AN EVALUATIVE METHODOLOGY FOR RECLAMATION ACHIEVEMENT & TECHNIQUES [1]

by

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Abstract. The UK Government was a signatory in 1992 to the Rio Earth Summit and is committed to sustainable development. Current planning policy for developments involving mineral extraction embodies this principle. In order to achieve sustainability, it is essential that appropriate and adequate techniques are used, and that successful reclamation is achieved. At present, there is no formalised method whereby an evaluation can be consistently and objectively carried out. This paper proposes a methodology for the UK whereby achievement can be assessed, and the reasons and course of action required are identified. The components of the methodology are the setting of standards and survey of achievement, examination of documentation, monitoring of implementation, and the judicious use of trials and experimentation. The application of the methodology within the UK context is discussed.

Additional Key Words: sustainability, planning conditions, standards, monitoring, implementation

Introduction

The UK Government was a signatory in 1992 to Agenda 21 at the United Nations Conference on the Environment and Development held in Rio de Janeiro, Brazil and commonly referred to as the 'Rio Earth Summit' (UK Government 1994). Government planning policy framework for developments involving mineral extraction now includes sustainability as a criterion for granting permission (Department of the Environment 1996 a & b, 1997). Consequently, successful reclamation of mineral sites is a key requirement if the commitment to sustainability is to be achieved in practice. This may require the original landuse to be satisfactorily restored or satisfactorily restored to an agreed alternative. In the case of some mineral workings, the restoration to wildlife habitat is seen as an acceptable alternative and an opportunity to contribute to the UK's biodiversity targets and aims which are part of Agenda 21 (Humphries et al 2000).

In order to achieve successful restoration, it is essential that appropriate and adequate techniques are used. The requirement for successful reclamation means that routine assessments of achievements and the effectiveness of techniques have to be undertaken, and where necessary, techniques improved or substituted. At present there is no formalised methodology whereby the need for improvement or alternatives can be evaluated. A formalised methodology is also required if there is to be objectivity, and consistency between assessments. This is the topic of this paper.

The Evaluative Methodology

The following is a presentation of the proposed methodology.

The Starting Point

The starting point of the methodology is the assessment of the success of reclamation achieved and ultimately sustainability (Figure 1). This requires the setting of objective and independent standards.

Standards. Other than the requirements of Schedule 5, Sections 3(1) & 3(2) of the Town & Country Planning Act, 1990 (UK Government 1990) to restore agricultural land to the same physical characteristics (where recorded) or to be fit for agricultural use (in the absence of records), there are no other statutory standards or targets for the

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reclamation of sites in the UK. Without standards it is not possible to assess objectively the restoration achievement nor the success and merits of techniques.

Standards, for example, could be simple landuse objectives (Humphries et al 1984; Humphries et al 1999), or the achievement of more precise physical soil and site characteristics (Street 1985; Humphries and McQuire 1994a; Bending et al 1999) or biological features (Vincent 1998; Humphries and Benyon 1999). These could be set in the planning consent and attached conditions (ie permit), as an attached legal agreement, or as a condition requiring specific details to be submitted later by the operator for agreement by the authority.

If standards are to be adopted they must be supported by sound experimental or empirical information. For example, in the 1980's it was recommended to the minerals industry that for successful reclamation of grassland it was necessary to build up a soil/vegetation/litter nitrogen capital of 1000 kg/ha or a soil nitrogen capital of about 700kg/ha (Coppin and Bradshaw 1982; Williamson et al 1982). The same advice is still being suggested as a target twenty years later (eg Bending et al, 1999). The estimates of nitrogen capital for successful restoration was based upon a series of studies of natural succession and surveys of revegetated china clay wastes. However, critical examination of the source literature results in the inevitable conclusion that there is in fact no evidence that the stated thresholds were of significance, and the levels cited had no empirical or experimental basis (Humphries and Rowell 1994). Hence, the nitrogen levels suggested in the literature should not be set as a standard.

The standards must also be appropriate to the particular situation. For example, recent government funded research (Bending et al 1999) proposed pH 6.0-8.5 as the "Minimum Standard" for the cultivation layer of soil forming materials for agricultural grassland restoration. On this account, the acidic soil forming materials used to restore a site in South Wales would have been discounted as the pH was typically 5.5 or lower. A satisfactory grassland fit for upland grazing (sensu Schedule 5, Section 3(2) of the Town & Country Planning Act 1990) has been achieved on this acidic material in the absence of natural soils, and has been accepted by the planning authority and its statutory advisor (Humphries et al 1999). Liming to raise the pH to the standard cited above was considered inappropriate for the upland site as this would result in grassland of a type out of local landscape and landuse character.

Surveys. Survey is the methodology whereby the restoration achieved and the effectiveness of techniques is assessed against the standards.

If sufficient sites are studied, trends can be identified and generalisations can be made about the overall effectiveness of techniques. For example, 70 tree planting schemes on colliery tips and lagoons at 34 collieries in England and Wales were surveyed in 1986 to determine their success (Humphries and McQuire 1994b). The survey identified that 46% had satisfactory establishment, but only 19% had achieved acceptable growth. A trend in mortality was identified with the highest mortality occurring in the first year. Poor establishment in the early spring was identified to be due to a range of factors, but late summer mortalities were invariable due to drought stress caused through competition from herbaceous vegetation. Competition was also the cause of the poor subsequent growth performance. Clearly, the techniques being used at the time to control competition from herbaceous vegetation were inadequate, not properly applied, or not applied at all (Humphries and Benyon 1994).

The evaluation is complete when a survey indicates satisfactory achievement of the standards (Figure 1). A satisfactory result should be reflected in the techniques required or specified in the reclamation of future sites. When the level of achievement is deemed unsatisfactory, then there is a need for further examination and the procedure shown in Figure 1 should be evoked.

Review of Documentation

The next stage in the evaluation of unsatisfactory schemes is the examination of the conditions attached to the planning consent (permit) and site documentation for relevant contractual works. The techniques to be used should be specified, be those recommended in the literature and proven through trials and survey.

Generally, planning conditions do not specify how the restoration is to be undertaken and which techniques are to be used. Similarly, it is

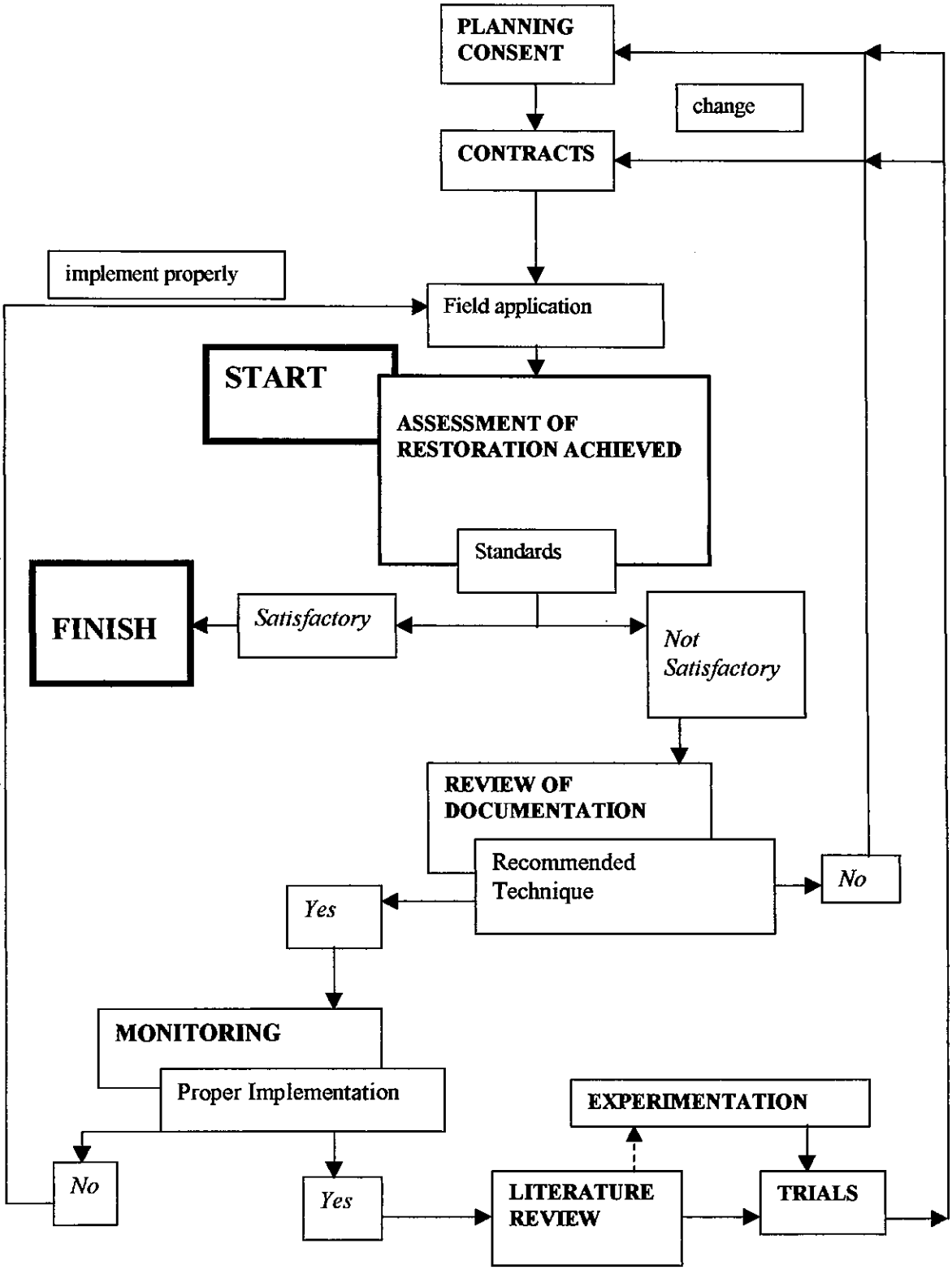

FIGURE 1 Evaluation Methodology and Pathway

common for the techniques not to be specified in the site contracts. This is a weakness in the process as less than satisfactory techniques may be used or key ones omitted, as was reported by Humphries and Benyon (1994) in their survey of tree planting practices on colliery wastes.

Where techniques are specified in conditions and contracts they are often older, less satisfactory practices and not the current recommended method. For example, this is well illustrated by the continued requirement of sequential soil placement and ripping without any consideration to the treatment of recompacted lower layers when soil is spread by earth scrapers or bulldozers. This is despite recompaction being widely reported in the literature and alternative practices being recommended (McRae 1979, 1983 & 1989; Bacon and Humphries 1987 & 1988; Humphries and Whittington 1988; Dunker et al 1992).

Broad guidance is available in the government guidance note, "The Restoration of Mineral Workings" (Department of the Environment 1996b), and reference is made to sources of recommended techniques that have over the years been published by a range of government departments and agencies, and researchers and practitioners. Whatever the source, recommended techniques must be rigorously tested and scientifically sound, and should be subject to critical scrutiny and review of the supporting literature. Literature reviews generally fall into two categories, those, which are simply a collation of examples or information, and those, which attempt an examination of the evidence in support of practices and their basis. Most literature reviews fall into the former category and need to be used with caution to avoid incorrect conclusions being arrived at (Humphries et al 1984; Humphries and Rowell 1994). Literature reviews are not without their limitations as they may be based upon unpublished work and it may be difficult to locate the original information.

When a critical review indicates that the benefits of a particular technique are well established and proven in the field, then there is a case for the technique being adopted as the recommended technique. Where there is an inadequate basis or field evidence for the technique, it should be rejected until there is satisfactory evidence from further trials or survey. However, some techniques may also serve other necessary operational functions. For example, the effects of cultivating the fine textured colliery shales in the English Coalfields of the UK is short lived and of questionable value (Rimmer & Colbourn 1978). Ripping is often required on the other hand to dislodge obstructions (boulders, wire rope, etc) and incorporation of ameliorants/treatments (Humphries et al 1984).

When the document review indicates that the recommended technique is not being used, the course of action is to amend the planning conditions or contractual documents as appropriate (Figure 1). If the review indicates the recommended technique is being used, then monitoring of the implementation of the technique needs to be undertaken as poor implementation may be the cause of the unsatisfactory achievement, rather than the limitation of a technique per se.

Implementation

It is important to recognise that the recommended, required and contractually specified techniques can be omitted or modified during implementation in the field as a result of variations in site condition, equipment availability, level of supervision, etc. Monitoring of proper implementation is therefore a critical part of the evaluation procedure.

The requirement to monitor is often omitted from the planning conditions and in the reclamation process to the potential detriment of the scheme. Monitoring should involve the careful observation and documentation of each stage of the reclamation process, and of deviations from the specified techniques and materials. For example, the close observation of 21 planting schemes in progress at 8 collieries in 1987 revealed that that poor stock handling practices probably accounted for the early season species specific failure of alder (*Alnus* spp), birches (*Betula* spp), and larches (*Larix* spp) (Humphries and McQuire 1994b). This was not surprising as these species are particularly susceptible to root desiccation on exposure. Either, no specific requirement to protect the plants at lifting at the nursery, during transit and at planting had been included in the contract, or if they had, it was not implemented in practice (Humphries and Benyon 1994). Incidents of the absence of packaging and

use of 'planting bags', and plant roots left fully exposed during planting were observed.

Where observations indicate poor implementation is the cause of unsatisfactory results, steps should be taken to make changes in field practices (Figure 1). An increase in level of supervision may be all that is required in many cases (Humphries and Benyon 1994; Endinger et al 1999). In other instances, contractual provisions are required which may include making the contractor responsible for achieving the required standard (Humphries and Benyon 1994).

When field based observations confirm that implementation has been satisfactory, this indicates that the recommended technique is not adequate, and an alternative is required. This is usually found by referring back to the published reports of studies, the commissioning comparative trials of alternatives or experimentation to identify novel ones (Figure 1).

Trials and Experimentation

Trials are a mechanism whereby alternative techniques are tried, compared and perfected under operational conditions and scale. The trials should only involve treatments and practices for which the process etc are fully understood from the literature or by experimentation. Trials are only appropriate in the evaluation process where recommended methods have been specified and properly implemented, but have failed to achieve the required standard (Figure 1).

Experiments are more rigorous than trials, and are a means of testing hypotheses about the effects of techniques or treatments, or processes involved in the treatments. They should not normally be used as a means of evaluation of techniques or achievement. Consequently, experimentation should only be undertaken when the primary evaluation methods of survey, literature and monitoring and trials indicate a real need to understand more about either, the processes or the effects of treatments in order to identify alternative treatments. Experiments should also only be undertaken after conducting an extensive and critical literature review. I recommend that it covers the past 40 years as it is not unusual to find that the proposed studies have already been reported elsewhere.

Careful design and control of field conditions within trials and experiments is essential if observed effects are to be attributed to a treatment (Humphries et al, 1984). For example, in the trial investigating agricultural restoration of landfilled gravel workings at Bush Farm in the early 1980's, the method of spreading of soil was not consistent between treatments and so confounded some of the treatment comparisons (Worthington, 1999). As a result, Worthington considered it was not possible to use the trial to fully achieve the original objective of evaluating the relative performance of earth scrapers compared to excavators and dump trucks as was recently attempted by Reeves (1999).

Discussion

With sustainable development now driving development policies in the UK (UK Government 1994), it is no longer acceptable for mineral extraction sites currently being granted planning permission to fail to achieve their reclamation objectives or to be sub-standard. It is therefore essential that appropriate standards and techniques be specified in planning conditions attached to the consent (permits) and contracted works, and that they are properly and fully implemented. The process of evaluation of achievements and practices are therefore critical parts of the reclamation process and the commitment to sustainable working of land for minerals. It can be argued that evaluation will need to be adopted as a routine procedure. Hence, there is a need for a formalised approach such as that described in this paper to have consistency between appraisals and determine the reason for any schemes failing to achieve the necessary standard.

Figure 1 clearly indicates that the key element in the proposed methodology is the setting of standards. This is based on the premise that the objective of the evaluation is to ensure sustainable development. In the UK it is up to the planning authority to specify the standards in the planning conditions and ensure they are achieved. Currently, standards are rarely specified in the conditions attached to planning consents (permits), and the standard achieved is rarely assessed at the end of the statutory five year aftercare period (Stephen, pers. com.). Even the existing statutory agricultural standards are rarely included in conditions by mineral planning authorities or offered in planning applications by operators. Instead, the process in the UK has been a subjective one of agreeing the site

either, has or, has not been generally restored in line with the expectations of the planning authority and its statutory advisors. It could be viewed this approach is no longer acceptable because of the requirement for sustainable schemes, and this calls for objective assessment and a methodology. This is particularly important now that schemes have become more complex and adventurous, often a response to the increasing difficulty companies are experiencing in obtaining planning consents. The achievement and undertaking of these schemes as originally proposed should be audited.

The planning authority will need to be aware of the standards available, their appropriateness and achievability, and methods of assessment. Any standards set must be reasonable and not unduly onerous if they are not to be open to legal challenge. It is likely that the relevant government agencies and departments would give advice on the standards to be set during the consultation process. Standards will need to be formulated and in this respect and this, and methods to assess them, is a potential area requiring further research.

In the past, there has been a lack of resources for the authority to undertake assessments. Recently there has been debate about who pays and undertakes the current subjective reviews, especially now that the Farming and Rural Conservation Agency is less able to be active owing to reduced funding. The adoption of the suggested formalised evalnation will require even more resources. One solution could be that the industry pays a planning fee for the evaluation to be undertaken by the authority or its appointed agents (Simpson, pers. com.). Alternatively, the industry could commission the assessments through accredited persons or bodies, and the reports submitted to the planning authority as a condition. This latter approach has been adopted in several schemes I have been involved in, and was routinely undertaken (known as 'site completion reports') by the nationalised coal industry prior to privatisation.

It will be difficult for planning authorities to be able to enforce standards where none have been specified, and it may even be difficult where the operator alone has offered them in their application. They may also be more difficult to achieve in the absence of restoration bonds. An alternative approach could be that standards need not be set if the best techniques available are required, because the best possible restoration would be achieved de facto. This approach has some attraction as it potentially avoids the uncertainty of enforcement of restoration achievement and resulting protracted arguments. It should be easier for the planning authority to enforce the implementation of techniques, provided that they are clearly and properly specified. If this approach were preferred, then the evaluation process in Figure 1 could easily be amended accordingly. However, this approach would require rigorous and routine monitoring at the implementation stage if it were to be tenable. Hence, this approach also requires more resources than are currently available to be effective. Again, this could be undertaken or commissioned by the industry with provisions for reporting to the authority.

On the other hand, it could be argued that without standards being set and the restoration achievement assessed, it will never be known whether mineral development are achieving the principle of sustainable development.

Irrespective of the approach adopted to ensure successful restoration is achieved, it is essential that the mineral planning authorities are aware of best practice and ensure it is used when granting planning permission and setting conditions, and the industry and its contractors implement them fully when undertaking the work. The required techniques stated in conditions and contracts need to be consistent with up-to-date recommended practices. However, it is essential that these are not too restrictive and allow flexibility in choice or application for reasons of site circumstances, simple economics, etc.. The key point is that, whatever technique is used it must achieve the restoration objectives. In many cases several techniques may give perfectly acceptable results. In this respect, the standards approach offers greater flexibility to the industry than might have been first thought. The alternative best practice only approach, by its very nature, appears to offer less flexibility. It is, therefore, important that the planning authorities are made aware if the standard set or more general restoration objectives can be met by only one or more techniques.

The lack of supervision and monitoring of implementation of restoration are recognised as important causes of poor achievements (Stephen pers. com.). It is essential that implementation is scrutinised and recorded during the site works

irrespective of whether the 'standards' or 'best techniques possible' approaches are adopted. Historically, both supervision and monitoring at the implementation stage have not been carried out on a consistent and routine basis in the UK. With the reduced resources for the FRCA, it is now essential that a requirement for monitoring is also incorporated in planning conditions and the results reported to the planning authority. It is here that the industry through its trade associations could assist by encouraging its members to commit themselves to monitoring and reporting.

Finally, I believe there is now justification for a national UK centre for reclamation to assist in the setting of standards, methods of assessment, and rating the efficacy of techniques in respect of standards. A centre would ensure that there is consistency and independence of advice. It would also serve to collate information, carry out critical literature reviews, review practices and disseminate information.

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