaeological intervention, this probably reflects the low number of active quarries in the sub-unit.

4.7 Sub-unit archaeological characterisation

4.7.1 *Sand and Gravel Areas*
4.7.1.1 Although the Upper Thames, Windrush, Severn, Leadon and Evenlode Valleys are characterised by their sand and gravel geologies, their archaeological signatures differ. An attempt has been made to characterise each sub-unit, although it should be remembered that this characterisation is based only on SMR data and only takes account of the archaeology recorded in that database.

4.7.1.2 The Upper Thames Valley has been exploited for aggregates throughout the historic period and extraction is ongoing. Archaeological sites are common in this area and are dominated by Multi-Period crop mark sites, predominately of the Later Prehistoric and Roman periods, although important Anglo Saxon cemeteries are also located in the valley. Extensive archaeological work has been carried out in the Upper Thames Valley and the nature of the archaeology is relatively well understood. The Post-Medieval period, however, has a lower than average record density. Sites within the Upper Thames Valley have the potential to preserve organic remains and good quality environmental evidence.

4.7.1.3 The Windrush Valley is the smallest sub-unit considered here, but has the densest concentration of records. The aggregate resource has been historically exploited in this sub-unit, but no production takes place at the moment. The majority of archaeological finds in the valley have been made in the course of research-led archaeological work which has subsequently informed planning-led mitigation. The archaeology of the sub-unit is dominated by Later Prehistoric and Roman records, although the valley scores higher than average record densities in all chronological periods. There is a high density of sites of unknown date, suggesting the need for better characterisation in this sub-unit.

4.7.1.4 The Severn Vale is the largest sand and gravel sub-unit, although historic exploitation of the resource has largely been limited to the areas now occupied by Gloucester and Cheltenham. There are presently only two active quarries in this sub-unit. The Prehistoric period is particularly poorly represented in the records for this sub-unit and only the Roman, Medieval and Modern periods have higher than average record densities. Alluviation in the valley tends to mask the archaeological deposits here and there are problems with the recognition of archaeological sites, which tend not to be visible on aerial photographs. The alluvial deposits do, however, have potential to preserve good quality environmental data and organic remains. The

Severn Vale is the most densely populated of all the sub-units, containing the urban areas of Cheltenham, Gloucester, Tewkesbury and Stroud.

4.7.1.5 The Leadon Valley has the lowest density of archaeological records for any sub-unit. The Later Prehistoric, Early Medieval and Modern periods are particularly poorly understood and the sub-unit scores below average record densities in all but the Medieval period. The valley has not been extensively covered by aerial photographic survey, but photographs held by the SMR illustrate the potential for cropmark formation in this sub-unit. A single quarry is presently in operation at Bromsberrow on the Gloucestershire county boundary.

4.7.1.6 The Evenlode Valley also has low record densities, with only the Post-Medieval and Modern periods having higher than average representation. The prehistoric period in particular is poorly represented, although the area is second only to the Leadon Valley in the low density of sites recorded. It is difficult therefore to characterise the nature of the archaeology in this sub-unit. Although gravel extraction has occurred in the valley, there are no active quarries in this sub-unit and no interventions are recorded by the SMR (Table 32).

4.7.2 *Limestone Uplands*

4.7.2.1 The areas surrounding a total of 18 quarries were considered in the Cotswold Limestone area for this Resource Assessment. Considered as a whole, the Roman to Post-Medieval period has lower than average record density. The prehistoric period has higher than average record density, although this is a less dense concentration than both the Upper Thames and Windrush Valleys. This is partly a result of the highly visible prehistoric monuments, such as long and round barrows, located on the Cotswold hills attracting survey and excavation work. The limestone geology is also less susceptible to cropmark formation than the sand and gravel areas, resulting in a less dense concentration of Multi-Period records. For all of the periods considered here, the quarries which have the highest numbers of records are those at which archaeological work has been carried out, illustrating the high potential for the limestone upland to yield archaeological information.

4.7.2.2 Along with the Upper Thames Valley, the Forest of Dean is the largest aggregate producing area in the county. There are currently three active quarries in this sub-unit. The late Prehistoric and Roman periods in this area are poorly understood but other periods are well represented. The Post-Medieval period is particularly well recorded, although there are a high number of sites of unknown date. The Forest of Dean contains important evidence for early industry and a larger, ongoing Resource Assessment (Hoyle *et al*, forthcoming, see Section 5.2.6.10) will provide a broader context for the archaeology identified in the aggregate producing area.

4.8 Overview

4.8.1 It should be remembered that this study is an analysis of SMR records, not sites. Because of the way in which data is recorded by the SMR, a single site may be represented by multiple records for a range of periods. No attempt has been made in this project to make records equate to sites. There are also problems with listed buildings recorded by the SMR, as the dataset is far from complete, and. the information regarding listed buildings given here should be treated with caution. Scheduled Monuments are less problematic, with all of the study areas returning an average density of these monuments.

4.8.2 A drawback of using the SMR as a tool for generating data for this study is that environmental sampling and radiocarbon determinations are not visible on the

SMR. It would only be possible to compile a comprehensive dataset by a search of all reports for fieldwork in the county. Some summary data is available online, although this is not up to date. The Arts and Humanities Data Service Archaeological Site Index to Radiocarbon Dates from Great Britain and Ireland records 110 radiocarbon dates for the county, the majority of which appear to belong to the Neolithic period. There are also 25 dendrochronology dates from the county listed by the Vernacular Architecture Groups Dendrochronology Database, also available through the Arts and Humanities Data Service. The English Heritage Environmental Archaeology Bibliography lists 150 references for environmental archaeological work in the county, although this includes faunal remains as well as pollen, charcoal and other environmental data. Multiple references are made to each site, making a rapid review difficult.

4.8.3 *Record densities:* For the ten period divisions considered here, the Upper Thames and Windrush Valleys score higher than average record densities in nine with the Forest of Dean scoring higher than average in eight (Table 34). In contrast, the Evenlode and Windrush Valleys score lower than average in eight of the period divisions, the Severn Vale scoring lower than average in six. The Cotswold Limestone sub-unit has an equal spilt of above and below average record densities.

4.8.4 *Areas of high period representation:* The Upper Thames Valley, the Windrush Valley and the Cotswold Limestone all have a higher than average number of records up to the Medieval period (Table 34). The Windrush Valley, in fact, has a higher than average density for all periods except Multi-Period. Within the Windrush Valley, the highest density of records are Roman in date. Other areas with higher than average records for this period are the Upper Thames Valley, the Severn Vale and the Cotswold Limestone. The Forest of Dean has a high density of Early Medieval records and a very high density of Post-Medieval records. The Evenlode and Windrush Valleys, as well as the Forest of Dean, score higher than average densities for the Post-Medieval and Modern periods. Record density for the Cotswold Limestone areas is consistently lower than that of sand and gravel units through all periods, but there is a higher than average representation of prehistoric sites for this area.

4.8.5 *Areas of low period representation:* Throughout the Prehistoric period the Severn Vale, Evenlode and Leadon Valleys score lower than average record densities (Table 34). The Leadon Valley in particular is poorly represented throughout prehistory. For the Roman period the Evenlode Valley and Forest of Dean score lower than average densities, a pattern which continues through to the Post-Medieval period in the Evenlode Valley. As well as the Evenlode Valley, the Leadon Valley and Cotswold Limestone score lower than average Early Medieval record densities, the Leadon Valley returning no records for this period. The Cotswold Limestone also has lower than average record densities through to the Modern period. All areas except the Leadon Valley score higher than average densities for the Modern period, but the for the Post-Medieval period all areas except the Evenlode Valley, the Windrush Valley and the Forest of Dean score lower than average. The Evenlode, Leadon and Cotswold Limestone score low on unknown period sites with the Upper Thames Valley being the only area with a high density of Multi-Period sites. The Leadon Valley has the most zero scores (5 in total), followed by the Evenlode (2). No other areas score a zero in any period, although there are only two Multi-Period records from the Cotswold Limestone area. These were both identified during the Cotswold NMP sample areas and illustrate the potential of aerial photographic analysis for this area.

4.8.6 This Resource Assessment and overview has provided the raw data for the Research Framework which follows. Potential areas for future research are identified in Section 5.3, below, and a research strategy, aimed at filling the gaps in the knowledge identified here, is suggested (Section 5.4).

5. Archaeological Research Agenda

5.1 Introduction

5.1.1 This Research Agenda is not intended as a review for the county: it is specifically aimed at the aggregate producing areas identified in this study. There is a need to place these areas within their wider context, but this has not been in the form of a comprehensive review of the archaeology of the county, which is being carried out as part of the ongoing South West Archaeological Research Framework. The Research Agenda proposed here was formulated in the light of the preceding Resource Assessment and a brief review of previous research projects undertaken in the county. These are summarised below.

5.1.2 Some general archaeological studies are available for the county, a partial overview being provided by Saville's *Archaeology of Gloucestershire* (1984). A revised edition of this volume is currently in preparation. Finberg published the general volume *The Gloucestershire Landscape* in 1975 and the prehistoric, Roman and Anglo Saxon periods for the county were each covered in a series of volumes published in the 1970s and 80s, but now out of print. The first edition of the *Victoria County History* for Gloucestershire was published in 1907, but work was not continued on this series until 1960. The present plan for Gloucestershire is for a total of about 20 volumes. The first three will be general volumes, with the remainder comprising roughly 320 parishes and smaller towns, arranged by Hundreds (the ancient administrative divisions of the county), together with the City of Gloucester and the Forest of Dean. Eight volumes have been produced so far and work is ongoing. The former Royal Commission (now part of English Heritage) also carried out surveys of the Iron Age and Romano British archaeology of the Cotswolds (RCHME 1976) and of model farms in the county (English Heritage 1997). The built environment of the county was covered in two volumes published as part of the *Buildings of England* survey carried out by Sir Nikolaus Pevsner and subsequently revised by Verey and Brooks (1999, 2002). Further details of synthetic work are considered by period below.

5.1.3 In general, the Resource Assessment has identified a need for more radiocarbon and environmental data. The available data suggests poor coverage and therefore poor understanding of the chronology and environment of archaeological sites within the county.

5.1.4 Another problem encountered during the project is that synthesis is made extremely difficult due to the number of contracting units working in the county and the varying quality of results. The SMR is extremely important as a repository for this data, although specific detail is only available by examining individual files and reports. Museums also contain important collections which need to be assessed and included within general frameworks. Material held by museums is not always included on the SMR and there is a general need for the assessment of collections and integration of these within wider Research Frameworks. A similar point can be made about the Portable Antiquities Scheme which, whilst recording previously unavailable data, has not been integrated with the SMR and could not be included in this study.

5.1.5 Whilst the county has been the focus of several research projects by various universities, this work is generally not accessioned to the SMR and there is no realistic way of assessing the level of undergraduate and post-graduate attention paid to the county. Similarly it is unrealistic to assess the level and number of departmental projects in the county.

5.1.6 In the following Agenda previous archaeological projects will be outlined in an attempt to illustrate how this work has informed the knowledge of the archaeology of the county. Projects with a specific research agenda, rather than developer funded work will be given priority, with large scale developer funded projects being included where they have contributed to the knowledge of the archaeology of the county. Specific areas which need further work are subsequently identified, based on the lack of understanding of the archaeological resource in specific sub-units. Themes for future research will then be identified. These themes may cross period boundaries or cover more general points such as the chronology and environmental context of sites.

5.2 Research Context

5.2.1 *Palaeolithic to Neolithic*

5.2.1.1 Overviews of the prehistory of the county can be found in Darvill (1978 and 1987) and Saville (1984).

5.2.1.2 The *English Rivers Palaeolithic Project* 1991-4 was aimed at recording all Lower and Middle Palaeolithic finds south of the Severn and Thames. It included the Upper Thames Valley and part of Gloucestershire (Wessex Archaeology 1996). The Upper Palaeolithic occupation of the county is poorly understood. Sites are few and the ability to predict sites of this date is poorly developed. Most records in the SMR are for findspots on the sand and gravel areas and as such this resource is at unique risk, as sites are impossible to locate from aerial and geophysical survey and most finds are made in the process of mineral extraction.

5.2.1.3 Mesolithic sites, represented by scatters of discarded stone tools, occur mainly in the upland areas of the county and are similarly difficult to locate. The ways in which these hunter-gatherer communities exploited the landscape and interacted with other groups in the region is not well understood. Similarly, the transition between hunting and gathering as a way of life and that of settled farming in the Neolithic period is poorly understood. The county has a unique and nationally important concentration of Early Neolithic burial monuments, known as Cotswold-Severn long barrows. The contexts in which these were constructed and used, as well as the factors which resulted in the need for their construction, are not known. Little is understood about contemporary settlements, which might be indicated by scatters of stone tools, brought to the surface by modern ploughing.

5.2.1.4 Although there are reasonably large scatters of lithic material from the Cotswold region of the county, little work has been undertaken on the nature of these scatters, what they represent and how they relate to contemporary monuments. Studies by Alistair Marshall (Marshall 1985) and a recently published PhD by Snashall (2002) made attempts to link lithic scatters to both settlements and monuments. Neither fully succeeded, partly due to underlying assumptions about the nature of lithic scatters.

5.2.1.5 Detailed recording and cataloguing of the long and round barrows of the county were carried out by O.G.S Crawford (1925), Glyn Daniel (1950), O'Neil & Grinsell (1960) and Darvill & Grinsell (1989). Little modern excavation has been undertaken at these sites, however, with the exception of Alan Saville's extensive excavation at Hazleton North (Saville 1990). Excavations have also been carried out at two of the county's causewayed enclosures: Peak Camp (Darvill 1981) and Crickley Hill (Dixon 1994) but have not been fully published. These monuments are also included in the national review of causewayed enclosures published by English Heritage (Oswald *et al* 2001), which lists a total of eight for the county. Small scale

excavations have taken place at Condicote henge (Saville 1983) and the Lechlade cursus (Barclay *et al* 2003), monument types which are poorly represented in the county.

5.2.1.6 Apart from the Cotswold-Severn tombs there are relatively few Neolithic monuments, such as henges, cursus and causewayed enclosures on the Cotswolds. The Upper Thames Valley also appears to have relatively few monuments of this date in comparison to the Middle Thames. The majority of sites of these types are known only as cropmarks and the true extent of prehistoric ritual monuments is poorly understood.

5.2.2 *Bronze Age to Iron Age*

5.2.2.1 As well as the overviews by Darvill (1978 and 1987) and Saville (1984), the Iron Age and Roman sites in the Cotswolds were surveyed by the Royal Commission (RHCME 1976) and the Iron Age has been discussed by Cunliffe (1984).

5.2.2.2 Although much Bronze Age evidence has been recovered from the Upper Thames Valley, this has been under developer funded and "salvage" conditions and there is no available synthesis of this data. Round barrows were surveyed by O'Neil & Grinsell (1960) and Darvill & Grinsell (1989) and Alistair Marshall has excavated two round barrows within the parish of Guiting Power, although these remain unpublished beyond interim notes. The Early Bronze Age cemetery at Netherhills, Frampton-on-Severn, also remains unpublished. No attempts have been made to integrate the evidence from Bronze Age round barrows, lithic scatters and metalwork with that for settlement and enclosure within the county.

5.2.2.3 The introduction of metal to the British Isles in the Early Bronze Age is not well understood. Gloucestershire contains good metalwork evidence for periods throughout the Bronze Age but more work needs to be undertaken to understand the contexts in which copper and bronze objects were used and disposed of. Although Early Bronze Age round barrows have been documented and surveyed, little excavation work has been undertaken under modern conditions. The chronology of Early Prehistoric monuments in general is poorly understood and more work is needed on regional chronologies.

5.2.2.4 Whilst farming was introduced in the Neolithic period, wide scale field systems are not visible in the archaeological record until the Middle Bronze Age. Farmsteads of this date have been identified in the Upper Thames Valley, although there is little evidence for their presence on the Cotswold Limestone. This may relate to differing practices in the two areas: the upland being used for seasonal grazing, for example, but the relationships between the upland and lowland sites of this period is not well understood.

5.2.2.5 Middle and Late Bronze Age field systems also appear to be absent west of the Severn, a pattern noted for the river system generally throughout its length. It has recently been suggested that the Severn may have acted as a boundary between influences from the west and those from the south throughout prehistory, although this needs more work to be fully understood.

5.2.2.3 A Late Bronze Age burnt mound has been excavated at the foot of the Cotswold escarpment at Charlton Kings (Leah & Young 2001) and a trough from a similar site, in a similar landscape position, has been identified at Frocester (Price 2000). The excavators at the Charlton Kings site suggested that further burnt mounds remain unrecognised at the foot of the escarpment, located beside palaeochannels and sealed by layers of alluvium and colluvium.

5.2.2.4 The Early Iron Age in the county is particularly poorly understood, but advances are being made in the identification and recognition of the ceramic sequence. The transition between the Iron Age and Roman periods, its context and effects, also needs further work in the county.

5.2.2.5 Work on the Iron Age of the region has tended to focus on hillforts and the extensive earthworks identified by Clifford as *oppida* (Clifford 1961 and 1937). Saville (1984) records excavations at nine hillforts, with extensive work at Salmonsbury Camp, Bourton on the Water (Dunning 1976), Leckhampton (Champion 1971 and 1976) and at Crickley Hill (Dixon 1994). Little work has been attempted to explore the wider landscape aspects of hillforts in the county and how they relate to other settlement types, despite good evidence for the latter from sites such as Guiting Manor Farm and Guiting Power (much of which remains unpublished). There is also good evidence for settlement in the Upper Thames Valley, but this has not been synthesised or integrated into wider overviews. Although the Iron Age of the region is beginning to be better understood, more understanding is needed, especially about the nature of the settlement pattern and of social organisation.

5.2.2.6 Although origins for hillforts have been identified in the Late Bronze Age, their subsequent development and context is poorly understood. The contemporary settlement patterns around the hillforts is not properly known and the relationship between the hillforts and settlement sites in the Upper Thames Valley is also poorly understood.

5.2.2.7 Large earthworks running across high land, known as cross ridge dykes also appear during this period and recent work is beginning to suggest that the earthworks at Badgendon appear to date, at least in part, to the Early Iron Age (Courtney & Hall 1984). The context for the creation of these sizable enclosures and land divisions is not understood and more work is needed on their date, form and function.

5.2.2.8 Tom Moore (2006) has recently pointed out that more research is needed into settlement pattern and social organisation in the Iron Age and that the period is still poorly understood, especially in the Forest of Dean and Severn Vale. Moore also identified a need to reassess the nature of hillforts and for better dating and understanding of the function of banjo enclosures.

5.2.3 *Roman*

5.2.3.1 In addition to Saville (1984) and the Royal Commission (RHCME 1976), the Roman period of the county was reviewed by McWhirr (1980). The Cirencester Excavation Committee (established in 1958), Gloucester Roman Research Committee and its successor the Gloucester and District Archaeological Research Group (GADARG) have also produced numerous monographs on the Roman archaeology of the county's Roman towns. A discussion of the Roman small towns in the county is also included in the report on the excavations at Wycomb and Kingscote (Timby 1998).

5.2.3.2 Towns appear for the first time during the Roman period yet the relationship between towns, villas and related settlements is not well understood. The supply of goods from the countryside into the towns and the economies of the region need more work. Similarly, the relationship between sites in different areas, such as the Cotswolds and the river valleys, needs to be explored. Early 2nd century reorganisation of the landscape is visible in the Upper Thames Valley and throughout most of the county, but the processes driving this are not understood.

5.2.3.3 Outside the towns, the long term research project at Frocester (Price 2000) and excavations at Uley (Woodward & Leach 1993) have revealed aspects of rural settlement and religious life during the Roman period.

5.2.3.4 The Forest of Dean was one of the major centres of iron mining in Britain from the late Iron Age onwards. Overprinting by younger operations and the mining of early slags as a resource in the Early Modern period have made identification of the evidence for this industry within the ore-producing region elusive. Evidence for smelting on sites outside the county and on sites in the Severn Valley appears to document the existence of a Late Iron Age industry based on Forest of Dean ore, although no smelting or mining sites of this age have yet been identified within the Forest of Dean itself. During the Roman period smelting was undertaken within a wide hinterland outside the core area of mining. To the north and west this hinterland extends far beyond the county (including several major smelting centres including Weston-under-Penyard and Monmouth), but to the south and east embraces a wide area of the Severn Valley, both west and east of the Severn. The nature of the relationship between ore production in the Forest of Dean and the smelting of the ores on dispersed sites across this hinterland, particularly in the Severn Valley remains a key area for investigation. Only a single production site (the Chesters villa, Woolaston) has been excavated in detail.

5.2.3.5 The main research focus on the archaeology of the Roman period has been on villas, with well known excavations at Barnsley Park (Webster 1981, Webster *et al* 1982 and 1985), Woodchester (O'Neil 1955), Chedworth (Richmond 1959) and Spoonley Wood (O'Neil 1952). Excavation has also taken place at several other villas in the county. Settlement sites have also been excavated at Kingscote (Eagles & Swan 1972), and Wycomb (Rawes 1980), and there is evidence for Roman wetland reclamation on both banks of the Severn Valley (Allen 2001, Allen & Fulford 1990). Large scale excavations at settlement sites in the Upper Thames Valley at Somerford Keynes, Whelford Bowmoor, Claydon Pike and Stubbs Farm are being synthesised by Oxford Archaeology as part of an, as yet unpublished, project "The Eagle in the Landscape". This project aims to explore a number of themes relating settlement hierarchies, social organisation and power structures within the Upper Thames Valley/Cotswolds area and its contrasts and similarities with other areas.

5.2.3.6 Throughout the Roman period there is a contrast between the apparently heavily Romanised south and east of the county and the area around the Severn and to the west. The line of the Fosse Way (running from Exeter to Lincoln) has been considered to be a boundary between communities largely sympathetic to the Roman way of life and those opposed to it, but more work needs to be undertaken on the allegiances and sympathies, as well as the material traces that these have left, of communities living in this apparent frontier zone. The level of Romanisation of the "native" population is also a theme which needs exploring, as recent work has shown that some communities living during the Roman period in parts of the county were not using Roman material culture (Jennings *et al* 2004) and that Iron Age burial practises continued into this period (Thomas *et al* 2003). This is in sharp contrast to the construction of villas, especially on the Cotswolds, and the adoption of a Roman way of life in other parts of the county.

5.2.3.7 The end of Roman Britain is poorly understood, with the elite which constructed villas and controlled the economic basis of the country seeming to disappear. Material culture becomes impoverished but the reasons for this are not understood. In other parts of the country, routine radiocarbon dating has indicated that occupation of some sites continues into the fifth and sixth centuries, but is otherwise archaeologically invisible due to the use of organic material for material

objects. The Roman settlements in the Upper Thames, Evenlode and Windrush Valleys and on the Cotswolds have good potential to answer questions of continuity and change at the end of the Roman period.

5.2.3.8 Neil Holbrook (2006) highlighted the need for understanding the land reclamation visible on the east bank of the Severn, its context, how it was funded and its relationships with the villa estates identified elsewhere in the county. There is also a need to better understand the Roman extraction of iron ore in the Forest of Dean, as well as the role of villa estates in this activity.

5.2.4 *Medieval*

5.2.4.1 The Early Medieval archaeology of Gloucestershire was summarised by Heighway (1987), with a general period summary in Saville (1984). Hooke dealt with the kingdom of the Hwicce, including Gloucestershire, in 1985 and Denis Price examined the evidence for the Norman occupation (1983).

5.2.4.2 Large Anglo Saxon cemeteries are known from the Thames gravels, especially in the area of Fairford and Lechlade (Boyle *et al* 1998, Dickenson 1976), although a single example was excavated at Lower Farm, Bishop's Cleeve in 1969 (Holbrook 2000). Quite how these fit into the settlement pattern is not understood, however, and contemporary settlement sites are very few. There also appears to be an absence of Anglo Saxon cemeteries (with the exception of Bishop's Cleeve) in the Severn Vale, although it is not know if this is a true pattern.

5.2.4.3 Research into the archaeology of the early church in the county include that at Deerhurst (Rahtz & Watts 1997). This formed part of a long term project, initiated by University of Birmingham and subsequently funded by the Society of Antiquaries of London's *Research Project on the English Church*. Smaller scale excavations were undertaken in Gloucester at St Oswald's Priory (Heighway & Bryant 1999) and St Mary De Lode (Bryant & Heighway 2003), both revealing early origins for these churches. The introduction of Christianity into the South West region is an area which needs further research. Although there is limited evidence for Roman Christianity, the influence of Ireland in the sixth and seventh centuries seems to have been a more important factor in the uptake of the new religion. The area to the west of Severn seems likely to have been Christianised early, but there is little physical evidence for this. For later periods, the understanding of the effect which monasteries and their estates had on the landscape is a key theme.

5.2.4.4 The linear earthwork of Offa's Dyke runs along the western border of the county and has been surveyed by Fox (1955) and Gelling (1983), with a management survey being completed in 1996 (Hoyle & Vallender 1997). The Gloucestershire section of the Dyke remains undated and it is a possibility that the earthworks in the county may not constitute part of the same monument as those stretches to the north in Herefordshire and beyond, the defensive line being established by the gorge of the River Wye. Recent survey work has suggested that this is not the case, but more work needs to be carried out to establish the date and relationship of earthworks identified in the county to the rest of the Dyke.

5.2.4.5 There has been relatively little work on Deserted Medieval Villages (DMVs) and moated sites in the county, especially their wider significance within the social and settlement hierarchy. A list of deserted medieval villages was drawn up by Aston & Viner (1981), who noted the lack of general work on DMVs and the lack of a general summary for sites in Gloucestershire. Hilton (1966) excavated a site at Upton, but recently interest has been revived by Chris Dyer (Aldred & Dyer 1991, Dyer 1987 and 2002). There is a more general need to understand the medieval

settlement pattern. Towns emerge in the Late Saxon period and a palace of this period was located at Gloucester. The relationships between the towns and the countryside, the development of towns as urban centres and the social structure of the inhabitants of towns is still relatively unknown.

5.2.4.6 A similar list of moated sites for the county was complied by Rawes (1978), who identified 114 in total. Most moated sites occurred in the Severn Vale, with few in the Cotswolds and none in the Forest of Dean. More intensive fieldwork, survey and excavation was suggested as a way of understanding these sites, as only two had been excavated at the time. The SMR now records 238 moats with some identified in the Forest of Dean, but the majority are still located in the Severn Vale and Leadon Valley.

5.2.4.7 The origins and development of towns in the county has been the subject of the *Gloucestershire Historic Towns Survey* (Douthwaite & Devine 1998). Winchcombe in particular has been studied in detail by Steve Bassett (Bassett 1977), although subsequent evidence from excavation has not been incorporated into the understanding of the town's development.

5.2.4.8 Although the Medieval period is seen as one dominated by pastoralism, industry played a role in the economic basis of society. There is evidence for an early Medieval pottery industry in Severn Valley but more needs to be known about the location of the kilns and the dispersal and nature of the products from these sites. Although documentary evidence (particularly Domesday) suggests a pre-conquest iron industry centred on the Forest of Dean, little field evidence of this period has been recognised (although undated slag has been found at the known pre-conquest site at Madgetts; Hoyle *et al.* 2004: 12). The Forest of Dean iron industry of the later medieval period resembles that of the Roman period in many respects, with major centres of production close to Dean, within a broader hinterland of dispersed smelting. Much of the ore mined within the study area was smelted outside, but Medieval surveys indicate that a large number of bloomeries operated within the Forest of Dean. Field evidence for these is largely yet to be recognised. Within the Severn Valley, Forest of Dean iron ore has been recovered from quay sites on both west and east banks of the Severn, but the trade networks and the basis of the dispersed smelting industry remain to be investigated.

5.2.4.9 Medieval land reclamation in the Slimbridge, Frampton and Saul areas was recognised by Allen (1986) and was seen as part of the general development of the Gloucestershire landscape over the last millennium, summarised by Finberg (1975). Roughly contemporary reclamation at Lydney has also been identified (Allen 2001).

5.2.4.10 Andrew Reynolds (2006) pointed out the need for more research on the continuity, or otherwise of villa estates and parishes. There is also a need to understand towns better, especially their hinterlands and little work has been carried out on buildings. In terms of artefactual studies, there has been little advance in pottery studies in last 20 years and more environmental data is needed from sites throughout the Medieval period.

5.2.5 *Post-Medieval*

5.2.5.1 The "industrial age" was summarised in Saville (1984) and the Gloucestershire Society for Industrial Archaeology has published an annual journal since 1971. The Post-Medieval history of the Forest of Dean was the subject of *The Forest of Dean: New History 1550-1818* by Sir Cyril Hart (1995).

5.2.5.2 The early iron industry in the Forest of Dean was the subject of a survey by Gloucestershire County Council Archaeology Service and funded by the Aggregates Levy Sustainability Fund. This formed part of a larger survey of the Forest of Dean (see Multi-Period Projects, Section 5.2.6, below).

5.2.5.3 Although frequently seen in opposition, early industry was initially complimentary to, rather than in conflict with, agriculture. The inter-relationship between the two is fundamental to understanding the emergence and growth of the county's industrial base. The interaction of the towns and the countryside throughout this period is also important, as is the industrialisation of the countryside with the introduction of enclosure and mechanical agriculture.

5.2.5.4 An English Heritage study of "model farms", which were designed as a single working unit from the 18th and 19th centuries was published in 1997. A total of 25 farms were recorded from Gloucestershire but only 18 were able to be located. This included one of the earliest planned farms in England at Taynton House.

5.2.5.5 Communications within the county and the links which these made to the wider world are an important theme for this period, with the River Severn of particular importance in this regard.

5.2.5.6 Archaeology has much to contribute to the knowledge of the Post-Medieval period, the study of which is dominated by documentary analysis. The key industries and their sites need further research from an archaeological point of view.

5.2.5.7 The *Defence of Britain Project* recorded a total of 150 archaeological sites relating to 20th century military defence in the county, as part of a national survey (CBA 2002). The majority of these sites were World War II pillboxes and the airfield at Kemble.

5.2.5.8 Mark Bowden (2006) has stressed the need to understand the development of Medieval and Post-Medieval quarrying, as well as the background to the industrial "revolution" generally. He also highlighted the lack of environmental data from the Medieval countryside.

5.2.6 *Multi-Period*

5.2.6.1 The Upper Thames Valley has been the focus of archaeological attention since the 1960s when it was realised that large numbers of archaeological sites were being lost without record due to gravel extraction. The Royal Commission on Historic Monuments published *A Matter of Time* in 1960 which examined the type and quantity of sites being lost and Gingel (n/d) made the recommendation that an archaeologist be appointed for the Cotswold Water Park to undertake a research programme of excavation. Gingel also produced lists of finds by period known from the area at the time.

5.2.6.2 The Directorate of Ancient Monuments and Historic Buildings commissioned a project in the late 1970s to assess the archaeological implications of gravel extraction in the Upper Thames Valley (Leech 1977). This formed part of larger survey including Berkshire and Oxfordshire and was partly a response to the Cotswold Water Park Plan for minerals extraction, which did not take account of the historic environment. This report noted that, despite the stress placed by Gingel on the urgent need for archaeological investigation within the Valley, "*no detailed investigation of the sites being destroyed has taken place between 1971 and the present*" (Leech 1977: 2).

5.2.6.3 *An Archaeological Strategy for the Upper Thames Gravels in Gloucestershire and Wiltshire* was published by Gloucestershire County Council in 1984. The strategy outlined the threats to the archaeological resource and outlined Areas of Identified Archaeology on the gravels. Consultation between gravel extraction companies and archaeologists at the earliest possible stage was considered vital to enable the recording of archaeological deposits in advance of extraction. Interestingly these proposals predated both PPG16 and Article 7 of the *Town and Country Planning (General Permitted Development) Order*.

5.2.6.4 The English Heritage National Mapping Programme commenced in 1992 in the Upper Thames Valley and was the first major project to be undertaken since the work of Benson and Miles (1974), Gates (1975) and Leech (1977) which looked at different parts of the Thames Valley. The project mapped data from existing aerial photographs in the possession of English Heritage and re-interpreted earlier surveys, with transcriptions being brought up to a common standard and new information from RAF vertical photographs and others taken in the intervening years being added to the existing data. Many sites had already been destroyed, mostly through gravel extraction, with permissions being granted for further extraction along the entire length of the river, highlighting the urgency for reconnaissance. In total 7% of sites recorded on photographs are known to have been destroyed by the early 1990s.

5.2.6.5 Lambrick (1992) highlighted the significance of investigations in the Upper Thames Valley since 1971, pointing out that "blank" areas allocated for minerals extraction were not blank, but masked by alluvium. Indeed, work by the Oxford Archaeology Unit revealed that 40% of archaeological evaluations on the Thames gravels produced either substantially new evidence or entirely new sites. It was also pointed out that there is an inverse relationship between the clarity of the superficial evidence and the quality of preservation of subsoil archaeology, as well as the preference for sites to occupy slightly higher, drier parts of the floodplain, as at Claydon Pike. The presence of sites elsewhere in the Valley was highlighted, however, and Lambrick suggested that it was dangerous to limit detailed evaluation to "gravel islands" within the alluvium. It was also pointed out that current strategies to avoid known sites concentrate extraction on lower terraces where archaeological detection is difficult, but preservation is at its highest.

5.2.6.6 During the 1970s and 80s, the Oxford Archaeological Unit carried out excavations within the Upper Thames Valley at Claydon Pike, Lechlade, Thornhill Farm, Fairford and Roughground Farm. This work was part of a 10 year programme of investigation, funded by the aggregates company ARC and the (then) Department of the Environment and carried out under the name of the Claydon Pike Landscape Research Project (Jennings *et al* 2004: 1-2). The excavations are now being published as a series of "Thames Valley Landscape" volumes with Roughground Farm, Thornhill Farm, Claydon Pike and Butler's Field being described as forming "one of the most thoroughly investigated archaeological areas in Britain" (Allen *et al* 1993) with evidence of occupation from the Neolithic to the Medieval period. A similar synthetic programme, under the title of *The Eagle in the Landscape*, is also underway for sites excavated at Somerford Keynes, Whelford Bowmoor, Claydon Pike and Stubbs Farm, again by the Oxford Archaeological Unit. This project focuses on the evidence for Iron Age and Roman occupation of these sites, all located in the Upper Thames Valley.

5.2.6.7 The ways in which the rich archaeological landscapes of the Upper Thames Valley fit in with the upland landscape throughout the prehistoric and historic periods needs to be understood more fully. The relationships between the function and role of contemporary sites needs to be explored in a wider, landscape context. Whilst the

Upper Thames Valley seems to be a particularly rich landscape, there is a need for survey and characterisation of the Severn Vale and smaller areas such as the Leadon and Evenlode Valleys. These have the potential to yield well preserved, multi-period sites, but detection is poor due to alluviation and the relatively low threat from aggregate extraction.

5.2.6.8 The work by the Oxford Archaeological Unit was partly developer funded. Pure research projects in the county include excavations at the multi-period site at Frocester and the work of the Cotswold Archaeological Research Group, which intended to research the evolution of settlement and the landscape in the Cotswolds and adjacent areas, looking at the relationship between settlement and the physical environment. Two study areas were explored in depth by the project: the Cleeve-Guiting limestone uplands and the Condicote-Windrush uplands/Windrush valley system. The project was coordinated by Dr Alistair Marshall (Bradford University) and published its first newsletter in 1982. A series of interim reports and notes were also published in *Transactions of the Bristol and Gloucestershire Archaeological Society*, but the project now appears to have ceased work.

5.2.6.9 Work at Frocester has been carried out over the past 40 years, the project being coordinated by Eddie Price and GADARG. Work at the site has been aimed at unravelling the history and development of the landscape around Frocester Court and, although the focus has been on the Roman period, important prehistoric and Medieval sites have been located and excavated by the project (see Price 1998, 2000).

5.2.6.10 Although another instance of “rescue” archaeology, work in advance of construction of the M5 during 1969 to 1975 led to the foundation of M5 Research Committee. The work on the motorway has been described as being responsible for the “creation of field archaeology of lowland Gloucestershire” (Fowler 1977). Very little was known about the archaeology of the Severn Vale previous to this work, which revealed a density of 0.8 sites per km along the motorway corridor.

5.2.6.11 Similar work in advance of road improvements took place along the line of the A417/A419 during 1996 and 1997 (Mudd *et al* 1999). A total of 35 sites were excavated along the 25km route of the road and included a pair of ring ditches near Preston; Middle Iron Age settlements at Highgate House, Preston and Ermin Farm; Late Iron Age enclosures at Duntisbourne Grove and Middle Duntisbourne and a Roman settlement at Birdlip Quarry. The route followed that of the Roman road Ermine Street and information was recovered for Roman activity along its length.

5.2.6.12 A final road scheme which produced important archaeological material was the construction of the Tewkesbury Eastern Relief Road. The final report is not yet published, but available reports held by the SMR for work carried out by the Cotswold Archaeological Trust in 1996-7 record important evidence for Bronze Age metalworking as well as Roman occupation along the line of the road.

5.2.6.13 The *Forest of Dean Archaeological Survey* is currently ongoing, undertaken by Gloucestershire County Council Archaeology Service and funded by a number of organisations including English Heritage, the Countryside Agency, the Forestry Commission and Gloucestershire County Council. This project is focussed in the central area of the Forest of Dean, which has fewer known and recorded archaeological sites than the rest of the county. An ALSF funded *The Scowles and Associated Iron Industry Survey* has also been undertaken as a sub-project of the main Forest of Dean survey. This recorded the features known as scowles from which iron ore has been extracted for early industrial use.

5.2.6.14 The Forest of Dean Survey was able to exploit National Mapping Project data for the area and further NMP work for the Upper Thames Valley was carried out as part of the present study (see Methodology, Section 2). Pilot sheets for the Cotswolds have also been analysed and have shown the high potential of this technique for enhancing the understanding of the historic environment. Although a large proportion of the county has been part of previous and ongoing NMP projects, a large gap exists along the length of the River Severn.

5.2.6.15 Historic Landscape Characterisation has been completed for the entire county. The aim of Historic Landscape Assessment (HLA) is to identify and understand the historic development of the landscape of the county. It emphasises the contribution of past historic processes to the character of the landscape as a whole with an aim of helping to guide decisions on its future change and management.

5.2.6.16 Surveys of National Trust estates undertaken by Gloucestershire County Council Archaeology Service include those at Minchinhampton (SMR 126), Crickley Hill (SMR 170), Rodborough Common (SMR 15500), the Sherborne Estate (SMR 15906) and Haresfield Beacon (SMR 21199). These surveys have been aimed at improving the knowledge of these estates to allow better management of the archaeology that they contain.

5.2.6.17 There is an average representation of Scheduled Monuments across all of the sub-units. As some areas have higher monument densities than others, there is a possibility that Scheduled Monuments are under represented in some sub-units. The Upper Thames Valley and the Windrush Valley are good candidates for review of scheduling, as both are unusual in terms of the potential threat to the archaeology (in the case of the Upper Thames Valley) and the sheer numbers of sites (the Windrush Valley).

5.2.6.18 In terms of understanding the historic environment as a whole, there is a real need for the integration of resources. The Sites and Monument Record, County Record Office, county and local museums, the Portable Antiquities Scheme and developer funded work all produce data, much of which is held in separate databases and is not easily accessible. Up to date radiocarbon, dendrochronological and palaeoenvironmental data is not easily accessible and stored in a variety of forms and locations. This study has exploited the County SMR as its primary database, but has highlighted some problems with this approach. SMRs in general need development to move beyond a tool utilised in the planning process and become more research friendly.

5.2.6.19 Whilst criticising the disparate sources of data available for study, several gaps are apparent in the data and further data collection is desirable. There are poor sets of radiocarbon and environmental data for all periods across the county and more work needs to be undertaken on regional and local chronologies and environments. Site prospection techniques are generally under-developed and more focus is needed on the application of geophysical, geomorphological and remote sensing techniques. Aerial photograph coverage is in need of expanding both in terms of coverage and repeat flying (coverage of most sites is a single sortie of APs) and analysis. The Severn Vale in particular is in need of a project similar to the National Mapping Programme, as well as the development of alternative techniques such as LiDAR.

5.2.7 *Local Societies*

5.2.7.1 The longest standing local group with an interest in archaeology is the Cotteswold Naturalist Field Club, established 1845. This is a multi-disciplinary club interested in geology, natural history and archaeology and publishes an annual proceedings. The Bristol and Gloucestershire Archaeological Society was established 1876 and also publish yearly Transactions, which has recently included a summary of archaeological work carried out in the county as well as more substantive archaeological reports. The Dean Archaeology Group (DAG) was formed out of the Forest of Dean Local History Society and has carried out a number of studies and surveys in the Forest. The Group publishes a newsletter and an annual journal *Dean Archaeology* as well as a range of monographs.

5.2.7.2 The Gloucester Roman Research Committee was established by W.H Knowles in the 1930s in an attempt to record and understand the Roman archaeology of the city. The Gloucester and District Archaeological Research Group (GADARG) was established in 1967 as its successor and a field archaeologist (Henry Hurst) was appointed by City Museum in 1968. GADARG publish an annual journal and excavate at Frocester. The Gloucester City Excavation Unit was established in 1973 with Carolyn Heighway as its head and continued to monitor archaeological work in the city until recently. The Cirencester Excavation Committee was established in 1958 and excavated at St Mary's Abbey and along the line of the Western Relief Road and Eastern Bypass from 1969 to 1974. The Committee was finally disbanded in 1997 and its tasks transferred to the Cotswold Archaeological Trust. The Trust published a synthetic volume on the archaeology of Cirencester in 1994, and this included a framework for future work in the town and its environs (Darvill & Gerrard 1994).

5.2.7.3 The Committee for Rescue Archaeology in Avon, Gloucestershire and Somerset (CRAAGS) was established in 1973 as a sub-unit of the CBA South West regional group. This committee received grants from the DoE for archaeological work in the region and carried out extensive work along the line of the M5 motorway (Fowler 1977).

5.3 Potential Areas for Future Research

5.3.1 Areas in which particular periods are poorly understood can be assessed by lower than average record densities within a sub-unit (Table 34). These are summarised below:

Prehistoric:	Severn Vale, Evenlode Valley, Leadon Valley
Roman:	Evenlode Valley, Forest of Dean
Early Medieval:	Evenlode Valley, Leadon Valley, Cotswold Limestone
Medieval:	Evenlode Valley, Cotswold Limestone
Post-Medieval:	Severn Vale, Leadon, Upper Thames Valley, Cotswold Limestone
Modern:	Leadon Valley

5.3.2 The Leadon Valley scores zero records most frequently by period (the Late Prehistoric, General Prehistoric, Early Medieval, Modern, Multi-Period records being zero) and has below average record densities for four out of six periods. The Evenlode Valley scores zero records for two periods (the Early Prehistoric and Multi-Period records) and also has below average records in four out of the six periods. No other areas score a zero density in any period.

5.3.3 The Forest of Dean has recently been identified as an area with few prehistoric sites and monuments, but this does not seem to be the case in the aggregate area. This, however, is likely to be a product of agricultural land use on the limestone leading to a higher incidence of fieldwalking and survey, in turn resulting in higher recovery rates. The archaeology within the aggregates area is therefore over represented in regard to the Forest of Dean as a whole. Although outside the aggregates area, the central Forest of Dean needs further work, to assess whether the prehistoric occupation of the limestone areas is a real pattern, showing preference for these areas in prehistory, or merely a product of archaeological work being focussed on the areas used for agriculture. To enable this, better methods for the identification and survey of archaeological sites in woodland need to be developed and tested.

5.3.4 Within the aggregates producing area of the Forest of Dean, the Roman period is the only one for which this sub-unit returns a below average record density (Table 34, figure 62). This may represent a genuine pattern, with a preference for site location close to the River Severn, but more work needs to be undertaken to establish this.

5.3.5 All areas except the Severn Vale and Evenlode and Leadon Valleys have higher than average densities of Unknown records (Table 34). Although it may be impossible to assign specific dates to some archaeological sites, more work is needed to better define and date sites in these areas.

5.3.6 The Upper Thames and Windrush Valleys have proven potential to answer research questions. Unfortunately, most work that has been carried out in these areas has not been research-led, but rather “rescue” or developer funded work. Such work has, however, substantially contributed to the understanding of archaeological record of this part of the county. The sands and gravels in general have good potential to answer archaeological questions and may represent preferred areas for prehistoric and later occupation. Heavy truncation of archaeological features and deposits in these areas can be a problem, however, but waterlogging can produce data, such as organic material and environmental evidence, unavailable elsewhere.

5.3.7 This study only examined limited areas around quarries on the Cotswolds. High potential for these areas has been shown by evaluation and excavation at Huntsmans Quarry, where a multi-period landscape has been revealed (Patrick Foster Associates 2000). This study has shown that little large scale work has been undertaken on the Cotswold Limestone and that the upland landscape needs to be better understood, especially the gaps between these sites. There is potential for good preservation on the uplands, although, like the sand and gravel areas, there is also the potential for plough damage and truncation of archaeological deposits.

5.4 Research Strategy

5.4.1 *Sand and Gravel Areas*

Much previous archaeological interest and planning policy for the minerals areas of Gloucestershire have focussed on the Upper Thames Valley, as the areas involved in extraction are large and the archaeology frequently obvious (see Section 5.2.6). Problems with the identification and evaluation of archaeological deposits in this sub-unit have been discussed (Allen *et al* 1997) and the archaeological signature of this area, and the factors affecting its visibility and preservation, is reasonably well understood. Other gravel areas such as the Severn, Windrush, and Evenlode Valleys are less well understood, as are the processes affecting the visibility of the

archaeology. These sub-units are potentially important sources of comparative data and need to be understood more fully.

5.4.2 *The River Severn*

The Severn as a river system is poorly understood and needs to be examined in its wider context. The Severn is the longest river in Britain and has nationally important archaeology of all periods along its banks and within its catchment. The physical processes affecting the valley are not properly understood and their impact on the visibility and preservation of archaeological sites and deposits unclear. The Monuments At Risk Survey project identified the south Cotswolds and Severn valley as having less archaeology than the surrounding regions for all periods (Darvill & Fulton 1998: 235), although the effects of alluviation and colluviation in the valley probably play an important role in the lack of visible monuments. These processes appear to at least partly relate to the opening up of land for agriculture in the Iron Age and later periods and their role needs to be understood, as they provide information not only for the valley itself, but also for its catchment. River confluences have been identified as important throughout prehistory and appear to have acted as foci for monument construction and for the deposition of material within the river channel. The Severn Vale within Gloucestershire contains four major confluences: the Wye, Leadon, Avon and Frome all join the Severn within the county. In the historic period the Severn was an important medium for trade, acting as an inland sea, facilitating movement and trade between South Wales, Somerset, Gloucestershire and the wider world.

5.4.3 *The Windrush Valley*

Although the Windrush Valley seems to be well understood, no large scale excavations have been undertaken under modern conditions in this area. The sheer scale of the archaeology in this small valley highlights the importance of the sub-unit, which has a higher than average record density in every chronological period. Recent geophysical survey has shown that significant and important archaeological deposits are still preserved within this valley.

5.4.4 *Minor Valley Systems*

Whilst the tributaries of the Severn, especially the Leadon Valley, need more work, the upper reaches of tributaries of the Thames are also located in the county. The headwaters of these tributaries have been identified as having concentrations of prehistoric monuments and their lower reaches have rich evidence for use in later periods. The Evenlode Valley is particularly poorly understood in Gloucestershire, although its lower reaches, located in Oxfordshire, have been subject to extensive archaeological work (Allen *et al* 1997).

- *There is a need for the synthesis of data from separate excavations and survey within the Severn and the minor valleys to allow the formulation of research and management strategies as a framework for future decision making, including priorities for preservation and investigation. There is a need for further work in the Severn and minor valleys to understand the nature, importance and extent of the archaeology in these areas.*

5.4.5 *Cotswold and Forest of Dean Limestone Areas*

In comparison to the sand and gravel areas, there has been much less archaeological interest in the areas producing crushed rock reserves, even when these are located close to important archaeological landscapes. Daglingworth Quarry, for example, is located close to the enclosure complex at Bagendon and Huntsmans Quarry lies within the rich archaeological landscape around Cow

Common. This lack of extensive interest is partly due to the smaller-scale "nibbling away" of the landscape due to limestone quarrying, rather than the more extensive sand and gravel quarries, and partly due to the less visible nature of the archaeology in these areas. The imbalance has been redressed slightly by Forest of Dean Survey, but more work is needed in understanding site location, identification and inter-relationships in the upland limestone areas. Although work has been less extensive on the limestone uplands, evaluative work at Huntsman's Quarry, Naunton (Patrick Foster Associates 2000) and along the line of the A417 in the vicinity of Daglingworth and Birdlip quarries (Mudd et al 1999), has shown that, although not highly visible, important archaeological deposits are present in these areas and is detectable only by archaeological fieldwork in advance of development.

5.4.6 *Upland and Lowland Landscapes*

Whilst the creation of data is important in it own right, the similarities and differences between the river valley systems, which produce sand and gravel aggregates and the upland, hard rock, areas need to be understood in their wider context. The relationship between these two landscape zones is of key importance to understanding the subsistence strategies and interdependence of past communities. This "landscape approach" has been stressed by Jennings (*et al* 2004: 159) who pointed out that "*detailed landscape studies incorporating environmental and structural and artefactual evidence from a wide range of settlement and non-settlement sites should….form a priority for future research*". This fits within a general need for more environmental and chronological data for sites of all periods within the aggregate areas.

- *The limestone uplands and river valley systems need to be considered in their wider landscape context. The connections between these geographical areas and their archaeological signatures needs to be better understood. Site visibility needs to be taken into account when comparing these areas.*

5.4.7 *Archaeological Prospection*

Although alluviation might form a barrier to cropmark formation, the analysis of aerial photographs may yield information about the frequency of sites in the Severn Vale and their relationship to the alluvial deposits. This work may be carried out as part of the National Mapping Programme for Gloucestershire, but would need to be incorporated into wider work based on the aggregate areas within the Vale. Areas such as the Leadon Valley may benefit from re-flying, as many sites in the region are known from single aerial photographic sorties. Capture of LiDAR data is also a priority for the Severn Vale generally. There is a wider need to understand the valley as a physical system which would add to the understanding of, and context for, data gathering exercises such as palaeoecological work, survey and desk based study. Further stages of this work might include geophysical survey, the capture of LiDAR data and more targeted assessment of the archaeology of the Vale. This would also allow better management of both the archaeological and aggregates resource in this area. The visibility of archaeological sites on the limestone areas and within alluviated river valleys is poor and the development of better prospection techniques for archaeological sites in these areas saves both money and time in the long term.

- *Archaeological prospection techniques for locating sites in alluviated landscapes need to be developed to allow a better understanding of the archaeological resource in these areas and the potential impact of aggregate extraction upon this.*

5.4.8 *The Impact of Aggregate Extraction*

During this project it was not possible to assess the degree of impact which past aggregate extraction has had on the archaeological sites and there remains a need for assessment of the quality of the remaining archaeology and its relative importance. The survival, importance and fragility of the resource in the aggregate areas needs quantification and sites worthy of designation need to be identified and protected. It may also be possible to characterise the nature of the marine archaeological resource within the channel of the River Severn, which was not attempted during the current project due to the lack of any threat.

- *The impact of previous aggregate extraction on the archaeological resource needs to be understood to allow better management and protection of the sites which remain. Management strategies need to be formulated for sites identified as particularly fragile or at risk.*

5.4.9 *Risk Modelling*

This Resource Assessment and Research Agenda has approached the archaeology of the county in terms of aggregate production. This is not the only development pressure in many of the sub-units considered, however, and there is a wider need to understand the archaeological assets of the county to enable better decisions to be made about the resource. Within the sand and gravel areas considered here, for example, there are threats from housing, as well as aggregates extraction. Part of the wider application of studies such as this may be the development of "risk modelling". The identification of potential risk for development in terms of the presence, absence or frequency and density of archaeological sites and monuments is a possible way of approaching this, but is in need of methodological development. Previous work in the East Midlands (Steadman *et al* 2004) attempted to score archaeological and environmental assets but ran in to difficulties over the quantification and interpretation of the data used. Site visibility is also an issue in formulating such assessments and prospection techniques are in need of development (see 5.4.7, above). Further research is needed into methodological approaches and should involve wide consultation with the minerals industry, strategic planners and geographical systems modellers, as well as archaeological curators and contractors.

- *Methodologies need to be developed to allow overviews of the potential "risks" of the development and expansion of aggregate extraction in the county. This needs to be coupled with the formulation of management strategies for specific archaeological sites and landscapes.*

5.4.10 *Publication Backlog*

Good progress is currently being made on the publication of backlog sites in the aggregate producing areas of the county, the only outstanding site identified by this project being the prehistoric and Roman site at Netherhills Quarry, Frampton-on-Severn. The archive for this site has recently been located at Cardiff University but needs further work.

- *The status of the archives for unpublished sites needs to be assessed. Unpublished excavation archives need to be brought towards publication.*

5.4.11 *Environment and Chronology*

A need for wider radiocarbon and environmental sampling has been identified in this Research Strategy, some of the raw material for which may be available via the analysis of existing site and museum archives. A summary of the known data is also

needed for the county, perhaps based on the model of that produced for Bristol (Bristol City Council 2004).

- *A synthesis of environmental and chronological data is needed. This will help to inform future projects aimed at further understanding the ecological context and chronological development of the archaeological record of the county. Specific gaps in the knowledge of the chronology and environmental context of archaeological sites in the county need to be identified and work undertaken to close these gaps.*

5.4.12 *Outreach*
Further outreach stemming from the current project might include a series of leaflets, website pages, exhibitions and guided walks based on the "Archaeology of…." specific areas, initially based on the sub-units identified in this study. For example *The Archaeology of the Windrush Valley* might include a web page of information linked into a series of events such as an exhibition and talk, guided walks around sites such as Salmonsbury Camp and a leaflet describing the key sites and the local context of the area.

- *Further outreach activities are needed to help inform both the public and the minerals industry about the importance of the archaeology of the aggregate producing areas of the county.*

5.5 Future Work

5.5.1 In this section a number of future projects will be suggested which will address the themes raised in Section 5.3. These are listed in order of priority.

5.5.2 *Severn Vale NMP*
The Severn Vale has been identified as an area in which the nature of the archaeological deposits is poorly understood. The compilation of the results of aerial survey as part of the National Mapping Programme would be an initial step in the identification of sites in this area and would serve to "fill in the blanks" between the Forest of Dean and Cotswold NMP, already undertaken.

5.5.3 *Development of LiDAR techniques and coverage*
Although the Severn has been covered by Environment Agency LiDAR surveys, the quality of this data for archaeological purposes within the county has not been assessed. The need for further coverage of the area should be explored, as well as any potential need for re-flying at different resolutions and an investigation of intensity data, to allow the best understanding of the results. Results from this work would compliment the results of the NMP.

5.5.4 *Severn Vale synthesis*
The nature, extent and importance of the archaeological resource in the Vale should be assessed. Existing records from survey and excavation within the Severn Vale (including any future NMP work) should be synthesised to allow the formulation of management and research strategies, identifying priorities for future preservation and investigation.

5.5.5 *Understanding the environment of the Severn*
Borehole data should be synthesised, to allow an understanding of the depth and extent of alluvium cover in the Severn Vale. This should be coupled with the collection of further data, in areas where this is lacking, and the collection of samples

for environmental analysis. A model for the geomorphological and environmental development of the river system should be devised.

5.5.6 *Risk modelling*
Methodologies should be developed to enable the identification of areas which are potentially of high and low risk for future aggregate extraction. This would involve wide consultation and the development of appropriate models to allow an assessment of the impact of future aggregate extraction on the archaeological resource and the identification of areas where such impacts may be more, or less, significant.

5.5.7 *The impact of past aggregate extraction*
The level of destruction of archaeological deposits as a result of aggregate extraction in the Upper Thames Valley should be assessed. The surviving archaeological resource needs to be characterised and its importance, significance and fragility quantified. This will allow better management of the sites and monuments in the area and will inform strategic planning decisions over future areas of aggregate extraction.

5.5.8 *Upland and lowland landscapes*
The Cotswold uplands stand between two major river systems: the Severn and the Thames. The relationships between the archaeological signatures of these river valleys and the limestone uplands needs further work with the relationships between the land use and settlement of these areas forming the focus of a detailed study. Such a study should take into account the different environments of these areas and the effect this may have had on their use and experience.

5.5.9 *Chronology and environment*
Data relating to the past environment of the county needs to be synthesised to allow an overview of environmental change and human impacts. Chronological periods and geographical areas where more data is needed should be identified and data collected to fill these gaps. Similarly, chronological data (primarily radiocarbon and dendrochronology dates) is in need of synthesis and gaps in the data should be identified. Material likely to enable these gaps to be filled should be identified and sampling programmes devised.

5.5.10 *Integration of museum and SMR data*
There appears to be little cross referencing between museum collections and the county SMR database. Museum collections from the county should be assessed and integrated into the SMR and collections with the potential to answer further research questions should be identified.

5.5.11 *SMR Development*
At present there are difficulties in using the SMR as a research tool. These should be addressed and the SMR developed to enable its use in both strategic planning and research roles.

5.5.12 *Outreach*
Information about the archaeology of the aggregate producing areas needs to be available to the communities living in those areas. There is a need for basic information about the impact of quarrying in the county to be made available to both the public and the minerals industry. A programme of activities to raise the level of awareness about archaeology and the minerals industry in the county should be formulated.

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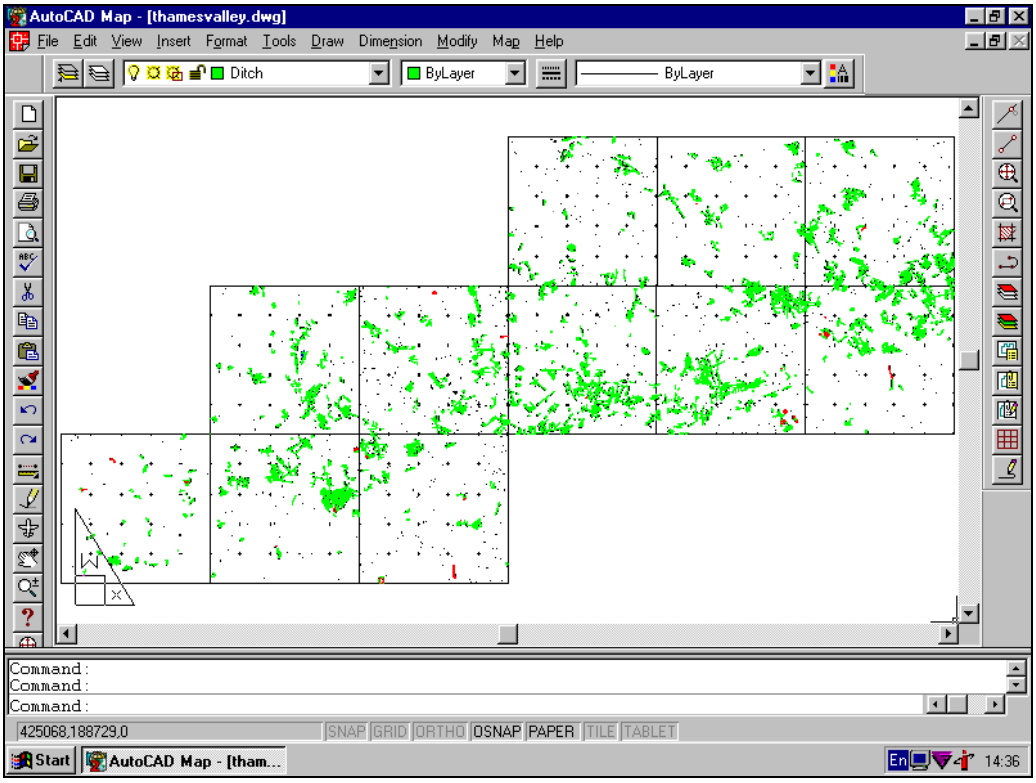
APPENDIX 1

NATIONAL MAPPING PROGRAME:
GLOUCESTERSHIRE THAMES VALLEY UPGRADE (3858)

REPORT ON PILOT STUDY TO UPGRADE
PAST NMP DATA TO CURRENT STANDARDS



Naomi Payne
Gloucestershire County Council
Environment Department
Archaeology Service
December 2004

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1. Introduction

This project was an extension to the National Mapping Programme (NMP) project on the Gloucestershire Cotswolds and Forest of Dean. It aimed to explore methods by which data from old NMP projects could be brought up to current NMP data standards, for use in English Heritage's National Monument Record (NMR). A further linked objective was to incorporate the old NMP data into the Gloucestershire Sites and Monuments Record (SMR). This part of the project was covered by funding previously obtained from the Aggregates Levy Sustainability Fund (English Heritage Project Number 3346, Objective 6.5). In order to achieve these aims, part of the data produced by the Thames Valley NMP project was to be employed for a pilot study. The Thames Valley was one of four National Mapping Programme pilot projects and was undertaken by the Royal Commission on the Historical Monuments of England (amalgamated with English Heritage in 1999) between June 1988 and November 1994. Eleven of the quarter sheets covered included land within the county of Gloucestershire, and this area formed the focus for the present project (see Figure 1).

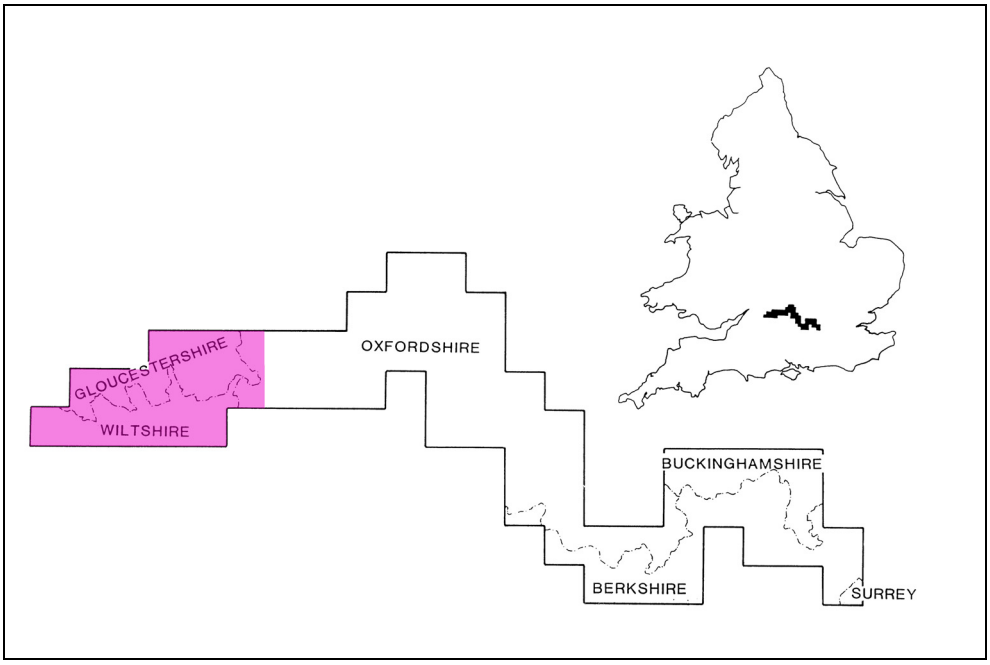

Figure 1. Thames Valley NMP study area, with the current project's pilot area highlighted

2. Project aims

The main aim of this project was to explore the best way to vectorise NMP raster data from the quarter sheets of a pilot area, to bring it into line with current NMP standards. The reason for this was so as to be able to provide comparable GIS functionality for all NMP projects, both past and present, as vectorised data is much more user friendly than raster scans. The quality of the MORPH2 descriptions produced for the Upper Thames Valley was also to be considered. The MORPH2 software was developed in 1988 to systematically record plough-leveled archaeological sites visible on aerial photographs (Edis, MacLeod and Bewley 1989: 112). The Thames Valley was one of three pilot areas used to test the new program and it continued to be used until 1996.[1] After the various MORPH2 fields (see Appendix C) had

[1] Pers. comm.. Helen Winton, Aerial Survey Team, English Heritage. Morphological details are still recorded for sites which meet particular criteria using an add-on to the AMIE database, the Aerial Survey Interim Recording Module.

been entered, additional software was used to automatically produce systematic descriptions, index terms and location data for the archaeological features found on aerial photographs. The resultant data was used to automatically fill the majority of monument record fields in the main NMR database (now called AMIE) for features recorded by the Thames Valley NMP project.

The incorporation of NMP data into the local SMRs and Historic Environment Records (HERs) is now the intention for each NMP project and is being carried out alongside the projects on Cornwall, Norfolk and Gloucestershire. Therefore an objective linked to the current project was the integration of the Gloucestershire sites identified by the Thames Valley NMP project into the county's SMR database and Geographic Information System (GIS). Although this part of the project had separate funding (English Heritage Project Number 3346, Objective 6.5), it is directly relevant to the current project and so a discussion of it is included in the final report. This report details the time, resources and general feasibility of the conversion of old NMP mapped data to current data standards. The Upper Thames Valley sample area will be available as a model for the rest of the NMP mapping of the Thames Valley and other old NMP projects.

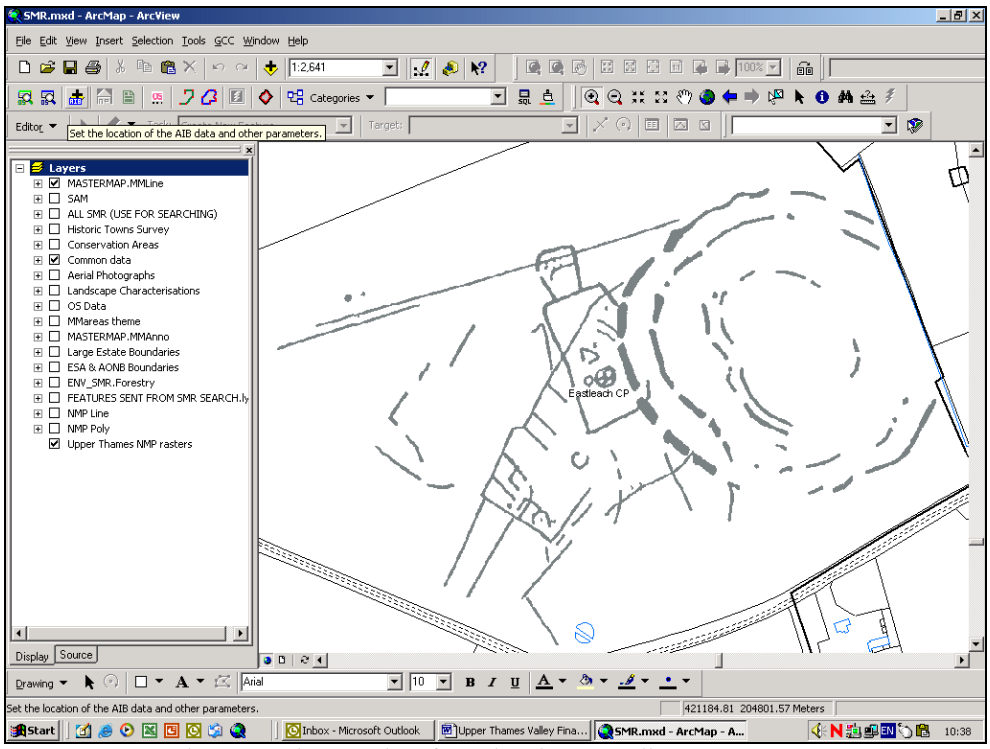

Figure 2. The scanned raster data from the Thames Valley NMP in use in ArcView

3. Digitisation: methodology

The existing Upper Thames Valley transcriptions were hand-drawn in pen and ink on drawing film. The quarter sheets have been scanned so that they can be used in computer applications such as GIS (see Figure 2). However, the ordinary scanning process produces raster layers which are purely pictorial; they have no embedded spatial information and no attributes can be added to the features depicted on them, hence the need for digitisation to enable full GIS functionality in line with current NMP standards.

Three methods of digitisation were trialled on the 11 quarter sheets of the Upper Thames Valley during this project: manual digitisation, vectorisation using Corel Draw and a combination of the two. Although the original drawings were created using a single line of a given thickness (generally 0.18mm) the effect of zooming in on a scanned version of the drawing meant that these lines appeared as filled polygons and were drawn in AutoCAD as such.

3.1 Manual digitisation

Manual digitisation involves the direct tracing of each feature from the raster scan, using a mouse, onto an appropriate layer (usually bank, ditch or large cut feature) in a prepared AutoCAD NMP template (see Figure 3).[2]

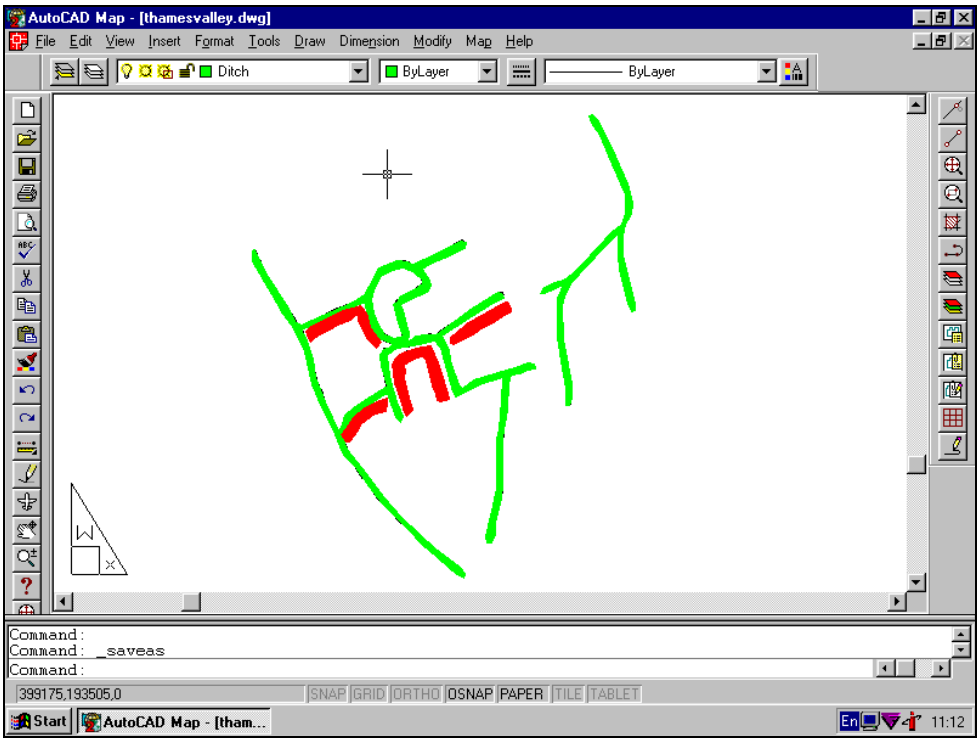

Figure 3. Sample of NMP data which has been manually digitised

The raster scans supplied by English Heritage (in .tif format) were inserted into the AutoCAD drawing using the bottom left hand corner as the insertion point and a value of 5000 in the scale box. The positioning was then perfected using AutoCAD grid lines and the align tool. This data was placed on a newly created layer, nmp_raster_data, that was added to the template for this purpose.

3.2 Automatic vectorisation

The second method involves the use of a graphics or GIS package with a vectorisation tool, which automatically traces around the features depicted on a raster layer. For the purposes of this project this was undertaken using Corel Draw OCR trace. The program was set to vectorise by outline with a node reduction of 30% and a noise reduction of 5% (see Figure 4). The blocks produced were then inserted in .dwg file format, using the centre of the quarter sheet as the insertion point, and a scale value of 250. The align tool was then used to get the

[2] AutoCAD Map R2 was used to carry out this project. More recent versions of the program are available.

imported data to exactly the right scale and position. Next, the features were selected and exploded, then transferred to a newly created layer, nmp_vector_data, which was coloured magenta to make it distinctive. The grid intersections which were drawn onto the original pen and ink transcriptions (and were therefore vectorised as well as the archaeological features) were deleted from the vectorised data. They should not be removed until this stage because they are needed to align the data (see above). As each site on the nmp_vector_data layer was dealt with, it was transferred to the relevant NMP layer (e.g. Ditch). This made it simple to keep track of what had been done (green) and what still needed to be done (magenta) on each quarter sheet.

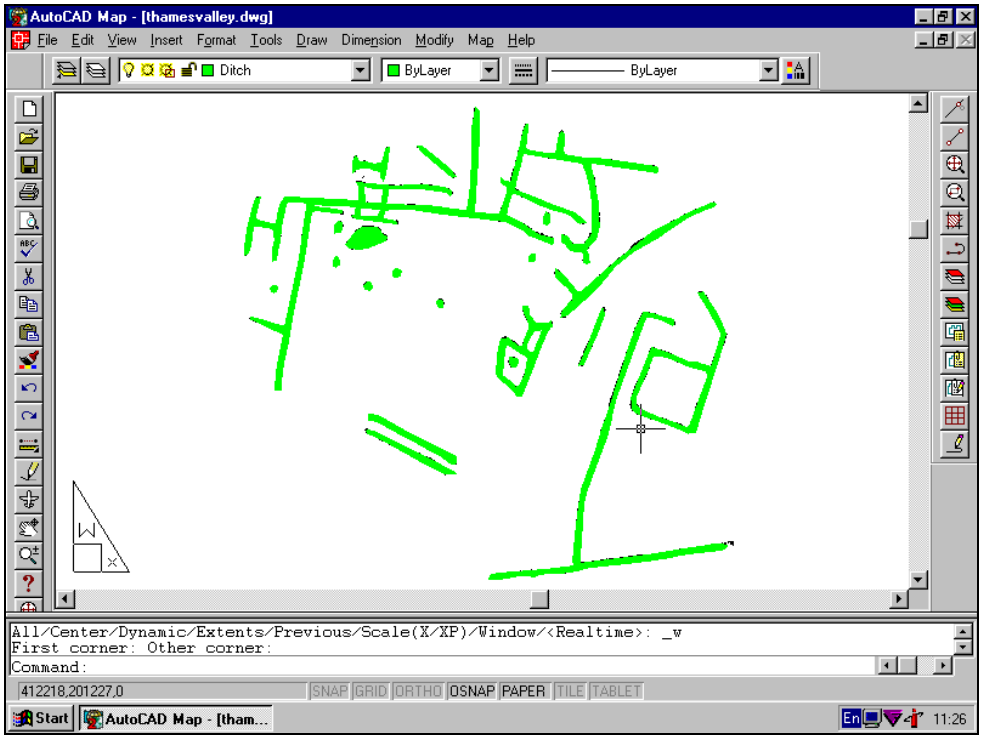

Figure 4. Sample of NMP data which has been automatically vectorised

3.3 Additional digitisation work

Each feature also had to be hatched, (in keeping with current NMP practice) in order to better distinguish each monument and the areas within. Hatching was undertaken on the Ditchfill and Bankfill layers (large cut features are not filled). Another routine part of NMP transcription is the creation of the monument polygon (i.e. the boundary of the site). Since there are no polygons from early NMP projects these are dealt with below as part of the issue of concordance rather than digitisation.

The AMIE number (and any other relevant attribute data where applicable) was also attached to the hatching itself and the monument polygon, as well as the digitised edges of the monument (see below).

3.4 Attribute data attachment

Whichever method was used to digitise the graphic data , attributes were subsequently affixed using the attach command in AutoCAD. The main attribute required is the Unique Identifier (UID) or AMIE number associated with each site. To locate the AMIE number for each site, photocopies of the quarter sheet transcriptions were provided by English Heritage. These had been annotated to include the MORPH numbers, which were cross-referenced with

the AMIE reports for that quarter sheet to find the relevant UIDs. The further annotation of the photocopied sheets with the AMIE numbers was found to be useful before commencing the digitisation of each sheet, and each AMIE number could then be ticked off when completed to keep track of progress.

Several other pieces of data are now routinely attached to each feature during the NMP process. As well as the AMIE number, there are four further fields to be completed: period, thesaurus term (type of site), evidence for site (e.g. cropmark) and photo reference. Once the AMIE number has been attached to monuments, it is possible to link the objects via their UID using the database link facility within AutoDesk Map. However, to bring the data to precisely the same standard as current NMP projects, this data would have to be added as well. This process was tested on one Thames Valley quarter sheet to assess its practicality (see page 92).

4. Digitisation: results

The following table lays out the time taken to digitise each quarter sheet. ST99SE and SP10SE were digitised manually. Although the numbers of sites digitised using this method were high, on these sheets the majority of sites were fairly small, discrete and simple. Having started to digitise another more complicated sheet using just the vectorisation tool, and breaking and joining lines where necessary, it was realised that a combination of digitising manually and employing the automatically vectorised data where possible was the best compromise for the fastest progress. During the digitisation phase of the project, an average of 66 sites was digitised each day. The time taken to digitise each site was very variable depending on its size and complexity, whether it overlapped any other sites and how much cross-referencing was necessary. In the table below, the two sheets which were digitised manually appear to have been completed more quickly, but this is a reflection of the size and discreteness of the sites in this area.

Quarter sheet	Time taken (days)	Number of UIDs	Number with banks	Number with large cut features	Extra time to add monument polygons
ST99SE	0.5	31	3	0	30 mins
SP10SE	0.5	67	1	0	1 hr 10 mins
SU09SE	0.5	33	6	0	40 mins
SU19NW	2	243	1	0	2 hrs 30 mins
SP10SW	0.5	65	0	0	1 hr 5 mins
SP09SW	1	36	3	0	55 mins
SU09NW	1	74	0	1	1 hr 50 mins
SU29NW	1.5	124	4	0	4 hrs
SU09NE	1.5	112	2	0	1 hr 55 mins
SP20SW	3	117	2	0	3 hrs
SU19NE	3.5	119	3	1	2 hrs 30 mins

5. Data concordance: methodology

Appendix A (page 95) contains a description of the structure of the Gloucestershire Sites and Monuments Record database, Appendix B (page 97) details the structure of the National Monuments Record database, AMIE. The following section discusses the method of incorporation of information from the AMIE database into the Gloucestershire SMR database.

5.1 Existing SMR records
Where an existing SMR record already corresponded to an NMP site, it was necessary to add the following new information, copying it directly from the AMIE record: area history, a cross-reference to the Thames Valley NMP project, source work references (to AMIE reports, NMP maps and relevant aerial photographs) and a photographic condition/damage record referring to the condition of the monument at the date(s) the aerial photograph(s) was or were taken.

5.2 New SMR records
New records required the same pieces of information as existing records, plus the following: parish, map sheet and site(s). Additional cross-references might be needed if other sites were mentioned in the descriptive text.

5.3 Descriptive text
The general descriptive text field provides an opportunity to write more fully about each Archaeological Site. The text generated by the NMP and recorded in the AMIE database was usually cut and pasted from the AMIE record (in Microsoft Word format) directly into the SMR Area Description, often with minor changes so that it fitted better within the context of each record.

5.4 GIS
Once each database record had been finalised, a GIS polygon could be created or amended where necessary for that site. Many of the old SMR polygons relating to crop mark sites had been digitised around the adjacent field boundaries. This was not only imprecise but made things confusing at locations where there were several sites close together with different SMR numbers and shared boundaries or overlaps. It has been possible to make over half of the existing polygon boundaries more accurate using the NMP data.

6. Data concordance: results

6.1 New and updated records
The following table outlines the number of new and updated records for each Upper Thames Valley quarter sheet and the amount of time taken to carry out the necessary work. Large areas of a number of these quarter sheets lie outside Gloucestershire, hence the varying numbers of records for each map.

Map sheet	New records	Amended records	No. of days taken
SP10SW	27	22	1.5
SP10SE	37	23	3
SP20SW	6	19	1
SU09NW	12	28	2
SU09NE	17	28	2.5
SU19NW	41	36	3.5
SU19NE	15	35	5.5
SU29NW	13	18	3
ST99SE	0	1	Negligible
SU09SW	1	6	0.25
SU09SE	1	0	Negligible

An additional five working days were required to add in the aerial photograph references (see below). Taking this into account, an average of 14 records per day were produced or updated.

6.2 Sources

The source fields in the NMR monument reports for sites observed in the Thames Valley NMP did not include detailed information about the particular aerial photographs used in the construction of each record. Instead, the relevant source entries referred only to an aerial photograph interpreter's comment, with their name and the date. NMP projects now routinely record precise data on aerial photographic sources (organisation, date taken, sortie and photograph codes) in the associated AMIE records. This information was available on the original Thames Valley record sheets for many sites, and it was necessary to photocopy these sheets and send them to Gloucestershire County Council, in order to finish updating the records. The cross-referencing involved in this task proved quite time-consuming and it took a further five working days to input the additional information.

6.3 Monument boundary polygons

As well as the digitisation of archaeological features, NMP projects also now digitise monument boundary polygons to show the extent of each site. Where no NMP polygons exist, as for the old NMP projects, defining the limits of NMP sites can be difficult, especially where crop mark complexes have been split into a number of separate records. English Heritage were able to supply photocopies of the NMP mapping with MORPH2 code annotations to Gloucestershire County Council, which helped to rectify this problem. The extent of each site was ascertained (sometimes using the NGRs and other information in the AMIE record for overlapping sites) and then the monument boundary polygons were digitised manually and visually around the edge of the site defined.

7. MORPH2 descriptions

Another aspect of the data concordance must be considered: the quality of the NMP General Descriptive Text added into each SMR record.

The MORPH2 database was designed to better record cropmark and soilmark sites which eluded straightforward interpretation (Edis, MacLeod and Bewley 1989: 113). It was also required because the NMR did not yet have a fully networked database when the post-pilot stage of NMP began.[3] Cropmark and soilmark sites formed the majority of sites being identified by the NMP at the time and as a result it was felt that morphological descriptions would be more suitable for NMP recording. When the NMR database was available for direct input by NMP staff, software was designed to automatically convert MORPH2 data to the standard for NMR database monument records. This included computer generated descriptions of each site, the quality of which are considered below. Appendix C (page 100) contains details of the data structure of the MORPH2 database.

The Thames Valley survey area was suited to recording using the MORPH2 database because the archaeology largely consisted of cropmark and soilmark sites. However, when the MORPH2 data from the Lincolnshire NMP project (1992-97) was transferred into the NMR's database, it was found to be easier to re-write and recast the text, some of the indexing, and in some cases the way in which the site had been divided into separate MORPH2 records. This was partly because the survey area contained many medieval and post-medieval sites, which did not lend themselves to the MORPH2 system of recording.[4]

Although the ideas behind the MORPH2 software were clearly well founded, the automatically generated descriptions relating to sites recorded by the Thames Valley NMP were found to be disappointing during the course of this project. From the point of view of a data user further down the line, in this case the Gloucestershire SMR, the lack of archaeological interpretation was frustrating and unhelpful. For example the omission of a

[3] Pers. comm. Helen Winton, Aerial Survey Team,. English Heritage
[4] Pers. comm. Helen Winton, Aerial Survey Team,. English Heritage

precise suggested date for many sites (e.g. classified as "uncertain" or the inexact "prehistoric or Roman"). This was due to a combination of factors. On the one hand there was a deliberate policy within MORPH2, that was trying to get away from the subjective recording of features and aimed not to "attempt to force sites of unconfirmed date and significance into pre-existing archaeological categories. On the contrary, it allows them to be compared, grouped and re-grouped on the basis of their empirically observed physical and spatial attributes." (ibid.) On the other hand the software was designed in such a way that multiple indexing was not allowed. This meant that it was impossible to record a site as Iron Age and Roman and therefore unless the recorder had evidence that a site had only been used in one period or the other it had to be recorded in the general terms of "Prehistoric or Roman". However, the end-user - in particular non-specialists - may find a (qualified) guide to a site's date and some interpretation very useful. This is also helpful for period-based searching on SMR databases, which are frequently requested. Orientation, which is often mentioned where appropriate in current NMP descriptions, does not appear to have been included as a field in the MORPH2 software, a notable omission.

The few non-MORPH2 generated descriptions included in the Upper Thames Valley data are distinctly better in quality and detail for a general audience. For example, Gloucestershire SMR 3257, the Neolithic causewayed enclosure to the east of Eastleach, has both a MORPH2 and a manual description. The manual description is arguably more readable and contains more information, but the MORPH2 description is in a standardised format and is therefore perhaps more easily comparable with other sites, as can be seen below.

Manual description of SMR 3257:

"Cropmarks of a causewayed enclosure centred on SP 2156 0472 are clearly visible on aerial photographs. The enclosure is curvilinear and roughly symmetric with four ditches. The outer enclosure is 230 x 230 metres in size and the innermost ditch encloses an area 125 x 85 metres in size. The ditches are between 1 and 8 metres wide and located in two pairs. The inner and outer pairs are separated by a space 20 to 40 metres wide. The ditch sections of the outer circuit are irregular in their construction having a lobed appearance. These irregularities only occur on the outer edge, the inner edge being relatively smooth and straight. The outer lobes are very pronounced at SP 2145 0473 and appear to form entrance terminals on either side of a causeway.

The cropmarks of the southern side of the enclosure are indistinct and only visible on the latest photography taken in 1990. This is probably due to a shorter period of ploughing as photographs taken in 1983 show this part of the site to be overlain by extant ridge and furrow. There is a large gap in eastern side of the two outer ditch circuits, this is where the site is overlain by a modern field boundary."

MORPH2 description of SMR 3257:

"The causewayed enclosure described above was mapped at 1:10,000 scale from good quality air photographs during the Thames Valley Mapping Project. It was seen as cropmarks and described as an incomplete, asymmetric, curvilinear enclosure, 115m by 70m, defined by 4 ditches and centred at SP 2156 0471. (Morph No. TG.57.19.1)."

On more complicated sites, for example the multi-part cropmark complexes which appear frequently on the Thames gravels, the MORPH2 descriptions do not make any attempt to connect the various parts of the sites or make sense of the features as a group. Sometimes these complex sites are split between more than one record, each with a separate UID and NMR Number, even though they appear to form unified complexes that would be misleading to break down into separate parts.

Despite this, the Thames Valley MORPH2 descriptions do make sense. Depending on the level of upgrading required, it might be considered most practical to leave at least some of these descriptions alone due to the amount of time it would take to update each one, in particular those sites which might be considered less important archeologically, for example quarry pits and trackways.

8. Other issues

The following issues were identified during the course of the project:

8.1 Vectorisation
8.1.1 Polyline width
When imported into AutoCAD, the vectorised polylines defining the outside of drawn features were assigned an actual rather than a default width, making them thicker than those which were manually digitised (see Figure 3 and Figure 4, above). In the version of AutoCAD being used, AutoCAD Map R2, it is only possible to edit the width of one polyline at a time. In AutoCAD 2000 and later versions, it is possible to change the width of groups of polylines, so this task was not attempted as part of this project, as it will be so much quicker to alter every feature when the data is returned to English Heritage. As noted above all features were drawn as filled polygons irrespective of size because the raster scans produced features with a defined width. This was merely an issue of appearance in this particular version of AutoCAD.

8.1.2 Resolution
The vectorisation was found to be adequate for the majority of ditches, despite the fact that the images on the scanned raster layers were quite blocky when zoomed in. This was also an issue for the manual digitisation, as it was not just a case of tracing around well-defined features, but digitising the line of best fit. If a higher level of reproduction from raster to vector were required, the settings could be altered in the software package used. Automatic vectorisation is not appropriate for banks, as the original project transcribed them as stippled features. Some pits also had to be re-digitised by hand because they were too small to have been picked up in the automatic vectorisation. Large cut features and hachured sites (see below) must also be re-digitised. However, this constituted very little extra work in the Upper Thames Valley (only 25 sites had associated banks, and there were only two large cut features in the whole pilot area). This should nevertheless be considered as a possible issue for the upgrading of other old projects.

8.1.3 Site complexity
If every site on a quarter sheet were discrete, automatic vectorisation would be an ideal method. However, because many elements of different sites overlap, the individual parts need to be broken up so that the appropriate attributes can be added to each polygon. The AutoCAD break and join commands can be used on the vectorised data to achieve this, but the process is time-consuming and sometimes it is quicker to re-digitise features by hand, in cases where there are a number of breaks and joins to carry out. This is also a problem where the datum crosses coincide with archaeological polylines. For features which run over two quarter sheets, polylines need to be joined together, or the features re-digitised. Occasionally features seem not to be properly vectorised as closed polylines, so the breaks have to be located and joined and/or the polygons closed. This becomes apparent when trying to hatch features which are not closed. During the course of this project the best method of digitization was found to be using automatically vectorised data as much as possible and digitizing manually where necessary.

8.1.4 Monument polygons
As has been discussed above, an additional requirement to bring the Thames Valley NMP up to current standards is the digitisation of monument polygons to show the limits of each site. During the pilot upgrade study, the monument polygons were added after the other data had

been digitised. On average, this was found to take around an extra 1.5 minutes per site. Over a large number of quarter sheets, this would add a noticeable amount of time to the total taken for digitisation. In several early NMP projects one of the products was an overlay with the groups highlighted. This might improve the speed of creating polygons as there would be less ambiguity in the drawing.

Comment [s1]: Can you add something here about the possible advantage of having original coloured morph sheets with monument groups (i.e the monument area for polygons) highlighted as per this?

8.2 Hachures and scoops

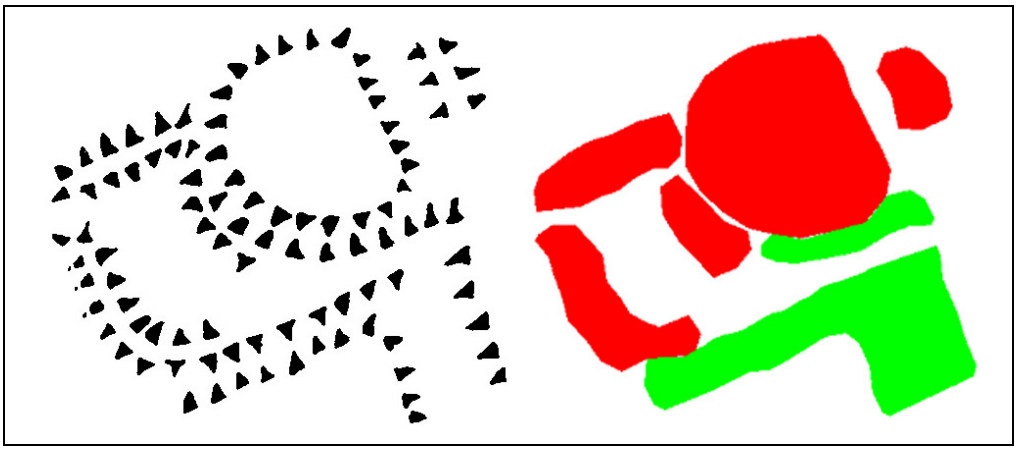

Figure 5. Medieval ringwork and bailey at Ashton Keynes, Wiltshire, as shown in the original transcription (left) and as digitised (right)

8.2.1 Hachures

During the original Thames Valley NMP project, at certain sites where earthwork survey had taken place, extant earthworks were transcribed using small hachures, reproducing the original depiction by the Ordnance Survey. These are sometimes difficult to digitise, because it is not always possible to differentiate between banks and ditches with certainty where there are single lines of hachures, for example the medieval ringwork and bailey at Ashton Keynes at SU 0488 9449 (see Figure 5).

8.2.2 Scoops

In the study area there are two sites which incorporate scoops, a NMP convention which is no longer used. These were represented by a large stipple on the original transcriptions. These features sometimes need to be digitised as ditches but in some cases they need not be digitised. For example in one of the cases in the Upper Thames, a scoop between two hollow ways at SU 0285 9747, does not need to be digitised because the hollow way is defined by the two outer ditches. The other scoop, at SU 0423 9249, is a wide ditch to the west of a sub-rectangular enclosure and was digitised.[5] As part of the digitisation, a check needs to be kept on what each feature represents, to make sure they are digitised on the correct layer. This is particularly important where conventions have changed since the early days of NMP. The two large cut features found in the study area, both gravel pits, were shown on the original transcriptions as extents of area, but they should have in fact been large cut features. This was corrected in the digitisation.

8.3 Omissions in the original project

8.3.1 Omission of MORPH numbers

Not every item on the morph overlays (especially small lengths of ditch within larger complexes) is labeled with a MORPH number. Sometimes the UID number can be identified using the AMIE descriptions, but during the course of this project, if no definite decision

[5] This was done on the advice of Simon Crutchley of the Aerial Survey Team, English Heritage

could be made they were allocated the AMIE number of the nearest similar features. There are also a number of MORPH numbers which do not have associated AMIE numbers (see table, below). In these cases, when they were digitised, the sites were tagged with the number '999', so that they can be easily picked out. The features should either have been described in another AMIE record, or if they constitute a site on their own, an AMIE record was never made for them. The upgrading of old NMP data would therefore involve the creation of some new AMIE records, as well as digitisation.

8.3.2 Missing AMIE numbers and records

An additional problem with the MORPH2 descriptions (see page 87) is that the splitting of each site into its constituent parts seems to have resulted in elements occasionally being left out. The following table lists the features on each Upper Thames quarter sheet which do not have associated AMIE numbers and records.

Quarter sheet	Features without AMIE records (tagged '999')
ST99SE	
SP10SE	TG.100.6.1, TG.100.13.1, TG.100.14.1, TG.100.20.1, TG.100.37.1, TG.100.38.1, TG.101.3.1, TG.101.12.1, TG.113.1.1-3
SU09SE	
SU19NW	TG.94.8.1, TG.94.27.1, TG.94.36.1, TG.94.39.1, TG.127.18.1, TG.128.44.1, TG.128.46.1, TG.128.47.1, TG.128.48.1, TG.128.70.1, TG.128.71.1, TG.128.72.1, TG.128.74.1, TG.128.82.1-2, TG.128.83.1, TG.128.84.1
SP10SW	TG.108.14.1, TG.112.1.1-2, TG.112.23.1
SU09SW	
SU09NW	TG.96.11.1, TG.98.35.1-2, TG.99.4.1, TG.99.28.1, TG.99.47.1
SU29NW	TG.62.34.1-9
SU09NE	TG.76.2.1, TG.76.6.1, TG.76.26.1, TG.72.29.1
SP20SW	TG.58.24.1, TG.59.37.1, TG.59.38.1, TG.59.39.1
SU19NE	TG.113.22.1-2, TG.114.2.1, TG.115.9.1, TG.115.17.1, TG.115.18.1, TG.118.19.1, TG.118.24, TG.120.6.1

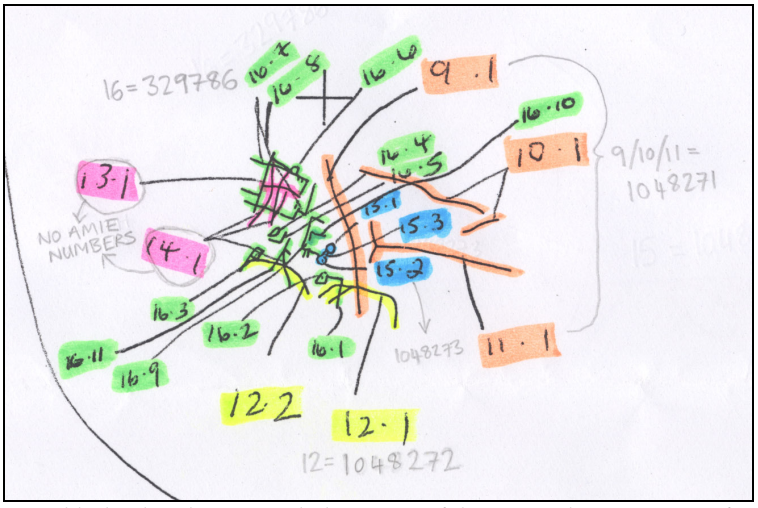

Figure 6. Highlighted and annotated photocopy of the original transcription for SP10SE

8.3.3 MORPH number annotation

Maps annotated with MORPH numbers are certainly confusing for complex cropmark sites, where there are two or more UIDs, for example the complex which includes UIDs 1048271, 1048272, 1048273 and 329786, which is located at SP 1600 0081 (see Figure 6). The annotated transcriptions supplied for the pilot study were photocopies, so lines pointing to features look similar to many of the features themselves, and furthermore it is not always obvious to what they point. Sometimes it helps to look at the AMIE descriptions, but where these do not exist it may not be possible to break up the sites with certainty. An added separation problem is that the pen and ink is solid, so sometimes where elements stop and start is not discernible, although this would also be true of the cropmarks illustrated. There are blown-up photocopies of some of the most complex sites in the original project archive, although these were not used for the pilot study. For the pilot study, highlighting pens of several different colours were used to pick out the various elements of individual sites (see Figure 6). This could then be used for reference to digitise the features.

8.3.4 Transcription inconsistencies

There are also some inconsistencies between the scanned and photocopied transcriptions supplied to Gloucestershire County Council. Two small ditches are not on the scanned copy of the pen and ink plot for SP10SE, but are on the photocopied map with the MORPH number annotations. There is a MORPH number and UID for the site (TG.100.24.1, UID 1049275), but these ditches cannot be digitised accurately (for the purposes of this project they were digitised by eye). Similarly, a short length of double ditch which is shown on the photocopied transcription of the SU09NE quarter sheet (at SU 0541 9514) does not appear on scanned version, so cannot be digitised.

On the SU29NW quarter sheet, at SU 2313 9860, there are several features on the scanned raster file which are not on the photocopied annotated map. There is therefore no way to work out the MORPH number or UID. The AMIE descriptions were searched to see whether the MORPH numbers were omitted in error from one transcription, but no site covered by the NMP was located at the right NGR. One of the two sites, that to the south-east seems to be UID 765503, however, in the descriptive text for this site it was apparently not plotted as part of the Thames Valley NMP. These features have been tagged with the number '111'.

8.4 Attaching further NMP data

One quarter sheet was used for a trial to assess the practicality of attaching the other NMP criteria (period, thesaurus term, evidence and photo reference) as well as the UID to features. ST99SE was selected and it took two hours to input the data for the 31 sites. The process was slow because there are several stages of cross-referencing to carry out. The most time consuming field to determine is the photo reference, for which it is necessary to look at the archive record sheets (which do not contain UIDs or MORPH numbers). The contents of the other fields are on the AMIE printout. The ST99SE quarter sheet is comparatively simple because every site is discrete, so it is easy to attach the data to every part (polylines, hatching and monument polygon) in one step. It is therefore anticipated that this stage would add considerable time to the digitisation process for the majority of quarter sheets. Furthermore, five of the sites (UIDs 1010763, 1010772, 1010775, 1010778 and 1010781) did not appear to have record sheets, so the AP reference could not be ascertained. In these cases a question mark was inserted into the photographic reference field.

8.5 Quarter sheet boundaries

On the southern edge of the SP20SW quarter sheet and the northern edge of the SU29NW quarter sheet, a site has been given a different MORPH (and therefore AMIE) number on each sheet. The sites consists of two pits centred on SU 2268 9999. On the SU29NW quarter sheet these have the number TG. 58.51.1 (UID 1042687) and on the SP20SW quarter sheet they

have the number TG.58.40.1 (UID 1041260).[6] The same applies to a nearby trackway which is labelled TG.58.30.1 (UID 1041253) on the SU29NW quarter sheet and TG.58.36.1 (UID 1041257) on the SP20SW quarter sheet.[7] Arrows also point to features on the southern sheet, labelling them as part of TG.59.20.1 (UID 1041275), but they appear to be part of the complex to the south numbered TG.59.43 and TG.59.45 (UID 225878). These examples appear to be mislabellings rather than duplications.

9. Conclusion and recommendations

Digitisation

• The process has been shown to be fairly quick and easy, taking a maximum of three days of digitisation work per quarter sheet, even for very complicated and busy sheets.

• The resolution of the standard NMP scanned pen and ink originals is of sufficient quality to be vectorised using a program such as Corel Draw OCR Scan.

• The best method for the digitisation of old NMP data is to use an automatic vectorisation tool with subsequent breaking and joining of features or their redigitisation as necessary.

• Creation of polygons is largely carried out manually and visually. However, where sites overlap each other, additional NGRs and the descriptive text in the AMIE records are sometimes helpful to help define the limits of each site.

• Additional time would need to be allowed for the attachment of data to the various polygons. Checking the AMIE numbers is fairly straightforward, requiring simple cross-referencing of AMIE records and annotated MORPH maps. With the exception of aerial photograph records, the other required information can also be taken directly from the AMIE records.

Concordance

• The concordance work involved copying information from the AMIE records and inserting it into the SMR database. An average of 14 SMR records per day were produced or updated, however, this included time taken to upgrade some existing records. If this had not been a factor it is estimated that 25-30 records could be created or updated per day. This is based on the process required to add and update records to the Gloucestershire SMR and may not correspond precisely to other SMR and HER databases.

• The automatically generated MORPH2 descriptions are not ideal for incorporation into SMR databases, and their restructuring and/or rewriting would aid interpretation and the understanding of the end-user.

General

• There are likely to be omissions and errors in the records and transcriptions which will take time to resolve. The time taken to do this must be factored into any planned programme of work.

[6] The feature was tagged with UID 1042687
[7] This feature was tagged with UID 1041253

10. Bibliography

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11. Acknowledgements

Thanks are extended to English Heritage for funding this project. I am also grateful to Simon Crutchley and Helen Winton (English Heritage), Jan Wills, Tim Grubb and Graham Tait (Gloucestershire County Council) for their help in completing this study.

Appendix A: Data structure in the Gloucestershire SMR

The following diagram (Figure 7) and explanation of the structure of the Gloucestershire SMR database are taken from the *SMR Data Audit Update* (2004).

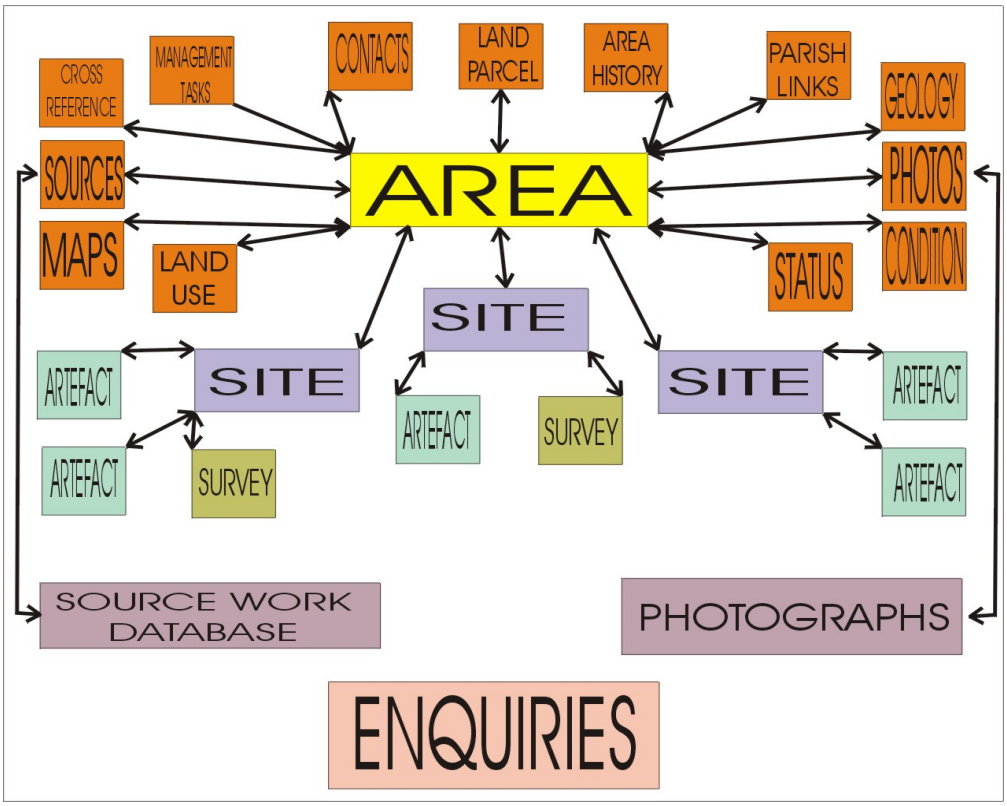


Figure 7. Diagram showing the structure of the Gloucestershire SMR database

1. Archaeological Areas

All data held on the SMR database must belong to a numbered *Archaeological Area* which is defined as an area of land which can be, for example, a village, a field or any defined polygon. Each Archaeological Area has many data records linked to it which relate to its location, history, geology, land use, contacts, and most importantly the Archaeological Sites and Archaeological Artefacts or Components, sub-records which together make up the Archaeological Area.

2. Archaeological Sites

An *Archaeological Site* can be a visible field monument such as a hill fort, a barrow or a deserted medieval village, a buried site known only from excavation evidence, a standing building or structure, a buried site known only from aerial photographic evidence, a site known from documentary sources, or a complex including many of these types.

3. Artefacts

An Archaeological Site can incorporate many linked *Archaeological Artefacts* or *Components* and *Site History* records. Archaeological Artefacts are, for example, arrowheads, coins, and pottery. Archaeological Components are components of an Archaeological Site, for example,

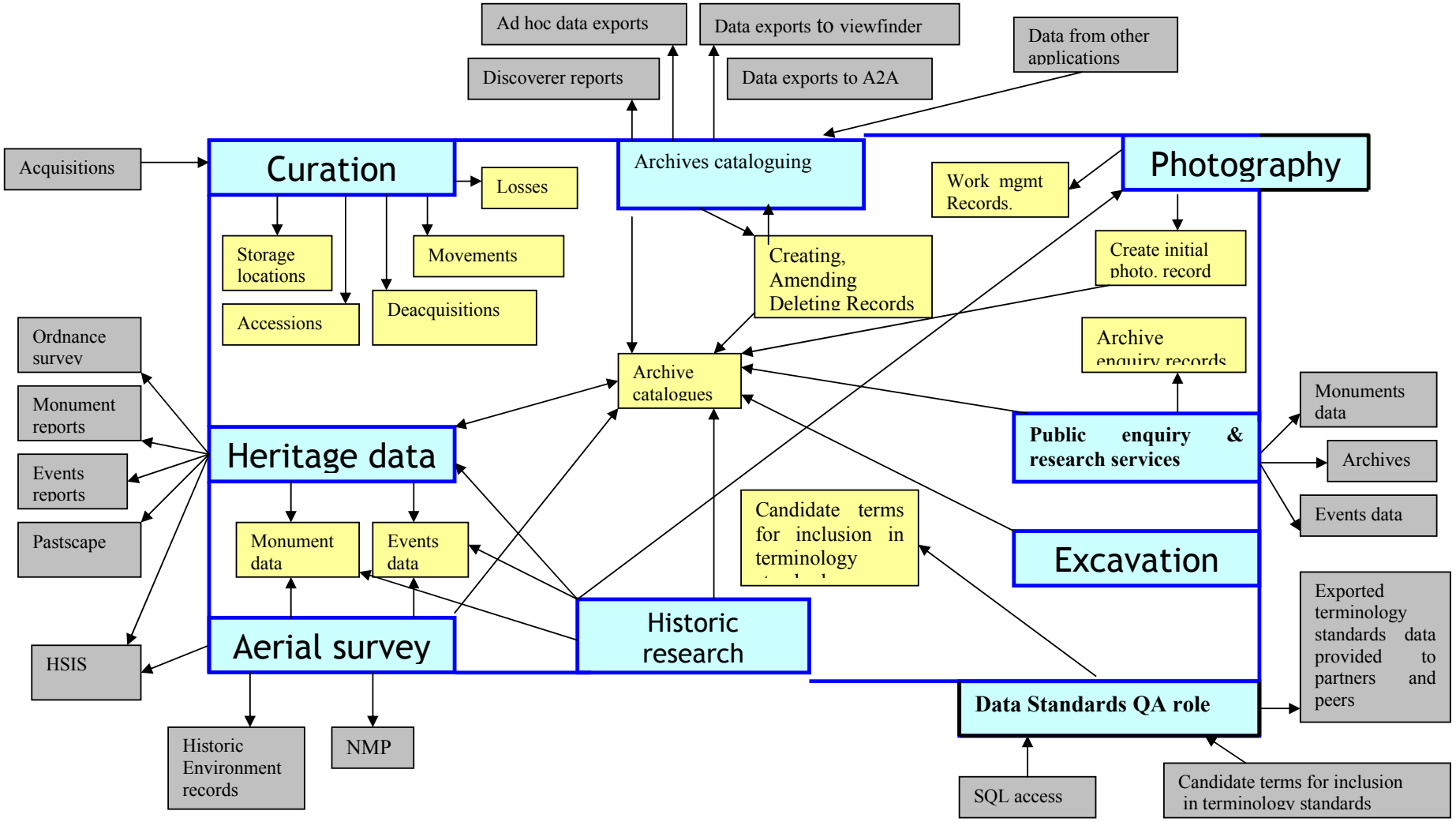
a thatched roof on a building, or a ring ditch in a settlement site.

4. Numbering

The numbering of these items of information reflects the hierarchical design of the database. An Archaeological Area will have a unique number, e.g., 10136. Archaeological Sites within that archaeological area will have subsidiary numbers, e.g., 10136/1 10136/2 10136/3. Archaeological Artefacts/Components within archaeological sites will have subsidiary numbers, e.g. 10136/1/1 10136/1/2 10136/1/3 10136/3/1.5.3.

Appendix B: Data structure of the AMIE database

(taken from English Heritage, National Monuments Record, *AMIE: Assessment and Strategy*, EH internal publication, October 2004)



NMR Inventory - A core data standard for Monument Records

ITEM	CORE DATA FIELDS
Monument Reference Number	Monument HOB UID
Name	Monument name
Summary Text	Summary text
Protection Status	'Protected' flag
Other Identifiers	Other Identifier scheme / value entries for the following schemes:- SAM / RSM Number LB Number SMR Number NBR Number, NMR Number MORPH Number Hydrographic Office Number Admiralty Chart Numbers
Cross-references	Minimum of one link to an Archive Uid (General Archive Material reference, Collection etc) Associations between Monument records
Locational Information	O.S. NGR (Easting, Northing, No. of digits, Shape -Feature centred) County / Unitary authority District Parish (non-parish area) Street , street number Locality
Monument Classification	At least one entry for the following Classification schemes, linked as appropriate to enhance retrieval: Monument type Evidence Main building material Covering building material
Monument Chronology	Period Date min, date max Display Date

People, Organisations and Roles	Historical Roles entries (i.e. associated with the Monument rather than with compilation of the monument record information) Role Name / Organisation Start Date End Date

ADDITIONAL CORE FIELDS FOR SURVEY RECORDING

ITEM	SURVEY ADDITIONAL CORE DATA
Text	Long text
Monument Condition	Evidence classification scheme entry on the Monument Condition table. Monument Condition
Locational information	Multiple NGRs (Shape e.g. polygon, Easting, Northing, No. of digits)

ADDITIONAL CORE FIELDS FOR MARITIME RECORDING

ITEM	MARITIME ADDITIONAL CORE DATA
Monument Classification	Construction Object material Destination Departure Port of registration Propulsion Nationality Manner of loss Vessel length
Locational information	Named location link Latitude/longitude

NON-CORE DATA

ITEM	NON-CORE DATA
Monument Condition	LAND CLASSIFICATION
Monument Name	Alternate, Former, Latest Names
Other Monument Identifiers	All Other Monument Identifier schemes not listed in Table 1

Appendix C: Data structure of the MORPH2 database

(taken from English Heritage, National Monuments Record, *Business case for an Import-Export Module*, EH internal publication, January 2001)

Primary Record Identification Table

Field Name	Contents	Restricted pick list entry
TIMESTAMP	Date and time created	
COUNTY	County	
PRI_PSH	Parish	
CNO	Complex number	
GPNO	Group number	
SSNO	Site number	
PRI_1GRE	NGR 10km square Easting	
PRI_2GRE	NGR 1km square Easting	
PRI_3GRE	NGR 0.lkm square Easting	
PRI_4GRE	NGR 0.01km square Easting	
PRI_1GRN	NGR 10km square Northing	
PRI_2GRN	NGR 1km square Northing	
PRI_3GRN	NGR 0.lkrn square Northing	
PRI_4GRN	NGR 0.0lkm square Northing	
PRI_EXT	Still in existence	✓
PRI_LOC	Location	✓
PRT_ASP	Aspect	✓
PRI_PER	Period	✓
PRI_INT	Interpretation code	
PRI_CERT	Sources	✓
PRI_STYPE	Site type (ENCLOSURE etc)	✓
PRI_GLE1	NGR letter of 100km square	✓
PRI_GLE2	NGR letter of 100km square	✓
PRI_NAR	NAR reference number	
PRI_SMR	SMR reference number	
PRI_VAL	Validity	✓
PRI_FORM	Form of remains (C, E, S, C&E, C&S, E&S, C&E&S)	✓
AUTHOR	Author	
PRI_FNGR	Further NGR data	
LE	5 figure NGR Easting	
LN	5 figure NGR Northing	
LOCATION	10 figure NGR	
PRI_MAP	OS quarter sheet number	

Additional NGR information table

Field Name	Contents	Restricted pick list entry
COUNTY	County	
CNO	Complex number	
GPNO	Group number	
SSNO	Site number	
GRIDREF	NGR e.g. SE 1234056780	
TIMESTAMP	Date and time created	

N.B. The GRIDREF field is only accurate to the nearest 10m, the zeros are added automatically to conform to the standard used by the AERIAL *program.*

Linear Feature Table

Field Name	Contents	Restricted pick list entry
COUNTY	County	
CNO	Complex number	
GPNO	Group number	
SSNO	Site number	
LFD_PATT	Pattern	✓
LFD_SHAP	Shape	✓
LFD_DNO	No of ditches	
LFD_BNO	No of banks	
LFD_PNO	No of pit defined elements	
LFD_FNO	No of foundation elements	
LFD_RFYN	Is it ridge and furrow	
LFD_CONT	Continuity	✓
LFD_ENO	Entrances	✓
LFD_DCHK	Definition check	✓
LFD_RTE	Route	✓
LFD_WDTH	Width	✓
LFD_LGTH	Length	
TIMESTAMP	Date and time created	

Enclosure Table

Field Name	Contents	Restricted pick list entry
TIMESTAMP	Date and time created	
COUNTY	County	
CNO	Complex number	
GPNO	Group number	
SSNO	Site number	
ENC_LINE	Linearity	✓
ENC_SYMM	Pattern	✓
ENC_SHAP	Shape	✓
ENC_ELYN	Is it elongated? (Y/N)	✓
ENC_PRES	No of straight sides (if curvilinear)	✓
ENC_CORN	No of corners	✓
ENC_STRS	No of straight sides	
ENC_CONS	No of concave sides	
ENC_COVS	No of convex sides	
ENC_DNUM	No of ditch circuits	
ENC_BNUM	No of bank circuits	
ENC_PNUM	No of pit defined circuits	
ENC_FNUM	No of foundation circuits	
ENC_LTH	Length	
ENC_BTH	Breadth	
ENC_DIA	Diameter	
ENC_COMP	Completeness	✓

ENC_INTF	Presence of Internal/External features	✓
ENC_INT	Entrances (Y/N)	✓

Entrance Table

Field Name	Contents	Restricted pick list entry
COUNTY	County	
CNO	Complex number	
GPNO	Group number	
SSNO	Site number	
ENT_POS	Entrance position	✓
ENT_FORM	Entrance form (TIT/CLAV, ANT/FUNN etc.)	✓

Macula Table

Field Name	Contents	Restricted pick list entry
COUNTY	County	
CNO	Complex number	
GPNO	Group number	
SSNO	Site number	
MCD_ PATT	Pattern	✓
MCD_SHAP	Shape	✓
MCD_ FORM	Form	✓
MCD_ SIZE	Size	✓
MCD_ NUM	Number of maculae described	
TIMESTAMP	Date and time created	

Linear System Table

Field Name	Contents	Restricted pick list entry
COUNTY	County	
CNO	Complex number	
GPNO	Group number	
SSNO	Site number	
LSD_PATT	Pattern	✓
LSD_SHAP	Shape	✓
LSD_FORM	Form	✓
LSD_CONT	Continuity	✓
LSD_UDT	Unit defined trackway	✓
LSD_ENO	Enclosure complex	
LSD_LGTH	Length	
LSD_BDTH	Breadth	
TIMESTAMP	Date and time created	

Industrial Complex Table

Field Name	Contents	Restricted pick list entry
COUNTY	County	
CNO	Complex number	

GPNO	Group number	
SSNO	Site number	
IND_BP	Bell pits	✓
IND_SHFT	Shafts	✓
IND_HUSH	Hushes	✓
IND_ADIT	Presence of Adits	
IND_OWYN	Presence of Open workings	
IND_PEAT	Presence of Peat cutting	
IND_PROC	Presence of Processing operations	
IND_FLUE	Presence of Flues	
IND_CHIM	Presence of Chimneys	
IND_BLD	Presence of Buildings	
IND_LEAT	Presence of Leats	
IND_DAM	Presence of Dams	
IND_TRAM	Presence of Tramways	
IND_TRCK	Presence of Trackways	
IND_LTH	Length	
IND_BTH	Breadth	
IND_DIA	Diameter	
TIMESTAMP	Date and time created	

APPENDIX 2

THE AGGREGATE LANDSCAPE OF GLOUCESTERSHIRE

PREDICTING THE ARCHAEOLOGICAL RESOURCE

AGGREGATES LEVY SUSTAINABILITY FUND:

ENGLISH HERITAGE PROJECT NUMBER 3346

Outline Methodology

Introduction
Gloucestershire County Council Archaeology Service was commissioned in March 2004 to undertake an assessment of the archaeological resource threatened by the extraction of aggregate minerals within the county. This project consisted of a consideration of the archaeology within the aggregate producing areas of the county and the formulation of a Resource Assessment and Research Framework for those areas. Although largely intended as a curatorial tool, the project was designed to have a wider audience, including Minerals and Waste Planning Officers, archaeological contractors and the academic community.

From the outset, the project aimed to formulate a straightforward, robust methodology with the potential to be exportable to similar projects in other parts of the region and country. This document outlines the methodology devised for the project, the sources used and the outcomes at the end of each stage of work, with the intention of acting as a guide for similar projects elsewhere. Crucial to the methodology was a long-term outlook, identifying potential threats to the resource well beyond the 10 year boundary of the Minerals Local Plan.

The minimum equipment required for the project was a GIS system connected to the County Sites and Monuments Record. This combined with British Geological Survey digital data for drift and solid geology, enabled analysis of both geological and archaeological data and the creation of spatial data specific to the project.

Aims
The project included the following aims:

- Production of baseline data for strategic and individual planning decisions
- Enhancement of the SMR and limited verification of the data
- Assessment of the state of knowledge of the archaeology of the aggregate areas
- Formulation of a research agenda and framework for these areas
- Increasing public and industry awareness of the archaeology of the aggregates areas

To achieve these aims a four point methodology was devised, each stage of which had defined outcomes, enabling the next stage to be undertaken.

1. Defining the Resource

The aggregates resource is defined by County Council Waste and Mineral Planning Officers in the Minerals Local Plan (MLP). This is subdivided into Areas of Search, Areas of Investigation and Preferred Areas. *Areas of Search* are broad areas with an undefined resource which have the potential to provide aggregates, but this potential is unexplored. *Areas of Investigation* are the first stage in the process of future mineral resource appraisal and represent more narrowly defined areas of potential resource. Areas of potentially workable limestone resource areas, termed *Preferred Areas*, can be considered to be the areas under most direct threat of extraction and selection of these areas is more tightly constrained by Minerals Planning Guidance notes such as MPG 1 and 6. These definitions mirror British Geological Survey (BGS) classifications of inferred, indicated and measured resources, which take into account the geological knowledge and economic viability of extracting certain geologies.

The BGS has produced digital geological mapping for the whole of the country, although some areas are currently still being re-mapped and may not be totally compatible with recently mapped areas. This was vital to the project and should be available before the project starts. The BGS are also in the process of producing Minerals Resource Maps for the entire country, although this project is ongoing (for details see: http://www.bgs.ac.uk/mineralsuk/planning/resource/home.html). Much of the data used in the BGS Resource Maps is derived from County Minerals and Waste Planning Officers, who hold information regarding active and dormant quarries and the materials that they produce. Minerals and Waste Planning Officers also hold the documentation for quarries in production since the introduction of the Town and Country Planning Act in 1948. In the absence of BGS Resource Maps for an area it is necessary to compile County Minerals and Waste Planning Officers data as a database which can be imported into a GIS system (for an example see Table 1).

No attempt was made to investigate quarries in operation before 1947 (prior to control of quarrying under the Town and Country Planning Act) as too little information was available about the nature of the products of these quarries.

Overlaying data about active quarries onto digital geology maps enabled the identification of the specific geologies being actively extracted. These geologies could then be extrapolated across the county as a potential resource. Dormant quarries were mapped in a similar way to enable the identification of geologies which have been historically quarried and may therefore be seen as suitable for quarrying in the future (see figure 1). One problem with some of the information held by Minerals and Waste Planning Officers is that there may be insufficient detail about the products of dormant quarries, making it impossible to be certain if aggregates were produced at specific sites. Hard rock quarries are particularly problematical in areas which produce both building stone and aggregates. A list of *all* quarries was compiled for the project, but only those *known* to produce aggregates were considered in detail.

In counties with a coastline, the marine resource should also be considered, although the methodology for understanding threats and impacts in this area is difficult to define and poorly understood.

The result of this stage of the project is a map of currently quarried geologies and those which have been exploited in the past. These geologies can then be treated as

a “potential” resource, although they may not be considered to be so in the MLP, which considers only a limited time-span.
Resources used:
Minerals and Waste Planning Officers data, paper maps and files.
Harbour Trustees and Crown Estate data regarding the marine resource.
Minerals Local Plan.
BGS digital data.
BGS resource mapping.

Outcomes:
Production of (digital) map of aggregates resource at broad and narrow levels: resource and potential resource.
Production of (digital) map of post 1947 aggregate producing quarries.

2. Defining the Study Area

The next stage of the project considered potential threat and former impacts on the archaeological resource of the aggregate producing areas. This involved breaking the data into a useable size by the definition of sub-units of study, based on the kind of geology being exploited (see figure 2). For ease of analysis these were divided into sands and gravels and hard rock geologies.

The sand and gravel areas, in the case of Gloucestershire fell into five clearly defined zones, corresponding to the major river valleys. Analysis was undertaken at this broad level on the assumption that *all* sands and gravels (with the exception of poor quality deposits such as head) were potentially exploitable.

Hard rock areas proved more problematical, due to the extensive areas of potentially exploitable limestone within the county. Each active and dormant quarry previously identified was treated as being potentially extendable, but only to the limits of the geology being actively quarried. Hard rock quarries tend to be less extensive than sand and gravel quarries, with smaller preferred areas for extraction identified in the MLP. To allow for future expansion, a radius of 2km was identified as corresponding to the largest preferred area in the MLP and this was used as a “buffer” around each active and dormant hard rock quarry site. Only the archaeology contained on potentially exploitable hard rock within each buffer zone was examined in the next stage of the project.

The areas identified in this stage of the project formed the basis of analysis for the next stage, which involved the querying of the SMR based on the geology within the sub-units defined. Urban areas were specifically excluded from consideration in the next stage, as Minerals Planning Guidance prohibits quarrying in areas of settlement. Although military establishments (Air fields etc) were include as these might be decommissioned and made available for extraction.

Resources used:
BGS digital data
SMR digital data
Minerals Local Plan.

Outcomes:
Identification of geographically defined units of study, based on the geology being exploited.
Preparation of (digital) maps of sub-units of study.

3. Resource Assessment

Frameworks for our Past (Olivier 1996) describes a *Resource Assessment* as summarising the current state of knowledge and understanding of the archaeological resource. The Resource Assessment for the project was limited geographically, but considered the full chronological range of sites and monuments in those areas producing aggregates.

The sub-units defined in the previous task were used as the basis for analysis of the SMR. Data was collected from the sub-units using GIS and exported to a database where it was sorted by location, period, site type and the nature of the archaeology. Protected sites (Scheduled Monuments and Listed Buildings) were also listed. This allowed an analysis of the date and type of all sites within given areas, and the production of period maps, based on potential threat. The SMR was the primary tool for this analysis, with only very limited verification of data undertaken. The process should be considered to be a "snapshot" of the resource at a point in time, rather than as a comprehensive study.

SMR files and datasets were also utilised to assess the level of intervention and recording for each site identified. Unpublished archaeological interventions were recorded, as were sites with potential for future work.

Resources used:
SMR site files and library
SMR digital data
NMP data

Outcomes:
Production of period based maps of the aggregate producing areas.
Gazetteer of sites by period within the aggregate producing areas.
Understanding of the gaps in the data produced as part of this assessment.

4. Formulation of Research and Management Frameworks

Frameworks for our Past (Olivier 1996) describes a *Research Agenda* as highlighting gaps in knowledge of the archaeological resource, the potential of the resource and the identification of possible research topics. This builds on data identified in the Resource Assessment and can be seen as a parallel process to ongoing Research Frameworks formulated by EH/ALGAO.

Fundamental areas covered in the Research and Management Frameworks were the identification of gaps in the knowledge of the archaeology of the aggregate producing areas; how these relate to the knowledge of the period generally for the county, and the ways in which these gaps could be closed. Further work based on the results of the Research Agenda, was also proposed, which included issues not addressed under normal planning-led investigation. Academic themes for further research were identified, as were geographical areas with the potential to yield good quality data to answer research questions.

The caveat that the Framework is limited only to the aggregate producing areas should be emphasised throughout, although consideration should be given to how these areas fit into and contrast with the wider archaeological record for the county.

Resources used:
General synthetic works: e.g. VCH, county archaeology series.
Specific research works: e.g. RCHME surveys, published research, papers etc.

Outcomes:
Research and Management Framework for the archaeology of the aggregate producing areas.

Key Themes
An SMR with GIS integration was key to the project, allowing rapid analysis of spatial and archaeological data. This, combined with good quality geological data from the BGS, was fundamental to the smooth running of the project in its early stages.

The formulation and utilisation of good data standards are crucial to the usability of the data produced during the project and to its incorporation into the SMR at its end. Data issues should be agreed between the SMR and the project co-ordinators at the start of the project.

Working with Minerals and Waste Planners and understanding their data was also a crucial aspect of the work, one outcome being that planners are now more aware of how archaeological aspects can be considered as part of the planning process. They have also found the geological information collated very useful as the archaeological team are rather more GIS literate than the planners.

An understanding of the general archaeological background of the county, as well as other projects already underway and how they related to the present project, meant that overlaps could be avoided and that the Resource Assessment and Research and Management Frameworks could be formulated relatively rapidly. Consultation with the SMR, County Archaeologist and archaeological contractors was vital.

Datasets should be clear and easy to use and should be available for dissemination in digital form. It is crucial that, at the outset of the project, there is an understanding of the different uses to which the data will be put, and the varying levels of specialisation and knowledge of the end-users of the data.

Knowledge of how research is undertaken and the data needed to carry it out, as well as an understanding of the formulation of methodologies, were key skills which allowed staff on the project to carry out the tasks efficiently and with academic and professional rigour.

Bibliography

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September 2004