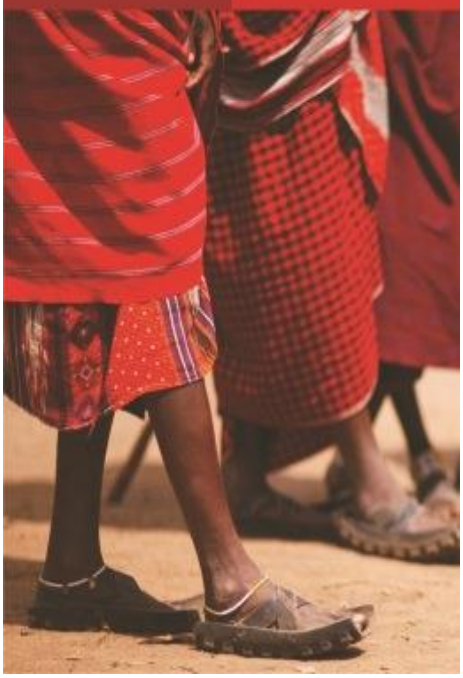

DIGBY WELLS
ENVIRONMENTAL

Rehabilitation Plan and Closure Cost Estimate for the De Groote Boom Mining Area

Rehabilitation and Closure Report

Project Number:

UAR2967

Prepared for:

De Groote Boom Minerals (Pty) Ltd

April 2015

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This document has been prepared by Digby Wells Environmental.

Report Type:	**Rehabilitation and Closure Report**
Project Name:	**Rehabilitation Plan and Closure Cost Estimate for the De Groote Boom Mining Area**
Project Code:	**UAR2967**

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EXECUTIVE SUMMARY

De Groote Boom Minerals (Pty) Ltd has requested Digby Wells to compile a rehabilitation plan and closure cost estimate for the new proposed mining operation in support of the mining permit application. This document is compiled in accordance with the relevant legislation governing mine rehabilitation, closure cost assessment (closure provision) and closure planning as described in the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002) (MPRDA).

De Groote Boom currently holds an approved Prospecting Right valid for three years (with the right to take a Bulk Sample) and it now proposes to mine primarily chromite (chrome ore, and all associated minerals) covering an extent of not more than 5 ha on the farm De Grooteboom 373 KT. It is assumed that approximately 5ha of land will be disturbed during the mining operation.

The main aim in developing this rehabilitation plan is to mitigate the impacts caused by mining activities and to restore land back to a satisfactory standard. Internationally and in the South African context, the broad rehabilitation objectives include three schools of thought, explained below:

- Restoration of previous land capability and land use;
- No net loss of biodiversity; and
- What the affected community wants, the affected community gets.

The rehabilitation plan compiled for the proposed project has followed the above methodology and details the following

- Statutory requirements;
- Soil and overburden management;
- Vegetation and fertilizer management;
- Alien invasive control plan; and
- Monitoring criteria and guidelines.

The total cost of the environmental liability for closure of De Groote Boom mining area, using the Department of Mineral Resources (DMR) standard method is **R2 148 139.** Allowance has been made for the creation of a free-draining topography, replacement of soil, re-vegetation, and for the general surface rehabilitation of the disturbed area.

The liability figures will be updated on an annual basis as required by the Department of Mineral Resources (DMR), or when detailed evaluations of the requirements for hydrogeological closure are available.

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1 Introduction

Mining in South Africa is renowned as a key element of economic development. However, this significant economic development is shadowed by the environmental damage caused by the mining operations. The disturbance of the natural environment by the mining industry has triggered the South African government to formulate laws that dictate that miners should pay to remediate the damage they cause.

Mine rehabilitation is a long term process which should ideally begin during the planning phase of a development. Mine closure should aim to achieve long-term site stability and the establishment of a self-sustaining ecosystem.

Digby Wells Environmental (hereafter Digby Wells), has been appointed by De Groote Boom Minerals (Pty) Ltd to compile a rehabilitation plan and closure cost estimate on the farm De Grooteboom 373 KT.

The objective of the rehabilitation plan is to ensure activities associated with the mining activities will be designed to prevent, minimise or mitigate adverse long-term environmental and social impacts and create a self-sustaining ecosystem.

1.1 Terms of Reference

De Groote Boom Minerals (Pty) Ltd has requested Digby Wells to compile a rehabilitation plan and closure cost estimate in support of the mining permit application. De Groote Boom has planned an open cut of 5ha and this report addresses the rehabilitation measures that will be implemented and provides the cost of environmental rehabilitation at closure.

1.2 Legislative Requirements and Guiding Documents

Relevant legislation governing mine rehabilitation, closure cost assessment (closure provision) and closure planning is described in the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002) (MPRDA). The definition for environmental management plan as stated in the MPRDA is '*means a plan to manage and rehabilitate the environmental impact as a result of prospecting, reconnaissance, exploration or mining operations conducted under the authority of a reconnaissance permission, prospecting right, reconnaissance permit, exploration right or mining permit, as the case may be*.' Reference is also made to the MPRDA Regulations, 53 – 57 and 60 – 62.

Section 41 (1) of the Mineral and Petroleum Resources Development Act (MPRDA), (28 of 2002) states that, "*an applicant for a prospecting right, mining right or mining permit must, before the Minister approves the environmental management plan or environmental management programme in terms of section 39(4), make the prescribed "financial provision" for the rehabilitation or management of negative environmental impacts*." In terms of Section 24P of NEMA, as amended by the National Environmental Management Laws Amendment

Act, 2014 (Act No 25 of 2014) (NEMLA) provides that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts[1].

There are several guideline documents which provide recommendations on how rehabilitation and closure should be undertaken. For the purpose of the plan the following guideline documents will be considered:

- Guidelines for the Rehabilitation of Mined Land. Chamber of Mine of South Africa/ Coaltech. November 2007;
- Best Practice Guidelines (BPGs) series developed by the Department of Water Affairs (DWA).

In addition to the abovementioned guideline documents further regulations must be considered pertaining to closure and rehabilitation. These include:

- National Environmental Management Act (Act 107 of 1998);
- National Water Act (Act 36 of 1998); and
- National Heritage Resources Act (Act 25 of 1999).

1.3 Aims and Objectives

The main aim in developing this rehabilitation plan is to mitigate the impacts caused by mining activities and to restore land back to a satisfactory standard. It is best practice to develop the rehabilitation plan as early as possible so as to ensure the optimal management of rehabilitation issues that may arise. It is critical that a mine's closure plan is defined and understood from before mining progresses and is complementary to the rehabilitation goals. Internationally and in the South African context, the broad rehabilitation objectives include three schools of thought, explained below:

- Restoration of previous land capability and land use;
- No net loss of biodiversity; and
- What the affected community wants, the affected community gets.

Rehabilitation and closure objectives need to be tailored to the project at hand and be aligned with the Environmental Management Plan (EMP). The overall rehabilitation objectives for this project are as follows:

- Maintain and minimise impacts to the ecosystem within the study area
- Re-establishment of the pre-development land capability to allow for a suitable post mining land use;

[1] It should be noted that draft Regulations dealing with the financial provision for the closure of a mine and the calculation of the quantum of that provision are currently circulating for comment. These Regulations will have a significant impact on the provision for closure but this report is based on the Regulations applicable as at 1 December 2014.

- Prevent soil, surface water and groundwater contamination;
- Comply with the relevant local and national regulatory requirements; and
- Maintain and monitor the rehabilitated areas.

In accordance with applicable legislative requirements for mine closure, the holder of a prospecting right, mining right, retention permit or mining permit must ensure that:

- The closure of a mining operation incorporates a process which must start at the commencement of the operation and continue throughout the life of the operation;
- Risks pertaining to environmental impacts must be quantified and managed proactively, which includes the gathering of relevant information throughout the life of a prospecting or mining operation;
- The safety and health requirements in terms of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) are complied with;
- Residual and possible latent environmental impacts are identified and quantified;
- The land is rehabilitated, as far as is practicable, to its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development; and
- Prospecting or mining operations are closed efficiently and cost effectively.

1.4 Project Description

The site is located on the farm De Grooteboom 373 KT which is located on the central part of the eastern limb of the Bushveld Complex in the Mpumalanga Province surrounded by known occurrences of economic minerals such as chromite (chrome ore, gold ore and all associated minerals). Geological information indicates the possible presence of the Critical Zone of the Bushveld Igneous Complex) BIC in the region of the farm mentioned above.

De Groote Boom currently holds an approved Prospecting Right valid for three years (with the right to take a Bulk Sample) and it now proposes to mine primarily chromite (chrome ore, ,gold ore and all associated minerals covering an extent of not more than 5 ha of the farm De Grooteboom 373 KT. It is possible that after competing work under the mining permit, De Groote Boom will commence with full scale mining of Chrome in terms of a mining right that would be applied for at that stage. Mining will be undertaken by open cut methods and the ore may be transported to a portable plant for crushing and screening. The ore will be stockpiled until transported off site by truck. The mining permit area is adjacent to the Bulk Sample area and the operational and related infrastructure areas are depicted on the infrastructure plan (Appendix A).

1.5 Assumption

The assumptions for the project were as follows:

- A contingency of 10% has been included to allow for unforeseen costs associated with contractors or rate increases;
- This study did not include a detailed assessment of issues concerning shallow aquifer ground water pollution and long term decant from workings, as there is no information available on which to base an estimated cost for long-term water impact management;
- Nine groundwater monitoring points were assumed adequate to monitor groundwater quarterly (i.e. 4 times a year) for 5 years after post mining activities. Additional monitoring boreholes might be required based on the hydrogeological studies recommendation; and
- The areas included in the current assessment were supplied to Digby Wells by De Groote Boom. These areas were assumed to be all that De Groote Boom will be liable for and no investigation was conducted to determine whether De Groote Boom is responsible for any additional areas. This report did not include a legal due diligence process.

2 Expertise of Specialist

The specialists involved in calculating the financial provision and compiling a rehabilitation plan for the De Groote Boom mining area were Hlayiseko Mashaba and Brett Coutts. Their curricula vitae are available on request.

3 Methodology and Approach

3.1 Rehabilitation and Closure Planning

3.1.1 Legal Requirements

Relevant legislation governing mine rehabilitation, closure cost assessment (closure provision) and closure planning is described in the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002) (MPRDA) Section 24P of NEMA, as amended by the National Environmental Management Laws Amendment Act, 2014 (Act No 25 of 2014) (NEMLA). The definition for environmental management plan as stated in the MPRDA is '*means a plan to manage and rehabilitate the environmental impact as a result of prospecting, reconnaissance, exploration or mining operations conducted under the authority of a reconnaissance permission, prospecting right, reconnaissance permit, exploration right or mining permit, as the case may be*.'

- Reference is also made to the MPRDA Regulations 53 – 57 and 60 – 62.

3.1.2 Soil Planning and Rehabilitation

The rehabilitation plan contains soil handling information, beginning with the preparation of the land for mining including:

- Soil stockpiling guidelines defining how soils can be stripped and stockpiled and in what manner;

Progressive monitoring should take place on at least a quarterly basis and should involve the following:

- Inspection of soil stockpiles to check degradation and/or pollution (these are stockpiles that have been created from areas where soil has been stripped); and
- Fertility analysis quarterly and amelioration procedures prior to re-vegetation.

3.2 Rehabilitation Plan Compilation

The rehabilitation plan compiled for the proposed project has followed the above methodology and details the following:

- Statutory requirements, both at a national and international level;
- Soil and overburden management;
- Vegetation and fertilizer management;
- Alien invasive control plan; and
- Monitoring criteria and guidelines.

4 Land Preparation

The aim of land preparation is to ensure that the area impacted is kept to an absolute minimum. The mining activities need to be designed with closure in mind. Top soil stockpile areas must be demarcated as no-go areas.

4.1 Vegetation Conservation

Vegetation must be removed and stockpiled together with the topsoil so as to preserve the organic content in the soil as well as the seed bank for the replacement of soil and re-vegetation. The occurrence of protected plant species will need to be determined before vegetation is removed and the required permits will be obtained for either destruction or relocation.

4.2 Soil Types

Three dominant soil forms were found in the study area, all found in typical positions within the landscape. The dominant soils associated with steep slopes were shallow and rocky (Mispah/Glenrosa). The dominant soils associated with footslopes are deeper (Hutton) as the soil forming process is an accumulation of soil from upper slopes.

The dominant land capability for the study area is the Class VI (Moderate Grazing) and Class VIII (Wilderness). The footslopes, where the slope is less than 5 % with the shallow soils (Mispah/Glenrosa) have a Class IV (Low Cultivation/ Intensive Grazing) land capability.

The deeper Hutton soils have Class III (Moderate Cultivation) land capability. The major concern for this area is the potential for erosion due to the steep slopes.

4.3 Soil Stripping

To reach the chromite, the mining process may need to remove the topsoil, sub-soil soft overburden and hard overburden. This section explains the correct measures that should be followed during the stripping of soil. This is a key rehabilitation activity as lost soils cannot be regenerated in the lifetime of the mining activities. Correct stripping of soils will firstly ensure that enough soils are available for rehabilitation and secondly, that the soils are of adequate quality to support vegetation growth and thus ensure successful rehabilitation.

4.3.1 Soil Stripping Depths

The topsoil of the soil profile can be stripped to a total depth of 0.3m and stockpiled separately from the sub soil as this is where the seed bank is. The subsoil approximately 0.7 – 0.9 m thick (on the Hutton soils) will then be stripped and stockpiled separately. The Mispah and Glenrosa soil forms will only need to be stripped to 0.3m. The maximum estimated volume of topsoil that will be stripped over 5ha is 15,000m^3.

4.3.2 Soil Stripping Method

Soils should be stripped and replaced using the truck and shovel method as far as possible. This method will limit the compaction of soils. If bowl scrapers are used then the soils must be dry during stripping to minimise compaction. The best time for stripping of soils is when soil moisture content is lowest which will be during the dry season.

4.3.3 Soil Stripping Supervision

Supervision by an environmentalist (or trained supervisor) must be done to ensure that the soils are being stripped from the correct areas and to the correct depths, and placed on the correct stockpiles with a minimum of compaction. Soils are most susceptible to compaction when the moisture content is high. The dry winter months (April - August) are thus more suitable for the stripping and replacement of soils. If soils have to be moved during wet months then special care should be taken to adopt methods that cause minimum compaction.

4.4 Soil Stockpiling

This section explains the correct measures to be followed during the stockpiling of soil. Stockpiling should be minimised as far as possible as it increases compaction and decreases the viability of the seed bank.

4.4.1 Stockpile Locations

The soils should be stockpiled on the parent soils and as close to the originally stripped and final rehabilitation areas as possible. The top and sub soils are to be stockpiled in a berm like manner within the study area.

4.4.2 Stockpile Management

4.4.2.1 Compaction Avoidance

Soils should be stockpiled loosely. Achieving this will depend on the equipment being used during the stripping and stockpiling process. Soils should be dumped in a single lift if truck and shovel methods are used. If the dumps are too low, then the height could be increased by using a dozer blade or backacter bucket to raise the materials. Generally no higher than 4m is the prescribed stockpile height (Tanner *et. al*., 2007).

4.4.2.2 Topsoil Stockpile Vegetation.

The stockpiles are potentially going to be in place for the life of the project and will be used to rehabilitate the disturbed area. Vegetation should be allowed to establish itself *in situ* on the topsoil stockpiles to avoid soil loss due to erosion and weed colonisation as well as fertility loss. Should vegetation not establish itself, then fertilisers will need to be applied into the stockpile to vegetate. A similar seed mixture to the final one recommended for rehabilitation should be used. See Section 5.6.1.2 on Re-Vegetation and Biodiversity Establishment.

4.4.2.3 Topsoil and Subsoils Stockpile Maintenance and Monitoring

Once established, stockpiles should be managed to ensure that losses from the piles are minimised and that additional damage the physical, chemical or biotic component is minimised. It must be ensured that the stockpiled soil is only used for its intended purpose. The topsoil stockpiles must be clearly demarcated as “No Go” zones and monitored frequently. Employee awareness programmes are to be carried out to reduce the risk of stockpile “robbery” / unauthorized use or contamination. The topsoil stockpile must remain vegetated at all times. The vegetation must be monitored and managed accordingly to avoid erosion losses.

5 Rehabilitation Actions

The actions contained within this section are to be implemented at closure. The report and its associated costing have been based upon DMR guidelines set out by the Department of Minerals Resources (2005) in the “Guideline Document for the Evaluation of the Quantum of Closure-Related Financial Provision Provided by a Mine”. The guidelines outline the methods for rehabilitation required for closure, and the actions which are described below follow these guidelines.

5.1 Opencast Area Rehabilitation

It is assumed that approximately 5ha of land will be disturbed during the mining operation. The purpose of pit closure is to ensure the pits become safe for humans and animals and for the purpose of the liability assessment it has been assumed that the shaping of the pit area slopes will be undertaken during the operational phase of the mine to reduce closure costs. After the mining activities are completed, up to 300mm thick of topsoil will be spread on the disturbed areas. Once placed, the “soil” should then be ripped, fertilised, and re-vegetated.

5.2 Processing Plant

De Groote Boom will be using a mobile plant for its processing activities and therefore no infrastructure associated with the plant will need to be stripped and broken down at closure. Cost has only been allocated for the general surface rehabilitation of the plant area. The general surface rehabilitation will ensure the following:

- Surface topography that emulates the surrounding areas and aligned to the general landscape character;
- Landscaping that would facilitate surface runoff and result in free draining areas. If possible drainage lines should be reinstated;
- An area without unnecessary remnants of structures and surface infrastructure to give the rehabilitated area a neat appearance. Special attention must be given to shape and/or removal of heaps of excess material; and the area should suitable for vegetation.

5.3 Pollution Control Dam (PCD)

The PCD close to the plant will be removed at closure. The plastic lining must be removed and can be recycled. The earth walls will be flattened and the area profiled. The pipes associated with the dam must be removed and if possible sold.

5.4 Stockpile Area

It is assumed that all the material from the stockpile area will be taken for processing and cost has been allocated to rip the footprint, reshape the surface and vegetate.

5.5 Access Roads

Access roads around the site should be ripped for all areas except those needed to access the facilities for inspection after closure. Roads that can and will be used by other users post closure should, however, be left provided this is agreed upon by all parties concerned. For the rehabilitation of roads, a cost has been allocated to rip the area, add 300 mm topsoil and vegetate.

5.6 Biophysical Closure and Rehabilitation

5.6.1 Final Landform and Ecological Functionality

The open cut area will be reshaped to create a gently sloping, free-draining topography during the operational phase. The topsoil and sub soil that was removed during the construction phase should be returned/replaced (as the final top layer), fertilised and ripped. After these tasks have been completed the open cut site can be included in the rehabilitation process for re-vegetation, monitoring and maintenance.

5.6.1.1 Soil Replacement

5.6.1.1.1 Location

Once the final land-form has been created, soil replacement can begin. All the stripped soil types are to be replaced into the original locations of the soils.

5.6.1.1.1 Compaction Avoidance

Compaction limits the effectiveness of replaced soils. The equipment used during the replacement of the soils has a major impact on the compaction levels. Ideally heavy machinery should not be used to spread and level soils during replacement. The truck and shovel method should be used since it causes less compaction than, for example, a bowl scraper.

When using trucks to deposit soils, the full thickness of the soil required can be placed in one lift. This does, however, require careful management to ensure that the correct volumes of soil are replaced. The soil piles deposited by the trucks will have to be smoothed before re-vegetating the area.

The Hutton soil is characterised by well drained and aerated soil conditions and is thus not highly susceptible to compaction potential.

The soil that is deposited with trucks need to be smoothed before re-vegetation can take place. A dozer (rather than a grader) should preferably be used to smooth the soil since it exerts a lower bearing pressure and thus compacts less than wheeled systems.

5.6.1.1.2 Soil Amelioration

Replaced soils require both physical and chemical amelioration as the actions of soil removal, stockpiling and replacement result in high levels of soil compaction and a dilution of the fertility of the soil originally present and concentrated in the surface layers. The actions that should be taken during the amelioration of soils are as follows:

- The deposited soils must be ripped to ensure reduced compaction;
- An acceptable seed bed should be produced by surface tillage;
- Restore soil fertility;

- Incorporate the immobile fertilisers in to the plant rooting zone before ripping; and
- Apply maintenance dressing of fertilisers on an annual basis until the soil fertility cycle has been restored.

5.6.1.2 Re-Vegetation and Biodiversity Establishment

5.6.1.2.1 Aims and Objectives

The main aim of re-vegetation for the study area is to restore the area to the indigenous Bushveld. It is advised to restore the study area as far as possible to a stable and sustainable ecosystem. The overall objectives for the re-vegetation of reshaped and top-soiled land are to:

- Prevent erosion;
- Restore the land to the agreed land capability;
- Re-establish eco-system processes to ensure that a sustainable land use can be established without requiring fertilizer additions; and
- Restore the biodiversity of the area as far as possible.

5.6.1.2.2 Rehabilitation Species

The rehabilitation “seed cocktails” generally consist of grasses as they rapidly establish and provide excellent protection against surface erosion. The following grass seed mix is recommended for rehabilitation re-vegetation:

- *Eragrostis tef;*
- *Digitaria eriantha;*
- *Cynodon dactylon;*
- *Cenchrus ciliaris; and*
- *Chloris gayana;*

5.6.1.2.1 Re-vegetation

The rehabilitated areas need to be stabilised with vegetation, mainly grasses at first. Long-term post-closure rehabilitation will allow the re-vegetation of the grasses, bushes and trees.

The recommended approach, for which the costing has been derived, is as follows:

- Lime and superphosphate must be applied to the surface
- These ameliorants are then incorporated by deep ripping, which penetrated 100mm through the soil into the underlying overburden material
- Compound (NPK + Zn) fertilizer must be applied, and disced in as part of seedbed preparation

- A grass seed mix is then planted, usually with first rains, or after rains have commenced
- The site is then mulched using locally obtained grass; this is to stimulate the long term establishment of indigenous vegetation and to reduce erosion during early plant growth.

5.6.2 Air Quality

Re-vegetation is critical for acceptable closure of the area and to achieve sustainable and good air quality. It is recommended to minimise the erosion to reduce the potential for fugitive dust generation.

6 Maintenance and Aftercare

Maintenance and aftercare must be planned for 2-3 years after the land preparation and replanting of vegetation has been completed. Maintenance will specifically focus on annual fertilising the rehabilitated area, control of all other alien plants and general maintenance, including rehabilitation of cracks, subsidence and erosion gullies. Continuous erosion monitoring of rehabilitated areas and slopes should be undertaken and zones with excessive erosion should be identified. The cause of the erosion should be identified, and rectified. Zones with erosion will need to be repaired with topsoil and re-vegetated.

7 Long Term Water Issues

Each mining operation has an effect on the ground and surface water regimes. These effects vary greatly according to the mining operation and the geological setting of the operation. This report did not attempt to quantify the groundwater impacts or the mitigation thereof. These impacts and their mitigation cannot be accurately predicted without the availability of a detailed hydrogeological study of the area, resulting in this omission.

8 Post-Closure Monitoring and Management

The purpose of monitoring is to ensure that the objectives of the rehabilitation programme are met and that the rehabilitation process is followed.

8.1 Groundwater and Surface Water

The post-closure monitoring should take place for five years or until a long term acceptable trend can be determined.

8.2 Flora

The following recommendations have been suggested for post mining rehabilitation and monitoring of the proposed development area. Biodiversity assessments mid wet season should be undertaken by a qualified ecologist / botanist to monitor the rehabilitation progress with regards to flora.

Mid wet season surveys are recommended to undertake the following suggested activities (Table 1).

Table 1: Flora monitoring recommendations post mining/during rehabilitation

Aspect		Suggested activity
	Vegetation	Transects (500m) through disturbed areas. Sample plots to be identified and monitored
	Alien vegetation	Transects (500m) through disturbed areas. Sample plots to be identified and monitored.
	Erosion	Identify possible areas of poor vegetation cover which might lead to erosion. Any evidence of erosion should be attended to, by planting species with a dense root system, such as *Cynodon dactylon*.

Alien invasive species tend to out-compete the indigenous vegetation; this is due to the fact that they are vigorous growers that are adaptable and able to invade a wide range of ecological niches (Bromilow, 1995). They are tough, can withstand unfavourable conditions and are easily spread.

Alien invasive control methods should be employed for the species that will be identified during the flora assessment. Alien species in South Africa are categorised according to the Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004). The species identified on site are listed as Category 1b which means that these Invasive species must be controlled by an invasive species management programme. For the removal of alien species the following is recommended:

- Physical chopping of the bushes and then painting the stumps with herbicide. A follow up of this activity will be essential; and
- Chemical control is suggested – herbicides. A follow up of this activity is suggested

Invasive alien plant species are difficult to control. Methods should be used that are appropriate for the species concerned, as well as to the ecosystem in which they occur. When performing the controlling methodology for weeds and invaders, damage to the environment must be limited to a minimum. The methodology must be performed for at least three growing seasons to ensure the seed bank is depleted. Continual monitoring will be needed for seeds that are likely to be blown in from adjacent areas.

8.2.1 Integrated Control Strategies

The satisfactory control of weeds and other invasive species is usually only achieved when several complementary methods, including biological control, improved land management practices, herbicides and mechanical methods, are carefully integrated. Such a strategy is termed an Integrated Control Strategy (ICS).

Follow-up control of alien plant seedlings, saplings and coppice re-growth is essential to maintain the progress made with initial control work, and to prevent suppression of planted

or colonizing grasses. Before starting new control operations on new infestations, all required follow-up control and rehabilitation work must be completed in areas that are originally prioritized for clearing and rehabilitation.

The following additional measures are recommended to prevent the future introduction or spread of alien species, and to ensure the rehabilitation of transformed areas:

- There must be no planting of alien plants (e.g. black wattle, eucalyptus and pampas grass) anywhere within the study area;
- Annual surveys, aimed at updating the alien plant list and establishing and updating the invasive status of each of the alien species, should be carried out (can be done by De Groote Boom staff);
- The transportation of soils or other substrates infested with alien species should be strictly controlled;
- Benefits to local communities as a result of the alien plant control programme should be maximised by not only ensuring that local labour is employed, but by also ensuring that cleared alien trees are treated as a valuable wood resource that can be utilised;
- It is considered essential that appropriate veld management (particularly appropriate grazing levels and burning frequencies) should be applied to areas of secondary indigenous vegetation (e.g. secondary grassland of historically cultivated areas), and especially the grassland and wetland vegetation of untransformed habitats.

8.3 Fauna

Mid wet season surveys are similarly recommended to undertake the following suggested activities (Table 2).

Table 2: Fauna Monitoring recommendations post mining/during rehabilitation

Aspect		Suggestion
Fauna	Large Mammals	Camera traps along transect (every 100m) for 2 nights
	Mammals	Sherman along transect (every 100m) for 2 nights
	Avifauna	Bird counts
	Herpetofauna	Pitfall traps along transect (every 100m) for 2 nights
	Invertebrates	Pitfall traps along transect (every 100m) for 2 nights

9 Financial Provisions

Closure liability costs were calculated by means of the DMR's standard method for assessment of mine closure (explained in Appendix B). The approach followed during these calculations was to assume a planned closure.

A summary of the calculated environmental liability costs is presented in Table 3 overleaf. The cost for rehabilitation and closure of the site according to the DMR Guideline format is R2 148 139.

Table 3: Financial Provision for De Groote Boom Mining Area

CALCULATION OF THE QUANTUM							
		Location:	De Groote Boom Minerals				
	Digby Wells Environmental	**Date:**	14-May-15				
			A	**B**	**C**	**D**	**E=A*B*C*D**
	Description:	**Unit:**	**Quantity**	**Master rate**	**Multiplication**	**Weighting**	**Amount**
	Class C (Low Risk)				**factor**	**factor 1**	**(Rands)**
Component			**Step 4.5**	**Step 4.3**	**Step 4.3**	**Step 4.4**	
1	Dismantling of processing plant & related structures (incl. overland conveyors & Power lines)	m^3	0.00	12.29	1.00	1.20	R 0
2 (A)	Demolition of steel buildings & Structures	m^2	0.00	171.24	1.00	1.20	R 0
2 (B)	Demolition of reinforced concrete buildings & structures	m^2	0.00	252.35	1.00	1.20	R 0
3	Rehabilitation of access roads	m^2	10000.00	30.65	1.00	1.20	R 367 778
4(A)	Demolition & rehabilitation of electrified railway lines	m	0.00	297.41	1.00	1.20	R 0
4(B)	Demolition & rehabilitation of non electrified railway lines	m	0.00	162.23	1.00	1.20	R 0
5	Demolition of housing &/or administration facilities	m^2	0.00	342.48	1.00	1.20	R 0
6	Opencast rehabilitation including final voids & ramps	ha	5.00	179531.13	**0.52**	1.20	R 560 137
7	Sealing of shafts, adits & inclines	m^3	0.00	91.93	1.00	1.20	R 0
8(A)	Rehabilitation of overburden & spoils	ha	0.00	119687.42	1.00	1.20	R 0
8(B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	1.06	149068.51	1.00	1.20	R 189 615
8(C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	0.00	432965.63	**0.66**	1.20	R 0
9	Rehabilitation of subsidised areas	ha	0.00	100220.18	1.00	1.20	R 0
10	General surface rehabilitation	ha	2.03	94812.62	1.00	1.20	R 230 964
11	River diversions	ha	0.00	94812.62	1.00	1.20	R 0
12	Fencing	m	0.00	108.15	1.00	1.20	R 0
13	Water management	ha	0.00	36050.43	**0.25**	1.20	R 0
14	2 to 3 years of maintenance & aftercare	ha	8.09	12617.65	1.00	1.20	R 122 492
15 (A)	Specialist study	SUM		**0.00**	**0.00**	1.20	R 0
15 (B)	Specialist study	SUM		**0.00**	**0.00**	1.20	R 0
						(Sum of items 1 to 15 Above)	**R 1 470 985.87**
	Weighting factor 2 (step 4.4)			**1.05**		**Sub Total 1**	**R 1 544 535.16**
	Preliminary and General			12% of Subtotal 1			R 185 344
	Contingency			10% of Subtotal 1			R 154 454
						Sub Total 2	**R 1 884 332.90**
						VAT (14%)	R 263 806.61
						Grand Total	**R 2 148 139.50**

10 Conclusion and Recommendations

The Rehabilitation Plan and Closure Cost Calculation was based on the survey data provided by De Groote Boom and where sufficient information was not available, an estimate was made based on previous experience.

The recommendations, based on the compilation of the liability assessment are as follows:

- Hydrogeological studies should be conducted for the mining area to define the post-closure influence of the mining on the groundwater quality on the farm, and its likely impact on the surrounding areas;
- Concurrent rehabilitation must be conducted where possible so as to reduce the liability burden when the mine ceases to operate; and
- The liability figures need to be updated on an annual basis as required by the DMR. This will ensure that all costs become more accurate over time and will reflect current market conditions.

11 References

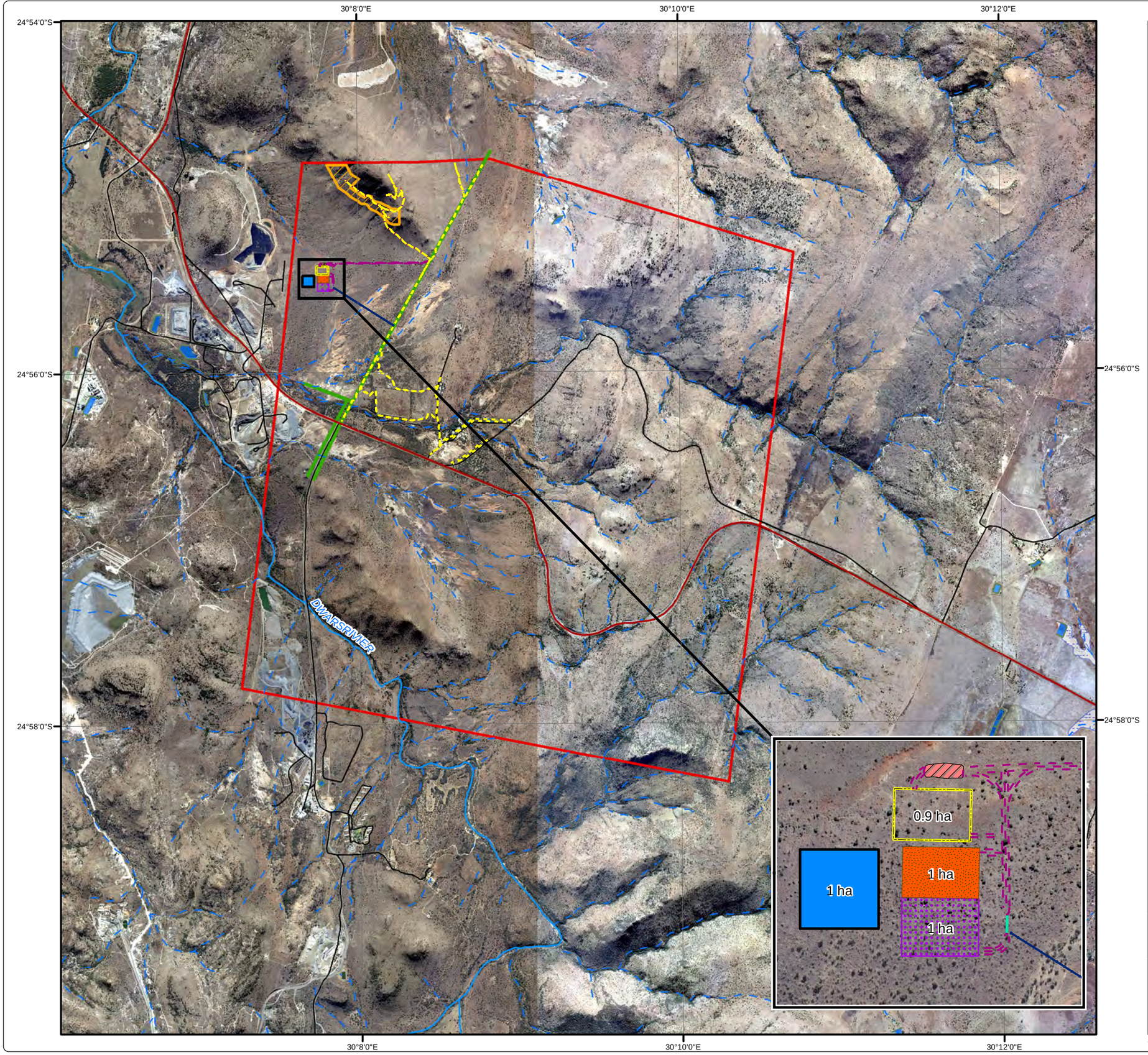
- Bromilow C. (2010) Problem Plants and Alien Weeds of South Africa, Briza Publications
- DME, 2005: Guideline Document for the Evaluation of the Quantum of Closure-Related Financial Provision Provided by a Mine, Pretoria, Department of Minerals and Energy.
- Mine Health and Safety Act (Act 29 of 1996) 1996. Government Gazette. No. 17242. Vol. 967. Cape Town. South Africa
- Tanner et al. (2007) Guidelines for the Rehabilitation of Mined Land. Chamber of Mines South Africa and Coaltech. South Africa

Appendix A: Infrastructure area

Plan 1

De Groote Boom Mining Permit

Mining Permit Activities



Legend

- Prospecting Area
- Study Area
- Main / Secondary Road
- Minor Road
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam
- Wetland

Infrastructure

- Existing Road
- New Proposed Powerline
- Proposed Haul Road (10m Wide)
- Break Test Ramp
- Crushing Area
- Pollution Control Dam
- Powerline with Servitude Boundary
- Stockpile Area
- Weigh Bridge
- Workshop

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Projection: Transverse Mercator
Datum: WGS 1984
Central Meridian: 31°E

Ref #: sdp.UAR2967.201504.136
Revision Number: 1
Date: 22/04/2015

N

0 0.5 1 2

Kilometres

1:40 000

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Appendix B: DMR Methodology

1 Infrastructure Measurement

Area measurements were measured by Digby Wells' GIS team based on the plan we received from De Groote Boom Minerals;

2 DMR Methodology

The DMR Guideline format makes use of a set template for which defined rates and multiplication factors are used. The multiplication and weighting factors which ultimately define the rate to be used are determined by amongst others the topography, the classification of the mine according to mineral mined, the risk class of the mine and its proximity to built-up or urban areas.

2.1 Rates

The DMR rates were published in 2005 and, due to inflation, are thus no longer accurate. As per the DMR's "Guideline Document for the Evaluation of the Quantum of Closure-related Financial Provision Provided by a Mine", the Master Rates for the DMR spreadsheet have been updated based on new rates released by the DMR in 2012. An inflationary figure for 2015 was then added to the 2014 rates to reflect the current 2015 rates.

2.2 DMR Classification

The DMR Guideline Document for the Evaluation of the Quantum of Closure Related Financial Provision Provided by a Mine (DME, 2005), classifies a mine according to a number of factors which allows one to determine the appropriate weighting factors to be used during the quantum calculation. The following factors are considered:

- The mineral mined;
- The risk class of the mine;
- Environmental sensitivity of the mining area;
- Type of mining operation; and
- Geographic location.

Once the risk class (Class A, B or C) and the sensitivity of the area where the mine is located (Low, Medium or High) had been determined using the appropriate tables (**Table 1**,

Table 2, **Table 3**, **Table 4** and **Table 5**) the unit rates for the applicable closure components were identified.

Table 1: Primary risk class for type of mineral mined (De Groote Boom Minerals's risk class highlighted in red)

Mineral	Ore	Size: large if > than (tpm)	Primary risk class			
			Large mine		Small mine	
			Mine and Mine waste	Mine, mine waste, plant and plant waste	Mine and Mine waste	Mine, mine waste, plant and plant waste
Antimony		1000	A	A	C	C
Asbestos		0	A	A	A	A
Base metals (Copper, Cadmium, Cobalt, Iron ore, Molybdenum, Nickel, Tin, Vanadium)	Sulphide	10 000	A	A	C	A
	Oxide	10 000	C	A	C	A
Coal		0	A	A	A	A
Chrome		10 000	C	A	C	C
Diamonds and precious stones		10 000	C	B	C	C
Gold, silver, uranium		10 000	B	A	B	A
Phosphate		10 000	C	B	C	C
Platinum		10 000	C	B	C	B
Mineral sands (Ilmenite, Titanium, Rutile, Zircon)		10 000	C	B	C	C
Zinc and Lead		10 000	C	A	C	A
Industrial Minerals (Andalusite, Barite, Bauxite, Cryolite, Fluorspar)		10 000	C	C	C	C

Table 2: Criteria used to determine the area sensitivity

Sensitivity	Sensitivity criteria		
	Biophysical	**Social**	**Economic**
Low	• Largely disturbed from natural state, • Limited natural fauna and flora remains, • Exotic plant species evident, • Unplanned development, • Water resources disturbed and impaired.	• The local communities are not within sighting distance of the mining operation, • Lightly inhabited area (rural).	• The area is insensitive to development, • The area is not a major source of income to the local communities.
Medium	• Mix of natural and exotic fauna and flora, • Development is a mix of disturbed and undisturbed areas, within an overall planned framework, • Water resources are well controlled.	• The local communities are in the proximity of the mining operation (within sighting distance), • Peri-urban area with density aligned with a development framework, • Area developed with an established infrastructure.	• The area has a balanced economic development where a degree of income for the local communities is derived from the area, • The economic activity could be influenced by indiscriminate development.
High	• Largely in natural state, • Vibrant fauna and flora, with species diversity and abundance matching the nature of the area, • Well planned development, • Area forms part of an overall ecological regime of conservation value, • Water resources emulate their original state.	• The local communities are in close proximity of the mining operation (on the boundary of the mine), • Densely inhabited area (urban/dense settlements), • Developed and well-established communities.	• The local communities derive the bulk of their income directly from the area, • The area is sensitive to development that could compromise the existing economic activity

Table 3: Weighting factor 1- Nature of terrain

	Flat	Undulating	Rugged
Weighting factor 1: Nature of the terrain/ accessibility	1.00	1.10	1.20

Note:

Flat - Generally flat over the mine area;

Undulating - A mix of sloped and undulating areas within the mine area; and

Rugged - Steep natural ground slopes (greater than 1:6) over the majority of the mine area.

Table 4: Weighting factor 2 - Proximity to urban area

	Urban	Peri-urban	Remote
Weighting factor 2: Proximity to urban area where goods and services are to be supplied	1.00	1.05	1.10

Note:

Urban - Within a developed urban area;

Peri-urban - Less than 150 km from a developed urban area; and

Remote - Greater than 150 km from a developed urban area.

The classification of De Groote Boom Minerals has been summarised in **Table 5**. It must be noted, however, that of the 18 closure components that exist only 3 are influenced by the risk class and sensitivity, the remaining 15 have a standard multiplication factor, irrespective of the class or sensitivity.

Table 5: Mine Classification

Mine	Risk Class	Sensitivity	Terrain	Proximity to Urban Area
De Groote Boom Minerals	C	Medium	Rugged	Peri-Urban