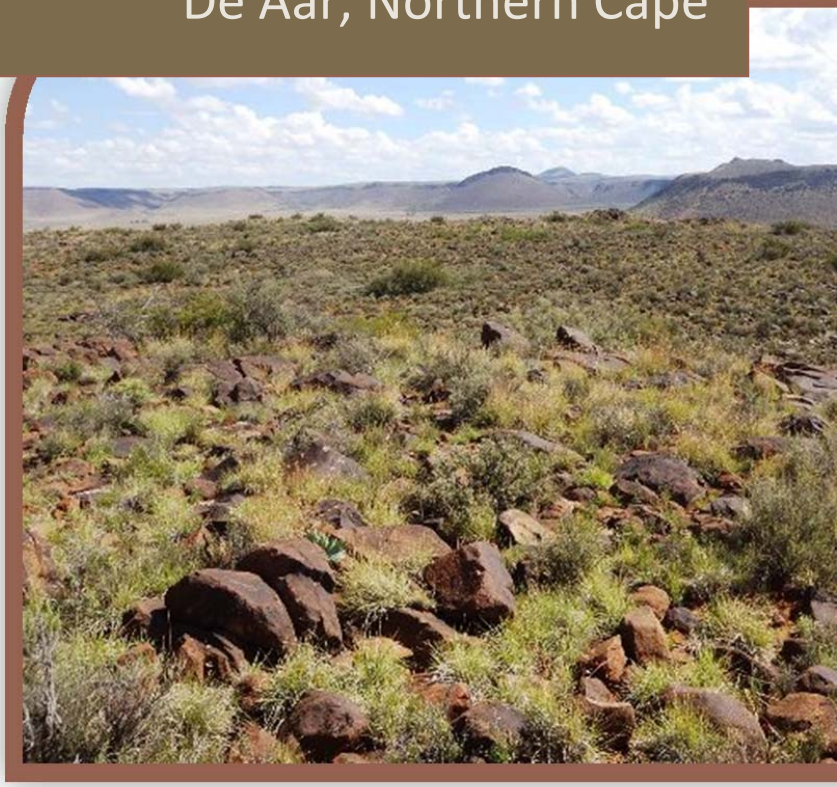
VEGETATION REHABILITATION PLAN

Longyuan Mulilo Maanhaarberg Wind Energy Facility, De Aar, Northern Cape



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Executive Summary

This document provides a rehabilitation management plan for the vegetation of the Longyuan Mulilo Maanhaarberg Wind Energy Facility, De Aar, Northern Cape.

The first section provides a summary of the purpose of the document and the people responsible for implementing it.

The next section provides a summary of the project components and the likely rehabilitation implications for each component.

The next section provides a summary of the current status of the vegetation on site, including which habitats are considered to be sensitive. This is followed by a discussion of potential constraints to successful rehabilitation on site.

The next section provides a rehabilitation implementation strategy, including steps such as identifying sensitive habitats, compiling a photographic record of current conditions, search and rescue activities, use of cleared plant material, seeding requirements and some general considerations.

The next section provides a description of rehabilitation measures, such as use of sand bags, fascine work, geojute netting and rolls and gabion baskets. This is a generic description and not all methods have to necessarily be used.

A rehabilitation programme is provided in the next section for different phases of the project.

The last section gives an outline of monitoring requirements for determining the success of the rehabilitation programme.

Contents

Overview

This document presents the Vegetation Rehabilitation Plan for the approved Longyuan Mulilo Maanhaarberg wind energy facility on the farms Smauspoort 130 and Zwartkopjes Portion 2 of 131 near De Aar, Northern Cape. The Environmental Impact Assessment (EIA) process for the approved facility was undertaken by DJ Environmental Consultants.. In accordance with the Environmental Authorisation (EA), a Vegetation Rehabilitation Plan has been compiled and will be included in the EMPr.

Purpose of the Vegetation Rehabilitation Plan

The site contains natural vegetation with biodiversity value and is currently used for live-stock grazing purposes. The purpose of the vegetation rehabilitation plan is to ensure that any areas that were cleared of vegetation or that were impacted in some way by construction activities on site are rehabilitated in such a way as to achieve the following:

- re-establish vegetation cover with suitable plant species so that remaining biodiversity features and prior land-use options are not compromised,
- reduce the risk of soil erosion in order to achieve long-term stability of the landscape,
- restore some ecosystem function to areas that are to be rehabilitated.

Responsible persons

Effective rehabilitation during the construction and operational phases of the project will be dependent on a number of project personnel. These are listed below:

The Developer

This refers to the project proponent, Longyuan Mulilo De Aar Wind Power. They will be responsible for the following:

1. Ensure that the requirements set out in this rehabilitation plan are adhered to and implemented;
2. Allocate the responsibilities assigned to the Environmental Control Officer (ECO) to an independent suitably qualified individual prior to the start of construction activities on site; and

3. Provide all principal contractors working on the project with a copy of this management plan as part of tender contract documentation to allow the contractors to cost for its requirements within their respective construction contracts.

The Engineer

The engineer of the proposed development will be responsible for the overall implementation of the rehabilitation plan during the construction phase of the project. To effectively implement the rehabilitation plan, the engineer must be aware of the findings, mitigation measures and conclusions of the Final EIA report, the requirements of the EA, and this rehabilitation plan.

The Environmental Control Officer (ECO)

The ECO is responsible for monitoring and verifying the implementation of the management plan during the construction phases of the project. To effectively implement the management plan, the ECO must be aware of the findings, mitigation measures and conclusions of the Final EIA Report, the EA, and this rehabilitation plan.

The Contractor

The contractor, being any directly appointed company or individual undertaking the implementation of works, will be responsible for complying with the rehabilitation plan at all times during the construction phase.

Proposed activities on site

This section provides an outline of the proposed activities on site in terms of the likely impacts expected from different project components. The purpose is to provide an indication of the type of rehabilitation activities that will be required.

Project components

The main infrastructure components to be constructed are as follows (see Figure on next page):

1. internal access roads,
2. turbine foundations,
3. crane pads,
4. construction yards,
5. overhead power lines,
6. substations.

Each of these are anticipated to have different types of impacts on natural vegetation and will require different rehabilitation efforts.

Internal access roads

Approximately 56.4 km of new roads are expected to be constructed. The running width of this is expected to be a minimum of 4 m, but the overall loss of vegetation will be wider than this to accommodate slope-offs to the road body, road-side drainage and cut-and-fill areas. Upon completion of construction, there will be an area of disturbance adjacent to the roads on both sides that will require re-vegetation. It is estimated that approximately 1 ha per kilometer of road will require rehabilitation.

The internal roads will include thirteen watercourse crossings, where culverts will be used to allow water-flow under the new road surface.

Turbine foundations

This will consist of a solid cement foundation of circular shape with a radius of 16 m and a foundation foot of 201m^2. This structure will be permanent. The turbine foundation will be

surrounded by the crane pad, so no specific post-construction rehabilitation will be required for the turbine foundation.

Crane pads

Crane pads will be levelled at each turbine site. The proposed dimensions are approximately 50 x 50 m and the maximum height difference across the width / length of the crane pad is 0.75m. This means that, due to the steep topography at the location of many of the turbine positions, a lot of cut and fill may be required to produce a crane pad of the required dimensions. It is likely that there will be a significant area around the crane pads that will be damaged by the required cut and fill and that this area may be significantly steep.

Construction yards

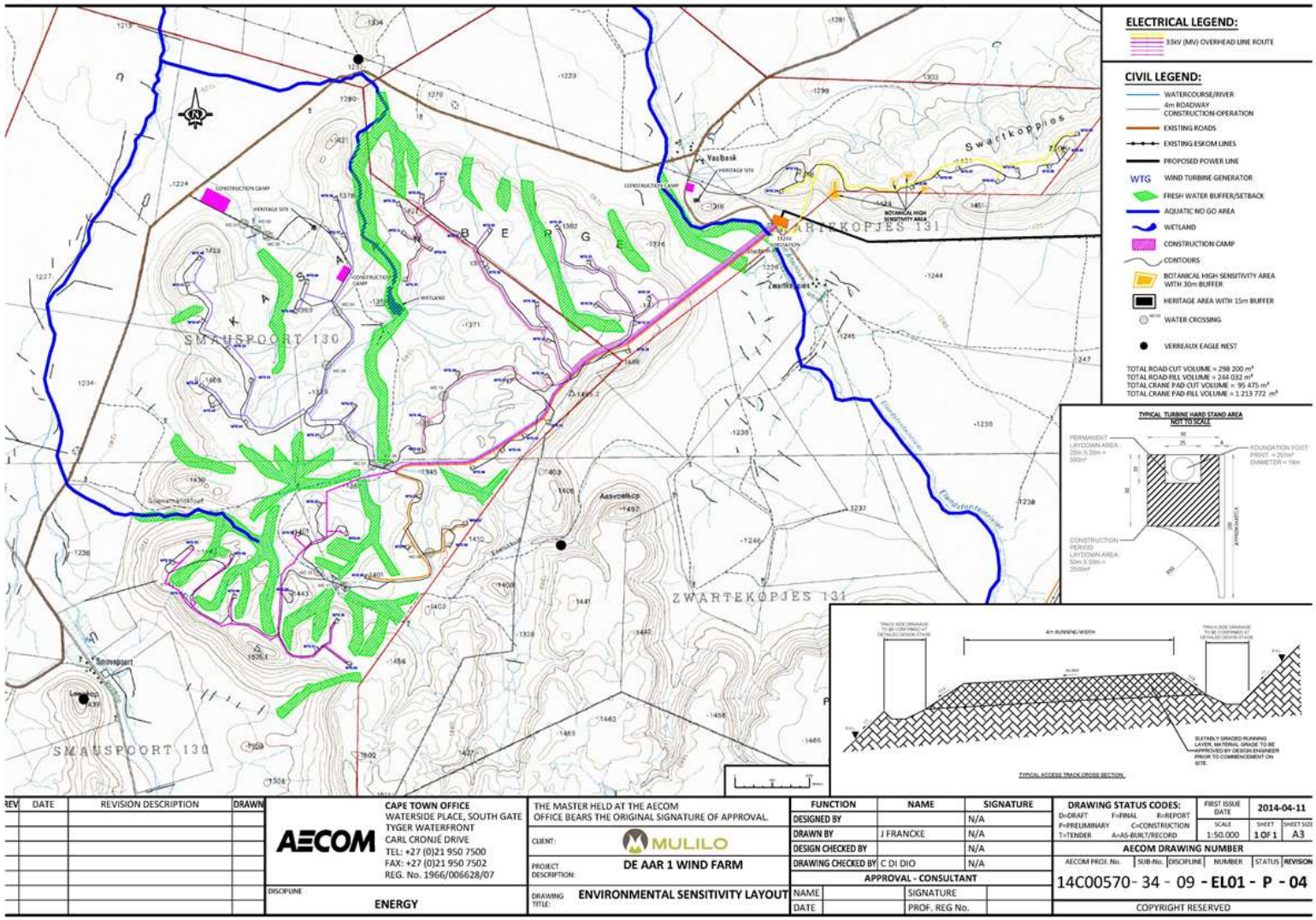
Three construction yards will be required that will contain staff welfare facilities, storage facilities, general stores and skips. It is anticipated that the required area to be cleared will be according to space requirements only and that no additional area will be cleared. It is therefore not expected that the area surrounding the construction yards will be significantly affected and that only minor rehabilitation will be required in these areas. However, disturbance associated with these areas is likely to persist for a long period of time.

Overhead power lines

These will consist of pole structures at regular intervals that are aligned reasonably close to the proposed road network. Disturbance associated with the construction of the overhead power lines will be largely restricted to the base around each pole structure. This will be relatively limited in extent.

Substation

A single site is required for the substation / control building, which will also have an Eskom switching / metering station adjacent to it. This area will be permanently cleared, but only to the extent required for the infrastructure thereon. It is therefore not expected that the area surrounding the substation / control building and switching / metering station will be significantly affected and that only minor rehabilitation will be required in these areas.



REV	DATE	REVISION DESCRIPTION	DRAWN

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DISCIPLINE: ENERGY

THE MASTER HELD AT THE AECOM OFFICE BEARS THE ORIGINAL SIGNATURE OF APPROVAL.

CLIENT: MULILO

PROJECT DESCRIPTION: DE AAR 1 WIND FARM

DRAWING TITLE: ENVIRONMENTAL SENSITIVITY LAYOUT

FUNCTION	NAME	SIGNATURE
DESIGNED BY		N/A
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DESIGN CHECKED BY		N/A
DRAWING CHECKED BY	C DI DIO	N/A
APPROVAL - CONSULTANT		
NAME		SIGNATURE
DATE		PROF. REG No.

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14C00570	34	09	EL01	P	04

Current status of vegetation on site

This section provides an outline of the existing status of the site with respect to natural vegetation. The purpose is to provide a context for the rehabilitation plan.

Ecosystem context

The site occurs within a relatively arid region and therefore requires rehabilitation methods that are different to those that would be used in more mesic areas. Rehabilitation methods that rely on agricultural techniques such as the application of fertilizer and the planting of alien species are not appropriate. The major implication is that active rehabilitation outside of the wet season may lead to very poor results on account of the dry conditions and low rainfall.

Site conditions

The site consists of low mountains interspersed by drainage valleys and surrounded by flat lowlands. The mountain areas are relatively rugged and rocky with shallow soils and high surface rock cover. The vegetation in these mountainous areas is primarily a grassy karroid dwarf shrubland with occasional low shrubs.

There is some microhabitat diversity on site, including stony areas (the major habitat on site), flat rock shelves, scarp slopes with large round boulders, scree slopes with loose rocks, and flat areas with deeper soils and lower rock cover.

Within the mountains, the drainage valleys and low-lying areas are flat and have deeper soils and low rock cover. The nature of these areas is driven more by fluvial processes. The vegetation in these areas tends to have higher grass cover with a higher incidence of taller shrubs in places. Erosion due to storm-water flow is an obvious issue in these areas, as observed on site, and can lead to loss of large volumes of soil and the formation of deep gulleys.

The lowland plains below the mountains are flat and covered by a very even karroid dwarf shrubland vegetation. The vegetation and habitat conditions are much more uniform and there is little variation from one place to another.

Proposed infrastructure affects primarily the rocky mountain areas on site. The proposed wind turbines are all sited within such areas. Internal access roads cross all habitats, as do internal

power lines. The on-site sub-station / control buildling, as well as the power lines connecting the sub-station to the Eskom Hydra sub-station are mostly within the lowland plains.

Vulnerable ecosystems and habitats

Some habitats are more vulnerable to disturbance than others and are therefore more likely to become problematic areas with respect to rehabilitation. In addition, some parts of the site will be subject to greater levels of disturbance than others, which will promote problematic conditions to a greater extent. The most sensitive habitats are as follows:

- drainage lines and watercourses;
- areas with deeper soils, including primarily valley bottom areas;
- areas prone to increased runoff following construction, for example road margins;
- areas of prolonged disturbance, for example, construction camps and laydown areas.

Potential constraints to successful rehabilitation

This section provides an outline of key risks and constraints to successful rehabilitation. These include the following:

- scale of clearing,
- climate harshness and unpredictability,
- disease and pests,
- weeds,
- seed availability,
- soil management,
- landform stability,
- ecosystem connectivity,
- ecosystem resilience.

Scale of clearing

Over the area of the entire project, the scale of clearing and the amount of rehabilitation that is required is relatively dispersed, but not a great area. It is estimated that approximately 1 ha of rehabilitation is required per kilometer of road constructed. This, in combination with areas around each crane pad site and along the edges of other infrastructure components will add up to approximately 100 ha in total. The risks are therefore moderate and it is expected that some problems will be encountered.

Climate harshness and unpredictability

The proposal area is in a semi-arid area where rainfall is unpredictable and the amount of rainfall is limited. These are expected to be significant constraints to successful rehabilitation. Any seeding or planting that is required will have to take place from the beginning of the rainy season and not in the dry winter period. Unfortunately, the rainy season is also associated with the hottest parts of the year, which will add to the stresses experienced by any plants attempting to become established, especially if associated with periods of drought. These conditions are likely to be a constraint to successful rehabilitation.

Diseases and pests

The project study area does not show visual evidence of being significantly impacted upon by diseases or pests. The vegetation on site appears to be in relatively good health and condition. There are indigenous animals on site that could potentially pose hazards to rehabilitated areas, for example, porcupines could dig up bulbs or aardvark could dig burrows in soft ground, etc., but these are considered to be natural ecological processes that could add variation to rehabilitated areas. These potential hazards are not expected to pose high risks to rehabilitated areas and no particular measures are proposed to limit them.

Weeds

The project study area has very low incidence of weeds on site and no invasive alien species were observed during the walk-through survey. There are, however, various species from surrounding areas that could become established on site. The rehabilitated and disturbed areas are most at risk because they provide the best conditions for the establishment of weeds and invasive plants. The potential risks are considered to be moderate, but controllable with the rigorous implementation of the Alien Invasive Plant Management Plan.

Seed availability

There is no native seed available from the current project site, but it should be possible to collect seed. Alternatively, indigenous seed is commercially available for various grass species. It is common practice to use a seed mix when sowing in areas for re-vegetation. The main risks associated with this approach are that seed available is usually for combinations of species that are not necessarily present or dominant on site. The risks are, however, considered to be relatively low for successful rehabilitation of disturbed areas since a combination of methods can be employed to encourage growth of indigenous vegetation.

Soil management

Topsoil is arguably the single most important rehabilitation resource in the project area. Topsoil and subsoil that currently occurs in areas to be cleared must be recovered to be used in rehabilitation areas. A potential problem is the fact that the soil is very shallow in many parts of the study area, which means that there is a limited supply of useable topsoil that can be used for rehabilitation. Topsoil must be carefully managed and stockpiled to ensure that it does not become degraded. The success of this process is one of the biggest risks associated with successful rehabilitation of disturbed areas.

Landform stability

The existing slope of the areas that will require rehabilitation varies from flat to very steeply inclining. Particular attention will have to be paid to maintaining surface stability during the early stages of rehabilitation. Minimizing surface water runoff from any small catchment areas that currently exist or that will be created from construction activities will be an important strategy, especially when these occur at elevated points in the landscape. Possible strategies that can be employed include the following:

- development and implementation of a comprehensive storm-water runoff management plan will ensure that rehabilitated areas will not be affected by surface water runoff from the development during and after construction;
- spreading a thin layer of cleared vegetation debris from cleared areas over re-contoured topsoil;
- shallow contour scarification and re-contoured rehabilitation surfaces;
- establishment of temporary shade-cloth fencing at strategic points within rehabilitated areas to minimize the impact from strong winds.

Rehabilitation implementation strategy

The rehabilitation process should form an integral part of site and construction activities. The ECO, who will be responsible for ensuring that the Rehabilitation Plan is implemented, must be appointed and on-site at project inception. This person should form an integral part of the project team.

The following descriptions outline the various stages and processes of the Rehabilitation Programme:

Identification and protection of environmentally sensitive areas

Sensitive sites and habitats must be identified prior to any construction activities taking place. No vegetation clearing, levelling, excavation or plant material removal is permitted without prior consent from the ECO. Areas highlighted as being environmentally sensitive from prior studies must be identified and the necessary fencing and protection of these areas initiated.

Comprehensive photographic record

In order for practical and attainable rehabilitation goals to be defined and met, it is recommended that a comprehensive photographic record of the entire length of all infrastructure components is compiled. This pre-construction photographic information would provide an accurate representation of the entire existing site and it would become a very valuable tool for the rehabilitation work, as it would serve as the basis for rehabilitation requirements, informing decisions on drainage, soil shaping, levels, plant choices and rehabilitation in general.

Search and rescue activities

Plant search and rescue activities must be initiated as the first stage of the rehabilitation process. The Specialist or ECO must identify within the construction footprint any viable plant material. This must include all plants specified in the Plant Rescue Plan, but can also include any plant material that could be used in rehabilitation. Plant material to be rescued must be potted into bags using local soil. Search and rescue will include removal of grass clumps, small shrubs, truncheons and cuttings and seed harvesting. Planting rescued plants into rehabilitation areas can be an effective means of establishing indigenous species quickly. The following principles must be applied:

- plants for transplant should only be removed from areas that are going to be cleared;

- Perennial grasses, shrubs, succulents and geophytes are all potentially suitable candidates for transplant;
- A system to identify rescue plant material and source area cross-referencing must be developed so that transplants are placed nearby to where they were sourced and not to distant areas;
- Rescued plant material must remain on site and not transported to off-site areas.

The initial search and rescue can be followed up with searches undertaken during clearing operations in order to rescue any additional plant material unearthed, such as bulbs, tubers and sub-surface root systems.

Cleared plant material

Surface plant material that is cleared during construction activities can be stockpiled and/or bagged to be used as mulch during rehabilitation. Mulching is the covering of the soil with a layer of organic matter of leaves, twigs, bark or wood chips. The main purpose of mulching is to protect and cover the soil surface as well as serve as a source of seed for re-vegetation purposes. The following principles should be adhered to:

- During site clearing the standing vegetation should not be cleared and mixed with the soil, but should be cleared separately, either mechanically or by hand using a brush-cutter. The cleared vegetation should be stockpiled and used whole or shredded to protect the soil in disturbed areas and promote the return of indigenous species.
- Mulch is to be harvested from areas that are to be denuded of vegetation during construction activities. No harvesting should take place outside the area to be disturbed by construction activities.
- Brush-cut mulch should be stored for as short a period as possible.
- Seed released from stockpiles should be collected for use in the rehabilitation process.

Seed collecting

Indigenous seed should be collected from plants present on site and should be used immediately or stored appropriately and used at the start of the following wet season. Seed can be broadcast onto the soil, but should preferably be applied in conjunction with measures to improve seedling survival, such as scarification of the soil surface or simultaneous application of mulch. The following principles apply:

- Indigenous seeds may be harvested for purposes of re-vegetation in areas that are free of alien invasive plants, either at the site prior to clearance of from suitable neighbouring sites;
- Seed may be harvested by hand and, if necessary, dried or treated appropriately;

- Seed gathered by vacuum harvester, or other approved mass collection method, from suitable shrubs or from plant litter surrounding the shrubs, must be kept apart from individually harvested seed;
- No seed of alien or foreign species should be used or brought onto the site;

Commercial seeding

In some areas the natural regeneration of the vegetation may be poor and the application of seed to enhance vegetation recovery may be required. Mixed seed is available from commercial suppliers. A typical seed mix may be as follows (This information is provided as a guideline. Site specifics and re-vegetation requirements may require changes to these mixes.):

Grass species	*Common name*	*General application (kg/ha)*
Eragrostis tef	Teff	4
Eragrostis curvula	Weeping love grass	10
Chloris gayana	Rhodes grass	10
Digitaria erianthe	Smuts finger grass	2
Cynodon dactylon	Couch/kweek/star grass	2
Paspalum notatum	Lawn paspalum	2

General considerations

- Progressive rehabilitation is an important element of the rehabilitation strategy and should be implemented where feasible.
- Once re-vegetated, areas should be protected to prevent trampling and erosion.
- No construction equipment, vehicles or unauthorized persons should be allowed onto areas that have been re-vegetated.
- Where rehabilitated sites are located within actively grazed areas, they should be fenced. Fencing should only be removed once a sound vegetation cover has been achieved.
- Any runnels, erosion channels or wash-aways developing after re-vegetation should be backfilled and consolidated to restore them back to a proper condition.

Description of rehabilitation measures

Rehabilitation measures that may be effected on site include systems such as soil terracing, berm creation, grass blocks, fascine work, gabion basket work, reno mattresses, retaining block mechanisms, sand bags, boulder and rock placement, stone pitching, and grading. Decisions pertaining to plant material choices and specific vegetation utilisation for specific areas from an integral part of the process, as the hard landscape components work in conjunction with the soft landscape components. This section provides a description of these measures.

Each area may require a different technique, but all possible should be considered and the most appropriate one for each case selected.

Sand bags

These are to be made from biodegradable material ONLY. Geojute sacks or similar are acceptable. No plastic bags are to be utilised. A sand mix or rocky soil mix could be utilised to fill the bags. No contaminants may be put into the bags (i.e. cementitious material, soil with chemical spill or fuel etc.).

Terracing and soils stabilization

Rows of straw, hay or bundles of cut vegetation may also be used. In this instance, the hay, straw or vegetation is dug into the soil in contours, in order to help slow surface wash and capture eroded soil. The spacing between rows would be dependent on slope and the specific area.

Fascine work

Logs or branches removed during site clearing operations may be utilized to form the vertical peg supports which are driven into the ground, leaving approximately one third of the total length exposed. Thereafter horizontal members are fixed behind these pegs. Wooden logs or branches may be utilized, narrow netting or shade cloth, or even the geojute rolls, to create the horizontal members. The spacing of rows of fascine work will be site specific and these “open areas” may be further protected with small branches and brush gathered during site clearing

activities. Fascine work must not be created in rigid blocks or grids, pegs should be alternately spaced in rows, to help prevent any water channeling occurring.

Geojute netting

Netting or matting may be utilised on slopes to assist with soil retention, weed control and vegetation establishment. The netting material helps protect the soil from wind and water erosion, and the required rehabilitation plant material can be installed by making small incisions for planting. The netting is biodegradable and will eventually break down and form a mulch layer.

Geojute rolls

These are long sections of Geojute “fabric” that are rolled into long cylindrical rolls. They are likewise filled with sand as described in Sand Bags above. These are effective on slopes and where a large area of clearing has been affected and erosion management is required. Geojute rolls will require some form of pegging to hold them in shape and in place. Short sticks obtained from alien invasive plant material removed during the construction process should be utilized for these purposes (neither plant material, nor seeds of any kind that could re-generate are to be utilized).

Detention ponds

Detention ponds should in no way block the water flow, but rather encourage the spread of the flow over a wider area, to help reduce velocity and encourage infiltration. Detention ponds should be vegetated with either wetland vegetation or grass – (site specific).

Drainage and stormwater pipes

High friction, semi permeable channels should be utilized where possible. A number of smaller storm water outfall points should be constructed, rather than one large outfall point. The design of drainage and storm water pipes should be to reduce flow velocity and avoid soil erosion. This can be achieved through the construction of water velocity dissipators below the pipe head wall. Rocks, boulders or concrete blocks may be utilized for these purposes, and they are set into the concrete apron below the headwall. Stone pitching may also be utilized.

Gabion baskets and reno mattresses

These represent engineered solutions to steep slopes and banks. They are utilised in areas where soil must be retained, and there are existing drainage and water problems. Gabion

baskets are formed wire baskets, filled to engineering specifications with uniform size rocks, with minimal gaps between, and approximately 1m x 1m x 1m in dimension - although the specific shape and size may vary according to application. Reno mattresses are similarly filled but they are created as larger area flat baskets that cover a greater surface area, hence the term “mattress”. Often these two systems are used in combinations.

Rehabilitation programme

The following table has been prepared as a guideline to the various activities required. The table provides general information and is to be read in conjunction with the Rehabilitation Plan detailed in the sections above.

Preconstruction actions

Action	Responsibility	*Frequency*
Identify and protect sensitive areas	ECO	Once-off
Comprehensive photographic record of areas to be cleared	ECO	Once-off
Search and rescue	ECO / Rehabilitation Specialist	Once-off

Construction phase actions

Action	Responsibility	*Frequency*
Vegetation clearing, stockpiling of plant material & topsoil	Contractor	Ongoing
Seed collecting	Contractor	Ongoing
Landscaping	Contractor	Ongoing
Fence off rehabilitation areas	Contractor	Ongoing
Implementation of rehabilitation measures (terracing, fascine work, mulching, etc.)	Contractor	Ongoing
Planting rescued plants into rehabilitation areas, seeding, etc. to establish new	Contractor	Ongoing

vegetation.		
Photographic record of rehabilitation actions	ECO	Once-off

Post-construction phase actions

Action	Responsibility	***Frequency***
Monitor site for erosion, alien plants, vegetation growth	ECO / Rehabilitation Specialist	3-monthly and ad hoc
Remediation in areas where rehabilitation is progressing poorly. If necessary, sow grass mix into bare patches.	Contractor	Ad hoc
Monitoring floristic data collection	Botanist	Annually for 3 years, then triennially

Monitoring programme

In order to monitor the impact of rehabilitation activities, monitoring must be undertaken. This section provides a description of a possible monitoring programme that will provide an assessment of the success of the rehabilitation activities.

Note: Monitoring requirements of the Alien Invasive Management Programme and Plant Rescue Plan are also applicable, but are not repeated here.

Pre-construction and construction phase monitoring

The following monitoring is required during the construction phase of the project:

Monitoring action	*Indicator*	*Timeframe*
Photographs of area prior to construction	Baseline condition / pre-construction state	Pre-construction

Operational phase monitoring

The following monitoring is required during the operational phase of the project:

Monitoring action	*Indicator*	*Timeframe*
Document rehabilitation measures implemented and success achieved in problem areas	Decline in vulnerable bare areas over time	Annually

Concluding remarks

The information in this document is intended to provide various options that can be adapted for specific situations on the ground. The exact approach adopted for rehabilitation is dependent on local conditions and situations and is not meant to adhere strictly to a formula. The experience of the ECO and the construction crew are important for ensuring that a successful rehabilitation programme is implemented.

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