TECHNICAL NOTES
WESTERN QUEENSLAND BEST PRACTICE GUIDELINES

Queensland Government
Department of Main Roads
Road System & Engineering
WQ51

SITE REHABILITATION AND RESTORATION

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1 Introduction

After a site has been disturbed due to road construction activities, it is the responsibility of Main Roads to restore the site. It is accepted that restoration may take many years to achieve. However Main Roads has a stewardship responsibility to ensure that the environmental value of our road corridors is maintained for future generations to appreciate.

This guideline discusses factors influencing successful site rehabilitation and restoration of disturbed areas.

1.1 Site Rehabilitation

Site rehabilitation should ensure that all disturbed areas caused by construction and maintenance activities are restored, leaving a stable environment that is conducive to the establishment of landscapes characteristic to the area.

1.2 Restoration

The aim of restoration is to get a seed mix that will provide an initial protective canopy cover using short lived annual grasses backed up by grass species that are likely to be durable and persistent. It is an important component of Main Roads activities, since vegetation acts to reduce dust and wind erosion, suppress weed infestations and provide protection to exposed surfaces from raindrop impacts and erosion processes.

1.3 Monitoring

To achieve continuous improvement and ensure the activities specified in contracts are being adhered to, regular monitoring should be undertaken with emphasis placed on the continuity between site characteristics and the adjacent landscapes.

2 Rehabilitation of Affected Areas

Rehabilitation should be done in accordance with the sites Environmental Management Plan (Construction and Maintenance). There are many areas affected by road construction and maintenance activities that require rehabilitation, the major areas being borrow pits, stockpile sites, campsites and sidetracks.

2.1 Borrow Pits

Borrow pits are areas either in a road reserve or adjacent land holdings that have been used to extract road building materials such as gravels and soils. They can vary considerably in size, depending on the quantity of material taken and the borrow pits' reserve body of remaining material. The variable size, shape and nature of borrow pits preclude very specific recommendations, however the following general conditions apply.

Before extraction commences, licenses and permits should be checked and limits of disturbance and/or clearing must be clearly marked out on the site before any ground disturbing activity takes place. All run-on surface water must be intercepted and diverted around the area to be excavated. As a concurrent operation all available topsoil must be removed and stockpiled as low, flat windrows around the top and sides of the area to be developed. These windrows may augment the run-on surface water management system.

At the completion of extraction, the former borrow pit must be made stable and safe. This usually requires the sides of the pit to be reshaped with gentle safe grades (e.g. 1:6 grade). All disturbed areas associated with borrow pits must be retopsoiled, seeded, fertilised and mulched (if appropriate) as part of the restoration plan.

Main Roads has been discouraging the conversion of borrow pits to stock watering points.

2.2 Stockpile Areas and Construction Camp Sites

Stockpile areas and construction campsites should be developed in a similar fashion to borrow pits. Limits of disturbance and/or clearing must be clearly marked out on the site using posts or flagging tape before any ground disturbing activity takes place. All run-on surface water must be intercepted and diverted around the proposed site. Windrows or rills of topsoil graded off the site can be formed up to make an effective temporary diversion bank. If required, a rill can be formed below the site using subsoil material, in conjunction with a sump or stacked rock containment structure, to restrict sediment and/or contaminant movement off-site.

Vehicle wash-down areas should be constructed and bunded as a separate area to ensure and contaminants are contained and removed at the close of the site.

Decommissioning of the site requires all stockpiled material to be removed. Since the area would generally be compacted, the area must then be contour ripped to a minimum depth of 250mm and retopsoiled. All disturbed areas associated with these sites must be seeded, fertilised and mulched (if appropriate) in conjunction with the restoration plan.
Livestock should be excluded until the area has become stable. Your District Environmental Officer may be able to offer advice on seeding and fertiliser application. Remember that standard agricultural and turf type fertilizers are likely to encourage much higher concentrations of trace elements and minerals than were present prior to disturbance. Soil tests on material being stockpiled will assist with these decisions. Follow up maintenance and weed control may also be necessary.

2.3 Sidetracks

Sidetracks can create a much greater impact than the actual construction site itself. Justification for sidetracks should be assessed during the planning phase of the project as part of the environmental impact and discussed with designers to minimise potential disturbance.

If sidetracks are justified, limits of disturbance must be clearly marked out on the site before any ground disturbing activity takes place. Once again, all run-on surface water must be intercepted and diverted around or through the proposed site. Windrows, rills of graded topsoil and stacked rock containment structures can be formed up to make effective temporary diversion banks to restrict sediment and/or contaminant movement off-site.

Rehabilitation of sidetracks requires removal of all temporary cross drainage structures from watercourses, together with the removal and disposal of fill materials used for temporary approaches, abutments, crossings or embankments. All remaining areas must be reshaped to blend back in with preexisting landforms.

These areas must be free draining, with drainage paths created so that water can move over and/or through the area without scouring. All disturbed or denuded areas must be contour ripped to a minimum depth of 250mm, retopsoiled, seeded, fertilised and mulched (if appropriate) in conjunction with the restoration plan.

3. Factors Influencing Western Queensland Successful Restoration In

3.1 Soil Moisture Availability

The climate of Western Queensland is highly variable in terms of season, intensity, frequency and duration of rainfall events (see WQ30). The reliability of rainfall is also low. It is therefore important to schedule seeding just prior to the commencement of the wet season. Accordingly, soil moisture levels should rise soon after planting. The commencement of the wet season will give a better prospect of follow up rain. Irrigation through the use of water trucks or similar methods will therefore be significantly reduced. Seasonal trends can be accessed and analysed on the following website.

www.longpaddock.qld.gov.au/RainfallAndPastureGrowth

3.2 Species Mix Selection

Plant species must be specifically selected according to the aim of the restoration plan (e.g. erosion control or re-establishment of riparian corridors). Selection of the species mix must also consider climate, soils, finished grades and the landscape contexts. Remember if no additional seed-bank is provided, the most aggressive, opportunistic weeds are likely to have no competition and dominate the site.

Native species generally require stable surface conditions and specific seasonal regimes to germinate. Initial erosion protection will be achieved in a highly disturbed construction site using fast germinating exotic

grasses. The aim is to create stable conditions that are conducive to local species establishing.

Surface topsoil (approx 5-10cm) when correctly stripped, stockpiled and managed can also supply a vast seed bank of endemic native species. The stockpile of topsoil reduces the need to source, purchase and sow large quantities of native grass seed. However it is important to establish an initial (temporary) grass cover to protect the surface and create conditions that are more suitable for existing seed supplies to germinate. Several initial water applications will ensure adequate settling of the seedbed and perhaps germination

Selection of species for roadside erosion control will normally focus on grasses, forage, and low growing ground covers.

3.3 Weed management

Topsoil may also contain a proportion of undesirable weed species. The management of these undesirable weed species will require careful consideration.

The success of weed management depends on the selection and combination of approaches. The approaches chosen need to be linked to the specific phenology of the existing weeds and the structure of the plant community present.

Borrow pits are prime habitat for weeds such as prickly acacia (*Acacia nilotica*), mesquite (*Prosopis sp*) and parkinsonia (*Parkinsonia sp*). The areas readily become weedy due to the more favorable moisture regime within the depressions, therefore weed inspection and control should be undertaken on a monthly basis for the first six months and quarterly for the subsequent six months. Any infestations should be included in the District Pest Management Plan.

3.4 Plant Nutrition

In an established ecosystem, nutrients are extracted from the soil by plant roots, then enter the plant's biomass and eventually end up as litter on the soil surface where the process of nutrient recycling commences. In disturbed areas, such as a roadwork construction site, this natural process is interrupted. In this situation the use of a supplementary fertiliser application is warranted.

In some severe cases follow up treatments at the start of the second growing season may also be beneficial. Slow release or heat-activated fertiliser can be used to extend the effect of any fertiliser application. Appropriate application rates need to be determined and will relate to factors such as rainfall, existing soil fertility and plant sensitivity. Soil tests to analyse a soil's chemical and physical properties are recommended. Data should then be interpreted by a pasture-agronomist (e.g. DPI).

Many native plants rely on mycorrhizal fungi to assist in nutrient, particularly phosphate, uptake. The inoculation of plant roots by mycorrhizal fungi tends to be strongest in nutrient deficient soils. Deep subsoil and fresh rock would contain few, if any, microorganisms so it is very important to conserve and reuse the 'native' organic surface topsoil.

3.5 Site Preparation

Civil construction earthworks contractors have traditionally been required to leave soil surfaces smooth and hard. However this is not an environment conducive to growing vegetation. Construction equipment also exerts considerable force on the soil resulting in compaction and degradation of the soil structure. Soil compaction will result in less infiltration of rainfall and increased runoff and soil erosion.

As a general principle when rehabilitating any disturbed site, steps should be taken to introduce some measure of surface roughness.

Wherever possible, measures such as scarifying or ripping should be carried out on or as near as possible to the contour. On level terrain ripping should be perpendicular to the prevailing winds. Previously stockpiled topsoil should then be spread over all areas to be revegetated.

The micro-topographic relief created by scarifying or ripping will also serve to trap native seeds blown in on the wind. The difference is dramatic at the microscale (1cm). Wind velocity, micro-rills and surface roughness will ultimately determine the success of the preparation. The roughened areas will also reduce runoff and form a series of small dams when it rains.
Accordingly, germination percentages will be much higher and soil losses will be significantly less on these "cultivated" surfaces.

4. Restoration

As restoration can be difficult in Western Queensland, it is good practice (and common sense) to minimise the extent of disturbance to existing vegetation during clearing and construction activities.

Site rehabilitation and restoration works associated with road construction projects should not be planned in isolation. They should be considered as an integral part of the road project by incorporation throughout the planning, design, construction and maintenance phases. It is equally important that the rehabilitation process be budgeted for in each of these phases.

Two Main Roads publications that are helpful for planning restoration activities are the *Road Landscape Manual* and Main Roads Specification MRS11.16 *Landscape Works*

Issues that need to be addressed during the restoration phase include:

- Identification of safety issues – this involves the application of technical road requirements and standards to landscape plans to ensure that proposed treatments will not impede safety.

- Identification of the aim of the restoration program - this could include the provision of erosion and sediment control, weed management, visual improvement, wildlife corridor or a combination of these.

- Selection of appropriate species - species mixes need to be formulated with regard to the aim of the restoration program and the intrinsic environmental values of adjacent areas.

- Development of an appropriate establishment technique – this could include seeding, seedling planting, hydro mulching, etc.

- Placement of plant and seed orders – sourcing stocks of preferred native vegetation species is difficult throughout Australia. Native grasses simply do not respond well to a cropping situation and therefore are not economic.
  However, there are many 'home grown' methods of collecting native seed. For instance one of the most successful methods is simply driving around the paddock with a wet hessian bag on the front of the vehicle early in the morning. It may be beneficial to get the local community, say through the local schools, to participate in seed harvesting. Planning for all your needs one year in advance allows for enough time to propagate and establish sufficient stock. Ordering shrubs from accredited nursery stockists should occur as early as possible.

5 Monitoring

Restoration of sites disturbed by construction activities is unlikely to ever mimic the original landscape. It is important to achieve stability and a vegetation community that will encourage native species. Monitoring helps managers decide whether a treatment or method is working based on the response of plants and the condition of soil surface condition. The most important aspect of monitoring sites in Western Queensland is to ensure that weeds are not permitted to dominate early in the life of the restoration phase. Common to most weeds is the ability to germinate, flower and produce an extraordinary amount of fertile seed in a very short timeframe.

Performance of the contractor can usually be gauged by comparing adjacent landscapes. Low continuity between these landscapes usually indicates that no attention has been given to site stability, watering regimes and weed control.

In semi-arid Western Queensland, vegetation growth and seed germination are not reliable indicators of stable landscapes. The soil surface of undisturbed landscapes in most semi-arid regions develops a stable organic crust. These crusts can also be useful indicators of a stable soil surface.

Tongway (1994) has produced a manual for monitoring soil surface stability that assesses a variety of indicators on how a landscape is behaving. The rationale is that in semi-arid areas a stable soil surface resists erosion and indicates a landscape at low risk. Many indices, such as biomass, are strongly dependent on antecedent rainfall and hence can vary considerably from season to season.

The features Tongway considered relate to organic crusts, sediment movement and other subtle indicators. The manual is useful and easily applied by anybody with some soil science, ecology or geomorphology training. The manual also has diagrams and plates representing most of the semi-arid landscapes of Australia. Monitoring techniques such as Tongways should be an integral part of project management in Districts

Clay soils, particularly cracking clay soils, present problems in using similar indices. Perhaps the most reliable indicator would be the absence of rill or gully erosion and the restoration of a structured soil surface. However, this can vary between different types of clay and is partly driven by intrinsic soil sodicity.

6 Authors

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7 References

(i) Tongway D. (1994). *Rangeland Soil Condition Assessment Manual.* Division of Wildlife and Ecology. CSIRO, Canberra.

(ii) Queensland Department of Main Roads (1999). Main Roads Specification MRS 11.16 Landscape Works

(iii) Queensland Department of Main Roads(2004) Road Landscape Manual. Road System and Engineering