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The use of geological sites by schools

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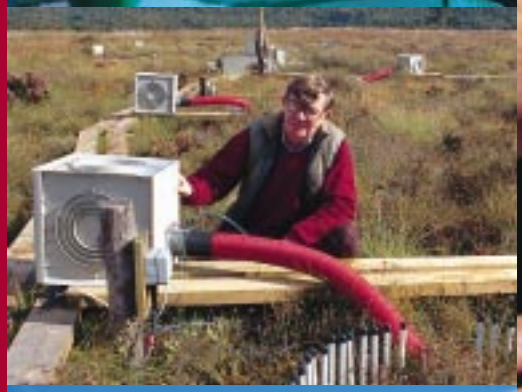

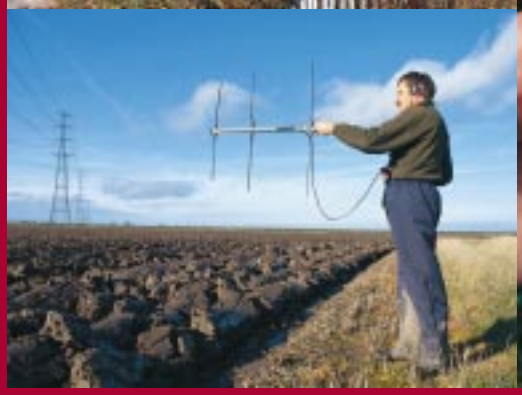

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English Nature Research Reports

Number 523

The use of geological sites by schools

A report commissioned by English Nature
Prepared by the National Stone Centre

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Contents

Introduction

It is now fourteen years since the last significant report on Earth Science school fieldwork was published the Nature Conservancy Council (NCC) (Fisher and Harley 1988). Although reference was made to the first stirrings that ultimately led to the National Curriculum (NC)(e.g. Anon 1985), the report itself was largely directed towards assisting teachers engaged in the then newly introduced GCSE system of examinations. In the intervening period, teaching of Earth Science in schools has changed almost out of all recognition - in particular with the introduction of the National Curriculum. During the same period, the Earth Heritage Conservation Strategy (Anon 1991) was produced, the RIGS system was developed and NCC was placed in England by English Nature, and charged with a different remit, that largely exclude links with formal education, whilst retaining a key involvement in site management.

It could be argued that a thorough review is long overdue. Given the limited time brief of the present investigation, it is unrealistic to consider the output as much more than a scoping exercise.

First impressions of the opportunities for school visits to geological sites might suggest enormous potential – after all, 'Earth Science' has a defined slot in the science curriculum, mandatory for all 5-16 year olds. However, the 'market' has become so segmented and constrained, particularly by systems and 'culture' that in reality, the present uptake is very small.

Summary of the brief

In summary, the brief required:

1. An examination of the direct, generic and indirect elements of Earth science/geology in the school curriculum, and in particular, the National Curriculum.

2. A review of the usage of geological sites (and particularly SSSIs) by schools and factors influencing same.

3. Preliminary conclusions to be drawn

Summary of the studies undertaken

National Curriculum (NC) and Syllabi

Science and geography Programmes of Study in the National Curriculum were trawled and all statements relating to Earth Science tabulated for Key Stages 1-4 and 1-3 respectively (see Appendix 1 for definitions).

The Science Schemes of Works for Key Stages 1-3 were scanned (but the task of systematic annotation proved to be too extended for this exercise).

The unitary examination awarding bodies AQA, OCR, Edexcel and WJEC were asked for information concerning their coverage of Earth Science. Current 'specifications' (i.e. syllabi) for geology (and some other subjects) at GCSE/A/AS levels were collated.

Site usage

Short articles were submitted the UKRIGS Newsletter (as an insert) and Teaching Earth Science (Appendix 3), with the purpose of eliciting responses indicating the experience of teachers and geoconservationists with regard their use of sites of geological interest. Emails Twenty-three English Nature Area Teams were also contacted.

The National Association of Field Study Offices (NAFSO) on-line directory of field centres was consulted. A sample of the details of those establishments with explicit/implicit Earth Science connections was recorded, and a small random selection of these Centres was subjected to a brief telephone survey.

Details of selected geological/geomorphological SSSIs were checked on the 'MAGIC' website.

A brief search was made of other relevant information and literature sources e.g. UKRIGS Conference Proceedings, Teaching Earth Science and Earth Heritage.

It was intended that more detailed investigation of the following areas would be carried out as brief case studies:

1) Wren's Nest Dudley (Alec Connah)
2) Lathkilldale, Peak District (Carol Youngson/Ben La Bas/Martin Cruttenden)
3) Dorset/Devon Coast WHS (Richard Edmonds)
4) National Stone Centre, Derbyshire

All four areas were visited and in the first three, the officers named were interviewed, mostly in brief. However, in the case of Dorset, a detailed analysis is currently being undertaken of educational visits by a secondee from Dorset LEA (Sarah Welton started early January 2003). At the time of writing, interim conclusions were still being sought as a matter of urgency, and were still not available at the time of completion.

Part 1

Earth Science in schools –context and curricula

Before embarking upon the more detailed analysis, it is useful to define the broader context of structures used in schools in terms of the age groups and qualifications. Clearly, towards the end of school life, the system merges into other educational systems provided by colleges, universities and training establishments. Whereas the following sets out the most widely used system, in some areas, middle schools operate, and in many places, the later school years are serviced by sixth form or tertiary colleges, or similar. Formal education in the UK is compulsory between the ages of 5-16 years.

The age bands employed in maintained schools are set out in detail in Appendix 1, but may be summarised here as:

Key Stage 1 (KS1)	5-7 year olds	) Primary
Key Stage 2 (KS2)	7-11 year olds	) School *
Key Stage 3 (KS3)	11-14 year olds	) Secondary
Key Stage 4 (KS4)	14-16 year olds	) Schools*

(*'middle schools' operate in some areas).

Appendix 1 also relates 'schools' systems and qualifications to other national qualifications.

The National Curriculum (NC) was introduced into education in the United Kingdom with variants for the four constituent countries (England and Wales nevertheless being similar). The introduction was made sequentially, subject by subject from 1989. The NC introduced for the first time in the UK, a mandatory curriculum for all 5-16 year old pupils in all state maintained schools (in England c 93% of the school population), setting out content, priorities and thereby accounting for a very large proportion of the available teaching week. It is also widely used in the non-maintained sector (see separate note below).

During the latter half of KS4, pupil's course work largely follows courses dictated by examination syllabi (known as 'specifications') for GCSE (including vocational GCSEs) AS, A levels and GNVQs (see below).

Earth Science in the National Curriculum: Science and geography

Earth Science is taught to students in various forms throughout the 5-16 age range and beyond. The two main vehicles are:

a) the National Curriculum (in particular as a small part of the science curriculum, and to a lesser extent, the geography curriculum);

b) geology for GCSE, A or AS examinations (see later section).

Most Earth Science is taught as a small part of NC science. Science, as a core subject, has a ring fenced time allocation for teaching at all levels from 5 year olds to 16 year olds. In

England this is estimated at 8-12 million pupils. Some Earth Science (mainly geomorphology and geohazards/major Earth events) is now delivered through the medium of geography, which, although an NC subject, is not a core subject and so tends to be more vulnerable to other timetable pressures. Furthermore NC geography is only defined at KS1-3 (and not KS4).

As most (but by no means all) use of geological sites by schools will be as a vehicle for the delivery of Earth science, it is instructive at this stage to consider the evolution of the Earth science content in the National Curriculum (for England). At the outset, (and much celebrated by geology teachers), Earth Science constituted a readily identifiable module in the mainstream science NC, ranking alongside chemistry, physics, and biology, although occupying less timetable time than each of these three. For example in the first Science NC, Earth science comprised *c*12% of all the science statements (only marginally below the 14.5% originally recommended by working groups).

Almost as soon as all the curricula for all the main subjects had been published, a process of review and revision began. The early response from non-Earth science teachers (and particularly chemists) was generally antagonistic and, in this context, the first review (1991) not only reduced the specific Earth Science content to 8% but disseminated those topics retained through the three 'mainstream' science subjects, in particular 'materials and their properties' (chemistry) and to a lesser degree, 'physical processes' (physics) and 'life processes and living things' (biology). In the wake of the Dearing Report, the Earth science percentage was further reduced to 6% and most recently in the 2000 review, fell to 4.4% accompanied by some readjustment between chemistry and physics (King 2002). In parallel with these changes there has been some trading of content to and from geography – much of it without evident logic.

The last two curriculum reviews noted were in part to enable more time to be freed up to permit literacy and numeracy to be given greater prominence. At KS4, two options are offered, single and double award science respectively. The double award (equivalent to 2 GCSEs) has more students, more depth and covers a broader field than single award (which contains little Earth Science).

The proposals of a 'ginger group' (Miller and Osbourne 1998) advocating radical change of the curriculum by concentrating on selected 'big ideas', are now being seriously and widely assessed in official and professional circles, even if only as a means of delivering the existing National Curriculum Science in a more appealing and motivating way. The government's supervisory agency, the Qualifications and Curriculum Authority (QCA) has commissioned one of the three English examination bodies (OCR), to trial such an approach. Whereas this concept has considerable potential for enabling some of the particularly topical big Earth science ideas to be addressed, those involved in the current exercise do not appear to share this view, instead favouring issues such as genetic engineering, energy conservation and DNA.

In January 2003, the Education Minister announced changes for 14-16 year olds, which would include the option for students to follow a less rigorous 'applied science' curriculum if appropriate, while retaining the existing science format for KS4 alongside.

In the light of the poor standards of Earth Science teaching, textbook coverage and even material from examination agencies, since 2001 the Earth Science Teachers' Association

(ESTA) have collaborated closely with the Royal Society of Chemistry, Institute of Physics, Institute of Biology and others, to establish the Joint Earth Science Education Initiative (JESEI www.jesei.org). JESEI's first output has been to establish a web site in which all those agencies are intimately involved, and which sets out high quality Earth Science teaching material for chemistry, physics and biology trained teachers to deliver (JESEI 2003). At the moment this does not specifically refer to fieldwork, but some of the work could clearly have fieldwork implications. This collaboration has provided a template for other initiatives.

As already noted, a relatively small portion of National Curriculum geography covers Earth Science topics, including some statements transferred from science in the last review. However, as geography teaching staff tend to be far more amenable to conducting fieldwork, this element is significant (see also Part 2).

Tables 1-7 in Appendix 2 set out statements in the National Curriculum (for Science and geography) relating to Earth Science, whether this be specific, generic or indirect. In the case of the latter, only selected examples have been included.

By way of general commentary it should be noted that in the science curriculum statement Sc3 – 1d at KS2 and Sc 3-d, ei, ii, fi-iii at KS3 are especially significant. The Earth Science statements in KS4 Science are perhaps the most specific and extensive. KS3-4 science refers to fieldwork.

All three geography key stages – specifically require fieldwork and whereas all make general references to environmental issues (some specifically to the use of resources), the main Earth science falls in KS2 – 6c and KS3 – 6b.

Earth Science opportunities in other National Curriculum subjects

Mathematics

Mathematics an NC core subject. Although there are a number of instances in which geology can be used to demonstrate mathematical principles and applications (particularly in geometry and trigonometry, shape, measurement, data handling), the main linkage lies maths being used to facilitate geological work. In either direction the key word is 'application'. Particular emphasis (especially over the last two years with the introduction of numeracy periods) is placed on the contribution of mathematics to learning across the curriculum.
In summary, progression takes the following form:

> Appropriate connections should be made at:
>
> Key Stage 1 between number and shape, space and measures
>
> Key Stage 2 between number; shape space and measures; and data handling
>
> Key Stage 3-4 between number and algebra; shape space and measures; and data handling

'Communications' subjects

Information and Communications Technology (ICT) has a similar role to mathematics in facilitating geological work and geology in turn, offering a means of demonstrating applications of techniques. English performs a similar role and even art has interrelationships – in offering a means of graphically communicating geology (e.g. relation between structure and landscape), and geology in providing inspirational ideas. There may also be opportunities in Design/Technology whereby models of Earth Science phenomena could be produced as part of project work.

Citizenship

In September 2002 the National Curriculum in England was extended to include 'Citizenship'. The statutory programme of study as three strands:

1. Knowledge
   About how the world works : politically, judicially, economically and culturally
2. Enquiry and discussion
   Becoming informed
   Exchanging ideas
3. Participation
   Contributing and then reflecting on what they have learnt. The intention is for all three strands to be developed together, with citizenship skills being every bit as important as knowledge.

Citizenship is therefore seen as being delivered in close association with other subjects, notably science and geography in respect of environmental issues.

Clearly conservation matters could conceivably be covered by visits to geological sites but no examples are known to date and decisions are likely to be coloured by dominant culture of the teachers or department charged with delivery.

Personal, Social and Health Education (PSHE)

Prior to the introduction of citizenship *sensu stricto*, similar issues were delivered through the medium of PSHE, alongside personal hygiene, behavioural matters etc. Some teachers taught about environmental issues under this head.

Earth Science at GCSE, AS, A level and GNVQ

During the latter stages of KS3 and throughout KS4 pupils are increasingly directing their studies towards examination based courses, in the main GCSE and A level, and more recently at the intermediate AS level.

As noted previously, three unitary examinations awarding bodies (AQA,OCR, Edexcel) in England and one in Wales (WJEC), were given the authority to establish syllabi ("specifications") and related geology examinations, namely WJEC for GCSE; both WJEC and OCR offer geology at AS/A level. The WJEC specifications are widely used in England, as well as in Wales.

As far as AS/A level is concerned, the WJEC format tends to have a more experiential and applied base, whereas the OCR approach is perhaps more theoretical and traditional. This is perceived by many to result in the WJEC being more favourably disposed towards fieldwork and OCR towards laboratory based assessment, but the OCR subject specialist was keen to emphasise that whereas it is theoretically possible to follow the OCR course without recourse to any fieldwork, he and those actively involved (e.g. moderators), see fieldwork as integral to the understanding of the subject. Furthermore they would strongly encourage the use of a range of sites "from Arran to the Canaries" rather than resorting just to those "on the doorstep".

Numbers studying for both GCSE and AS/A level geology have declined in recent years falling from *c*4,000-4,500 about five years ago, to an entry level of *c*2600 in 2002. (cf. 2435 in 2001). The numbers of entrants are split almost equally between WJEC and OCR. The slight increase in 2002 is probably the result of the introduction of A/S examinations (in which more subjects are to be studied initially at an intermediate level, before deciding whether or not to proceed to A level). GCSE entrants in 2002 were 1004 (and WJEC also noted that within their total, AS entrants were 1,353 and A level entrants 938 in the same year). Teaching of A level geology is conducted at *c*400 centres, that in the main, are schools and sixth form colleges.

The specifications of the two agencies for the examinations were explored briefly. As both of these documents are lengthy (between 45 and 88 pages long) and cover all the main investigative areas that are to be expected of such courses, time constraints did not allow for their study. However, further work in this are might prove worthwhile.

In the late 1990s geography was claimed to be the most popular 'non-core' subject studied at GCSE. This subject was studied at the then 'O' level by *c*265,000 pupils annually and by *c*45,000 at the then 'A' level (Hawley 1998 a). These figures only represent examination years and need to be doubled to achieve the total level of involvement. They will have been modified by the introduction of AS examinations but do serve to give a general indication of scale. Whereas, some examination courses are heavily biased towards human geography, most offer human and physical geography and most contain a fieldwork obligation in some forms. But this is not necessarily Earth science-related.

A much smaller cohort study for GNVQ (General National Vocational Qualification) (including land and environment; leisure and tourism, science). However numbers in schools specifically, are still relatively modest (most of these courses being offered by colleges) and courses rarely have a significant Earth science fieldwork-based element.

Special note on non-State (non-maintained) schools

Non-state education in England accounts for 7-8% of the school population and is mainly delivered in private sector/independent schools, plus a very small element of home-based tuition. Although those involved in this sector are not required to apply the National Curriculum, most and in particular, those in the main independent groups such as Woodard, utilise this format as this ensures compliance with independent school inspection criteria, permits easier interchange between state and non-state sectors and forms the basis for most published course texts and publicly recognised examinations. Even where NC usage is not

universal, there is a tendency for such schools to employ the NC for the more 'technical' subjects, especially science.

Although relatively small numerically, favourable staff pupil ratios, sometimes better teaching resources, in many cases a more flexible approach to out of school activities (e.g. Duke of Edinburgh Awards, Outward Bound type activities, subject clubs) and also in some cases, the range of subjects taught (including 'minority' subjects such as geology), means that the independent sector tend to indulge to a greater degree in geological and other fieldwork. As the geographical spread of such schools is not uniform (e.g. accounting for up to a quarter of the school population in some south eastern counties) this may have disproportionate implications for the use of geological sites in particular areas of the country.

To some extent, some of the more traditional schools in the maintained (i.e. State) sector follow similar practice.

Part 2

Schools use of geological sites

This section contains general observations on the schools' use of geological sites, comments from users, an examination of factors influencing decisions on whether or not to visit and finally a summary of case studies and field centres.

General comments on the scale of fieldwork

Various studies have been conducted over the last twenty years, but as far as is known, none have addressed the situation since the NC changes in the late 1990s and the decline in GCSE and A level teaching together with the advent of AS in the same period.

Hawley (1998 a) for example comments that 'whereas 10 years ago an estimated half million pupil days per year, mostly by 14-19 year olds were spent in field visits' (quoting Robson et al 1989), "the present day figure is probably much greater than this, resulting from the requirements and recommendations of the Science and Geography National Curriculum programmes of study, together with increasing expectations of fieldwork entitlement at higher education level". Whereas it is extremely difficult to quantify the extent of fieldwork per se, he makes no distinction between school and higher educational users.

Hawley (1998 b) states that 'the benefits of learning through fieldwork are generally accepted: improving motivation, interest, knowledge, skills and understanding in pupils, and fieldwork can engender positive attitudes towards conservation and the environment'. Although Hawley does voice some caution in referring to the reservations of some teachers, he does not appear to reflect the apparent gravity of the current situation. This is perhaps better expressed in the concerns voiced and attitudes challenged at the NAFSO Conference in 1999 – 'many of those whose centres are under threat, are being attacked by people – county education officers among them – who argue that there is no evidence that fieldwork has any positive benefits upon children. They say money should be directed into mainstream provision because that's where the difference will be made to a child's achievement' (Nundy 1999). The author goes on to counter this view.

As an aside, whereas the number of higher education establishments offering geology degree courses doubled with the upgrading of polytechnics and colleges to universities, firstly the number of courses is now being aggressively slimmed down and the real fieldwork content is being replaced in part (wholly in some institutions) by 'virtual fieldwork' or much reduced field contact. Much of this has taken place on the grounds of cost, but foot and mouth disease, the limits on supervision ratios, as well as the pairing up of fieldworkers have also been influential. It is logical that this change in culture will spill over into the schools market, as new graduates are recruited as teachers. Such trends are already becoming very apparent in schools.

This next section therefore seeks to bring together qualitative information, which might assist in indicating the general scale of site usage; trends in site usage, and the possibility of gaining a better understanding of site usage in the future. A variety of lines of inquiry were followed (see Summary in Introduction), the results of which are detailed below.

Responses from teachers

An article was placed in Teaching Earth Science 27 (3) 2002 under the title '*Do you use geological sites? Have your say'*. (see Appendix 3). The level of specific responses was most disappointing, with only six formal replies. These were received from teachers, or in two cases, teacher trainers (all keen and well known in Earth Science teaching circles). However, publication did stimulate some informal discussion the outcome of which is also reported below.

Responses related to experience of sites with respect to both SSSI's and RIGS were elicited from West Yorkshire (2), South Yorkshire (1), Derbyshire (3), Staffordshire (1), Cheshire (2), Devon (general). All were in related secondary school work, mainly 'A' level geology, although in one case (which referred largely to other sources of information), primary visits were mentioned.

The generally anecdotal nature of the responses makes it difficult to draw clear conclusions, but in several discussions, reference was also made to the experience of colleges. No clear indications were available on frequency of use, although even those teachers actively engaged in school fieldwork, rarely visited more than two sites and only occasionally made more than two visits in a school year - in contrast to the higher levels of say ten years ago. Those involved in A/AS level particularly, tended to use one or two favoured sites intensively and in particular for specific project work, year after year. In most cases, teachers would produce their own work material, often derived by selective editing (deletion) of pre-existing published items/ mapping, to ensure that students are motivated to produce 'original' responses. One small problem encountered in this respect was that of obtaining suitable non-copyright teaching material for sites, especially large-scale map bases for sites devoid of built reference points. In such cases, where available, maps intended for orienteering may be more useful than OS maps.

Teachers selected sites on the basis of a combination of local knowledge, experience of/information from colleagues, site/area guides (e.g. trail guides, quarry visits, Geologists' Association and similar publications of classic areas, and more recently the small but growing number of RIGS guides).

Most sites visited were open to the general public (e.g. National Trust, Country Parks) but also included a quarry and two former mines. Geological subjects covered included coastal geomorphology (Devon), Permian patch reefs (South Yorks), Triassic aeolian/fluvial sandstones and evaporites (Cheshire/Staffs), mineralisation (Cheshire/Derbyshire), Carboniferous palaeontology / structures / sedimentation (W.Yorkshire).

An example of a worksheet prepared by Peter Kennett for briefing science teachers is given at Appendix 4.

Responses from RIGS Groups

Replies were received from Dorset, Staffordshire, Derbyshire, Hereford/Worcester, and indirectly, Devon. All responses were relatively short, and most in turn referred to more substantial sources and in particular, to web-based material.

The returns may be summarised as follows:

Devon - The RIGS group have produced *the Educational Register of Geological Sites* (Anon undated) containing detailed appraisals of 80 locations in the county. Suitability for school (primary or secondary)/ college / university use is delineated. Available in paper form for purchase and downloadable from the web (with some difficulty); this was perhaps the most comprehensive work encountered in the survey.

Dorset - Schools worksheets on Dorset RIGS website currently for two sites (Portesham and Poxwell Quarries), more are planned to cover the county. Concerns raised included lack of funding and difficulties in publicising material available. The correspondent hoped that the current study might raise awareness.

Avon - Have identified the sites most suitable for use by educational groups (but no information was given as to how these are being promoted, if at all). Reference was made to the *Staple Edge Geology Teachers Trail* (for NCC) "which was intended to divert geology teachers away from over used SSSIs". The respondent pointed to the significance of experience gained from fieldwork in contrast to that from books, videos, the internet or museum visits", regretted the diminishing number of school visits and finally welcomed any initiative (such as this) to encourage more visits.

Staffordshire - Referred to articles in the UKRIGS Conference proceedings, specifically in respect of Hulme Quarry SSSI/NNR at Park Hall County Park.

Derbyshire/Peak Park - Like many RIGS groups, the National Park commissioned an analysis of the potential educational use of RIGS sites, but regrettably, this has not been extended into other parts of Derbyshire, nor has it been publicised. The question of how much information could/should be placed in the public domain (i.e. Peak Park website) is currently being discussed, as is the possibility of extending the work to other parts of Derbyshire.

In addition the publication, the *Geology of Cornwall* (Selwood et al 1998), carries a summary list of all Geological SSSIs, GCR and RIGS sites in the county.

In this section again, little or no specific information was provided on levels or specific types of usage of sites. One of the few common themes from this sector related to the best means of promoting the greater use of sites.

It is probably also worth recording that most responses, in referring to 'geology' (as distinct from Earth Science) are probably directing their interest/or conditioning their perceived use of sites, to A/AS level rather than earlier years.

English Nature Area Teams

All Area/sub Area Teams (23) were circulated, where contact details were available. Replies were received from Northumbria, Derbyshire/Peak Park, Dorset, Gloucestershire, London, North Mercia, Avon, North and East Yorkshire, Yorkshire Dales. However, those from London (unsurprisingly) and Gloucestershire (perhaps surprisingly) could offer no specific information, although in the latter case, reference was made to Wilderness Field Centre.

North Mercia - Referred (very briefly) to Wren's Nest, Hulme Quarry at Stoke (already described in an ESTA/RIGS group response), The Long Mynd and Cross Hands Quarry (Warwickshire), in each case giving location and contact details only.

Peak District – Apart from information on Lathkilldale (see Case Studies below), Cresswell Crags SSSI was noted for its relative popularity with school groups. This was put down to the existing visitor centre, with a seasonally employed education officer, and the strong appeal of the subject matter (Palaeolithic habitation/fauna). In contrast, Duckmanton Railway Cutting SSSI was of a much more 'academic' interest, and managed as a nature reserve, attracted few visitors.

Northumbria - By far the fullest reply, this contained some useful referential information on six sites in this very large and geologically rich area. Clearly both knowledge of visits and where known, the level of detail on known visits is patchy but could serve as a useful indicator of the type of data held (albeit again rather anecdotal), which could be teased out, if a more penetrating survey was conducted. To illustrate this point, the main body of the response is included in Appendix 5.

In those instances where site wardens are normally/frequently present or where a permit access system operates, some data on visits is available (see also for example the case studies). As an example, at Ingleborough in the Yorkshire Dales, some 20-25 permits are issued annually, but no analysis of type of usage (e.g. schools / universities split), or the reason for the visit (e.g. for geological/ecological study.) is maintained. It would appear that an exercise to ascertain numbers in each category could be undertaken fairly easily, but as the total numbers formally recorded are usually small, the result would not be statistically significant.

In many cases, respondents only refer to their knowledge of one or two sites being used by schools for geological purposes e.g. 'as far as Warwickshire is concerned, there is only one site used by schools - Cross Hands (SSSI) 'or 'Flamborough Head is a site I know is used by schools for amongst other features its geological interest. I have no handle on the level of use etc.', however, in the latter case, the possibility of commissioning work into fossil collection and recreational use is being contemplated.

In many cases the references to specific sites are accompanied by a non-English Nature contact (e.g. RIGS or LEA) who may be able to supply further information on usage. The reply from Dorset, simply referred on to the WHS Team and Richard Edmonds for example. In the time available, it was not possible to follow through most of these leads.

In summary although the returns were positive and attempted to assist, with notable exceptions, they were ostensibly from non-Earth scientists and referred the reader to other sources, implying that the Area Teams generally maintained relatively few records in this respect or direct knowledge of this sector.

Factors affecting the level of fieldwork

Fieldwork can be defined as study outside the classroom, a definition endorsed by the National Curriculum. The factors influencing decisions as to whether to undertake fieldwork are numerous and result in a complex interplay, but they can be summarised as follows:

1. Curriculum requirements
2. Timetabling flexibility
3. Logistical criteria

These are now examined in turn.

Curriculum requirements

Firstly, most activities undertaken in schools are determined initially by specific or implied reference to statutory requirements. There is of course flexibility and scope for 'voluntary' activities based on more eclectic or altruistic reasoning, ideas about environment and aesthetics but the main drivers are pragmatic, i.e. the National Curriculum and examination course requirements. The basis for this is not simply a desire by school staff to restrict their involvement, it is to some extent framed by legislative, liability and financial considerations, actual or widely perceived. In purely practical terms, in order to justify an out of school visit to fellow staff, parents, governors, etc., (to overcome the hurdles exemplified in later sections), it is almost imperative to be able to reference NC or exam course 'deliverables'.

Curriculum factors include both overt and indirect influences. Firstly some subjects e.g. National Curriculum geography specifically requires fieldwork to be undertaken from Key Stage 1 onwards, but fieldwork, using the above definition, does not necessarily even mean leaving the school premises. Specific subjects such as GCSE and A/AS level geography, geology and environmental science and land-based industries GNVQ's usually also require an element of field study (but surprisingly even some undergraduate geology/earth science courses do not now include mandatory fieldwork). Even in some of those courses where fieldwork is carried out, more emphasis is placed upon ICT familiarity than the fieldwork needed to produce the data input for ICT use! Furthermore, in the case of geography, a very significant proportion of the subject matter covered by fieldwork relates to human (and particularly urban), rather than physical geography.

Despite the fact that 'fieldwork' is also specifically given in NC science as an example of a means of gathering data at KS3 and 4, in most science teaching (with the partial exception of biology), there is no culture of fieldwork in the science teaching community, particularly in secondary schools. There are obviously exceptions in individual schools, especially where the teaching staff concerned have some Earth Science grounding, but less than 5% have an Earth Science degree, for about 15% first degrees contained some Earth Science and a just under 20% studied some Earth Science in school (King 2001). The second category of exception comprises the non-maintained sector, where fieldwork tends to be practised more, and interdepartmental collaboration tends to be greater.

The general lack of a fieldwork culture in science is especially unfortunate as the bulk of Earth Science (albeit a small proportion) is delivered through the medium of science and science, as a core subject, unlike geography has a 'sacrosanct' position in the teaching

spectrum. This paucity of fieldwork involvement was reflected in the results of a survey conducted in 1998 of Earth Science in secondary schools in selected areas of England and Wales (and in particular the schools served by Keele, Manchester (Metropolitan), Bath, Reading and Swansea Universities). Of a total of 162 responses, over 80% of science teachers undertook no Earth science fieldwork, whereas those carrying out a day or more, accounted for only about 5% of the total (King 2001). Thus of those few engaged in fieldwork, most only appear to be devoting half a day or less annually to such activities. Furthermore, it could be argued that the most of these areas studied were perhaps better placed than many, to undertake fieldwork.

In summary, although far greater numbers of pupils are studying more Earth science in science than in geography, the number engaged in fieldwork is minute, notwithstanding the specific reference to fieldwork in parts of the secondary science curriculum.

Timetabling flexibility

At the outset, distinction is drawn between practices in primary and secondary schools; although there are many restraints in common, they tend to be particularly dominant if not overwhelming considerations, in secondary education.

In primary schools (KS1/2) (*c*23,000 sites), a single teacher delivers most of the teaching to a particular class, and although blocks of work/lessons, address particular curriculum areas, in general, these are multidisciplinary in approach. So that, although literacy and numeracy have discretely allocated time, the teaching of a geographical topic for example, may mesh with number work, science, English and ICT. Primary schools do have lead subject teachers/specialists (particularly for science), but their role is mainly one of supporting colleagues and disseminating/updating information, techniques, etc. This general system means that there is much more flexibility for (a) individual classes undertaking out of classroom work for more than a single period and (b) for collaborative outdoor work between classes and often for the whole or large parts of a school/school year. Against this there is of course the shorter Primary school day and other logistical/risk, and teacher cover factors (see below). It is also probable that, particularly for rural primary schools, there is a broadly based appreciation of the value of the outdoor or at least out of school experience, and the immediate neighbourhood is itself more evident.

By contrast secondary schools (*c*5000 sites) draw pupils from much larger catchment areas and do not tend to have the same affiliation with their immediate environment. Almost all teaching is subject lesson based and seldom multidisciplinary, with precious little direct liaison, let alone collaboration, between science and humanities departments, despite government efforts in the mid 1990s to engender this (through environmental or economic understanding and other inter subject initiatives). However, the gradual increase in interest in environmental matters (the rate of increase appears to have slowed a little recently) supports a contrary and positive trend, which should be harnessed.

Nevertheless, in most secondary schools subject lessons occupy a quarter or even half a school (split by breaks) and this offers some scope for very local visits.

The introduction of specific literacy hours, then followed by numeracy hours, in recent years, occupying significant portions of school days, created considerable pressures on timetabling; one of the easiest solutions adopted was to eliminate any 'non-essential' or time consuming

elements, such as fieldwork! The situation has relaxed a little now that these requirements have bedded into primary work.

The severe shortage of science teachers in many areas has also pressurised staff to cut corners and is hardly conducive to promoting fieldwork.

A more indirect consequence resulting from 'timetabling' and other pressures is the likelihood that union action will be more likely to be directed towards the withdrawal of participation in out of school activities, in or out of school time.

Logistical considerations

Finance is a significant element and takes many forms. Firstly, requirements for additional staff cover (at say £70–120 per day), is usually needed to secure appropriate ratios for out of school activities or to supervise pupils remaining at school if they are unable to participate.

Where fieldwork is justified as part of course work (which it usually has to be), schools cannot necessarily require parental contributions and pupils cannot be excluded if no payment is forthcoming.

Although the entry to many sites may be free or low cost, transport charges are a growing factor in decision-making. Significant rises in coach costs arise from high fuel costs, increases in insurance (following a number of celebrated court cases), in some instances causing coach companies to withdraw from this sector altogether, upgrading of safety measures on coaches, cost of vetting drivers (Criminal Records Bureau - CRB). These requirements also have a logistical effect in that companies, even more than in the past, tend to allocate vehicles and related drivers specifically for school use, and they usually have to be available for morning and afternoon school to home contract journeys; as a consequence, restricting the out of area journey time and in particular, opportunities for long distance residential fieldwork. The availability of coaches has become increasingly difficult therefore from the late 1990s onwards.

Insurance costs for schools and the limitations on acceptable risk have become more acute, particularly in the last two years. In this period (and especially from 2002), many if not most schools require staff to carry out risk assessments (particularly following the canoeing tragedy and the Yorkshire Dales river walking tragedy) and LEAs are increasingly advising teachers/governors to tighten up procedures. For example, very recent advice from Derbyshire County Council specifically cautions those visiting areas with water, moving machinery and quarries as particular danger areas.

The same stance is likely to be taken by the teacher's unions, culminating in a 'when in doubt, don't go out' policy to safeguard members.

Schools require prior and specific written parental consent before students can participate in out of school activities. Lead times therefore inhibit response to topical events, as this usually necessitates a long pre-planning phase.

Again in terms of supervision, traditionally, parents and helpers have accompanied school trips to maintain supervision ratios. However, liability/responsibility, insurance cover and the

introduction of universal CRB vetting procedures (with long waiting lists), have all played a part in inhibiting activities.

The impact of foot and mouth disease was not only felt during the period of the epidemic, but has caused teachers to reconsider long traditional patterns of fieldwork, either abandoning the practice, or making changes to it.

Case studies

The case studies were carefully selected in order to reflect as far as possible a representative cross section of the following.

a. geographical spread e.g. South, Midlands, and North.

b. Aspect/situation e.g. terrain – coastal, mountainous, 'middle' England, urban/urban fringe.

c. Potential 'market segments'/technical interest, e.g. of appeal to different age groups/Key Stages.

d. A mix of subject groups.

e. A mix of classic geological and 'low profile' sites.

The next section examines the following case studies:

a. Wren's Nest, Dudley, West Midlands.

b. Lathkilldale Peak District

c. National Stone Centre, Derbyshire

d. East Mendip Study Centre

The East Mendip Study Centre was added to the list at a late stage. Suitable information on the Dorset Coast was unavailable at the time of writing (see Introduction) but a short note is included here.

Possible sites in Cumbria/Northumberland Border (N. Pennines) were proposed for inclusion, but the weather (heavy rain and flooding in late October) precluded this. However, a subsequent helpful response from the EN Area Team does throw some light on adjacent area (see Appendix 5)

Wren's Nest, Dudley, West Midlands

Context - Compact site surrounded by extensive urban area. A faulted pericline extensively quarried during the industrial revolution – exposes highly fossiliferous Wenlock Limestone.

Created an NNR in 1956/7 – (Britain's first)

Facilities - Senior Warden: Alec Connor is based in a building adjacent to the site and is on the staff of Dudley Metropolitan Borough Council (DMBC) – works closely with Graham Wharton of Dudley Museum and Art Galleries.

Visitors - Widely used informally by locals (dog walking etc) but not to the extent which might be anticipated in such an urbanised area.

Population in Dudley and adjacent Metropolitan Boroughs : estimated (by NSC) at 2 million. DMBC estimate that 12,000 people live within 'walking distance' (not defined). An estimated 10,000 people 'use' the reserve site annually.

Up until c1994/95, recorded numbers participating in visits as a group were typically 3,000 - 3,500 annually. Numbers have since declined to typically 700-800. By far the greatest proportion comprises primary schools.

Length of average stay 2-2.5 hours – guided walk covers geology, industrial archaeology, natural history, ending with fossil hunting (in designated areas). Other reasons for visiting include caves, habitats and soil chemistry.
(12 visits by a single college at Brierly Hill)

Perceived reason for decline in visits:

1. reduction of Earth Science in National Curriculum;
2. cost of school visits (pressures on school budgets if figures are not directly based on evident NC requirements);
3. adverse publicity about the site - 'Wild West' image.

Measures taken to combat the decline:

i. poster competition 'Wren's Nest – a special place' involving local schools (£500 prize) – large numbers circulated - only one school took up the challenge;

ii. schools KS2 pack on site (see below).

In the most recent figures (April 2001 to March 2002) the numbers of individuals engaged in visiting as a group are heavily concentrated in July (280), Sept (100) and November (166). This unusual pattern in part reflects heavy block bookings by particular schools.

Analysis of reasons for visiting indicates that fossils/minerals and to a lesser extent industrial history were particularly important features. Surprisingly, the number expressing interest in ecology was fairly small, however, many groups apparently tend to justify their visits in relation to environmental education, adopting a cross curricular approach.

Information available
Interpretive material on site is minimal, the reason stated being the susceptibility of the site to severe vandalism. However the level of printed material is significant and includes:

1. Geological handbook and field guide for Wren's Nest NNR 16pp (NCC 1978 £1.90) – covers geology palaeontology, economic history - of appeal to specialists/interested amateur and A/AS level, but presentation is relatively 'dated'.
2. Relevant leaflets (DMBC undated but apparently recent):
    a. The Geology of the Wren's Nest NNR
    b. The Wildlife of Wren's Nest NNR
    c. Exploring the past : introduction to the rocks and fossils of the Dudley area
    d. The Countryside in Dudley - what's on 2002/2
    e. Wren's Nest NNR fossil collecting code

3. Wren's Nest NNR KS2 Pack (DMB c2000 £10):

   a. Teachers Guide (booklet 1)
   b. KS2 Activity Pack (booklet 2)
   c. Work sheets (available for photocopying) (booklet 3)

   This publication was prepared in conjunction with the EN, and Reserve/Museum staff, by Steve Lockwood ((then) geography curriculum advisor. DMBC-LEA). The main approach is multi-disciplinary, covering history (particularly industrial). Presentation is simple, but substantial for a single site.

4. Wren's Nest NNR through time from past to present (DMBC – Alec Connah undated) – a small teachers' guide to interpretive facilities (geology and industrial history)

Other Matters - Fossil collecting policy – collecting of loose small (50p sized or under) is allowed in moderation (3 best examples).

Safety – DMBC advised that if protective fences were to be erected around the exposure, they would need to be 2.4m high.

A major concern expressed is the difficulty in promoting the NNR for geological visits.

Conclusions - The site is extremely unusual in being urban-based and as such, suffers from particular problems. Without the direct support of DMBC, it would be difficult to envisage how this site would 'survive', however, this linkage does also appear to bring with it, some limiting factors. The Reserves leaflets are reasonably attractive (but could usefully include a geological cross section). Access restriction, finance and site sensitivity inhibit major development; although a large project has been mooted on several occasions, this is very much a site loved and cherished nationally but 'unknown in its own locality'. A more modest but 'organised' sequential approach to promotion might be more appropriate – incrementally going out in person to local schools and spelling out how the site might be used to their particular educational advantage.

Lathkilldale, nr Bakewell Derbyshire/Peak District

Context - Six kilometres of classic limestone dale scenery covering an area of 272 Ha, and accommodating an intermittent stream. Patch reefs; highly fossiliferous limestone outcrops; caves; former 'marble' quarry (Ricklow) and lead mines.

Designated an SSSI in 1987, most of the site is an NNR.

Facilities - On site none. *En route*: small car parks/pull in areas at some access points above the Dale; formal car parks and toilets at Over Haddon and near Monyash. Administered from nearby EN Area Team office at Over Haddon.

Promotion – No advertising but local Tourist Information Centre and Youth Hostel Association hostels are informed; 300 local schools receive a mail out each year; significant percentage of repeat visits.

Visitors - Specific events are held geared to KS2 – two main options (a) geology (b) woodland. The inclusion of 'river' in the general title is a particular draw to KS2 and the

'geology' days are the most popular. A charge of £55 is made for groups of up to 25 children. The tour lasts 4 hours and covers c4Km of the upper part of the Dale from Monyash to Haddon Grange. The main topics relate to the geography (especially rivers disappearing underground only to re-emerge) and to some extent, the science curricula.

The site was closed during the foot and mouth epidemic, since then numbers have remained relatively low.

The other main category of visitors is undergraduate students, following environmental ecology and geology courses.

Visitors studying geology were as follows:

Year ends	Primary (guided)	Secondary (unguided)*	Tertiary (guided)
March 2000	663	70	48
March 2001	551	50	n.a.
March 2002	467	174	n.a.

*where known

	Primary (guided)	Secondary (unguided)
Staying locally	120	129
Day visits	347	45
Total	467	174

In addition, in 2000 a further 55 primary pupils were unguided by EN. As the site access is normally unrestricted, these figures must represent minima.

Other users - Guided walks (including some with a geology focus) are provided for the public. The site is used extensively on account of its botanical interest – for which it is also an SSSI/NNR. There are also some industrial archaeological features (associated with 'marble' quarrying and lead mining), which have been described in some detail, (surface and above ground) and some speleological interest.

Information - There is no interpretive material on site, but the nearby EA Area office houses an interpretive panel and outlet for literature which currently comprises '*Lathkilldale NNR-Geology* (EN (30p reprinted 1996). EN recognises that this booklet is somewhat dated and a new geological field leaflet is nearing the final stages of production. (the present leaflet contains a number of references to concepts that have been overtaken by research over the last 30 years e.g. the Precambrian is now known not to lie directly below the Carboniferous Limestone, the palaeogeography of the area during limestone deposition was more a shallow water promontory than a 'coral atoll' Other statements are simply misleading, e.g. Brachiopods are described as 'oyster like shellfish', etc.).

Management - The midpoint of the Dale is almost overlooked by the current EN Area Office at Over Haddon, which houses a small information point and outlet for booklets. This office is to be relocated shortly (2003) after which it is planned to create a new information point/base for wardening the Dale.

National Stone Centre, Wirksworth, Derbyshire

Context - The SSSI covers half of a 20 Ha site. The limestones on site contain a rich assemblage of fossils. The site consisted of six quarries and is regarded as being of national importance in respect of 'very distinctive fossil reef environments deposited in Dinantian times. The site demonstrates sediments laid down in the reef itself, in front of the reef, behind the reef and between individual reefs' – these are the words used in the notification (1985). Most of these terms have been superseded in more recent geological research, notably the "reefs", not being structural frameworks, are now classed as mud mounds.

The site was acquired from Tarmac by the County Council on behalf of the NSC in the 1980's and sensitively transformed using a 100% Derelict Land Reclamation Grant in the late 1980's. The NSC opened to the public in 1990 (although there had been physical open access for many years previously).

Facilities - In addition to the Discovery Centre, having the Story of Stone exhibition, almost about a quarter of the site now has established trails with interpretative panels which focus upon geology and to a better extent landscape and history. These trails are now being upgraded (by creating full disabled access, new panels etc.) with the aid of LHI and Aggregates Levy Grants etc. The site also accommodates the Millennium Wall, exhibiting nineteen different types of drystone wall.

A temporary office building contains a meeting room usable for indoor class work and a reference library. The NSC's geological collection is currently being organised for use by researchers and school groups. Groups are also guided to a nearby operational quarry and a range of educational activities is offered. Major developments are under consideration in partnership with the Derbyshire Wildlife Trust and White Peak Observatory.

Visitors – Currently 100 – 150 school groups receive guided site visits each year. In the mid 1990's the level was 200-300 (estimated to be 3000-4500/ 6000-9000 students respectively), 70% of guided groups visit between April and July; a further 14% in October. However, in the mid 1990's the NSC introduced an alternative in a visit to Dene Quarry, and the numbers of groups visiting there have ranged between 70-100 p.a. Visits to the Story of Stone exhibition currently run at 8,000 p.a., having reached *c*16,000 individuals soon after opening. Here again the fall in the past has been partially offset by the addition of a range of geologically related school activities. Special event days (*c*12 p.a.) attended by up to 200 children (*c*2,400 p.a.).

In addition probably 60,000 people visit the shop and at least double this number enter the site annually (free of charge). The High Peak Trail bisects the site and carries at least double this amount again. Major cities are within easy reach; more than half the population of England and Wales live within 80 miles (1.5-2 hours travel).

Information - The indoor Story of Stone exhibition does not relate specifically to the site but rather to stone in the UK in general. The interpretative panels on site were emplaced when the site opened in 1990. After extensive vandalism, the frames were replaced and panels re-erected in 2002; however they are decidedly dated. A one-page trail guide (photocopied) is available in the shop (10p) for general visitors. The general policy has been to limit the amount of literature available to visitors, in order not to diminish the income from guided

groups. As a result even the material available is of poor quality. This policy is being reviewed.

Management - The National Stone Centre (NSC) is a company limited by guarantee having charitable status. Members are drawn from local/national government agencies (inc EN), industry and education.

Hanson East Mendip Study Centre, Whatley, Frome, Somerset

Context

The Centre is located alongside a branch railway to Whatley Limestone Quarry, one of the largest operations in Europe (Hanson's largest unit). The Centre is staffed by former teachers/ecologists, one of whom specialises in geology. Within a short distance and within the Hanson estate, lies the former Vallis Vale Quarries, designated a SSSI (24 Ha), on the basis of the Inferior Oolite/Carboniferous Limestone unconformity.

Facilities - A temporary office type unit houses a classroom, offices, kitchen and stores and a small display of the use of aggregates in the community. Equipment includes mainly items for ecological work and reference material. Groups undertake supervised visits to Whatley Quarry, the plant and rail depot, to nearby water-based features and to Vallis Vale. Visits are free and a maximum of one school per day is catered for.

Visitors - In 2002 the Centre attracted 3522 school students, 65% of whom studied Earth Science; two thirds were primary (mainly KS2); one third secondary. The main areas of activity apart from the visits already noted, included rock testing and the environmental and/or geological aspects of quarrying.

Information – the Centre itself has a small reference library of teaching material, posters and journals. The Centre is promoted mainly by means of an A4 coloured leaflet. The main support for learning at the Centre and at other quarries in the Hanson Group is their large corporate loose-leaf folder "*Material World*". This is geared to KS2 and contains a mix of company generic material relating to quarries, quarry products, material uses and environmental measures. The plan is to enable quarry managers in the group to develop links with local schools using this as a vehicle and within three years, to reach 20,000 pupils. In the first year (2002), contacts were made with 5,500 pupils nation-wide.

It was also pointed out that in addition to the formal links established with schools, quarry open days drew in the public, including school children – recent examples included Whatley; 5,000-10,000 visitors and Chipping Sodbury: 3,000 visitors over 1-2 days.

Management - The centre is run by the quarrying section of Hanson plc. Two other centres based on gravel workings at Great Linford (Bucks) and Austerfield (Doncaster), established by Hanson have been handed over to local trusts /authorities.

Dorset and East Devon World Heritage Site (WHS)

Information on the use of the Dorset Coast World Heritage Site by schools is currently still in the process of being collated by a separate researcher and it was agreed that it would be counter-productive to explore this unilaterally at this particular stage, thereby duplicating work and potentially frustrating the more detailed study.

However, the opportunity was taken to interview Michael Edmonds, Dorset Coast officer instrumental in promoting the WHS concept and particularly from the Geological / Geomorphological standpoint. He confirmed that, whereas the potential was almost unbelievable in scale, in reality, even local schools, only utilised the opportunities to a very modest degree. This was being addressed although many of the structural and cultural qualifications voiced by schools were reiterated. He considered that there was particular promise in pursuing the environmental education route and in particular, agreed that a more holistic approach embracing geology coastal scenery, historical extractive industries and vernacular buildings could be of great appeal to school and general visitors alike.

Context - *c*150km of the coast of Dorset and E. Devon (WHA 2,550 Ha), possessing a nearly continuous sequence of rocks for the whole of the Mesozoic Era (spanning 190m years) and containing internationally significant fossil localities. The WHS includes 67 GCR sites including extensive (almost continuous) coastal SSSIs.

Visitors - Total numbers visiting the coastal areas (and hinterland) e.g. Dorset and East Devon in late 1990s were estimated to be 14 million annually.

One of the most popular Centres (but not a NAFSO member so not included in the above) related to geology, is the Charmouth Heritage Coast Centre, in West Dorset. This opened in 1985 and in 2002 attracted *c*62,000 visitors including 4,800 school children.

Field centres

In the light of the rather disappointing (but not wholly unexpected) response from teachers, RIGS groups and EN Area Teams, other approaches were considered to gain an insight into the level of usage. It was decided to examine the web-based descriptions of organisations affiliated to the National Association of Field Study Officers. Of the c170 members, c150 are English based field centres. Of these, the web pages relating to 70-80 of these were visited. The intention was to identify those centres that either promoted geology/earth science as general interest or offered related courses. The exercise proved far less clear cut. For example, of the order of 30 centres acknowledged (even implicitly) geological/geomorphological features of significance in their neighbourhood. However, these ranged from significant named geological features e.g. Whin Sill intrusion, a more commonly general statements which were almost certainly directed to attracting ecological study – e.g. 'chalk grassland' 'rocky shore', 'estuarine environments', 'gritstone moorland'. Very few indeed (less than 10) made explicit reference to geology as a draw to potential users or specific geological courses. Even those referring to the Jurassic Coast, or the Sandstone Way (Cheshire) did not develop these themes further.

As a cautionary note, it should be recorded that each centre, whatever the size, is only allocated a single web page on the NAFSO Directory; further examination of the web site of selected centres may be worthwhile. No quantification is given of the number of members attending the courses, but the numbers of staff and bed spaces available may be used to gauge the overall scale of usage.

Particularly remarkable was the lack of any reference to geology/Earth science opportunities at centres in some key geological areas, e.g. Malham. However, on the positive side, it is clear that as virtually all the centres offer some form of environmental education.

As might be expected geological interest was concentrated at centres in the north and west.

There is a real opportunity here for 'one-to-one' promotion by EN of geological sites in reasonable proximity to field centres. Despite the conventional claims of those involved in Environmental Education to be 'all embracing', in reality the very basis of ecology – i.e. geology is often overlooked (in order to promote Earth science) but could provide a means of developing further the subject (i.e. environmental education) and ensuring it remains 'fresh'. There are clear parallels with 'JESEI' a scheme aimed at promoting higher standards of Earth science teaching by 'main stream' science teachers.

Part 3

Interim conclusions and recommendations

The conclusions and recommendations below must be regarded as interim in nature.

1. The word 'geology' is normally associated in schools very specifically with those GCSE, A/AS examinations/syllabi related to that particular subject title.

2. Almost universally in schools, the term 'Earth Science' is used to describe those elements of geology falling within other subject curricula.

3. Contrary to widely held views, the National Curriculum (England) still contains elements of Earth science.

4. However, in the main repository for Earth science in the National Curriculum, i.e. the broader science curriculum in England, the Earth science content (as measured by 'Statements') has diminished to about a third of the scale of a decade ago.

5. There is also a small element of Earth science (particularly geomorphology and perhaps surprisingly, tectonic processes) taught as part of National Curriculum geography.

6. The balance between, and content range of Earth science in science and geography curricula respectively has changed and the assignment to the two subjects is not particularly logical.

7. Science is currently a core subject and is mandatory for 5-16 year olds (although some changes are expected for 14-16 year olds), but geography although required to be taught to 5-14year olds, does not have the same degree of 'timetable protection' as science.

8. There is no established culture of fieldwork/out of school visits in general in secondary school science departments, particularly at secondary level.

9. Exceptions to the above tend to be found in the non maintained school sector (in England only 7-8%), home tutoring and in some of the more traditional grammar schools in which cases, visits are sometimes made jointly with geography - their continuance generally relies upon the commitment of older staff or upon cross links to other outdoor 'adventure' activities.

10. The policy in primary schools towards out of school visits has generally been more positive than in secondary schools, for a number of reasons. Hitherto it has been easier to 'manage' timetabling flexibility on account of the more subject - integrated (holistic) approach to teaching, whilst the curriculum requires 'multidisciplinary' teaching staff at this level, and a closer relationship to the neighbourhood of the school may exist at this level.

11. However, this more relaxed situation concerning fieldwork in primary schools, particularly evident over the last eight or so years, has shown signs of changing adversely, especially over the last 18 months, and for reasons which are a mix of structural and topical issues.

12. The main reasons for the latter are quoted as:

    a. foot and mouth restrictions caused a rethink of traditional patterns, unquestioned over many previous years;

    b. growing awareness of risk (health and safety) and potential for litigation;

    c. increased insurance premiums (in the light of the above and post '9/11');

    d. timetable pressures, (e.g. following the sequential introduction of mandatory literacy and numeracy periods introduction of 'citizenship' etc.);

    e. increased journey costs and limitations on coach/bus use;

    f. local/perceived changes in rules about parental financial school contributions to cover field visit costs;

    g. need for increased staffing/parental cover (all of whom have to be vetted).

Assessing the scale

13. There is no central, readily accessible database of school visit numbers or profiles. Such information where gathered is very rarely in the public domain and almost always specific to particular sites (all of which vary) and even then, is partial in nature.

14. Concerning alternative systematic sources, some data has been collected in the past by or on behalf of the Countryside Agency/Commission and ETC or various regional tourist boards. This has not been examined in this study but, based on previous experience, tends to be generally out of date and to be sociological in nature and partial. Some data, produced particularly for marketing purposes, is expensive to acquire.

15. In few instances do school visits (particularly for fieldwork) feature significantly, if at all, in tourism surveys (despite the fact that they often contribute overnight stops rather than day visitors); their spend is seen by marketing professionals as *de minimus* and is therefore disregarded, even by some organisations claiming to promote sustainable tourism.

16. Some localised/semi-regional studies are in hand which may assist (notably the Dorset/Devon Coast research).

Redressing the balance

17. As 'environmental education' has gained broad and increasing acceptance (in stark contrast to geo-education), the establishment of closer linkages between the two (i.e. a more holistic approach) could be of considerable benefit to Earth Science.

18. Given the generally discouraging circumstances described above, there is some merit in building linkages with other agencies, if only in creating a better awareness of the potential of geological sites. Examples might include for example, initiatives with NAFSO member organisations – by offering an additional dimension to mainly ecologically-based courses or with QPA/BAA highlighting geological features at quarries or nearby geoconservation sites visited by local schools.

19. As a direct parallel it is worth considering the partnership model developed into JESEI (Joint Earth Science Education Initiative) which has most successfully engaged organisations hitherto perceived as being antagonistic to Earth science teaching in school, not only to raise standards, but to raise the profile of the subject.

20. If not already in place, dialogue could be developed with the Countryside Agency on their stance concerning fieldwork as a means of promoting greater, responsible and sustainable use of the countryside by the public. Within this the potential for encouraging more urban based communities (particularly ethnic minorities) to get to know 'their' countryside might be worth considering via school visits. After all most rural dwellers have 'been to town' – the reverse is not as true for town dwellers.

21. In the longer term, it will be a matter of lobbying to change the culture in education by influencing the key curriculum decision makers.

22. This preliminary investigation suggested that some other avenues could be explored more fully, for example a better assessment of use in some areas, gauging the extent of geological work by field centres, examining the education content of available support information and how it might be improved.

23. Lists of SSSI's, their individual site locations and citations are readily available, and most helpfully to via the MAGIC website. However the 1300 geological/geomorphological SSSI's , about a third of the total, are not separately identified. Not only should separate listing be regarded as a priority, the list could have much greater appeal to potential users if the site were further subdivided by type of geological interest.

24. Having digested the report, a brainstorming session might be worthy of consideration; to tease out more clearly the degree of flexibility, options/scope and best means of tackling the present situation.

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Appendix 1. National qualifications and educational stages

Appendix 1a. Relationship between age, year group, key stage and school

Age* (Years old)	Description Used in Schools (Year Group)	Abbreviation	Key Stage (KS)	School	
5 or under	Reception	R	1	Infants	)
6-7	Years 1 & 2	Y1-2	1	Infants	)Primary
8-11	Years 3-6	Y3-6	2	Junior	)**
12-14	Years 7-9	Y7-9	3		)
15-16	Years 10 & 11	Y10-11	4		)Secondary
17-18	Years 12 & 13	Y12-13	****		)***

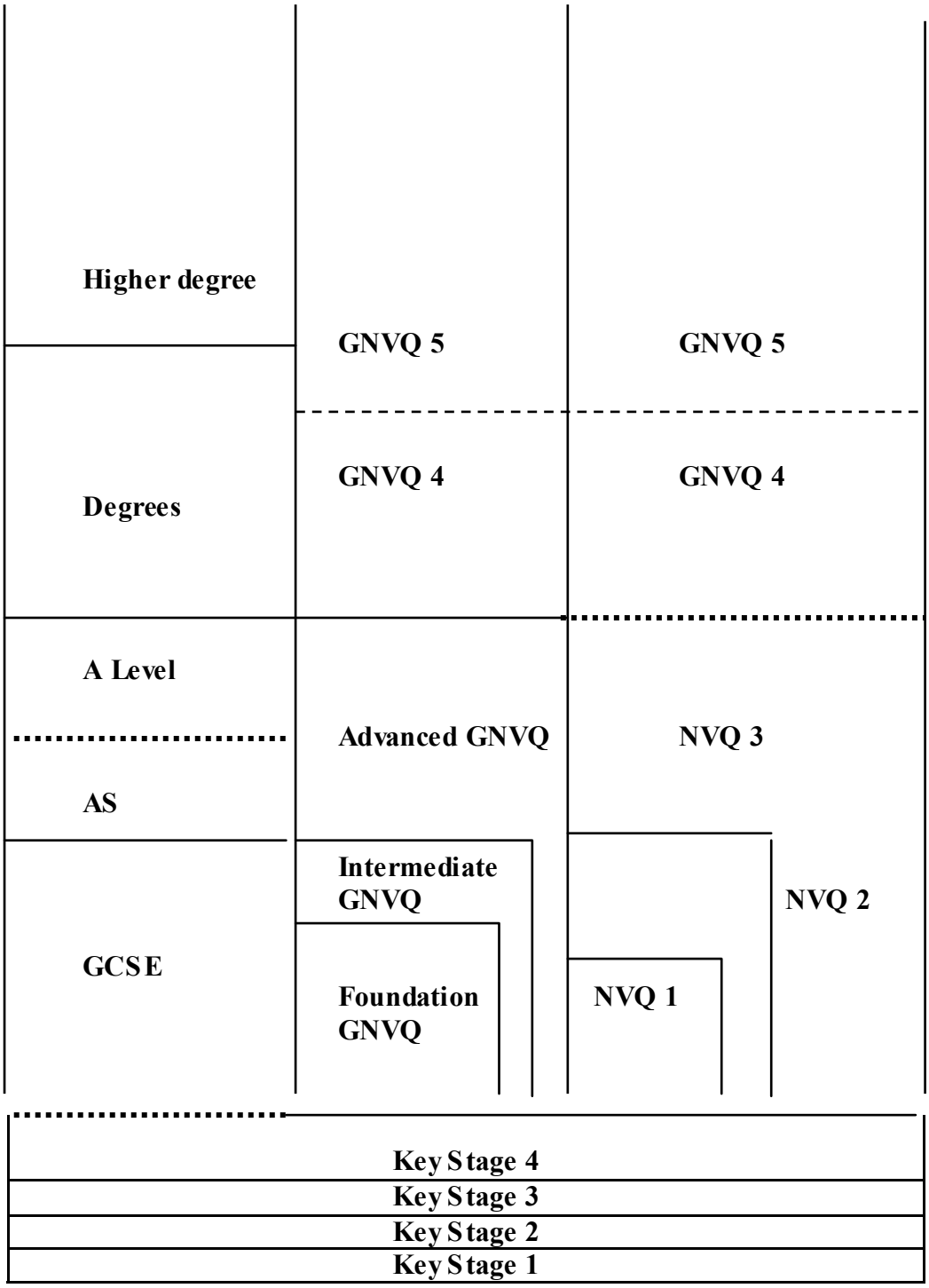
* Age of majority of pupils at year end of school.

** In some areas, Middle Schools operate, generally covering parts of KS2 and 3,

*** In many areas separate 6th Form or Tertiary Colleges operate, catering for post-GCSE level students (usually 17-19 year olds).

**** GCSE exams are usually taken at 16 years; GCE 'A' level exams at 18 years, GNVQ's at various levels are also taken from this stage onwards.

Appendix 1b. National qualification framework



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Appendix 1c The National Curriculum (England and Wales)

CORE SUBJECTS

ENGLISH
SCIENCE
MATHEMATICS
ICT

EVERYONE 5-16 YEARS

OTHER NC SUBJECTS

(OPTIONAL AT LATER STAGES)

HISTORY
GEOGRAPHY
ART
DESIGN/TECHNOLOGY
MUSIC
PHYSICAL EDUATION
CITIZENSHIP

Appendix 2. National Curriculum Statements re Earth Science

Table 1. KS1 Science

National Curriculum for Science (England) (KS1) statements relating to Earth Science			
Reference	**Page**	**Significance**	**Pupils should be taught:**
Sc1 1	16	I	… to collect evidence by making observations and measurements …
Sc1 2a	16	I	Ask questions … and decide how they might find answers to them
Sc1 2b	16	I	Use first hand experience and simple information sources …
Sc2 1a	17	G	The difference between things that are living and things that have never been alive
Sc2 5b	17	I	Identify similarities and differences between local environment and … in which these affect animals and plants that are found there
Sc2 5c	17	I	Care for the environment
Sc3 1a	18	G	Use their senses to explore and recognise the similarities and differences between materials
Sc3 1b	18	G	Sort objects into groups on the basis of simple material properties
Sc3 1c	18	G	Recognise and name common types of material [for example …]and recognise that some of them are found naturally
Sc3 1d	18	G	Find out about the uses of a variety of materials … and how these are chosen for specific uses on the basis of their simple properties
Sc3 2b	18	G/S	Explore and describe the way some everyday materials [for example … clay] change when they are heated or cooled
Sc4 1	20	I	… pupils should be taught the … through:
Sc4 1a	20	I	A range of domestic and environmental contexts that are familiar and of interest to them

Notes: 1. Where statements have been subdivided, this is indicated by i, ii, iii, etc.
2. items in square brackets are non statutory

Significance S = Specific
G = Generic
I = indirect

Table 2. KS2 Science

National Curriculum for Science (England) (KS2) statements relating to Earth Science			
Reference	**Page**	**Significance**	**Pupils should be taught:**
Sc1 1a	21	I	That science is about thinking creatively to try to explain how living and non-living things work, and to establish links between causes and effects …
Sc2 1a	23	G	That the life processes common to humans and other animals include nutrition, movement, growth and reproduction
Sc2 4b	24	G	How locally occurring animals and plants can be identified and assigned to groups
Sc2 4c	24	G	That the variety of plants and animals makes it important to identify them and assign them to groups
Sc2 5a	24	I	About ways in which living things and the environment need protection
Sc2 5b	24	G	About the different plants and animals found in different habitats
Sc2 5c	24	G	How animals and plants in two different habitats are suited to their environment
Sc2 5d	24	G	To use food chains to show feeding relationships in a habitat
Sc3 1a	25	G	To compare everyday materials and objects on the basis of their material properties, including harness, strength, flexibility and magnetic behaviour, and to relate these properties to everyday uses of the materials
Sc3 1d	25	S	To describe and group rocks and soils on the basis of their characteristics, including appearance, texture and permeability
Sc3 2a	25	I	To describe changes that occur when materials are mixed […]
Sc3 2b	25	G/S	To describe changes that occur when materials [for example … clay …] are heated or cooled
Sc3 2d	25	G	About reversible changes, including dissolving, melting, … freezing and evaporating
Sc3 2f	25	G	That non-reversible changes [for example … plaster of Paris with water] results in the formation of new materials that may be useful
Sc3 2g	25	G	That burning materials [for example … natural gas] results in the formation of new materials and that this change is not usually reversible
Sc3 3a	25	G/S	How to separate solid particles of different sizes by sieving [for example, those in soil]
Sc3 3b	25	G/S	That some solids [for example salt, …] dissolve in water to give solutions but some [for example, sand, chalk] do not
Sc3 3c	25	I	How to separate insoluble solids from liquids by filtering
Sc3 3d	25	I	How to recover dissolved solids by evaporating the liquid from the solution
Sc3 3e	25	I	To use knowledge of solids, liquids and gases to decide how mixtures might be separated
Sc4 4a	27	G	That the Sun, Earth and Moon are approximately spherical …
Sc4 1a	27	I	A range of domestic and environmental contexts that are familiar and of interest to them
Sc4 1b	27	I	Looking at the part science has played in the development of many useful things

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Table 3. KS3 Science

National Curriculum for Science (England) (KS3) statements relating to Earth Science			
Reference	**Page**	**Significance**	**Pupils should be taught:**
Sc1 1aii		I	[about the interplay between empirical questions, evidence and scientific explanations using historical and contemporary examples [for example … the possible causes of global warming]
[Sc1 2dii]		G/I	[… how evidence may be collected in contexts [for example, fieldwork …] in which the variables cannot be readily controlled (-in an Earth science context)]
Sc2 5aii		G	About ways in which … the environment can be protected
Sc2 5aiii		I	… the importance of sustainable development
Sc3 1eii		G/S	[how elements combine through chemical reactions to form compounds [for example … most minerals] with a definite composition]
Sc3 2d		S	How forces generated by expansion, contraction and the freezing of water can lead to the physical weather of rocks
Sc3 2ei		S	About the formation of rocks by processes that take place over different timescales…
Sc3 2eii		S	… the mode of formation determines their texture and the minerals they contain
Sc3 2fi		S	How igneous rocks are formed by the cooling of magma …
Sc3 2fii		S	How … sedimentary rocks (are formed) by processes including the deposition of rock fragments or organic material, or as a result of evaporation …
Sc3 2fiii		S	How … metamorphic rocks (are formed) by the action of heat and pressure on existing rocks
Sc3 2I		G	About possible effects of burning fossil fuels on the environment and how these effects can be ;minimised
Sc3 3gii		S	How acids in the environment can lead to … chemical weathering or rock
Sc4 5ai		G/S	About the variety of energy resources, including oil, gas, coal … wind, waves …
Sc4 5aii		I	. the distinction between renewable and non-renewable resources
Sc4 5bi		G	About the Sun as the ultimate course of most of the Earth's energy resources …
Sc4 5bii		S	… to relate this (the Sun as the ultimate source of most energy) to how coal, oil and gas are formed

Notes: 1. Where statements have been subdivided, this is indicated by i, ii, iii, etc.
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(with acknowledgement to King *et al* 2002)

Table 4. KS4 Science

National Curriculum for Science (England) KS4 statements relating to Earth Science			
Reference	**Page**	**Significance**	**Pupils should be taught:**
Sc1 1b		G/S	How scientific controversies can arise from different ways or interpreting empirical evidence [for example, Darwin's theory of evolution].
Sc1 2dii		G/I	[…how evidence can be collected ;in contexts [for example, fieldwork…] in which the variables cannot be readily controlled]
Sc2 3I		S	That the fossil record is evidence for evolution
Sc2 3j		S/G	How variation and selection may lead to evolution or to extinction
Sc2 4bii		I	How the impact of humans on the environment depends on social and economic factors, including …industrial processes and levels of consumption and waste
Sc2 4c		I	About the importance of sustainable development
Sc3 2g		S/G	About the variety of useful substances [for example, chlorine, sodium hydroxide, glass, cement] that can be made from rocks and minerals
Sc3 2pi		G/S	How the Earth's atmosphere… (has) changed over time
Sc3 2pii		G/S	How the Earth's …oceans have changed over time
Sc3 2q		G/I	How the carbon cycle helps to maintain atmospheric conditions
Sc3 2ri		S	How the sequence of… rock formation and deformation is obtained from the rock record
Sc3 2rii		S	How the … evidence of rock formation (igneous rocks) … is obtained from the rock record
Sc3 2riii		S	How the … evidence for rock formation (sedimentary rocks)… is obtained from the rock record
Sc3 2riv		S	How the … evidence for rock formation (metamorphic rocks) .. is obtained from the rock record
Sc3 2rv		S	How the … evidence for rock… deformation is obtained from the rock record
Sc4 3mi		S	That longitudinal and transverse waves are transmitted through the Earth …
Sc4 3mii		S	…how (the) travel times and paths (of earthquake waves) provide evidence for the Earth's layered structure
Sc3 3ni		S	That the Earth's outermost layer, the lithosphere, is composed of plates in relative motion…
Sc4 3nii		S	… that plate tectonic processes result in the formation … of rocks
Sc4 3niii		S	… that plate tectonic processes results in the … deformation … of rocks
Sc4 3niv		S	… that plate tectonic processes result in the … recycling of rocks
Sc4 6f		S	Some uses of radioactivity including radioactive dating of rocks

Notes: 1. Where statements have been subdivided, this is indicated by i, ii, iii, etc.
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(with acknowledgement to King *et al* 2002)

Table 5. KS1 Geography

National Curriculum for Geography (England) (KS1) statements relating to Earth Science			
Reference	**Page**	**Significance**	**Pupils should be taught:**
1a	16	I	Ask geographical questions
1b	16	I	Observe and record
1c	16	I	Express their own views about people place and environments
2b	16	I/G	Use fieldwork skills (for example on a …. Local map)
2d	16	I	Use secondary sources of information (for example … artefacts
2e	16	I	Make maps and plans
3a	16	I/G	Identify and describe what places are like [for example in terms of landscape, jobs, weather]
3b	16	I	Identify and describe where places are
3c	16	I	Recognise how places have become the way they are and how they are changing
3d	16	I/G	Recognise how places compare with other places [for example compare the local area with places elsewhere in the United Kingdom]
3e	16	I	Recognise how places are linked to other places in the World
4a	17	I	Make observations about where things are located … and about other features in the environment
4b	17	I/G	Recognise changes in physical and human features
5a	17	I/G	Recognise changes in the environment
5b	17	I/G	Recognise how the environment may be improved and sustained
6 6a 6b	17 17 17	I/G	Knowledge, skills and understanding through the study of two localities: The locality of the school A locality *either* in the United Kingdom *or* overseas that has physical and/or human features that contrast with those in the locality of the school
7 7a 7b	17 17 17	I/G	In their study of localities pupils should: Study at a local scale Carry out fieldwork investigations outside the classroom.

Notes: 1. Where statements have been subdivided, this is indicated by i, ii, iii, etc.
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Notes to above: 2b Fieldwork skills are developed during fieldwork outside the classroom.
6 The 'locality' of the school is its immediate vicinity, including school buildings and grounds and the surrounding area within easy access. The contrasting area should be of a similar size.
7a 'Scale' refers to the geographical extent of a study. A local-scale study is a study of a small area (for example a neighbourhood, village or small town)

Table 6. KS2 Geography

National Curriculum Geography (England) KS2 statements relating to Earth Science			
Reference	**Page**	**Significance**	**Pupils should be taught:**
1a	18	I	Ask geographical questions [for example 'what is this landscape like? What do I think about it?]
1b	18	I	Collect and record evidence
1c	18	I	Analyse evidence and draw conclusions
1d	18	I	Identify and explain different views that people, including themselves, hold about topical geographical issues
2b	18	I/G	To use appropriate fieldwork techniques [for example labelled field sketches]
2f	18	I	To use ICT to help in geographical investigation [for example checking a data file to analyse fieldwork data]
3a	19	I/G	To identify and describe which places are like ???
3b	19	I	The location of places and environments they study and other significant places and environments [for example … places and environments in the news]
3c	19	I/G	To describe where places are [for example in which region/country the places are, whether they are near rivers or hills…]
3d	19	I/G	To explain why places are like they are [for example in terms of weather conditions, local resources, historical development]
3e	19	I	Identify why places change … and how they may change in future
3f	19	I	To describe and explain how and why places are similar to and different from other places n the same country and elsewhere n the World
3g	19	I	To recognise how places fit within a wider geographical context … and are interdependent
4a	19	I/G	Recognise and explain patterns made by individual physical and human features in the environment
4b	19	I/G	Recognise some physical and human processes [for example river erosion…] and explain how these can cause changes in places and environments.
5a	19	I/G	Recognise how people can improve the environment [for example by reclaiming derelict land] or damage it … and how decisions about places and environments affect the future quality of peoples lives
5b	19	I/G	Recognise how and why people may seek to manage environments and to identify opportunities for their involvement [for example taking part in a local conservation project
6	20	I/G	Through the study of two localities and three themes:
6a	-	I/G	Locality in the United Kingdom
6b	-	I/G	A locality in a county that is less economically developed
6c	20	S/G	Water and its affects on landscapes and people including physical features of rivers [for example flood plain] or coasts [for example, beach] and the processes of erosion and deposits that affect them
6d/e	20	S/G	An environmental issue, caused by change in an environment … and attempts at environmental sustainability [for example… creating a new nature reserve…]
7b	20	I	Study a range of places and environments…
7c	20	I/G	Carry out fieldwork investigations outside the classroom

Notes for: (2b) Fieldwork techniques are developed during fieldwork investigations outside the classroom.
(4) 'process' refers to a series of events that cause change in a place or environment (for example a river flow eroding the banks of a river…)
(7) 'scale' refers to the geographical extent of a study, ie local …; regional – a larger area like … a stretch of coast.
1. Where statements have been subdivided, this is indicated by i, ii, iii, etc.
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Table 7. KS3 Geography

National Curriculum Geography (England) KS3 statements relating to Earth Science			
Reference	**Page**	**Significance**	**Pupils should be taught:**
1c	22	I/G/S/	Collect, record and present evidence [for example, ….data about river channel characteristics]
1e	22	I	Appreciate how people's values and attitudes [for example …affect .. environmental…issues and to clarify and develop their own values and attitudes about such issues.
2b	22	I/G	To select and use appropriate fieldwork techniques [for example, land-use survey, ….]
3a	23	I	The location of places and environments studied, places and environments in the news and other significant places and environments …
4a	23	I/G	Describe and explain patterns of physical and human features and relate these to …
4b	23	I/G	Identify, describe and explain physical and human processes, and their impact on places and environments.
5a	23	I/G	Describe and explain environmental change [for example …..soil erosion] and recognise different ways of managing it
5b	23	I	Explore the idea of sustainable development and recognise its implications for people, places …..for their own lives.
6b	24	S	Tectonic processes and their effects on landscapes and people, including: (i) the global distribution of tectonic activity and its relationship …the … plates (ii) the nature causes and effects of earthquakes or volcanic eruptions (iii) human responses to the hazard [for example flooding, landslides], and human responses to it
6j	25	I/G	Environmental issues including: (i) how conflicting demands on an environment arise (ii) how and why attempts are made to plan and manage environments (iii) effects of environmental planning and management on people, places and environments [for example, managing coastal retreat, ….]
6k	25	I/G	Resource issues, including: (i) the sources and supply of a resource (ii) the effects on the environment of the use of a resource (iii) resource planning and management
7 7c	25 25	I/G	In their study of countries and themes, pupils should: Carry out fieldwork investigations outside the classroom

Notes for: (2b) Fieldwork techniques are developed during fieldwork investigations outside the classroom.
(6b) Pupils could use the Internet to access resources that explain and explore tectonic processes
(6c) links to other subjects. This requirement builds on Sc3/2d.2f
1. Where statements have been subdivided, this is indicated by i, ii, iii, etc.
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Appendix 3. Extract from Teaching Earth Science v.27 (3) 2002

We need your help so that we can help you. Many readers of Teaching Earth Science use geological and geomorphological sites as a teaching resource – these might include National Nature reserves (NNRs), Sites of Special Scientific Interest (SSSIs), Regional Important Geological/Geomorphological Sites (RIGS), show caves, country parks, coastal, river and other natural sections, pits and quarries.

If this includes you or your school or you manage such a site for visits by school groups, then read on.

The National Stone Centre (NSC) has been asked by English Nature to examine particularly the opportunities presented by the National Curriculum for using geological sites. The brief also includes a review of the use of geological sites for teaching earth science and by schools in general. The NSC is working closely with ESTA members on this scheme. The time allowed for the project is very limited indeed and so will only enable a scoping study to be carried out.

So we need as much help as you can give us.

Please let the NSC know which sites you use and how you use them – with what groups – for what purpose – what curriculum area and how often? Do you use background material published by others or produce you own customised material? Do you experience access problems to sites? Ideally would you like to use geological sites more frequently? If so, what factors constrain use – cost, timetabling, staff cover, insurance cover, distance, curriculum/specification limitations? If you wish we can e-mail these questions to you so that you can respond by e-mail (see below).

The exercise may be a first step in helping English Nature to work more closely with schools – to help you to use geological and geomorphological sites. So your comments could have a positive payback for you in time.

If you can help, please respond, if possible before 23 December 2002 to
ian@nationalstonecentre.org.uk

Appendix 4. Teachers briefing notes kindly provided by Peter Kennett

South Elmsall Quarry (SSSI). (Grid Ref: SE 484117)

We shall try to use this quarry to show the kind of work that can be done in almost any similar exposure (*): also to try to find out the "story" of this particular site.

PLEASE DO NOT READ THE DISPLAY BOARD UNTIL LATER!

General view

1. *Is this the whole quarry, or was there more of it once? If so, what has it been used for?

2. *Are the rocks the same throughout all the quarry faces?

3. *Do the rocks appear to be of igneous, metamorphic, or sedimentary origin?

4. *Which way are the layers inclined (dipping)? How could we measure the dip from the horizontal and its direction? Why might this information be useful?

5. Whereabouts in the face are: a) the youngest rocks; b) the oldest rocks? How can you tell?

6. Do any features cut through the layers? Which came first, the layers or these features? How do you know? Has there been any slippage along these features (i.e. a fault). How can you tell?

7. *Before we go any further, does the face look safe to work under?

Group work

8. Group A – study the north face of the quarry and draw a scaled sketch of it (2D). Look particularly for changes as you look <u>up</u> the face, and as you look <u>along</u> it.
   Try to determine the rock type (hint – apply a drop of dilute HCl).

9. Group B - study the east face of the quarry and draw a scaled sketch of it (2D). Look particularly for changes as you look <u>up</u> the face, and as you look <u>along</u> it.
   Try to determine the rock type (hint – apply a drop of dilute HCl).

10. Get together and compare notes. What are the main differences between the two faces and why?

11. Now we'll try to repeat observations which are recorded on the display board.

- *The rock is dolomite (limestone which is rich in magnesium carbonate)*
- *…twiggy marine animals called bryozoans…* (look for whitish encrustations a few cm across).

- *The layers were built up mainly of small, almost spherical limestone grains called ooliths (*a few mm across*).*
- *Some of the grains stuck together as they were formed and some grew into larger balls called pisoliths, or pea-stones.*
- *Fossil shells are abundant in some of these beds.*

12. "How do they know that?"

Suggest what evidence enabled the author to state:

- *In time, these colonies* (of organisms) *became 'patch reefs'* (i.e. local mound-shaped features on the sea bed, lying very near to sea level. The organisms are called stromatolites, and have modern equivalents in Shark Bay, W. Australia).
- *The rock was formed about 255 m.yr ago… in the Permian Period.*
- *At this time, the area basked in the tropics…*
- *…and was submerged beneath a …sea.*
- *This sea… lay in a desert region.*

Economics

- Suggest what the extracted stone might have been used for.
- Can you estimate how much has been taken out, from just this visible part of the old quarry? (Assume a relative density of 2.7, i.e. 2.7 tonnes per cubic metre of rock, or call it 3 for easy sums!).
- There is an old colliery site (Frickley) lying 2.5 km south west of here, and another at Askern, 8km to the north east. Can you explain their presence, given that coal forms from land vegetation, and we have been looking at marine sediments? Which of these collieries is likely to be the deeper?

Reflection

- You have used the following geological principles in trying to work out the "story" of South Elmsall-by-the-sea. They have horrible names, but the ideas are simple.
- Try to allocate each principle to your earlier work. Were any of the principles broken?:
- "The present is the key to the past" (Uniformitarianism)
- "The topmost beds are younger than those beneath" (Superposition) How could we prove that they are the right way up?
- "Beds are normally deposited in horizontal sheets" (Original horizontality)
- "Beds normally continue in a lateral direction" (Lateral continuity)
- "A rock or structure must be younger than any rock or structure which it cuts across" (Cross-cutting relationships)

Appendix 5 Notes provided by English Nature, Northumbria Area Team

1- Castle Eden Dene NNR, our education officer (Steve Metcalfe) runs an education programme which is mainly aimed at primary school children from the surrounding area, but geology is not one of the subjects on offer though some geographical subjects are catered for.

2- Upper Teesdale NNR - Having spoken with Chris McCarty the Site Manager for the reserve school groups are fairly regular visitors, but as EN does not supervise the visits we have no information regarding the subjects studied, school type, etc.... Usually the groups arrive in coaches so I guess the average group size is 30 ?

3- Lindisfarne NNR - Phil Davey is the site manager. EN helped fund a leaflet last year to interpret the geological site at Cocklawburn for children. Will send on a copy of the leaflet.

4- Rogerley Quarry SSSI, Co. Durham. - Poole Grammar School, Dorset used to visit the quarry regularly over several years, until 1994 when the owner closed the site to educational visits. The visits to the quarry were part of a one-week A-level geology fieldtrip to Weardale. The students sketched the Great Limestone and overlying beds. The riverine channel deposits and the lateral movement of the river channel were also discussed.

5- Harthope Burn SSSI, Northumberland - Royal Grammar School from Newcastle-upon-Tyne visited this site at the end of September 2002 to carry out river fieldwork. Three groups of about 20 Year 11 GCSE students (each group visited on a separate day) carried out simple measuring techniques, mapped a short stretch of the river, measured a number of cross-sections and took flow-meter velocity recordings. The work formed the basis of the GCSE course work required by the examination board Edexcel.

6- Other SSSIs known to have been visited by schools, university students, BGS, archaeologists, etc include:

Roman Wall Escarpments, Northumberland

Greenleighton Quarry - a student undertook a study there in this summer.

Upper Teesdale - in particular Lady's Rake Mine and Willy Hole Mine. These sites are of particular interest to local geology experts (RIGS groups are not currently active in our Team area) and industrial archaeologists. These two sites are well visited, as the tenant farmers are very enthusiastic about the mines. Don't know about school visits.

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Top left: Using a home-made moth trap.
Peter Wakely/English Nature 17,396
Middle left: Co_2 experiment at Roudsea Wood and Mosses NNR, Lancashire.
Peter Wakely/English Nature 21,792
Bottom left: Radio tracking a hare on Pawlett Hams, Somerset.
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Main: Identifying moths caught in a moth trap at Ham Wall NNR, Somerset.
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