alsf Sustainable Aggregates
forward thinking projects

SUSTAINABLE AGGREGATES

A REVIEW OF AGGREGATES LEVY SUSTAINABILITY FUND RESEARCH PROJECTS

Research funded through Defra's Aggregates Levy Sustainability Fund

miro Mineral Industry Research Organisation

defra Department for Environment Food and Rural Affairs

ENGLISH HERITAGE

SUSTAINABLE AGGREGATES

Sustainable Aggregates:
Aggregate resources produced from sand and gravel deposits, crushed rock or dredged from the sea contribute to the economic and social well being of the UK. Their production and supply has environmental effects.

The Aggregate Levy Sustainability Fund (ALSF) has provided funding to undertake work to minimise and mitigate these effects. This report is part of a portfolio of work that reviews ALSF and other work undertaken between 2002-2007 on 'promoting environmentally-friendly extraction and transport' of land-won aggregates to provide a state of knowledge account and to highlight the gaps in our understanding and practices.

Written by: Ruth Allington, GWP Consultants; Toby White, Leeds University;
Paul Pounsford, Daybreak Communications
Edited by: Abbie Drew, MIRO
Designed by: Sadie Ferriday, MIRO

alsf Sustainable Aggregates
forward thinking projects

WWW.SUSTAINABLEAGGREGATES.COM

Living within environmental limits is essential for any economic activity. Since its launch in 2002 the Aggregates Levy Sustainability Fund (ALSF) has made a significant contribution to knowledge and practice in how to produce aggregates in a sustainable way. It has invested nearly £40m in over 360 research and development projects covering an enormous range of topics. The Sustainable Aggregates series of benchmark reports has been developed to reflect the latest information and good practice from ALSF or other recent work to make them easily accessible to those who can apply them in practice. The reports are available at www.sustainableaggregates.com. This companion booklet summarises the key findings of the reports and provides a sign-post to further information in the reports.

© Clive Nicholas

EXECUTIVE SUMMARY

Since its launch in 2002 the Aggregates Levy Sustainability Fund (ALSF) has made a significant contribution to knowledge and practice in how to produce aggregates in a sustainable way. It has invested nearly £40m in over 360 research and development projects through MIRO, CLG and English Heritage covering an enormous range of topics.

The *Sustainable Aggregates* series of 12 benchmark reports has been developed to reflect the latest information and good practice from ALSF or other recent work to make them easily accessible to those who can put them into practice. There are 12 benchmark reports under 4 themes as follows:

Theme 1 Reducing the environmental effect

1. Water environment
2. Dust, noise and vibration
3. Transport

Theme 2 Sustainable provision of aggregates

4. Assessment and Planning
5. Optimising the Efficiency of Primary Aggregates Production
6. Sustainable Utilisation of Quarry By-products

Theme 3 Creating environmental improvements

7. Biodiversity
8. Geodiversity
9. Restoration

Theme 4 Heritage

10. Rich Deposits: aggregate extraction, research and the knowledge pool
11. Sustainable Heritage: aggregate extraction and management of the historic environment
12. The Sands of Time: aggregates extraction, heritage and the public

In addition to these 12 reports an overview report has been produced to provide an overview of the design and management approaches available for reducing the environmental footprint of a quarry throughout its lifecycle. It first identifies the elements of the environmental footprint and the range of environmental effects associated with each and then how they are avoided, mitigated or incorporated in the delivery of long, medium and short term environmental benefits. Chapters covering health and safety and stakeholder engagement are also included.

The reports have been written by recognised experts in their fields and reviewed by industry representatives and other key stakeholder groups, and have been designed to be easily accessible and to be widely shared.

They are aimed at a wide range of industry stakeholders, including operators, planners, environmentalists, NGOs, suppliers, the archaeological community, civil servants, local authorities, academics and interested parties from local communities associated with quarrying.

The reports also take stock of the knowledge base in each topic, identifying any gaps and recommending where future research effort might focus.

This companion booklet summarises the key findings of the reports and provides a sign-post to further information in the reports. Readers are encouraged to consider who within their organisation would find these resources of benefit and whether some of the aspects covered in the reports might have an immediate application.

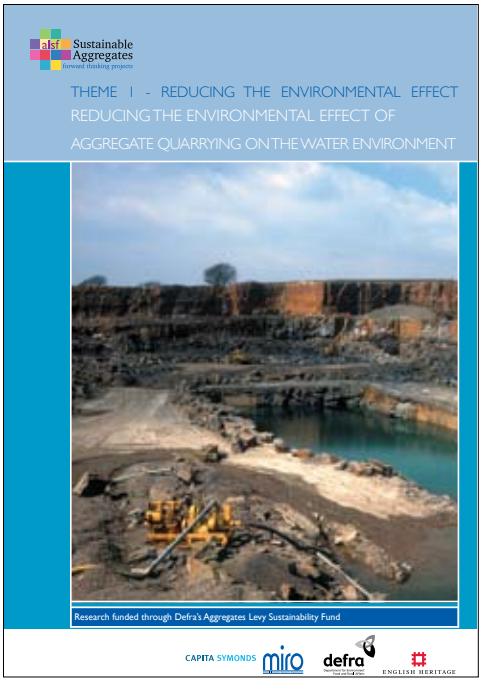
Slopes © David Jarvis Associates/University of Sheffield

SYNOPSES OF ALSF REVIEW REPORTS UNDER THEME 1: "REDUCING THE ENVIRONMENTAL EFFECT"

REDUCING THE ENVIRONMENTAL EFFECT OF AGGREGATE QUARRYING ON THE WATER ENVIRONMENT

Quarrying, both for aggregates and other minerals, can potentially have a wide range of both positive and negative impacts on many different aspects of the water environment. In most cases, the adverse effects can either be anticipated and prevented, or at least reduced to an acceptable level by means of careful assessment, planning and monitoring, and through the timely implementation of appropriate mitigation measures. Similarly, potential benefits on the water environment can be optimised if the opportunities are foreseen and planned for from the outset.

The ALSF has supported considerable research into ways of improving the assessment, monitoring and mitigation of these potential impacts, and into ways in which improvements can be achieved. The 'benchmark' review aims to bring together the key findings of that research and to highlight the ways in which the findings can be used by quarry operators, regulators and others to reduce the environmental footprint of aggregate quarrying on the water environment. The report also identifies specific gaps in essential knowledge or good practice guidance in these areas which may need to be addressed by future work.



The key issues involved can be summarised for each of the three 'life-cycle' phases of the quarrying process: planning and design, operations and post-closure.

Planning and design phase

In recent years, the importance of the water environment has risen high on national and European policy agendas. In particular, the Water Framework Directive (WFD) has placed increased emphasis on the need for holistic catchment management, with requirements for the protection and improvement of both groundwater and surface water, and with the maintenance or enhancement of water-dependent ecosystems being seen as one of the highest priorities. In this context, one of the most important aspects of minimising the adverse effects of quarrying on the water environment must involve giving due consideration to the strategic importance of mineral extraction alongside all relevant social, economic and environmental issues in both regional scale and local spatial planning.

ALSF research in the area has provided both policy recommendations and guidance on how this can be achieved, along with more detailed guidance on site-specific development control. This has included the use of a risk-based approach to the development of impact assessment, mitigation and monitoring. Underpinning all of this is a need to understand the way in which the water environment actually works and how quarrying operations can affect those natural processes. This is an area of very active research and increasing practical interest, particularly in terms of the policy-driven need to gain a better understanding of interactions between groundwater, surface water and ecosystems. The first part of the review thus provides a summary of the current 'state of the art' knowledge and ongoing research in these areas.

Operational phase

The operational phase of aggregate quarrying runs from the first implementation of a minerals planning permission through to the completion of restoration and immediate aftercare works. Potential impacts and opportunities for improvement can be found throughout all of these stages. Recent research in these areas, from the ALSF and elsewhere, is reviewed in relation to the effects associated with: Excavation and Stockpiling; Quarry Dewatering; Site Processes and Management; and Quarry Restoration. In each case, the review provides an outline of the issues involved and summarises the findings of recent research that have helped to improve understanding or to develop better ways of doing things, so as to minimise impacts and/or to encourage the type of enhancement required by European legislation. Separate chapters at the end of the report provide reviews of investigation, impact assessment and monitoring techniques which may be used throughout the lifetime of quarrying operations to help avoid or control any adverse effects.

Post-closure phase

The post closure phase of aggregate quarrying relates to the period of after-use, following the completion of extraction, restoration and aftercare. Unlike many other impacts associated with mineral working and transportation, certain impacts on the water environment are likely to persist long after quarrying itself has ceased, particularly those associated with any permanent change in topography. Research and good practice in this area are covered specifically in Chapter 9 of the review but, in order to control these long-term effects there is a need for the restoration design and subsequent after-use options to be borne in mind and planned-for, initially at the planning and design phase and throughout the operational phase.

ALSF review reports

- ALSF research, development, review and dissemination projects on water have been reviewed by Capita Symonds Limited: Reducing the Environmental Effect of Aggregate Quarrying on the Water Environment.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

Significant further information can be found in the ALSF Report: *Good Practice Guidance on Controlling the Environmental Effects of Mineral Working on the Water Environment* (Thompson et al, 2007). www.goodquarry.com and www.bgs.ac.uk/Planning4Minerals contain useful background information on the water environment, potential effects of quarrying on the water environment and recommended good practice. www.netregs.gov.uk provides information on UK water legislation.

REDUCING THE ENVIRONMENTAL EFFECT OF AGGREGATE QUARRYING: DUST, NOISE AND VIBRATION

The wide range of ALSF projects connected with the three environmental footprint elements of dust, noise and vibration have been considered in one review project. The projects include assessments of potential impact, development of new monitoring equipment and methods, and application of new operational systems and techniques to mitigate any effects. The review has also included an extensive literature review from non-ALSF sources in each of the subject areas and commented on the applicability of emerging techniques and technologies to the UK quarry industry.

Dust monitoring, modelling and validation

Dust is defined as particulate matter, 1 – 75 µm (micron) in diameter, and is carried by moving air when there is sufficient energy in the airstream. An ALSF-funded project has assessed a newly developed method for dust monitoring and compared it with other available systems. New directional dust thresholds have been proposed and initial work has been carried out on dust characterisation to help identify the source.

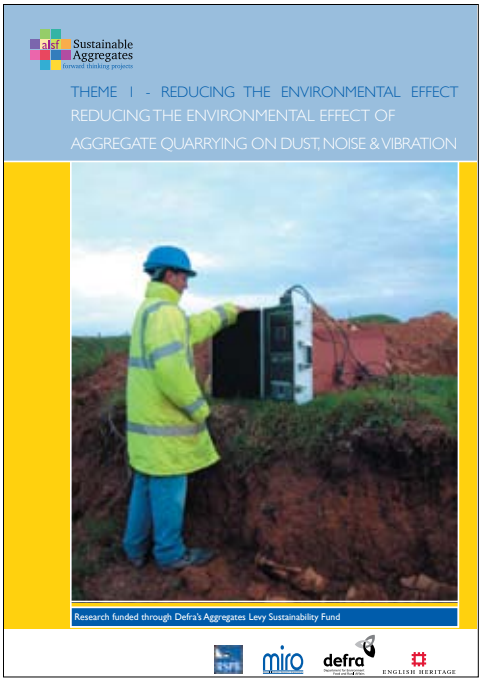
ALSF projects have also collated a comprehensive review of the fugitive dust emissions that may be generated from surface mining operations and summarised the range of conventional mitigation technologies and strategies that may be applied to control these emissions. One project has then gone on to conduct a series of preliminary dust dispersion measurement and modelling studies at a major UK limestone quarry. An ALSF project has also considered the specific effects of dust on the historic environment.

Site generated noise

No noise mitigation research studies have been funded from the ALSF MIST/SAMP programmes, but a number of projects have collated information and good practice and one project has considered the potential noise impacts of quarry operations on the historic environment.

Blasting vibrations and air-overpressure

The levels of vibration from UK quarry blasts have been shown to be well below the levels that could give rise to damage in domestic buildings. However, blasting remains a major cause of complaint due to the disturbance that can be felt by individuals.



ALSF projects have been concerned with minimising the ground vibration levels radiating from a quarry blast, to prevent disturbance to local residents. One project has developed a standard database that enables all blast and vibration parameters to be recorded and reported in a standard format to demonstrate compliance with planning conditions. The use of the database by regulators can help to build up a large body of data, giving more robust background to the setting of planning conditions. When used on site, it gives the blasting engineer increased control over the blast and enables modifications to be made to the blast design to minimise vibration levels.

These modifications to blast designs may involve the use of electronic detonators. These have been the subject of other ALSF projects which have assessed their

benefits and developed an effective procedure for their application. This system is now in commercial use in a number of quarries.

Another ALSF project has developed new monitoring equipment that enables simultaneous recording of ground vibration, air overpressure and noise caused by blasting. This should enable the cause of any disturbance to be identified and then mitigated more effectively.

ALSF review reports

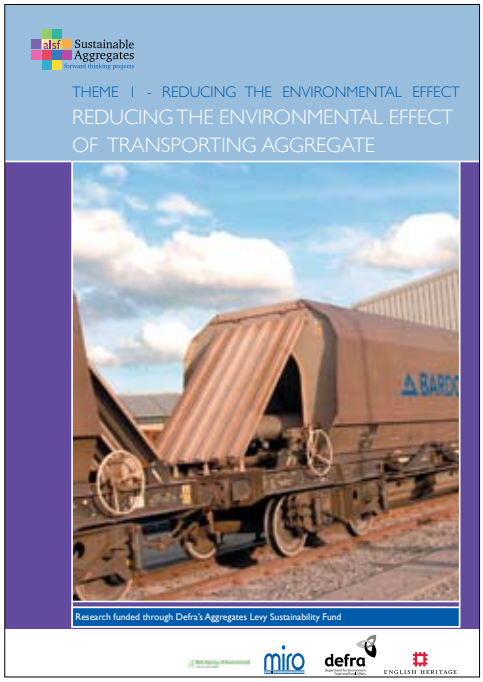
- ALSF research, development, review and dissemination projects on dust, noise and vibration have been reviewed by William Birch and Hugh Datson (University of Leeds) and Ian Lowndes (University of Nottingham): *Reducing the Environmental Effect of Aggregate Quarrying: Dust, Noise and Vibration*.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

Further background information on all these potential effects is available from www.bgs.ac.uk/planning4minerals/ and extensive discussion of the issues and good practice is given in www.goodquarry.com.

REDUCING THE ENVIRONMENTAL EFFECT OF TRANSPORTING AGGREGATE

The transport of aggregate from a quarry or other source to the point of use is essential, but does extend the environmental footprint beyond the originating site by affecting communities in the vicinity of transport routes and infrastructure. It also affects the global environment as it is estimated that transport accounts for between 20% and 40% of the total carbon dioxide emissions generated by the aggregate industry as a whole. Alternatives to road transport are limited (currently represented by rail: 7.1%, marine dredge: 6.9%, ship: 2.9%, inland waterways: <0.5% of aggregates sold) and even where these are used, the aggregates are likely to be moved by road for part of their journey. The alternative modes of transport will, of course, have their own environmental implications.



The ALSF work on transport sits in the context of other work that contributes to improving knowledge and practice for reducing the adverse environmental effects of transport. Of particular relevance to the operators of Heavy Goods Vehicle (HGV) fleets like aggregate lorries is the Freight Best Practice programme, funded by the Department for Transport to promote operational efficiency within freight operations in England.

The environmental effect of transport associated with quarries can logically be divided up into the different phases of the quarry life-cycle.

Planning and design phase

A Transportation Assessment should be carried out as part of a planning application with or without an Environmental Assessment (or periodic review), and should address all the potential issues identified above. Business advisors have been funded through the ALSF to help aggregate transport operators review their businesses and identify action plans to improve the efficiency of their operations.

In addition, rail and water freight grants have been offered to help operators transport aggregates by rail or water instead of road where the environmental benefits justify doing so.

The location of the site access point is critical and it should be sited to minimise the impact on any local towns or villages. It may be necessary to change the road layout at the site access point, to maintain traffic flow and improve safety through increased visibility.

Operational phase

Agreed haulage routes are likely to be defined in the planning permission and/or associated legal agreements (Section 106) and it is vital that these are complied with during operation. Drivers should also be encouraged to drive safely and considerately at all times. The 'Safe and Fuel Efficient Driving' (SAFED) scheme has been run as an ALSF project for the aggregates industry, funding the training of driving instructors and drivers to develop their skills.

Every attempt should be made to ensure that there is minimum debris deposited by trucks on the public roads. This means that all loads should be sheeted and will usually require a well designed wheel wash. Vibration is usually less of a problem than noise, which can be considerable if an empty vehicle is travelling on a poorly maintained road. Bumps and potholes in the road can exacerbate suspension noise, impact noise from movement of tipper bodies, and various rattles. All of these can be reduced relatively easily. Engine and exhaust noise should be reduced by ensuring that vehicles are well maintained.

A research project funded by WRAP is currently in progress considering emissions (carbon and others) at all stages of the aggregates life cycle, including transport.

Post-closure phase

Movement of vehicles in and out of a site undergoing final restoration, following cessation of mineral extraction will need to be controlled in the same way as movement during the excavation phase (even though aggregate production (and therefore transportation) will by that time have ceased). There will be significantly fewer vehicles entering and leaving the site on a regular basis at this stage of the quarry life cycle However, there may still be significant on-site vehicular movements arising from all or some of the following activities: dismantling and removal of quarry plant and buildings; modification or stopping up of site access points; removal and spreading of soils from long term screening bunds; replacement in the void of long term out of pit tips; treatment of quarry faces for long term stability; and planting and landscaping work.

ALSF review reports

- ALSF research, development, review and dissemination projects on transporting aggregates have been reviewed by Chris Fry (AEA) and Matthew Wayman (C4S): *Reducing the Environmental Effect of Transporting Aggregate*.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

Information on the Safe and Fuel Efficient Driving programme can be found at www.safedaggregates.org.uk/. www.bgs.ac.uk/Planning4Minerals gives a useful introduction to the transport issues, and www.goodquarry.com describes a number of mitigation measures that will help to reduce the impact of transport on the local environment.

Reedbed, open water and associated floodplain habitats created following gravel workings at Watermead country park, Leicester.

SYNOPSES OF ALSF REVIEW REPORTS UNDER THEME 2: "SUSTAINABLE PROVISION OF AGGREGATES"

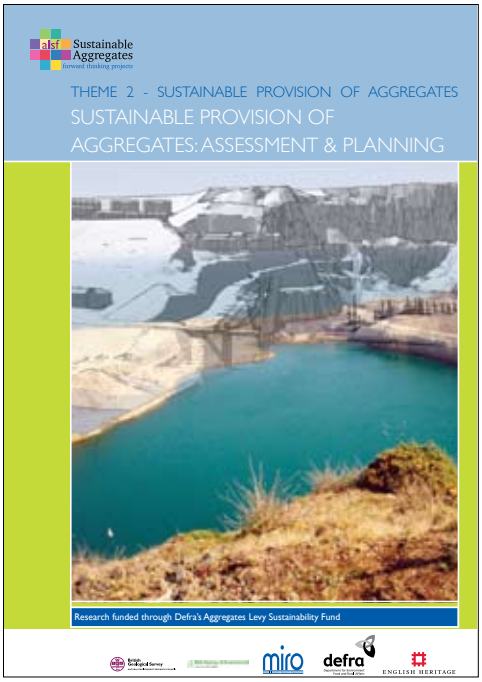
SUSTAINABLE PROVISION OF AGGREGATES: ASSESSMENT AND PLANNING

The planning system is the strategic and regulatory context for aggregate operations in the UK. A number of ALSF funded projects have been directly concerned with planning and the assessment of aggregates provision. The research varies considerably in scope and content, with projects applicable to various phases of the quarry life-cycle (planning and design, operational and post-closure phases). Because of the broad range of issues, the review used three topic areas arranged in a hierarchy from national, through regional and local, to site level.

Primary aggregates are essential to the continued development and maintenance of England's infrastructure of housing, industry and transport. To ensure their continued provision in a steady and sustainable manner it is essential that aggregate assessment and planning be carried out both nationally and locally in an effective and efficient way. The review has shown that the assessment and planning system for aggregates in England is generally working satisfactorily and continues to deliver adequate supplies of aggregate. However, there are several areas where performance could be significantly improved.

National level

Planning at the national level includes government policy and guidance on minerals as well as wider planning issues (e.g. Minerals Policy Statement 1 and associated documents, such as the National Guidelines for Aggregates Provision).



To help with the assessment of provision, ALSF projects have looked at improving aggregate resource information (such as technical properties and distribution) and attempted to collate this information. Some projects have then suggested ways in which resources could be better identified, safeguarded and utilised. Sustainability issues have been considered, particularly in relation to the supply of sufficient aggregates to meet demand. Sustainability has also been the focus in an ALSF project on the transportation of aggregates.

Some ALSF projects have assessed or developed tools (based on GIS) to assist with scoping and broader multi-criteria decision making, often in the context of Strategic Environmental Assessments. These tools have relevance at every level of planning and decision making.

All the ALSF projects consider a wide ranging stakeholder audience and take their involvement in the aggregates industry into consideration when providing products or recommendations.

Regional and local level

The planning framework at the regional and local level includes Regional Spatial Strategies and Minerals and Waste Development Frameworks. The assessment side includes Sustainability Appraisal (SA), Strategic Environmental Assessment (SEA) and the environmental appraisal of the provision of aggregates.

ALSF projects have confirmed that aggregate resources (identified, economic, permitted reserves) are currently falling. One ALSF project has suggested a method for identifying Mineral Safeguarding Areas, so that important minerals are not sterilised by non-mineral development. The benefit of improving the knowledge base at a local level has been highlighted in another ALSF project; this could have applications on a much wider scale.

Site level

At the site level, the planning context includes the Minerals and Waste Development Framework administered by the Mineral Planning Authority. Important elements of assessment are Development Control and Environmental Impact Assessment (EIA). Taken together, these planning and assessment systems give rise to the granting of planning permissions and their monitoring and enforcement. There are about 500 active sand and gravel extraction sites in England and about the same number of aggregates quarries. As quarries exhaust their mineral reserves, new reserves are required. Thus there is a need for a steady stream of mineral planning permissions for new quarries and for extensions of existing operations.

Comprehensive scoping at site or project level has been shown in ALSF projects to improve the quality of Environmental Impact Assessments. A number of ALSF projects have considered the planning implications at a local level of different potential environmental effects, including the potential for birdstrikes and the use of geophysical surveys for delineating archaeological features and mineral deposits.

The importance of good communication and stakeholder consultation has been highlighted in several ALSF projects throughout the planning system, particularly at the local level.

ALSF review reports

- ALSF research, development, review and dissemination projects on aggregate assessment and planning have been reviewed by E. Steadman, T. Colman and A. G. Gunn (BGS), C. Fry (AEA) and R. Greenwood (TRL): *Sustainable Provision of Aggregates: Assessment and Planning*.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

www.bgs.ac.uk/Planning4Minerals contains useful background information on the planning system in the UK and www.goodquarry.com contains descriptions and links to all the relevant government policy statements and guidance.

OPTIMISING THE EFFICIENCY OF PRIMARY AGGREGATE PRODUCTION

The UK quarrying industry is under increasing pressure to improve the sustainability of its operations. Ways in which this can be achieved include reductions in quarry fines production and reductions in energy and water consumption. There is no standard definition for quarry fines, but it is often taken to be material less than 6mm, for which there is sometimes no market. The objective of some ALSF projects has been to optimise the production of primary aggregates from quarry operations, whilst minimizing the generation of unsaleable mineral wastes and energy consumption.

Planning and design phase

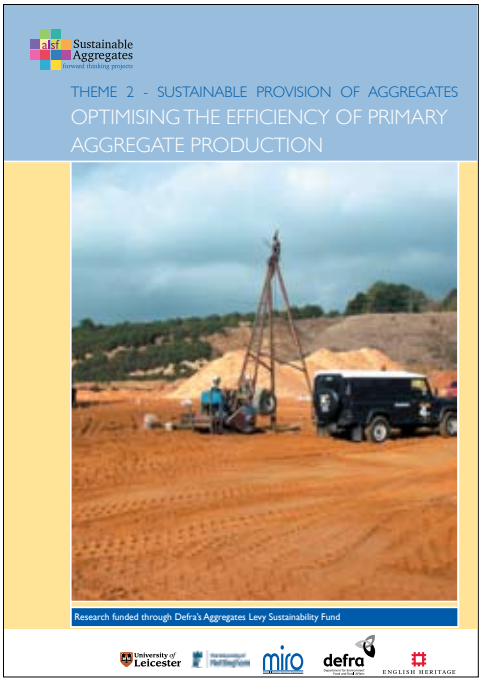
One way of optimising production is to improve aggregate reserve definition by use of better, more accurate, exploration and assessment techniques. ALSF projects have been involved in developing and comparing different methodologies including geophysical surveys (electromagnetic and resistivity surveys and use of ground probing radar) and "match to specification" analysis, relating the resource to the desired product. This is important in the increasingly complex glacial deposits that are now being worked. The new quality assessment and presentation techniques allow quarry design and scheduling based on yields of individual products rather than on broader sand, gravel and silt classifications.

Operational phase

Although no ALSF projects have looked at minimising fines through blast optimisation, the review considers the potential application of research carried out elsewhere.

Several ALSF projects considered opportunities for minimising fines production through carefully selected or modified crushing and screening circuits. The selection and set-up of the appropriate crusher was shown to be a key factor in optimising the product to fines ratio in a range of rock types. A number of comminution flow sheet computational simulations have been undertaken within case studies in ALSF projects, with the objective of modelling and then measuring changes in product and fines output.

The main aim of another ALSF project has been to identify and appraise process methods for the removal of quarry fines that do not use, or that conserve the use of, water (impact on which is a major element of environmental footprint). Water has also been a major factor behind projects investigating the potential benefits of a slurry pump transport and ultrasonic separation system, and looking at different drying and attrition technologies to remove clay.



Post-closure phase

Stockpiles of unsaleable products can remain a problem after an operation ceases, if this material cannot be used in planned restoration or disposed of in some way for a beneficial use. However, consideration of this aspect was beyond the scope of this review.

ALSF review reports

- ALSF research, development, review and dissemination projects on optimising primary aggregate production have been reviewed by Ian Lowndes (University of Nottingham) and Kip Jeffrey (University of Leicester): *Optimising the Efficiency of Primary Aggregate Production*.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

Extensive information is available on www.goodquarry.com which was used to disseminate the output of some of the projects covered by this review report.

SUSTAINABLE UTILISATION OF QUARRY BY-PRODUCTS

Quarry by-products include overburden, waste rock rejected at the face, quarry fines, and dusts, and are produced during the extraction and processing of aggregates. The focus of this review is quarry fines and dusts, which are often taken to be material less than 6mm and can form an integral part of many aggregate products. However, they are sometimes produced in excess quantities that do not match market demand. Where a production/market imbalance exists, aggregate producers need to identify alternative utilisation routes, some of which have been researched in ALSF projects.

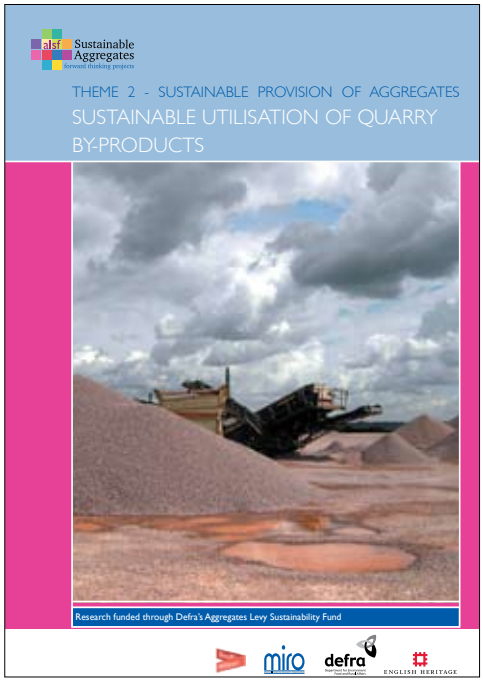
End uses for quarry fines can be divided into bound and unbound applications.

Unbound

Fines are commonly used in reclamation of mineral workings and other bulk filling applications. Several case studies are highlighted in an ALSF report. Quarry fines can also find application in road pavement construction.

Quarry fines are considered a valuable additive for soil enhancement and can also be included in artificial soils, where ALSF projects have shown that limestone fines can help to remediate acidic material. ALSF projects have also investigated the combination of basaltic quarry fines with organic process residues for the development of composts.

Unbound fines have also been investigated for use as fillers, the production of Portland cement and in new, innovative products, such as in green roofs and earth construction applications.



Bound

In the field of controlled low-strength materials, one ALSF project has investigated the use of quarry fines as the main component of pumpable infill grout. Other case studies are included in an ALSF report.

The use of quarry fines in concrete is well established, but ALSF projects have highlighted that there is little data on the technical suitability and market availability for quarry fines to be used in concrete or mortar. Utilisation in heavy ceramics such as bricks, pipes and tiles is more limited, but still possible. The production of lightweight artificial aggregates by mixing waste plastics and quarry fines is being explored and the use of energy saving microwave technology is the subject of another ALSF project.

Hydraulically bound mixtures (used in road and paving construction, shore and slope protection, dams, etc.) comprise a combination of aggregates with binder mixtures that set and harden in the presence of water. A current ALSF project is

aiming to develop specifications for HBMs with quarry fines in their structure.
Quarry fines may also be used in asphalt paving and surface treatment as fine aggregate or/and filler.

Barriers to utilisation

ALSF projects have highlighted a number of issues which prevent quarry by-products from being used more than they are. Geographical location and distance from end-use market is possibly the main reason, although lack of fines characterisation, lack of awareness of possibilities, lack of fit-for-use specifications and the effect of the Aggregates Levy are also considered to contribute.

ALSF review reports

- ALSF research, development, review and dissemination projects on sustainable utilisation of quarry by-products have been reviewed by Evaggelia Petavratzi (Scott Wilson): *Sustainable Utilisation of Quarry By-products*.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

Additional information on quarry wastes and quarry by-products is available on www.goodquarry.com.

© Kate Barton

SYNOPSES OF ALSF REVIEW REPORTS UNDER THEME 3: "CREATING ENVIRONMENTAL IMPROVEMENTS"

CREATING ENVIRONMENTAL IMPROVEMENTS THROUGH BIODIVERSITY

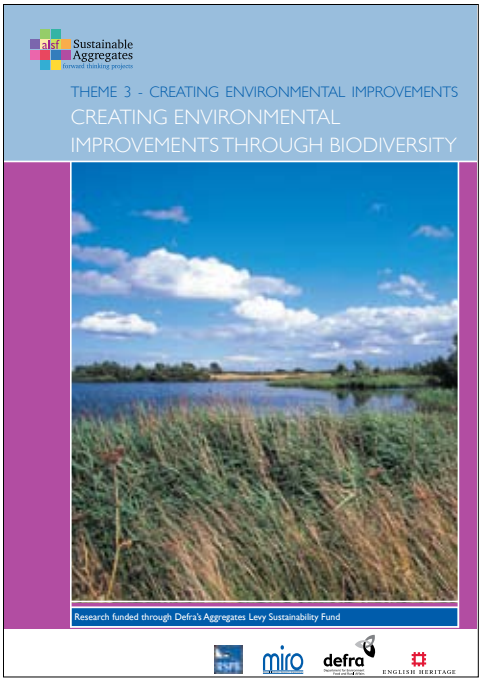
Biodiversity is the term used to describe biological diversity, which is recognised as being crucial to the sustainability of our planet. It is used to describe the variety (and variability) of all living things and the relationship between them. Quarries often have the opportunity to make a practical contribution to the conservation of biodiversity, but they can also have a damaging effect on biodiversity.

A large number of biodiversity related projects has been funded by the ALSF, through both MIRO (which have mainly been focussed on research) and Natural England (where the emphasis has been on practical projects). These were all reviewed in the course of writing the report. Non-ALSF work that was contemporaneous with the ALSF work has also been reviewed and cited in the report.

The relationship between biodiversity and quarries can logically be divided up into the different phases of the quarry life-cycle.

Planning and design phase

At the planning and design phase, where potential sites are being identified, the priority recommended by many ALSF reports should be to choose those where the potential is greatest for maximising benefits and minimising damage to biodiversity. All the reports agree that this requires the earliest possible agreement of habitat end-uses and the comprehensive monitoring of baseline levels. ALSF projects have highlighted that habitat creation is currently delivered on a site-by-site basis and that, in future, it would be desirable if habitats being created aim to make substantial contributions to local and national Biodiversity Action Plans (BAPs), and seek to expand on existing habitats in the surrounding area. Damage to existing protected or important habitats and corridors should be avoided and care should be taken with less obvious wildlife such as invertebrates, plants and fungi. The application of Strategic Environmental Assessment in limiting impacts on biodiversity has been considered by some ALSF projects, including developing GIS tools for this purpose.



Operational phase

During the operational phase, there will be considerable change (ideally planned/predicted) inside and possibly adjacent to the site. ALSF projects have highlighted the changes in surface and ground water that can affect certain habitats and therefore need to be managed or mitigated to minimise damage and maximise opportunities for benefit. A number of organisations produce briefing sheets that give guidelines for accommodating different species of plant, invertebrates, etc. in operational areas. However, it is important to consider the spatial and temporal changes that will take place and to remain flexible to deal with the unpredictable. Progressive restoration offers many opportunities for increasing the biodiversity value of a site whilst it is still operating.

Post-closure phase

ALSF projects have shown that the restoration of quarry sites provides the greatest opportunity to benefit biodiversity, and high quality wildlife habitat has been created on a number of sites thanks to the vision and hard work of the minerals industry, planners and NGOs. Reports show that the minerals industry has the potential to make a significant contribution to UK BAP targets for habitat expansion by building on existing successes. Habitat creation should always follow best practice, with site investigations and on-site trials, natural regeneration (where possible) and local seed sourcing all being important. ALSF projects have continued to add to this body of knowledge and advise that skilled ecological guidance should always be sought. Restoration schemes should not be too ambitious, benefiting from having larger areas of fewer habitats. Additional site requirements such as geological conservation and public access can be successfully incorporated, but early discussion between all parties is crucial for effective site design.

The long-term management and funding of any habitat creation restoration scheme is crucial to its success. ALSF projects have confirmed the importance of stakeholder partnerships that are involved in extended monitoring and management. The partnerships often involve a mixture of councils, statutory bodies (such as Natural England), NGOs (such as RSPB and Wildlife Trusts), voluntary groups and the land-owners. The on-going commitment of the operating company beyond its statutory duties may be required for some schemes to succeed, but ALSF projects have also looked at the potential for some schemes to generate an income source.

Some successful schemes have imaginatively integrated a number of different end-uses, involving a wide range of stakeholders. ALSF projects have looked at restoration schemes where biodiversity has been enhanced alongside geodiversity, education, recreation or flood-alleviation schemes.

Some projects have highlighted the importance of the regional and national context. Schemes for enhancing biodiversity should not just be considered at the specific site level, but should also consider the wider benefits and objectives for biodiversity and landscape. A number of reports suggest there should be a national data collection scheme facilitating a co-ordinated strategy, and the importance of the Nature After Minerals programme is recognised.

ALSF review reports

- ALSF research, development, review and dissemination projects on biodiversity have been reviewed by Jacqui Weir and Alice Davies (RSPB): *Creating Environmental Improvements through Biodiversity*.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

The After Minerals website (www.afterminerals.com) contains excellent case studies and advice on creating a range of habitats, as well as information on the habitat potential of every active mineral site in England. The Post-Mining Alliance (hosted by the Eden Project) also seeks to pool resources and case studies on aspects of post mining regeneration, including biodiversity (www.postmining.org).

Further background information is available from www.mineralsandnature.org.uk, www.goodquarry.com and www.bgs.ac.uk/Planning4Minerals.

CREATING ENVIRONMENTAL IMPROVEMENTS THROUGH GEODIVERSITY

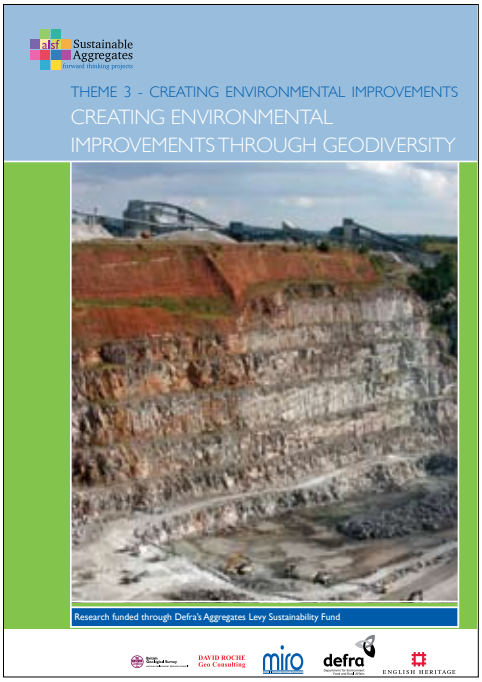
Geodiversity refers to the variety of rocks, their associated geological features and processes within nature, and includes land-shaping processes and soils as well as bedrock geology. It underpins the extremely varied landscapes that exist in the UK, together with the biodiversity that thrives on them, and it has a major influence on local culture and heritage. The term "geoconservation" refers to the policies and procedures supporting the practical enhancement of geodiversity.

It is clear that quarrying and mineral extraction have a strong relationship with geodiversity, as they are both concerned with material in the ground. It might appear that quarrying would have an entirely negative impact, but this is certainly not the case. Excavation through quarrying reveals strata and features that would not otherwise be visible, and provides many opportunities for research, education and recreation. Much knowledge of the geology of the UK, the processes of rock formation, and to some extent the landscape, has been achieved through examination of quarry faces.

At each phase of a quarry life-cycle (planning and design, operational and post-closure) the objectives must be to minimise damage to important features of geodiversity, and to maximise the benefits.

Planning and design phase

The importance of the geodiversity associated with a specific operation can only be understood in the context of the wider region. To this end, a number of ALSF projects have assisted with the preparation of a geodiversity audit of an area, followed by the development of a Local Geodiversity Action Plan (LGAP). Examples of LGAPs funded through the ALSF's MIST / SAMP programmes are Durham, Leicestershire and Rutland, Gloucestershire Cotswolds, Northumberland National Park. Other LGAPs are not necessarily supported by comprehensive geodiversity audits. One project has established a procedure for assessing the value of geodiversity at a geological site to assist with local audits and action plans.



The importance of planning for geodiversity at the earliest stage of quarry design is emphasised to enable incorporation of geodiversity interests and geoconservation at every stage of a quarry's life-cycle. One ALSF project has created a procedure for producing a Company Geodiversity Action Plan (cGAP), which should ensure that operating companies are planning and taking opportunities for geodiversity throughout the life-cycle of a site.

Operational phase

Many quarries are unaware of any geodiversity features they may have, so two ALSF funded projects undertook comprehensive geodiversity audits at active aggregate sites (in Devon and Somerset).

Geoconservation does not always mean preserving things intact. Ongoing quarrying reveals fresh strata, often with new geological features. Geological exposures which are lost through quarrying can be recorded and they may be replaced by features of equivalent interest as the excavation progresses. They can sometimes be recreated by special excavation in a different location. In many quarries, final restoration landforms can be created progressively which can enable early establishment of new (or replacement) sites of geodiversity interest.

A significant number of ALSF projects have had strong educational and leisure elements. These include the creation of public viewing areas over active sites and the provision of materials using different media which enhance the learning experience (e.g. books, DVDs, internet sites, interpretation panels). Part of one project has examined the issues associated with enabling safe access for visitors to quarries so that they can observe the geodiversity as part of professional, educational or leisure activities.

Post-closure phase

Quarries that are coming up to closure have the opportunity to incorporate geodiversity as an important part of their final restoration. In some cases, these opportunities will have been identified at an earlier stage of design, assessment and operation, but there may also be opportunities that are identified during the life of the quarry that were not anticipated in the planning and design phase.

There are also opportunities to incorporate geodiversity in quarries that have been closed for some years through improvements to restoration schemes or as part of other after-uses (such as built development). A large number of the educational and leisure resources mentioned above have also been produced through ALSF projects for former quarries. Many closed quarries are very old and may just have been abandoned with little or no restoration taking place. Here, new exposures are not likely to be created, and preservation or enhancement of important features through on-going maintenance may need to be considered. ALSF projects have enabled practical restoration with improved safety and accessibility, geodiversity trails and guided walk booklets, together with similar resources to those mentioned in the section on the Operational phase above.

ALSF review reports

- ALSF research and development projects on geodiversity, also incorporating other activities in this area, have been reviewed by Peter Scott, David Roche, and Clive Nicholas (David Roche Consulting) and David Lawrence and Keith Ambrose (BGS): *Creating Environmental Improvements through Geodiversity: A "state of knowledge" review of research and applications*.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

Natural England's website has a section on geological conservation at www.naturalengland.org.uk/conservation/geology/default.htm and a number of the ALSF projects have produced websites. Natural England has also produced two very helpful documents on geodiversity (*Natural Foundations: Geodiversity for people, places and nature*) and geoconservation (*Geological Conservation: A guide to good practice*) which are both available as free downloads from their website.

Detailed background information is also available from www.goodquarry.com.

CREATING ENVIRONMENTAL IMPROVEMENTS THROUGH RESTORATION

For the purposes of this review, restoration has been defined as the reclamation, rehabilitation or re-integration of an aggregate quarry to a positive after use. Restoration covers all stages of the rehabilitation process from start to finish: planning, consultation and assessment; investigation; design; implementation; and management stages.

Quarry restoration often involves creating a new landform that affects the visual impact and landscape character of the site. It always gives rise to changes in the ground and ground surface that provide a new context for the site in terms of the other major elements of the post-closure environmental footprint: water, biodiversity, and geodiversity. These changes may provide opportunities for a range of after-uses, and challenges to be overcome (such as long term site safety if public access is contemplated). It may be possible to establish some elements of the new environmental footprint progressively (as excavation proceeds) and, even where progressive restoration is not an option, there are a number of techniques of temporary restoration that can limit landscape and visual impacts during the life of a quarry.

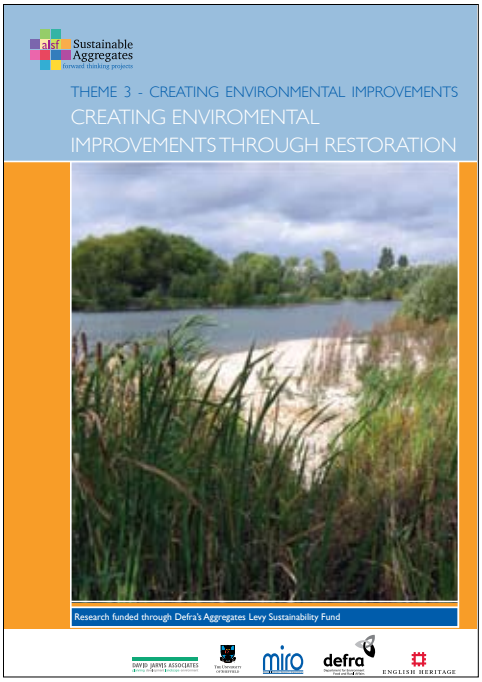
Numerous ALSF projects were relevant to this review. However, many of the site specific projects funded by Natural England and English Heritage were of a practical nature and were not written up in report format, so just forty reports were included in the review.

The projects cover issues and techniques relating to restoration at each of the quarry life-cycle phases (planning and design, operational, and post-closure).

Planning and design phase

The need for quarry restoration to be planned from the outset (and continually reviewed throughout the operational phase and again before the final restoration is implemented) is recognised by many of the ALSF reports. Some cover the legislative framework while others consider the planning and design process, including the technical aspects. Stakeholder involvement is emphasised frequently.

Restoration both incorporates mitigation measures relating to elements of the environmental footprint of quarrying and can be used in its own right as a mitigation measure. It is thus an essential consideration in quarry design and environmental assessment at the planning stage of the quarry life-cycle. ALSF reports consider a number of specific technical aspects of restoration as a mitigation measure, including: water-based restoration; visual screening; resolving conflicts with aviation; creating secure and sustainable final slopes; and enabling stakeholder communities to visualise future restored quarry landscapes. Many reports emphasise the role restored quarries can play in the promotion of educational, cultural, ecological and geological objectives.



Operational phase

Virtually all the ALSF reports provide some useful information on the preparation and enablement of restoration during and/or at the end of the operational stage of the quarry life-cycle. Restoration approaches suitable for non-agricultural uses are considered, while other projects cover matters such as spoil remediation or special blasting techniques for producing safe faces and slopes. The topic of quarry "wet" areas and their restoration is researched, with good advice and

recommendations. The subjects of art/culture and science have been addressed by some reports, considering the educational and cultural opportunities a quarry restoration can provide. Some projects which had a focus on training included aspects of restoration.

A few reports considered the benefits of progressive restoration techniques. These are particularly achievable in sand and gravel quarries but also in some hard-rock operations where the deposit is to be worked in phases or upper slopes can be restored as the quarry is deepened. Progressive restoration requires a lot of pre-planning, investigation, preparation and management. This is ideally achieved through an integrated quarry design process that balances the commercial objectives of the quarry with its environmental impact and the safety and operational issues that arise. In many cases, progressive restoration may mitigate negative impacts and reassure stakeholders. In some sites, it also presents the opportunity to release completed areas for a beneficial after-use (subject to safety and environmental considerations associated with the proximity of ongoing working).

Post closure phase

Final restoration is comprehensively covered by all the reports reviewed, with some suggesting innovative uses. These include Arts/Sculpture facilities, biomass energy production, restoration for the benefit of people with disabilities, and a wide range of educational uses. Geoconservation and bioconservation are two of the key objectives of many of the restoration schemes considered.

Proper consideration of restoration management is essential if a restoration scheme is to succeed in the longer term. All the ALSF reports cover the ongoing management issues, many emphasising the importance of continuing stakeholder involvement and some highlighting the importance of safety.

ALSF review reports

- ALSF research, development, review and dissemination projects on restoration have been reviewed by David Jarvis and colleagues (David Jarvis Associates Ltd) and John Cripps and colleagues (University of Sheffield): *Creating Environmental Improvements through Restoration.*
- All ALSF review reports are available at www.sustainableaggregates.com Of particular relevance to quarry restoration are the review reports on the water environment, assessment and planning, sustainable utilisation of quarry by-products, biodiversity, geodiversity

Other sources of information

Further background information is available from www.mineralsandnature.org.uk and www.bgs.ac.uk/planning4minerals/. The website www.goodquarry.com has an extensive section on restoration, with many examples and links to a variety of successful schemes.

SYNOPSES OF ALSF REVIEW REPORTS UNDER THEME 4: "HERITAGE"

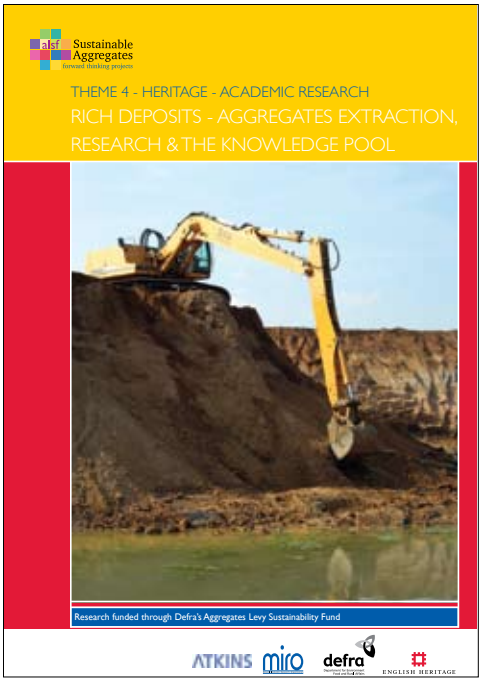
RICH DEPOSITS – AGGREGATES EXTRACTION, RESEARCH AND THE KNOWLEDGE POOL

Quarrying and extraction of aggregates on land and at sea affects buried archaeological remains and the historic landscape. ALSF projects have helped the aggregates industry and heritage sector predict where archaeological remains might be and develop ways of mitigating these effects. In this way remains and valuable elements of our landscape are not needlessly lost without record. Focussed on the places and types of archaeological assets which are affected by aggregates extraction, the dividend has been new knowledge and new ways of exploring, understanding, explaining and challenging our thoughts about our past.

The review report draws on a survey of project designs, reports and other outputs, as well consultation with the 'knowledge society' and interested members of the public. These are the groups that both generate and put new knowledge to work in planning and managing archaeological issues with the aggregates industry, engaging communities in history and environmental issues and training future archaeological and historic environment specialists.

Impact

ALSF projects have resulted in the development of reliable and cost-effective techniques of mapping and survey and a body of baseline knowledge about the location, nature and quality of archaeological resources that could not have otherwise been gained. Projects have assisted the aggregates industry, together with archaeological and environmental planners, to determine how to avoid many areas of important remains (terrestrial and marine) and historic landscapes and to mitigate the impact where needed.
A number of ALSF projects have focussed on the particular topographic contexts or landscape units that yield aggregates and minerals. They have helped the management of extraction and provided unrivalled opportunities for adding substantially to the understanding of these contexts, which are often unique in their nature and have hitherto been little understood.



Projects have resulted in management and conservation plans and strategies for groups of sites or monuments, reconciling competing interests and providing the way forward for managers and local communities. Other ALSF projects have analysed data and synthesised large bodies of information from previous work and investigations. Often drawing on a variety of evidence, this work has resulted in new interpretations and knowledge of archaeological material.

ALSF funding has enabled the investigation and reporting of a number of important archaeological sites for which planning permission had been granted prior to the current planning regime and which therefore could not directly be funded by the relevant aggregates companies.

The archaeology and history of aggregate and quarry industries themselves are increasingly being recognised as important components of our present historic landscape, valued by communities and tourists. A number of projects have focussed on these monuments and remains, resulting in the development of management strategies.

Recognition

The appreciation of the importance of ALSF research has increased within the aggregates industry as it has provided tools for planning and environmental management.

Local authority historic environment officers are also aware and recognise the benefits of the ALSF research projects. Enhanced knowledge through synthesis of data and analysis of information from previous investigations has added to their ability to manage and communicate the wider historic environment resource within their authority area.

Universities and academic specialists have been very engaged in ALSF projects, contributing to and often leading the research and development of new techniques. The fund has provided rare opportunities to look at landscapes, contexts, deposits and topics that would be otherwise unavailable.

Communication and dissemination

A key objective of almost all the ALSF projects has been to disseminate the benefits and findings of the research, and the results of this dissemination is best seen in the way the research is put to use by the wider 'knowledge society'. Techniques developed in individual projects are often used in other regions or by other companies. Research proposals and designs build on established wider research agendas and the data generated by ALSF projects stimulates and contributes to new agendas and frameworks. The archaeological community share and disseminate this information and ensure that it is put to use.

Data and information from many ALSF projects have helped to reconstruct past environments and provided the basis of interpretation. This has taken the form of stories for school children, adult learners and tourists, and engaging communities in the understanding, enjoyment and care for their history and archaeology.

Lessons and pointers to the future

ALSF research projects have often brought disparate things together. These include partnerships and stakeholders; universities, planning authorities and the aggregates industry; generations and communities; techniques and professional disciplines; landscapes and regions; and artefacts, ecofacts (organic and environmental remains which have cultural relevance) and archaeological deposits.

Within environmental issues, promoting the value of a heritage research project is often challenging when compared to, for example, the development of a nature reserve. Projects which have engaged a range of stakeholders and their interests from the outset have increased over recent years and it is one of the success factors in ensuring and communicating benefits.

The concern that projects should benefit the industry as well as the historic environment sector seems

generally to have ensured that ALSF projects have resulted in little 'dead-end' knowledge. Knowledge seems to have been readily taken up, used and put into action by all sectors, although some individuals in local authorities would like information to be disseminated to them in a more accessible form.

ALSF review reports

- ALSF research, development, review and dissemination projects on aggregate extraction, heritage and the public have been reviewed by Atkins Heritage with Gill Andrews (Archaeological Consultant) and Professor John Barrett (Sheffield University): *Rich Deposits – Aggregates extraction, research and the knowledge pool*. There are two additional review reports covering other aspects of ALSF heritage projects.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

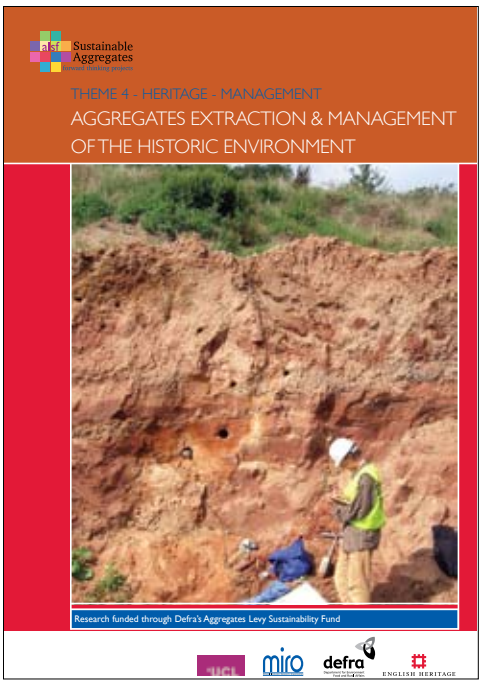
Details of all English Heritage ALSF projects can be found on their website; http://hec.english-heritage.org.uk/admisremote/ALSFOnline/HOME.ASP

Further background information is available from www.bgs.ac.uk/planning4minerals/ and www.goodquarry.com.

SUSTAINABLE HERITAGE – AGGREGATES EXTRACTION AND MANAGEMENT OF THE HISTORIC ENVIRONMENT

This report reviews the impact that ALSF projects aimed at developing new guidance, standards and best practice have had on the aggregates industry, archaeological curators and practitioners. The report provides a critique and summary of the suite of guidance to industry undertaken through the ALSF, placing such guidance in the context of wider research into the historic environment.

This report is derived from consultation with stakeholders, a dataset of available resources, and a literature review surveyed over September – November 2007. A 'route map' of ALSF products and related resources supports the full report.



Impact

The impact of the ALSF has been extremely positive across all sectors. Industry and the planning sector have benefited from the acquisition of new datasets (especially in the marine zone), allowing for better pre-planning and risk-avoidance, allied to the provision of enhanced management guidance. Archaeology has benefited from new investment, supporting proactive research into archaeological sites as well as the development of analytical techniques. All sectors have benefited from the experience of collaborative projects that promote best practice in data acquisition, analysis and management.

The sum of the ALSF projects is recognised as being fundamental in providing a sounder knowledge base for the management of heritage resources; the ALSF is seen to be in the interests of industry, the development of this understanding increasing the confidence of all stakeholders.

The ALSF is recognised as being a major 'driver' of fundamental research into

many aspects of archaeology, with a PR benefit to be gained from industry supporting such work through collaborative enterprises, data-sharing and the sponsorship of PhD students.

As a direct consequence of the ALSF, 'UK Plc.' is better able proactively to manage its strategic aggregates resource as well as reactively to deal with unexpected archaeological discoveries.

Recognition

The recognition of the ALSF role by all sectors has been very good; it is rare for the role of ALSF not to be recognised in at least some format. Nonetheless, the general consensus is that the ALSF needs an even higher profile as there is a willingness to further acknowledge the ALSF contribution where possible.

The absence of an instantly recognisable ALSF 'heritage' logo has been a major barrier to greater recognition of the scheme, making it difficult to identify specific ALSF funded support. Site entrance and display boards, 'hard' media and websites would all benefit from such a logo. The absence of a single, dedicated web-presence for all products of ALSF projects is similarly felt to be a barrier to higher recognition.

On the world stage the ALSF is held up as a model of innovative heritage management, providing proactive, collaborative research of benefit to all stakeholders. ALSF heritage investment represents an extremely cost-effective form of strategic investment.

Communication and Dissemination

Communication and engagement between the public and private sectors in the marine zone has been extremely thorough, and can be considered one of the great successes of the ALSF; this is often in contrast to the terrestrial ALSF.

Communication is most effective at the local level and is usually the result of the long-term work of individual researchers and curators being exposed to project fieldwork. Positive lessons can be learnt from ALSF projects where researchers have succeeded in establishing good communication with quarry managers.

Integrated involvement of industry representatives within the design, implementation and dissemination of ALSF projects has provided essential reassurance to industry. Such collaboration ultimately saves money and time, improves the quality of advice, and reduces risk. Some of the most useful collaboration has included training across industry and the heritage sector, being designed to raise mutual understanding and cross working, and presenting heritage data and guidance in a timely fashion and in ways that reveal the benefits to industry.

Tight timescales and timetabling has been a problem for many ALSF projects. The final size of the extensions to the original fund only being known so close to each new financial year has been a disincentive to proposing relatively 'high-risk', high-capital ALSF projects and/or those requiring major advance capital investments. Such a short 'window' also makes it difficult to get projects together in time to take advantage of the best weather conditions for survey, a particular problem for marine and aerial surveys.

ALSF review reports

- ALSF research, development, review and dissemination projects on sustainable heritage have been reviewed by J, Flatman, J. Short, J. Doeser, and E. Lee (Centre for Applied Archaeology of the Institute of Archaeology, University College London): *Sustainable Heritage – Aggregates extraction and management of the historic environment*. There are two additional review reports covering other aspects of ALSF heritage projects.

- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

Details of all English Heritage ALSF projects can be found on their website; http://hec.english-heritage.org.uk/admisremote/ALSFOnline/HOME.ASP

Further background information is available from www.bgs.ac.uk/planning4minerals/ and www.goodquarry.com.

THE SANDS OF TIME – AGGREGATES EXTRACTION, HERITAGE AND THE PUBLIC

The "sands of time" report reviews the impact that ALSF outreach projects have had in explaining archaeology, the historic environment and aggregate extraction to the widest possible audiences. In the absence of formal standards against which outcomes can be measured, the report provides an overview of current practice through a series of case studies. A guide to good practice in outreach is then offered as is an index of outreach resources, both printed and web based, produced by the ALSF.

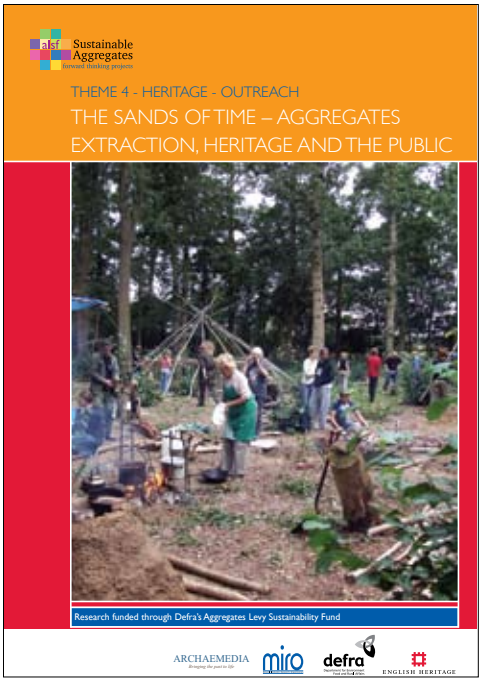
Impact

It is clear that over the last six years the impact of the ALSF on the quantity and nature of heritage outreach work in England has been huge. Appropriate and realistic levels of funding have been provided, for the first time in some areas, allowing projects to be carried out to high professional standards. The freedom to experiment and innovate has produced many new ideas and products and the available resources have re-energised many within the outreach community. Ideas and enthusiasms are now being shared in an atmosphere of mutual support while outreach has gone from being a sometimes reluctantly accepted 'add on', to being a fundamental part of an increasingly wide range of projects.

It is fair to say that, over the past six years, the ALSF has fundamentally changed the nature and extent of outreach work in England.

Recognition

It is clear that despite having been in existence for six years and having, during that time, had a substantial and widespread impact, the ALSF perhaps surprisingly still has a remarkably low profile. This absence of identity may also be why the connection between aggregate extraction and historic landscape studies is often not as strong as it could or should be.



Industry perception

The aggregate industry, while feeling that its support is often not adequately acknowledged, welcomes ALSF involvement in strategic archaeological surveys that may help with long term mineral planning. The industry also considers that heritage outreach projects are a good use of ALSF funds and come closest to fulfilling the stated remit of the Aggregate Levy. A greater concentration of spending on local communities affected by aggregate extraction is considered desirable, in order to enhance this kind of outreach.

Identified concerns

The main concern expressed by all who were consulted and evident in project

outcomes, was the timing of ALSF funding, especially within short funding rounds. This has had a demonstrably detrimental effect on the ability of the ALSF to deliver as wide a range of projects to as wide a potential audience as should have been possible given the scale of the grants.

The ALSF has developed a unique and vital place within heritage outreach in England. It is to be hoped that it will continue, ideally with an extended funding window as the absence of ALSF support would severely restrict the profession's ability to deliver high quality outreach to a population that increasingly wishes to engage with its shared past.

ALSF review reports

- ALSF research, development, review and dissemination projects on aggregate extraction, heritage and the public have been reviewed by Julian Richards (Consultant): *The Sands of Time – Aggregates extraction, heritage and the public*. There are two additional review reports covering other aspects of ALSF heritage projects.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

Details of all English Heritage ALSF projects can be found on their website; http://hec.english-heritage.org.uk/admisremote/ALSFOnline/HOME.ASP

Further background information is available from www.bgs.ac.uk/planning4minerals/ and www.goodquarry.com.

A SYNOPSIS OF THE OVERVIEW REPORT:

SUSTAINABLE AGGREGATES - THE DESIGN AND MANAGEMENT APPROACHES TO REDUCING THE ENVIRONMENTAL FOOTPRINT OF THE SUPPLY CHAIN FOR LAND-WON AGGREGATES

The overview report draws on the information in the 12 reports which have been produced as part of the thematic review of Aggregates Levy Sustainability Fund (ALSF) research projects for land-won minerals. It puts them into the context of the quarry life-cycle, specifically in relation to the various elements of environmental footprint and the stages in the supply chain for land-won aggregates. In particular, the report helps to emphasise some of the major findings of the ALSF research and enables some of the complex inter-relationships between environmental footprints at different stages of a quarry's life to be described.

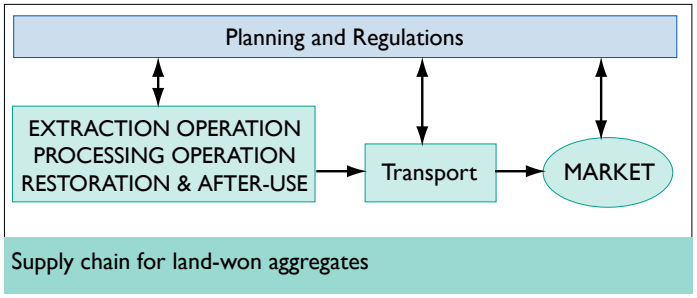
Environmental Footprint

The overview report builds on the concept of environmental footprint and, drawing on the twelve themes, shows how the design and management of the quarry has a key role to play in determining the overall balance of negative and positive environmental effects.

The table below summarises the main "receptors" or "sources" that need to be considered as part of this process. Each of these elements of the environmental footprint, with the exception of carbon footprint, is the subject of one of the themed reviews.

Receptors of environmental effects of quarrying	Sources of environmental effects of quarrying
Potential for temporary or permanent adverse environmental effects of aggregate quarrying that must be mitigated	
■ Water environment	■ Dust, noise and vibration
■ Archaeology/historic environment	■ Transport
■ Biodiversity	■ Use of energy, carbon footprint
■ Geodiversity	■ Use of quarry wastes and by-products
■ Visual amenity/landscape character	
Potential for temporary or permanent beneficial environmental effects	
■ Water environment	■ Use of quarry wastes and by-products
■ Archaeology/historic environment	■ Biodiversity
■ Biodiversity	■ Geodiversity
■ Geodiversity	
■ Visual amenity/landscape character	

The overview examines the relevance and importance of all of these environmental effects in relation to each of the stages in the supply chain for land won aggregates:



The quarry life-cycle

Using the concept of the environmental footprint the report examines the change in emphasis in the design and management of the quarry as it moves through the three distinct phases of its life-cycle.

- planning and design phase
- operational phase
- post closure phase.

The report explores the role of the Environmental Statement (ES) and Environmental Impact Assessment (EIA). It emphasises the central role the EIA plays in the quarry design process in order to meet the key environmental objectives of the planning and design phase of the quarry life-cycle. Many ALSF projects have shown that it is at the early stages of quarry planning and design that potential adverse effects can be "designed out" and maximum benefits can be incorporated.

In the operational phase of the quarry life-cycle, the emphasis shifts from prediction of environmental effects (and design of management and mitigation approaches to limit adverse effects) to monitoring and management of actual effects within a legal and planning framework.

In the post-closure phase, attention may still be given to monitoring and management of any continuing effects following cessation of excavation and processing. The focus will now be on delivering maximum benefits from the agreed restoration scheme and ensuring that the site is suitable for the proposed after-use.

Characterising the environmental footprint

Having established the conceptual framework described above, that brings together the twelve themed reports, the overview report aims to:

- Provide a non-technical description of each of the environmental footprint elements relevant to the supply chain for land-won aggregates.
- Identify specific environmental effects associated with each stage of the supply chain throughout the quarry life-cycle.
- Describe how adverse effects are avoided or mitigated and how positive effects can be incorporated in the delivery of long, medium and short term environmental benefits.
- Provide a descriptive summary of the ALSF research relevant to each environmental footprint element
- Provide sources of further information (primarily the relevant thematic review or reviews).

Health and safety & stakeholder engagement

Two further sections consider the importance of health and safety and stakeholder engagement to achieving effective management and mitigation of the environmental footprint throughout the quarry life-cycle and supply chain. While some projects have dealt specifically with these topics, they cut across, and are relevant to, the entire ALSF land-won aggregate research and development programme.

ALSF review reports

- The overview report has been written by Ruth Allington (GWP Consultants LLP) and Toby White (University of Leeds): SUSTAINABLE AGGREGATES: An overview of design and management approaches to reducing the environmental footprint of the supply chain for land-won aggregates.
- All ALSF review reports are available at www.sustainableaggregates.com.

Other sources of information

Further background information is available from www.bgs.ac.uk/planning4minerals/, while www.goodquarry.com gives detailed information about many of the environmental footprint elements.


alsf
Sustainable
Aggregates
forward thinking projects


miro
Mineral Industry Research Organisation


defra
Department for Environment
Food and Rural Affairs


ENGLISH HERITAGE