1. Drainage
Most restored mineral sites will require underdrainage where agriculture is the proposed after-use. Even on sites where the soil prior to being worked was free draining, this may not be the case once it has been disturbed. Indeed, what may have made the site free-draining, i.e. sand, gravel, chalk etc. may well be the very material extracted. The drainage of a restored site requires more detailed consideration than the under drainage of an undisturbed soil.

2. Drainage details should be checked for the following
   a. is underdrainage to be installed while restoration is in progress
   b. do ditches need lining to prevent erosion
   c. are there any temporary water management arrangements
   d. does the site need to be sealed against the inflow of water

For more detailed information see:
- MPG 7 The Reclamation of Mineral Workings (DoE 1996)
- The Design of Field Drainage Systems (MAFF Booklet 345)

Cross references:
- RN 4, 5, 8
- AC 9
1. Drainage

Most restored mineral sites will require and benefit from the installation of an underdrainage system where a restoration to agriculture is proposed. Restored soil is disturbed soil, having lost its natural structure which provides channels for drainage water and root penetration. Thus, sites in their pre-working state may have been considered free-draining, but may no longer be so once disturbed. In addition, what may have been a significant factor in making the site free-draining, i.e. the underlying sand and gravel, chalk etc. will have been the very material removed. To add to the problem, the underlying mineral may well have been replaced by a much less permeable layer. It is the restored profile, therefore, that dictates the drainage need and not the pre-working natural state of the soil.

2. Drainage details should be checked for the following

a. is underdrainage to be installed whilst restoration is in progress
   The most common method of installing land drains (continuous lengths of perforated plastic pipe) is from the surface using a machine which cuts a narrow trench into which is fed the pipe and permeable backfill (if required). Thus, on restored land, the work is carried out once all the soil has been replaced. However, some operators choose to drain as part of the restoration process. In practice, this means that as soil is replaced in, for example, 20m strips, the drainage pipe is laid on the overburden/fill/cap surface and perhaps then covered with a permeable backfill (usually washed gravel). Although a number of operators employ this system, it is not without its problems, viz...

   (i) the gradients on the pipe are dictated by the gradient of the surface on which they are laid, whereas when installed from the surface, there can be a considerable degree of flexibility.

   (ii) once the pipe has been laid, damage can occur by the tipping/movement of soil above it, or by indiscriminate trafficking by operators machinery. If this damage goes unnoticed, it may have long-term effects.

   (iii) where a permeable backfill is required, it is normally laid over the pipe to within 22.5cm of the ground surface. This allows a good connection to be made by the subsoiler leg which will usually operate at a depth of 30-37.5cm. To achieve this depth by simply tipping over the laid pipes can be both difficult and expensive to achieve.

   (iv) the design and layout of such a scheme needs to follow the restoration phasing as it is laid in front of the restored soil. It may well be that the final topography of the larger area demands a very different type of drainage layout. Where any doubts exist about this method of draining, specialist advice should be sought.
b. do ditches need lining to prevent erosion
Newly cut ditches, especially in recently restored ground, are particularly prone to erosion and slippage of the banks. Care therefore needs to be taken in both their design and location.

With regard to their design, this should be undertaken by a competent person who is able to assess likely flows, which may be generated from inside and outside the permitted area. The design should have the capacity to deal with expected flows, provide sufficient freeboard for any underdrainage outfalls and banks at a batter (slope) calculated to provide stability. Vegetation is extremely important in stabilising ditch banks and thought should be given to seeding the banks to accelerate the natural (and slow) process of colonisation. Depending on the location, aspect, after-use etc. of the site, a conservation type seed mix may be an option.

Insofar as the location of the ditch is concerned, this is likely to be determined by the final topography of the site. Quite clearly, steep gradients, sharp bends and numerous changes of direction should be avoided where possible to reduce the risk of erosion. There may be options for where a ditch is to be located and the above factors need to be taken into account. If steep gradients are unavoidable it may be an option to consider piping the worst sections.

c. are there any temporary water management arrangements
During the process of restoration, there may be aspects of operations being carried out elsewhere on the site which may impact, albeit temporarily, on the drainage of restored areas. These operations should be kept to a minimum, but where unavoidable or unplanned, due to unforeseen circumstances, it is important to reduce their impact. Although it may be known that the effects will only be temporary, the design of any channels or underdrainage systems may need to follow the same design criteria as if the situation was permanent. If the impact is relatively small, it may still be possible to proceed with the planned drainage/ditch programme for the restored area.

If the impact is great, then it may be advisable to postpone any planned works rather than to make a permanent design change to overcome a temporary problem.

d. does the site need to be sealed against the inflow of water
Depending on how the site is to be restored, i.e., proposed after-use, final levels, topography etc. the site may need to be sealed along certain sections to prevent the ingress of water from outside the site. This may be necessary on either a temporary or a permanent basis. The need for such work and its design requires specialist knowledge. However, the reason for this type of work, and its impact (if any) on the site should be clearly explained in non-technical terms, and there should be a willingness to amend the scheme if necessary.
Where a site is restored to a permanently lower level, the need for pumping may become a necessity if the site is to retain the agreed land-based after-use. Due to the costs and commitment involved with such schemes, it is unlikely to be a realistic option on anything other than a major scheme. Further guidance can be found in MPG 7 The Reclamation of Mineral Workings (DoE 1996) paragraphs A22-A28 (incl.) - Low Level Restoration in Areas with a High Water Table.

The issue of balancing lagoons may need to be taken into account either as temporary measures or more long-term features in a final restoration scheme. As a temporary measure, they can offer storage facilities to control flows both inside and outside the site until such time as they are no longer necessary, perhaps due to the completion of other works within the application site, which makes their function no longer relevant.

In the case of more permanent structures, these enable drainage (underdrainage and surface water drainage/run-off) flows to be controlled. This may be necessary if existing off-site ditches/curverts/pipes/soakaways etc. are unable to cope with any long-term increase in flow intensity.

Whether these balancing lagoons are of a temporary or long-term nature, the need for them is likely to be identified at the application stage. The detailed calculation on flows/storage capacities needs to be prepared by someone with the necessary competencies, as it is unlikely that an unqualified person will be able to assess the technical issues involved.