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The impact of 'rock-fall' mesh/netting on scientifically and educationally important geological exposures: a case study

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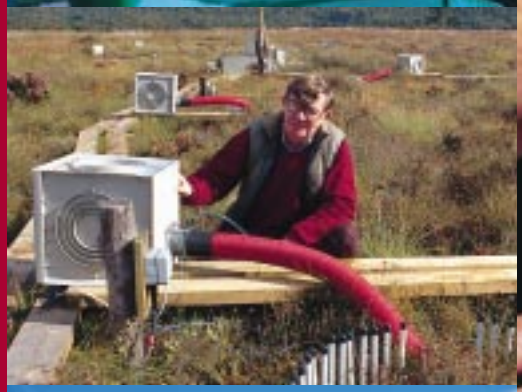

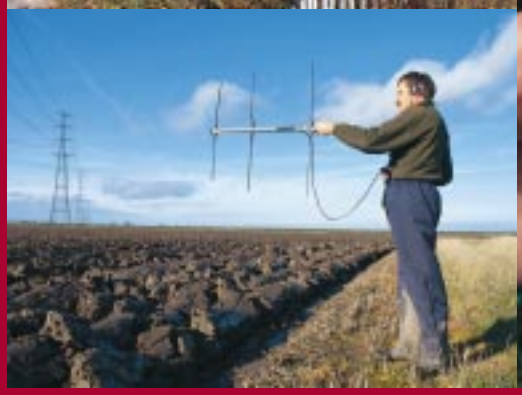

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The impact of 'rock-fall' mesh / netting on scientifically and educationally important geological exposures: a case study

Colin Prosser
English Nature

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Project officer	Hannah Townley, Environmental Impacts Team Hannah.townley@english-nature.org.uk

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Executive summary

There are many threats to the conservation of scientifically and educationally important geological exposures. The nature of these threats, the impacts they may have and the management strategies that can be used to deflect or mitigate against them are generally well understood. Occasionally, however, a new threat comes to light and its impact needs to be assessed and understood. The application of 'rock-fall' mesh / netting on to scientifically and educationally important geological exposures is one such new and growing threat. The impact of this operation, often used as part of a package of engineering measures used to stabilise a rock face, needs to be better understood and ways of assessing and demonstrating any impact arising needs to be developed.

This report considers the impacts of 'rock-fall' mesh / netting on scientifically and educationally important geological exposures through use of a case study. The case study relates to proposals to undertake engineering works on a stretch of geologically important cliffs at Black Rock, Brighton. These proposals were considered at a public inquiry, held in Brighton in 2004. This inquiry provided a forum for rigorous examination of the evidence both for and against there being an impact from the application of 'rock-fall' mesh / netting. The findings of the inquiry, and the subsequent planning decision described, and accepted, the impacts that 'rock-fall' mesh / netting would have on the scientifically and educationally important geological exposures at Black Rock. These impacts include a reduction of visibility of the exposure, especially from oblique angles, the trapping of debris and increased vegetation growth behind the 'rock-fall' mesh / netting and the restriction of the ability to accurately sample from the geological exposure. Mitigation measures such as removable sections of 'rock-fall' mesh / netting were considered but are not yet developed to a point where they could be considered as a viable option. A checklist for use in assessing future schemes involving the application of 'rock-fall' mesh / netting onto a geologically important rock face is proposed, based on the experience and findings of this case study.

Contents

1 Introduction

The geology (including geomorphology) of Great Britain is rich, diverse and extremely important as a scientific, educational and recreational resource. This rich geodiversity, along with early pioneering work in the development of the science of geology that took place in Great Britain, has bestowed an international importance and a very high heritage status on Great Britain's geology. Fortunately, the need to conserve this geological heritage has been recognised and acted on in Great Britain, and a well established legislative framework through which to conserve geological sites has been in place for nearly sixty years. The primary tool for conserving nationally important geological features in Great Britain is through designation as a Site of Special Scientific Interest (SSSI) whilst regionally and locally important features may be conserved as a Regionally Important Geological / geomorphological Site (RIGS) (Prosser, Murphy & Larwood 2006).

The conservation of geological sites involves a range of activities including audit, safeguard, management and interpretation. This report relates to site safeguard and in particular the assessment and nature of an emerging threat. Threats to geological sites are varied and numerous but the nature of their potential impact on a geologically important feature, and the management strategies which may be deployed to deflect or mitigate against these threats, are generally well understood (Prosser, Murphy & Larwood 2006). Occasionally, however, as a result of the development of new engineering solutions, or as a response to changing social circumstances, such as increased concerns about health, safety and public liability, new threats come to light or become more significant through wider application.

One such operation posing a growing threat to geological features in recent years is the application of 'rock-fall' mesh / netting as a means of stabilising and making safe geological exposures. The main driver for the increasing use of this engineering option is undoubtedly health and safety legislation and a growing culture of 'litigation'. Land owners / managers are becoming increasingly concerned about being potentially liable for any incident relating to rock faces present on the land they control. There is, therefore, a growing trend towards attempting to eliminate all risk from rock faces in order to try to ensure the absolute safety of any property or people in the vicinity of a rock face. Such risk elimination strategies often result in engineering schemes intended to stabilise rock faces being proposed. These schemes often involve the application of 'rock-fall' mesh / netting, occasionally as a discrete operation, but more often as part of a wider package of engineering works that may include re-profiling of the rock face, the application of rock bolts / nails and seeding of the face to establish vegetation. Given that maintenance of the scientific and educational importance of a geological exposure usually requires that it is clean and well-exposed, and that the application of 'rock-fall' mesh / netting involves draping a layer of material over the exposure, it is easy to appreciate why this engineering option is regarded as a growing threat to the conservation of geologically important exposures.

The aim of this report is to consider the impacts of 'rock-fall' mesh / netting on scientifically and educationally important geological exposures through use of a case study. The case study relates to proposals to undertake engineering works on a stretch of geologically important cliffs at Black Rock, Brighton. These proposals were considered at a public inquiry, held in Brighton in 2004. The inquiry provided what is almost certainly the first ever forum at which the potential impacts of 'rock-fall' mesh / netting on scientifically and educationally important geological exposures were subject to rigorous examination. This report aims to capture the experience from this case study and use it to illustrate the

conservation issues that arise when considering the impacts of 'rock-fall' mesh / netting on a geologically important exposure. The report outlines the arguments presented at the public inquiry, both for and against there being an impact from the application of 'rock-fall' mesh / netting on the scientifically and educationally important exposures at Black Rock. It describes the post-inquiry findings of both the planning inspector, who heard the inquiry, and the First Secretary of State, who issued the planning decision letter. Finally, it draws some conclusions and proposes a checklist of points to consider when assessing the impacts of a scheme involving the application of 'rock-fall' mesh / netting on a geological exposure of scientific and / or educational importance.

As the first report to address this subject matter, it is intended that it will inform cases of a similar nature that may arise in the future.

2 Rock-fall' mesh / netting

The term ''rock-fall' mesh / netting' is used here in generic way to mean the wire mesh / netting that is used as an engineering solution in improving slope stability. There are two broad types of 'rock-fall' mesh / netting used for different engineering purposes. Steel wire 'rock-fall' mesh is applied to a cleaned and levelled slope and is tensioned over previously drilled and tensioned soil or rock bolts / nails and spike plates. The mesh fits to the topography and prevents slides and breakouts. 'Rock-fall' netting is used to act as a constraint to falling fragments of rock. It is draped over the face and is typically fixed using mechanical or resin anchors. It is not tensioned and its prime purpose is to catch falling rock, rather than to significantly add to slope stability.

For brevity, and because the potential impacts of both mesh and netting on geological features are very similar, the generic term 'mesh' is used henceforth in this report to encompass both 'rock-fall' mesh and 'rock-fall' netting.

3 Black Rock case study - background

3.1 Scientific and educational importance

Black Rock lies at the westerly end of the Brighton to Newhaven Cliff Site of Special Scientific Interest (SSSI). It is a nationally important Geological Conservation Review (GCR) site (Ellis and others 1996) for both Quaternary stratigraphy and Cretaceous stratigraphy. It is because of these nationally important features that the site was designated as an SSSI. It is also designated as a locally / regionally important RIGS site, primarily on account of its educational value.

Black Rock is of outstanding importance for the study of Quaternary stratigraphy, and has a long scientific history. It was first described in 1818 (Daniell) and is still subject to ongoing research today. The site (See Figures 1, 2 &3) demonstrates an ancient (200,000 year old) cliff and abrasion platform cut into the chalk, an overlying raised beach deposit (the Black Rock Member), and a sequence of chalk rubble and crudely bedded chalky debris, probably formed when frozen soil and sediment thawed, became waterlogged, and then slid down slope (together known as the Supermarket Member) (Hutchinson & Millar 1998). Black Rock is the type locality for both the Black Rock Member and the Supermarket Member. It has also yielded important mammal remains including mammoth, woolly rhinoceros and

horse (Parfitt, Owen, & Keen 1998). Very importantly, in relation to the proposals for 'meshing' the rock face at Black Rock, is the fact that the cliff face is visually spectacular, clearly demonstrating an ancient cliff-line, a raised beach and a sequence of sediments that later, during the ice-ages, covered both the ancient beach and cliff the cliff-line.

3.2 The proposed works

Although Black Rock is a former sea-cliff, it has been isolated from the sea since the construction of the Brighton Marina some 30 years ago (Figure 2). Until relatively recently, the geological site and the surrounding marina development had co-existed well, with the Brighton Marina Company even sponsoring the publication of a leaflet written by the Brighton and Hove Geological Society that promotes the geological interest of Black Rock. However, during 2000 and 2001, rock falls from Black Rock, one of which damaged the supermarket located near the foot of the Black Rock cliff, resulted in the local planning authority closing the public footpath below the rock face and proposing engineering works to the face that would allow the footpath to be re-opened once the works were complete. The proposed works involved re-profiling and seeding part of the face, and applying 'mesh' and rock bolts/ nails to other parts. Given the scientific and educational importance of this site, and the likely impact of the proposals on the geological features, English Nature objected to the plans (Bennett 2003). An extended period of discussion with the local planning authority failed to find a solution that satisfied the interests of both parties and the First Secretary of State decided to determine the application himself through calling it in for public inquiry.

3.3 The lead-up to the public inquiry

In the lead up to the public inquiry held in January 2004, the respective positions of the local planning authority proposing the scheme, and English Nature opposing it, can be summarised as follows:

The local planning authority were of the opinion that cliff falls of the type experienced in 2000 and 2001 were a serious risk to the safety of pedestrians using the footpath directly underneath the cliff (the Undercliff Walk), the infrastructure associated with the supermarket at the foot of the cliff, and infrastructure such as the roads at the top of the cliff. In order to re-open the Undercliff Walk, which they had closed on safety grounds immediately after the falls, and to ensure that the supermarket would be free of any future disruption, they planned to engineer the cliffs. This would involve re-grading and rock bolting/ nailing to reduce the likelihood of significant falls and the application of 'mesh' to the cliff face in order to help reduce the risk from falling rock. The local planning authority accepted that the cliff face was of great scientific and educational importance, but argued that the 'mesh' would not seriously obscure the geological features. They also argued that if the works to stabilise the cliff were not undertaken, then the site would become too dangerous for any future geological study or future management to clear away any fallen rock, thus rendering it useless for scientific / educational purposes.

The position of English Nature, backed by those in the geological community who use the site for scientific and educational purposes, was that the application of 'mesh' to the rock face, and rock bolting / nailing to some extent, would obscure the geological details on a site where the visibility of the geology is extremely important. Whilst the direct effect of applying 'mesh', in terms of obscuring the geology, was regarded as a serious concern, so too was the potential longer term effects of the 'mesh' in trapping fallen rock and allowing

vegetation growth behind it. As well as obscuring the geological features, the trapped material would make it more difficult to undertake accurate stratigraphical sampling from the rock face. English Nature's view was that if the Undercliff Walk footpath was diverted away from this short stretch of cliff face, the arguments for applying 'mesh' to the cliff face would be removed, and that given the scientific and educational importance of this site, such a diversion was justifiable.

4 Black Rock case study – issues considered at the public inquiry

4.1 Introduction

As previously stated, the Black Rock public inquiry provided a forum for a rigorous examination of the issues surrounding the potential impacts of 'mesh' on features of geological importance. Whilst the public inquiry considered a wide range of planning and engineering issues related to the proposed engineering scheme for the cliffs at Black Rock, this report focuses only on the issues relevant to the application of 'mesh'. Although intended to be an accurate reflection of the issues raised, the report focuses on the case relating to the practicalities of geological conservation rather than on wider issues raised at the inquiry relating to the relative importance of the economics of the marina development compared with geological conservation.

4.2 Key issues

Three key issues discussed at the Black Rock public inquiry are considered below.

Issue 1: Is the application of 'mesh' really necessary at Black Rock?

The local planning authority argued that the proposed engineering works were required in order to re-open the Undercliff Walk footpath, to ensure the safety of the supermarket below, and to prevent further cliff retreat which, if left unchecked, would undermine the road that runs along the top of the cliff. They argued that there could be a major rock fall resulting in a health and safety disaster and the possibility of a major road into Brighton being closed.

English Nature argued that the proposed scheme of rock bolting/ nailing and application of 'mesh' need not be an 'all-or-nothing' scheme. By separating these two engineering operations, it was pointed out that bolting/ nailing alone would largely deliver the local planning authority's objectives in terms of stabilising the rock face. Bolting/ nailing alone would be expected to remove the risk of major rock falls that could impact on the supermarket below or undermine the road above. Although bolting/ nailing would have an impact on the geological features in the cliff, it would be significantly less than that from the 'mesh'. By separating these two engineering operations and by accepting the impact of bolting/ nailing alone, the added engineering benefits arising from the application of 'mesh' was brought into focus and could be shown to be largely that of protecting the Undercliff Walk footpath from falling rocks. Thus, it was then argued that by adopting a bolting/ nailing solution, and by diverting the small section of footpath running under the cliffs at Black Rock to a safer distance, it would be possible to safeguard the supermarket and road without the need to apply 'mesh' onto the rock face at all.

Issue 2: What are the potential impacts of the 'mesh' on the scientific importance and educational value of the site?

The local planning authority argued that the impact of the 'mesh' on the scientific interest and educational value of the site would be negligible, with the geological structures still being present and clearly visible through the 'mesh'. A stretch of chalk cliff adjacent to Black Rock, which had already been subject to the application of 'mesh', was used to illustrate that the geological features underneath the 'mesh' were still clearly visible and that the visual impact of the 'mesh' was thus minimal. It was also argued that any debris or vegetation collecting behind the 'mesh' would be cleared away on a regular basis to prevent build-up.

English Nature identified three potential impacts on the scientific and educational interest of the Black Rock exposure arising from the application of 'mesh'. These being:

A. **The impact on the integrity of the geological features at Black Rock**. This relates to direct physical impact on the geologically important features themselves. Conservation of the features requires that they are not physically damaged or removed. English Nature accepted that the application of 'mesh' would have no direct impact on integrity as it would obscure, rather than damage or remove the features. The installation of the associated rock bolts / soil nails etc needed to support the 'mesh' would, however, have a small impact through drilling holes for bolts.

B. **The impact on the special scientific interest of the geological features at Black Rock**. This was assessed against the two key characteristics of the site which underpin its scientific importance, namely importance of clear visibility of the exposure and the importance of being able to accurately sample from different horizons in the geological exposure.

B1 Impacts on the ability to interpret the site visually: In terms of assessing the impact of 'meshing' Black Rock, clear visibility allowing visual interpretation of the rock face is an essential component of the site's scientific value, as much of its scientific importance results from the features and structures visible in the cliff. Black Rock is a visually spectacular and complex site, with intricate vertical and horizontal variation in its stratigraphy over a relatively small area (Figures 1& 3). Visual appreciation of the three key geological features: 1) the ancient cliff-line, 2) the raised beach and 3) the sequence of later sediments that filled the angle between the ancient cliff and the ancient beach are critical in understanding the site. The ability to visually appreciate the interrelationship between these three features is even more important in understanding the geology of Black Rock.

In terms of the impact of 'mesh' on the visibility of the site, English Nature argued that the 'mesh' and to some extent the associated rock bolts / nails, would obscure important detail of the rock layers and structures in the chalk rubble and debris deposits (the Supermarket Member) and the raised beach (the Black Rock Member), and would also obscure the critical junction between the ancient chalk cliff and the later ice age sediments (Figures 1 & 4). In short, the visibility of all three scientifically important geological features, and the relationship between them would be affected by the application of 'mesh', although an alternative option which would leave the raised beach free of 'mesh' was also proposed by the local planning

authority. In presenting the case that the 'mesh' obscured the geological features, English Nature argued that:

- The wire which makes up the 'mesh' directly obscures a proportion of the rock face. It was calculated that the actual wire proposed for use at Black Rock (an 80 mm mesh size with a wire diameter of 3.7 mm) would directly obscure around 9% of the face to which it was applied (Figure 5). If the 'mesh' was applied as proposed by the local planning authority in their planning application, it was argued that serious damage to the scientific interest of the site would take place, through partly obscuring the Supermarket Member and the Black Rock Member along a stretch of cliffs 120 metres long and 18 metres high, a total of 2160 square metres.
- The effect of the 'mesh' would be to fragment the view of the face into thousands of small parcels, further affecting the visibility of the face and the ability to interpret the intricate geological features exposed. It was also argued that the criss-cross lines of the 'mesh', especially when the face is viewed from oblique angles, would make it extremely difficult to pick out the vitally important geological structures in the rock that allow the site to be interpreted and appreciated.
- The 'mesh' would be likely to trap fallen debris behind it, thus encouraging the growth of vegetation. Overtime, the accumulation of debris and the growth of vegetation would lead to a further decrease in the visibility of the geological features.
- The large extent of 'mesh' would seriously damage the scientific and educational interest of the site by interrupting the continuity of the exposure. Even though some clean exposure would be visible at either end of the site, the 'mesh' across the middle section would break-up the exposures, making it harder to appreciate the relationships between the different geological features exposed in the cliff.

B2 Impacts on the ability to accurately sample from the rock face: Physical access to the features in order to undertake accurate scientific sampling from clearly identifiable stratigraphical horizons is also essential to the scientific value of the site. Given the complex variations in the glacial deposits, and recent advances in science that have resulted in the sequence being reinterpreted as being older than originally thought, the ability to undertake detailed logging and analysis of the succession exposed here is essential for future study. This is only possible if the stratigraphy and its variation are easily visible, and is physically accessible to scientists through abseiling from above or using 'cherry-picker' machinery from below.

In terms of the impacts of the 'mesh' on the ability to sample from the face, English Nature argued that the 'mesh' would trap debris behind it and encourage vegetation growth over time. As well as directly obscuring the rock face, it was argued that such a covering of trapped rock debris and vegetation would make it extremely difficult, if not impossible, to study and to sample at close quarters from, a clean, well exposed rock-face. As described below, the likelihood of an exposure behind a covering of 'mesh' being regularly cleaned is not high given the safety and cost implications of

such an operation. Thus, debris behind the 'mesh' is likely to be a long-term, if not permanent impact.

C. **The impact on the educational value of the geological features at Black Rock.** The educational value of the site lies largely in the ability to see clearly the features exposed in the cliff and the relationships between them. Thus, the impact of the 'mesh' is largely one of reducing visibility. At the public inquiry, English Nature argued that the educational value of the site would be seriously damaged as a result of the reduced visibility of the chalk rubble and debris sequence (the Supermarket Member), the raised beach (the Black Rock Member), the ancient chalk cliff line itself, but most importantly as a result of the reduced visibility of the relationship between these rock units – the key element of site's educational interest.

Issue 3: Can the 'mesh' be designed to minimise its impact on the geological interest of the site?

The local planning authority argued that fears about the 'mesh' permanently obscuring the face, and about material accumulating behind it were unfounded. They argued that the 'mesh' could be designed to have removable strips. This would allow geologists to access sections of the face on request. They also argued that regular 'bleeding' of any material collecting behind the face would take place to stop the accumulation of debris.

English Nature accepted that production of specially designed 'mesh' may be possible but that as the 'mesh' would be in place, other than on rare occasions when it was removed for scientific study, the geological features would still be obscured for most of the time. It was also pointed out that nothing like this has been attempted on a geologically important site before, and that Black Rock, a nationally important geological site, where visibility is of critical importance to the site's interest, should not be used as an experiment on which to develop 'mesh' design. It was also argued that it would be very complex to design a scheme of 'mesh' in this manner, and that the likelihood of sections of 'mesh' actually being removed to facilitate scientific study and cleaning may not be high once the 'mesh' was in place. In particular, it was unclear who would pay for the removal of sections of 'mesh' and there was concern expressed that the costs and safety implications of doing so could prevent it from happening.

5 Black Rock case study – supporting evidence

As that this was the first serious examination of potential impacts of 'mesh' on geologically important features, and because there were no previous case studies upon which to draw, English Nature opted to submit supporting evidence alongside the site specific analysis described above. To this effect, three other areas of evidence were explored and submitted, these being:

5.1 What can we learn from other places where 'mesh' has been applied?

Given the lack of published literature on the potential impacts of 'mesh' on geological features, and the fact that there is no record of a geologically important rock face being draped in 'mesh' and monitored to record its impact over time, hard evidence to prove that geological exposures would be obscured in the manner anticipated by English Nature and the geological community, was difficult to find. However, in seeking examples of rock faces that

had been subject to the application of 'mesh' in the past, the eastern side of the M3 road cutting, to the east of Winchester, and known as the Spitfire Bridge Section, was examined. This site was similar to the cliff at Black Rock, both in terms of rock type and angle of slope. It had been 'meshed' late in 1986 and demonstrates clearly how a geological exposure, similar to that at Black Rock, has deteriorated through time behind 'mesh'. The site shows how the rock face has weathered to a more stable and less steep slope, and how trapped rock debris and vegetation growth has formed a thick layer behind the 'mesh', completely obscuring all natural rock exposure. This site was used to illustrate how Black Rock may look if 'mesh' was applied as proposed and how this could result in the loss of the scientific interest and education value of the site (Figure 6).

5.2 The views of site users regarding the application of 'mesh'

In the absence of hard evidence from case studies, it was decided to submit the thoughts of those who use Black Rock for scientific and educational purposes on how they believe the application of 'mesh' would impact on their use of the site. Consequently, views were sought and many letters were received, all of which were submitted in full as evidence at the public inquiry. A number of quotes were lifted from the letters and used at the public inquiry to illustrate the views of site users. These included:

Mr Cooper (Brighton and Hove Geological Society and Sussex RIGS Group) who viewed "*with some horror any requirements for bolting and particularly meshing. This will clearly harm the structure of the exposure and detract from the visual aspects of this large site*". He noted that the 'meshing' to the east "*is already a visual nuisance and can only get worse as detritus and vegetation builds up behind the mesh*" and that the proposals "*would have a deleterious effect on the exposure which in time would become obscured by falling debris caught in the mesh and subsequent growth of vegetation*".

Dr French (The Geologists' Association) noted that the proposals, including covering the lower part with 'mesh' "*will immediately ruin the visual significance of the site and in the longer term will probably result in the establishment of vegetation over much if not all of the exposure*".

Dr Gibbard (University of Cambridge) noted that "*the meshing will obscure the very sediments the site is preserved to expose*" and that "*Once covered there would be expected to be considerable local opposition, understandably, to cleaning the face for professional purposes*".

Mr Hopson (British Geological Survey) expressed the opinion that the works proposed "*would essentially destroy the site in terms of its scientific and educational use. Access for further sampling and measurement would be severely restricted, and it is inevitable that the build-up of debris behind the mesh, over time, would finally obscure that detail left for observation*".

Professor Keen (Quaternary Research Association) stated that "*The placing of mesh over the section will stop any future attempts to clean the section for study and the driving in of bolts may actually cause further cliff collapse.*"

5.3 Analogies to illustrate the visual impacts of 'mesh'

In order to convey, in a visual manner, the impact that 'mesh' may have on the visibility of a geological feature, despite a large proportion of the feature still being visible through the openings in the 'mesh', it was decided to draw on three analogies, all unrelated to geology. The first of these was to draw attention to the impact that a wire mesh covering would have on the visual appreciation of a famous painting, for example the effect of viewing the *Mona Lisa* through a covering of chicken wire. The second was to consider the effect that scaffolding has on the visual appreciation and understanding of the architecture of a fine historic building. The third was to demonstrate the effect of placing a fine mesh (eg that used to make bags in which oranges are sold) over an Ordinance Survey map. This showed how features such as roads and contours become extremely difficult to distinguish despite the fact that a large proportion of the map is still visible through the 'mesh'.

6 The findings of the public inquiry

The 'Black Rock' public inquiry was held between 27 and 29 January 2004. In the spring of 2004, the planning inspector who heard the inquiry, submitted a report and recommendations (Simpson 2004) to the First Secretary of State. Subsequently, having considered the report and recommendations, the First Secretary of State, issued a decision letter (Moore 2004) which, in this case, largely agreed with the inspector's conclusions and recommendations. In short, the decision was to recognise a need for some cliff stabilisation work to prevent significant cliff falls, and thus to consent some rock bolting / nailing of the cliff face, but to also recognise the potential adverse impact of 'mesh' on the geological interest of this site and thus not to consent the use of 'mesh' as part of the stabilisation work* (Prosser 2004).

The detail of the inspector's report and the First Secretary of State's planning decision are given below:

The planning inspector's report (Simpson 2004): relevant statements

Paragraph 15.9: *"In aesthetic terms the existing mesh is not attractive, particularly when viewed at an oblique angle as is the case when viewing the mesh from the 'Marina to Marine Drive' footpath at the western end of Black Rock. The proposed meshing would be equally unattractive when viewed from this point. More importantly, it would impede oblique views of the stratigraphy of the combe rock. Conclusions on the likely impact of the mesh on perpendicular views of the stratigraphy are less easily drawn. The degree to which the finer detail of the exposure would be obscured by the physical presence of the mesh is uncertain, although the areas of stitching and overlap between the sections of mesh to the east are relatively conspicuous. To the extent that the mesh would allow a build up of talus, this would tend to further obscure the finer detail of the stratigraphy and decrease the educational value of the exposure".*

Paragraph 15.10: *"To overcome this objection, periodic release of the mesh for maintenance and scientific research purposes is suggested on behalf of BHCC….. However, there is no*

* Due to an administrative error, the actual planning condition excluding the use of 'mesh' was accidentally omitted from the list of planning conditions issued in the original inspectors report (Simpson 2004) and in the letter from the First Secretary of State. To correct this mistake, both documents were subsequently re-issued in 2005 with the condition included as intended.

evidence that this has been tried successfully elsewhere, and certainly not on this scale….. It was suggested that panels of mesh could be designed to be capable of being opened, although it was thought unlikely that whole vertical sections of mesh could be removed. As a requirement of this approach is that the 'openable' sections of mesh would need to be designed-in from the outset, that would also require some prior judgement as to those areas of the cliff that, from a scientific research viewpoint would benefit from this increased accessibility. That is not yet known. Moreover, the scale of plant and staff that would need to be present during any such operation, and the frequency with which it would need to be undertaken for maintenance purposes, are also not known".

Paragraph 15.16: **"***While English Nature raises some concerns about the insertion of soil nails into a cliff face comprising material much less solid than the intact chalk immediately to the east, its principle concern is with the impact of the mesh. This impact relates more to the ability of the scientific community to continue to study the features of geological interest rather than actual physical damage. For this reason it is difficult to draw clear conclusions or parallels from the impact of the meshing on the visibility of the intact chalk to the east, although from what I saw it is apparent that finer features are more easily obscured".*

Paragraph 15.17: *"While the soil nails would provide the mechanical or 'engineering' support for the cliff face and prevent the type of substantial cliff failure experienced in 2001 the mesh holds in place some of the material which would otherwise fall as a result of the normal self-cleaning processes of cliff face degradation. The size of the mesh allows some of the smaller pieces to fall through and to the ground below. Those generally larger pieces are retained more or less in situ, although there is some build up of talus, and without regular maintenance there would be a tendency for vegetation to become established".*

Paragraph 15.18*: "Both of these 'accreting' features would tend to obscure the detailed stratification they cover. While this is of less significance in the intact chalk to the east because its features are more generally replicated in areas that have not been meshed, it is of great significance within the Supermarket Member because of the lateral and vertical variability of the rock unit, and the relative fineness of the stratification which is more easily obscured."*

Paragraph 15.21: *"In relation to its designation as a GCR site the fact that meshing would inhibit scientific research and compromise its value as an educational resource constitutes an adverse impact….."*

Paragraph 15.58: *"Taking into account the significance to the scientific community of the unique combination of geological features found here, and the need to ensure the continued visibility of those features for academic study, I am satisfied that the meshing of the face as proposed would constitute a significant and material harm to the SSSI…."*.

Paragraph 15.61: *"I have concluded that the harm could be sufficiently ameliorated, and the development could go ahead, subject to the imposition of conditions, the most significant of which would require the omission of all meshing".*

Decision letter: Relevant statements made by the First Secretary of State (Moore 2004):

Paragraph 13: *"For the reasons given by the Inspector at paragraphs15.16 to 15.18 of his report the Secretary of State agrees that the modified application would obscure the features of the Geological Conservation Review site (GCR). He therefore agrees with the Inspector that the meshing element of the modified application would inhibit scientific research and compromise its value as an educational resource".*

Paragraph 17: *"The Secretary of State considers that the modified application with "opened" sections of meshing, …., would still result in some damage to the rock face. He also considers for the reasons given by the Inspector …..… that the "opened" meshing proposal would still inhibit scientific research and compromise the cliff's value as an educational resource. …..…the Secretary of State concludes that the modified application, which includes the proposal for "opened" sections of meshing, would be contrary to the adopted and emerging development plan as well as national planning policies".*

Paragraph 19: *"The Secretary of State agrees with the Inspector's conclusion that adequate rock face stability could be achieved by the use of soil nails or "rock bolting" without the need for meshing".*

Paragraph 20: *"Without the meshing the rock face would remain open and its educational value would not be compromised. The Secretary of State agrees with the Inspector's conclusion that the modified application, without meshing, would have markedly less conflict with national policies in PPG9. He considers that the modified application without meshing, …..…, would still result in some damage to the rock face. However, he agrees with the Inspector that the harm to the cliff could be sufficiently ameliorated by the imposition of conditions, the most significant of which would require the omission of all meshing".*

Paragraph 33: *"The application site is an important geological site and deserves its SSSI and GCR notification. In order to protect the SSSI from further cliff falls the Secretary of State agrees with the Inspector that some form of cliff stabilisation is necessary. However, the modified application would be harmful to the SSSI and GCR contrary to the adopted and emerging development plan and national policies. If the meshing were not included then the modified application would stabilise and protect the cliff minimising the harm to the SSSI and GCR reducing the conflict with PPG9. The Secretary of State concludes that by excluding the meshing the harm caused to the cliff by the modified application would be sufficiently ameliorated".*

Paragraph 34: *"The modified application without meshing would not stop minor rock falls and in the Secretary of State's view there remains a risk to public safety from such falls. Whilst the Council wishes to reopen the Undercliff Walk there are two other alternative public walkways and the Secretary of State agrees with the Inspector that the re-opening of Undercliff Walk is not of sufficient importance to outweigh the harm that would be caused to the SSSI and GCR by the modified application including meshing. The Secretary of State therefore concludes that the modified application should be allowed subject to conditions excluding the meshing and preventing the re-opening of the Undercliff Walk".*

7 Conclusions and discussion

The Black Rock public inquiry provided the first significant examination of the potential impact of the application of 'mesh' to a scientifically and educationally important geological exposure. As such, the case provides a basis from which to consider any other schemes which involve the application of 'mesh' to geologically important rock faces.

Of particular significance in terms of geological conservation, is the fact that in this case, both the Planning Inspector and the First Secretary of State concluded that 'mesh' would have an adverse impact on the scientific and educational value of the site (see section 6 above). The inspector and the First Secretary of State make a number of very significant comments and observations about a number of aspects of the application of 'mesh' to a geologically and educationally important exposure. These include comments about the impacts of 'mesh' in reducing visibility, the practicalities of designing removable 'mesh', and the trapping of debris behind 'mesh'.

Although 'mesh' was found to have an adverse impact on the scientific and educational value of the features at Black Rock, it is important to appreciate that Black Rock is a visually spectacular site with fine-scale, complex, laterally and vertically variable stratigraphy. Its scientific and educational importance depends upon it being clearly visible. Should an exposure of a more homogenous rock type be subject to proposals to apply 'mesh', the task of demonstrating an adverse effect is likely to be more challenging. Although Black Rock sets a precedent of a sort, each case will still need to be considered on its own merits.

It seems likely that there will be an increased number of schemes coming forward that involve the application of 'mesh' to geologically important exposures. In order to prepare for these cases, research based on monitoring of the impacts of 'mesh' on geological sites over time, and exploration of 'mesh' design in terms of 'removable sections' would be extremely useful.

Based on the experience of Black Rock, it is possible identify some of the key points that need to be considered when assessing the impacts of a scheme involving the application of 'mesh' to a scientifically and /or educationally important geological exposure (see Table 1 below).

Table 1. Key points to consider when assessing the impacts of a scheme involving the application of 'mesh' to a scientifically and /or educationally important geological exposure.

1. Is the engineering scheme really necessary – are there alternative solutions such as relocating the infrastructure threatened by an 'unstable' face?
2. Is 'mesh' really needed as part of the scheme – can the objectives of the scheme be met using other solutions such as rock bolts, catch fences, drainage?
3. Can the objectives of the scheme be met with a combination of measures including use of 'mesh' only in non critical areas of the site, or on a greatly reduced scale?
4. What is the scientific / educational interest of the site?
5. What is the nature of the geological features exposed in the site – are they intricate, finely bedded, laterally or vertically variable or are they thickly bedded or homogenous?
6. How is the site used – how important is visibility of the rock face and how important is it to be able to access the face to sample from it?

7. What are the views on the impacts of 'mesh' of those that use the site for scientific and educational purposes?
8. What area or proportion of the geological exposure will have 'mesh' applied to it and how does this relate to key features of the site such as different rock types or boundaries between rock types?
9. What percentage of the rock face is actually obscured behind the wire which makes up the 'mesh'?
10. What is the impact of the 'mesh' in terms of fragmenting the view of the geological features of the site?
11. What is the likely effect of the 'mesh' in terms of trapping debris behind it and encouraging vegetation growth – how do you know?
12. Are there any other similar sites that have been subject to 'mesh' that can be used to demonstrate the impact of applying 'mesh'?
13. What analogies can be used to illustrate the impact of applying 'mesh' in terms of reducing visibility?
14. What ongoing management of the site is required in order to maintain its scientific and educational value and what impact would the 'mesh' have on the ability to carry out this management?
15. Is having removable sections of 'mesh' compatible with the scientific and educational value of site and is achieving this technically and financially feasible and safe?
16. If the option of removable sections of 'mesh' is appropriate, what would the procedure be for removing a section of 'mesh', how would commitment and funding to do this be guaranteed, who would pay for it and what are the health and safety implications?

Should a situation arise where permission for the application of 'mesh' is granted, mitigation measures surrounding the size of the apertures in the 'mesh', the degree of overlap between adjacent panels of 'mesh', a requirement to undertake photographic and geological surveys before the application of 'mesh', and monitoring of the impacts of the scheme over time should be sought.

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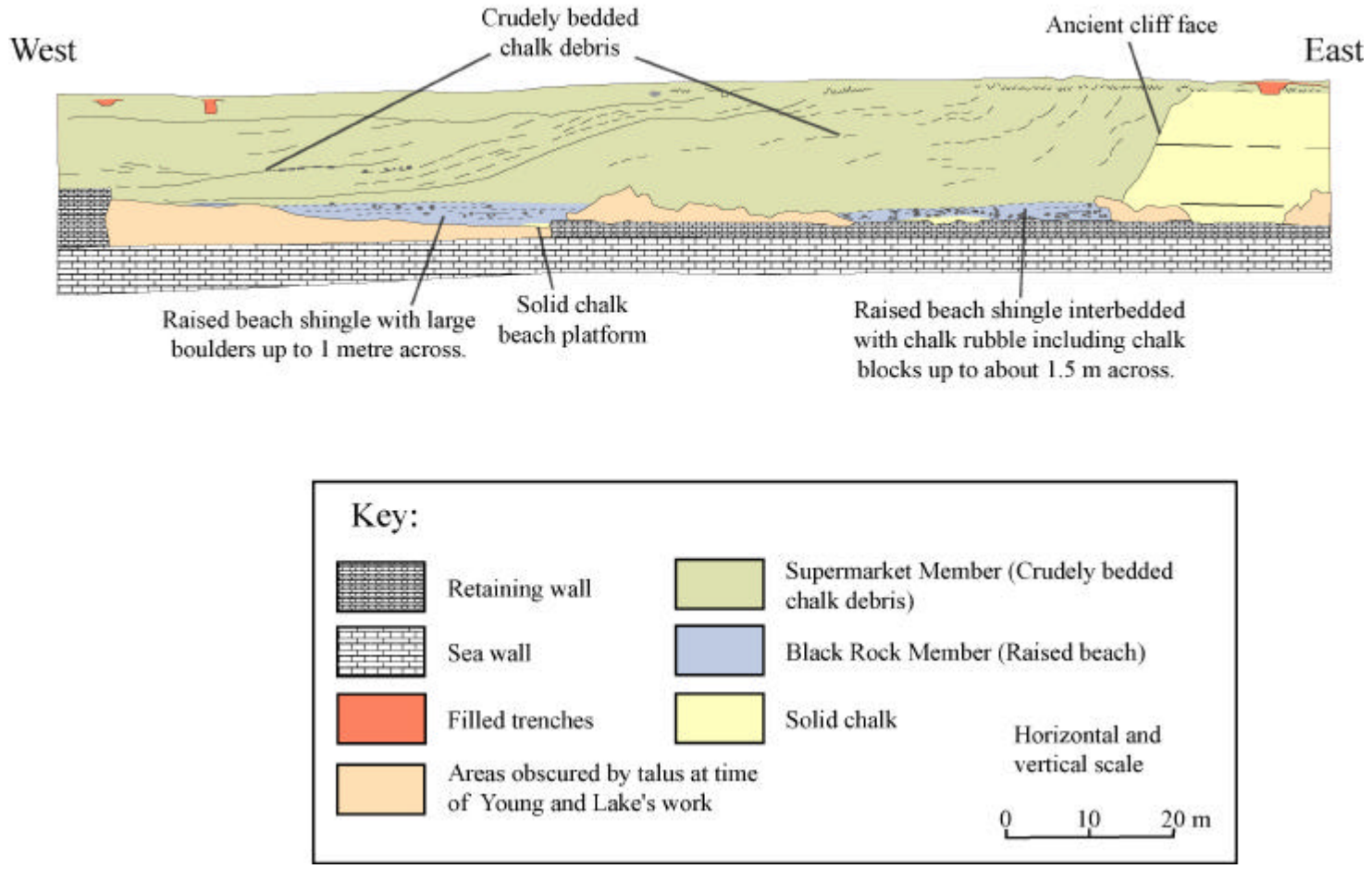

Figure 1. Section showing distribution of Quarternary sediments and the position of the ancient chalk cliff at Black Rock. After Young & Lake (1988 Figure 26)

Figure 2. The cliffs at Black Rock looking eastwards. The previously 'meshed' area of chalk is clearly visible as a darker area. Colin Prosser/ English Nature.

Figure 3. The Quaternary exposures at Black Rock illustrating the visually spectacular and complex laterally and vertically variable stratigraphy. Colin Prosser/ English Nature.

Figure 4. The ancient chalk cliff-line, marked by the junction of the browner sediments on the left and the whiter chalk on the right, and by the end of the thin flint band half way up the cliff face. The geological community argued that this scientifically important and hard to distinguish feature which would be obscured if the existing 'mesh' was extended westwards to cover it. Natalie Bennett/ English Nature.

Figure 5. Detail of recent 'mesh' on the chalk at Black Rock. It shows early stages of vegetation growth and accumulation of debris behind the 'mesh'. Natalie Bennett/ English Nature.

Figure 6. The Spitfire Bridge road cutting east of Winchester, a similar section to that a Black Rock. This site illustrates how rock debris and vegetation has accumulated behind the 'mesh' over time, completely obscuring the geological exposure. Tony Cosgrove/ English Nature.

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Research Information Note

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The impact of 'rock-fall' mesh / netting on scientifically and educationally important geological exposures: a case study

Report Authors: Colin Prosser Date: June 2006
Keywords: geological conservation, geological exposures, site management, 'rock-fall' mesh, slope stability, Black Rock, public inquiry

Introduction

There are many threats to the conservation of scientifically and educationally important geological exposures. The nature of these threats, the impacts they may have and the management strategies that can be used to deflect or mitigate against them are generally well understood. Occasionally, however, a new threat comes to light and its impact needs to be assessed and understood. The application of 'rock-fall' mesh / netting (henceforth referred to as 'mesh') onto scientifically and educationally important geological exposures, usually as part of an engineering scheme aiming to achieve face / slope stability, is one such new and growing threat. The impact of this operation needs to be better understood and ways of assessing and demonstrating it need to be developed.

What was done

In 2004, proposals to apply 'mesh' to scientifically and educationally important geological exposures at Black Rock, Brighton, (a Site of Special Scientific Interest (SSSI) and a Regionally Important Geological / geomorphological Site (RIGS)) were heard at a public planning inquiry. In preparation for this inquiry, considerable analysis and thought went into considering how best to assess and demonstrate the impacts of 'mesh' on the important geological exposures at Black Rock. The inquiry provided a forum for rigorous examination of the evidence both for and against there being an impact from 'mesh', and the findings of the inquiry and the planning decision letter issued by the First Secretary of State provided further analysis and opinion on the subject. This report uses the Black Rock case study, including the public inquiry and subsequent findings, to consider the impacts of 'mesh' on geologically important exposures. It goes on to provide a checklist which may be used in assessing the impacts of 'mesh' on geological exposures of scientific and educational value in cases which may arise in the future.

Results and conclusions

The preparation for the public inquiry, the inquiry itself, the findings of the inquiry, and the subsequent planning decision described, and accepted, the impacts that 'mesh' would have on the scientifically and educationally important geological exposures at Black Rock. These impacts include a reduction of visibility of the exposure, especially from oblique angles, the trapping of debris and increased vegetation growth behind the 'mesh' and the restriction of the ability to accurately sample from the geological exposure. Mitigation measures such as removable sections of 'mesh' were considered but are not yet developed to a point where they could be considered as a viable option. A checklist for use in assessing a scheme involving the application of 'mesh' onto a geologically important rock face has been produced based on the experience and findings of this case study.

English Nature's viewpoint

English Nature has a key role to play in conserving geologically important exposures and in assessing, managing and mitigating against threats likely to impact on such exposures. The application of 'mesh' on to scientifically and educationally important geological exposures is undoubtedly a growing threat that needs to be better understood and managed. This report provides the first published attempt at capturing current thinking on how to assess and demonstrate the impacts of 'mesh' on geologically important features and provides guidance that should applicable in assessing similar cases in the future. Whilst this case study provides a sound basis from which to assess and demonstrate the impacts of 'mesh', it reflects only one case study. Similar proposals on less visibly significant homogeneous geology, for example, may lead to different conclusions being reached, thus highlighting the need for each case to be assessed on its own merit.

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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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