6. PROCEDURE

6.1 GENERAL

On receipt of a permit or license the employee responsible for implementing and reporting on the conditions must ensure that the original permit is forwarded to
(* the Administrative Assistant and that the reporting frequency is recorded. The responsible employee must ensure that the Administrative Assistant is informed when a statutory report is submitted to a government department.

Note that monitoring is also required as per the Environmental Risk Report and the Closure Plan once an application for mine closure is submitted to the DME.

6.2 ENVIRONMENTAL MANAGEMENT PROGRAMME

In terms of the Minerals and Petroleum Resources Development Act 28 of 2002, Namaqualand Mines is required to conduct monitoring and performance assessments and to compile and submit a report to the DME as agreed in the EMP or by the Minister or every two years. Compliance to the approved Environmental Management Programme(s) and Addenda must be assessed. These self-assessments forms part of internal audits and currently an annual report is compiled and submitted to DME in January. The SHE Lead is responsible for this.

The above includes the monitoring of rehabilitation. Rehabilitation targets are set annually. Rehabilitation plans are available from Survey. Progress is measured by Survey and evaluated at EMSC Meetings. It is also tracked on Isometrix.

6.3 WATER MANAGEMENT

Water quantity and quality are monitored as required by permit conditions and reported quarterly to the Regional Director: Northern Cape, Department of Water Affairs and Forestry (DWAF). An independent laboratory monitors potable water, ground water and sewage effluent.

Water quality of the FRDs is monitored on a quarterly basis as required and described in the Code of Practice (COP) Fine residue.

The SHE Lead must ensure that the quarterly reports are submitted to DWAF.

The Engineers responsible for the sewage works at Kleinzee, Dreyerspan and Koingnaas must ensure that changes in personnel and other requirements in terms of Regulation 2834 are communicated annually to the Director General of DWAF.

See Appendix 1 for the Water Sampling Protocol.

6.4 AIR QUALITY

a) Fall out dust

If required monitoring is conducted in the town areas bi-monthly. This is usually required when mining operations occur close to the town's proximity. These samples will be collected at required locations. In addition total particulates at mining operations are measured on an ad hoc basis (when requested) by the Occupational Hygiene consultant. Reports are available at the Environmental Management Section.

b) Environmental perimeter nuisance noise

The Occupational Hygiene consultant monitors environmental perimeter nuisance noise on when mining occurs near town areas. The results are recorded and concerns elevated and the report are filed at the Environmental Management Section.

6.5 ELECTRICITY CONSUMPTION

Power consumption are monitored and measured by the Technical Support Department (Electrical Engineer).

6.6 WASTE MANAGEMENT

The monitoring of the 22 permitted waste sites on Namaqualand Mines is the responsibility of line management. The responsible Line Managers are responsible for submitting an annual report for each site as required by DWAF.

Waste water from the various oil separators are monitored at least annually to ensure that no substance that is likely to cause pollution enters the environment. The Environmental Management Section is responsible for ensuring that the inlet and outlet of the separators are monitored. The SHE Manager / Environmental Management Co-ordinator maintains the monitoring results.

6.7 OTHER MONITORING AND REPORTING AS REQUIRED BY PERMITS AND LEGISLATION

The SHE Lead or his/her delegate is responsible for monitoring and reporting on archaeological permits.

The Chief Safety Officer is responsible for monitoring and reporting on occupational hygiene matters. Aspects such as airborne pollutants and noise are monitored.

6.8 OTHER MONITORING AND REPORTING REQUIRED BY DE BEERS

Other environmental monitoring is conducted as requested by the De Beers Group and reported by the SHE Lead on EPRA. De Beers group determines the performance indicators. Environmental Sustainability performance is reported in the De Beers Annual Review. See Environmental Performance Review procedure NM-PR-21-SHHE and EPRA database.

6.9 MONITORING OF OBJECTIVES AND TARGETS

(* Conformance to NM environmental, safety and occupational health objectives and targets is tracked through progress reports as required. Effectiveness of actions is assessed during internal audits but the overall effectiveness of EMPs
(* are evaluated annually and reported at OH&SMS and EMS Steering Committee and OPCO Meetings.

6.10 MONITORING EQUIPMENT

Where monitoring equipment is required to measure key characteristics, this equipment is appropriately maintained and verified at regular intervals. Calibration is done to national or international standards and records of the calibration are maintained. Records should indicate the date of last calibration, company/person who carried out calibration, acceptance criteria and the effect on equipment suitability.

6.11 LEGAL COMPLIANCE MONITORING

(* Legal compliance to all identified environmental, safety and occupational health legislation was assessed during the initial review. Compliance will be self-assessed or by an independent legal specialist annually and when notification of changes to legislation is received.

Compliance is reported to the OH&SMS and EMS Steering Committee and OPCO Meetings. Compliance to permit/ license conditions is also reported annually to the De Beers Group (See EPRA). Records to demonstrate legal compliance are currently kept for an indefinite period. A major breach in legislation is reported in terms of NM-PR-15-SHHE.

7. RECORDS

Description	Responsible	Location	Retention	Status*
Objectives	Y1	Isometrix database	Current	A
Rehabilitation plans	U1	Survey	Current	A
Correspondence with Government Depts.	B2	Records	6 years	A
Permits and licences	B2	Records	Current	A
Potable water monitoring results	K1	Specific section	6 years	A
Water intake records	T1	Specific section	6 years	A
Quarterly water intake reports to DWAF	T1 / Y1	Specific section	6 years	A
Discharge monitoring results (seawater)	T1	Specific section	6 years	A
Sewage effluent monitoring results	K1	Mechanical services workshop	6 years	A
Quarterly wastewater reports to DWAF (sewage and sea)	Y1	SHE Department	6 years	A
Dust	Y1	Towns	6 years	A
Nuisance noise	Y1	Towns	6 years	A

Electricity Consumption	E1	All	6 years	A
Waste monitoring results	K1, M1	Specific section	2 years	A
Annual waste report to DTEC	Y1	Environmental Section	6 years	A
Monthly occupational hygiene report	Y1	Safety	LOM	A
Archaeological reports, Correspondence with SAHRA	Y1	Environmental Section	6 years	A
EMS and OH&SMS SC Minutes	Y1	Environmental Section	6 years	D
EPRA	Y1	Environmental Section	6 years	A
EMP performance assessment	Y1	Isometrix	Current	A
EMP performance report to DME	Y1	Environmental Section	6 years	A
Annual EMS / OH&SMS review	Y1	Isometrix	Current	A
Calibration records	All	Specific department and section	Current	D

* A = Archive; D= Destroy

8. AMENDMENT RECORD SHEET

Recorded below are all the amendments which have been made to this document and the date the amendment was effected.

Issue no	Page no	Section	Subject	Date
01	All	Complete	NM-PR-06-ENV replaces PR-18-60-05, issue 3	01/08/01
01	All	Complete	Total review to include reporting and related responsibilities as well as records. See SABS finding R 05. This document replaces NM-PR-06-ENV.	08/11/02
02	All	1, 3, 4, 5, 6.1, 6.2, 6.4, 7	Update legislation and references. General update to include designation changes, new SANS ISO 14001:2004 standard requirements and hydro-carbon monitoring (Finding DB04).	01/02/05
03	All	4, 5, 6.1, 6.3, 6.4, 6.5, 6.6	Update monitoring as currently on-mine. Include waster sampling protocol, dust, noise and electricity monitoring, change responsibilities	16/10/06
04	All	All	Review procedure	08/10/08
05	All	All	Include OHSAS 18001:2007 requirements	30/07/09

PA Sparks
OPERATIONS MANAGER
/mvw

NR Williams
SHE LEAD

Appendix 1

WATER SAMPLING PROTOCOL AT NAMAQUALAND MINES

Water Sampling Procedure for Oil/ Diesel Separators, groundwater and seepage from FRDs
Frequency: Annual
ISO Reference Procedure NM-PR-17-SHHE
Environmental Officer

Position No	Monitoring Positions	Responsible Person on Site
1	E44 wash bay	E44
2	K17 wash bay	K17
3	K46 wash bay	K46
4	K48 wash bay	K48
Other		
5	Swartlintjies seepage	K3
6	Jetsump KNC	K8
7	Mannels Vley	Y10 (see licence conditions)

Sampling Positions

Samples are generally taken from the separation chambers inlet and outlet of active separators i.e. the monitoring positions listed above. If there is no flow at the outlet or inlet, samples are taken from the last chamber of the separator.

Sampling Methodology

Samples are taken using a sampling tube at approximately 0,5m below liquid level (bll) from the small separators and at 1mbll from the large separators.

At present water from the sampling tube is transferred into the 1000ml glass bottles supplied by Al Abbott. The bottles are filled with liquid with a convex meniscus and capped without air bubbles. The samples are stored on ice packs and refrigerated overnight. AL Abbott collect samples a day after sampling is completed.

(*For sampling at the Swartlyntjies sampling are done at both the first and second trenches, as well as at prescribed boreholes up and down stream from the seepage plume. Samples are taken using a bucket connected to a rope, next to the pumps. Samples are then transferred to sampling bottles provided by AL Abbott.

Mannels Vley samples are taken by consultant from pre-determined sampling points.

Sampling Equipment

Gloves
1000ml Sampling tube
Soap
Distilled water
Sample bottles

Sampling Frequency

Samples are taken annually in November.

Laboratory

T.R. Davies
AL Abbott and Associates (PTY) LTD
No1 Vine Park
7925
Woodstock Cape Town
T: (021) 448 6340
alabbott@iafrica.com

Sampling Parameters

pH, Conductivity (mS/m), Sodium Adsorption Ration, Chemical Oxygen Demand, Oil and Grease, Sodium, Chloride, Total Suspended Solids.

Results

Al Abbott Laboratories report the results electronically and in hard copy.

Reporting

The results are reported at the management review session. Namaqualand Mines are seeking approval from DWAF to dispose of final effluent on haul roads in mining areas.

Actions

Separators producing water of poor quality are being scheduled for upgrading and sometimes replacement

(*Appendix 2

AIR QUALITY SAMPLING PROTOCOL AT NAMAQUALAND MINES

Air Quality Sampling for Fall-out Dust and PM10

Frequency: Monthly

ISO Reference Procedure: NM-PR-17-SHHE

Position No	Monitoring Positions
Kleinsee	
1	Driving School
2	West-End Hostels
3	B-Band Flats
4	Jnr School
Koingnaas	
5	Hostels
6	Mine Offices close To the Power Station

Sampling Positions

Samples are taken at the above mentioned sampling positions as predetermined by Dr. JDR Beukes. There are four monitoring sites in Kleinsee and two in Koingnaas.

Sampling Methodology

Samples are taken using the international *Standard Test Method for Collection and Measurement of Dust fall (Settle able Particulate matter) – ASTM International Designation: D 1739-98 (Re-approved 2004).* This method is prescribed by the Government of South Africa for personal dust monitoring. Measurements are usually taken for a period of 7 to 8 hours per measurement.

Samples are not taken during rain, because the sampling equipment is not waterproof.

Measurements for PM 10 are done according to SANS 69 following reference method EN 12341.

Sampling Equipment

Fall-out Dust:
270 mm diameter buckets
Fixed dust collecting stands
Distilled water
Bleach

PM10:
Dust Track electronic sampler
PM1o Sampling head

Sampling Frequency

Samples are taken at monthly intervals.

Laboratory

Johann DR Beukes
Health and Occupational Hygiene Laboratory

P.O. Box 51630
Wierda Park
0149

Tel: +2712 653 3850
Fax: +2712 653 0958
Cell: +2782 446 7532
e-mail: jdrb@telkom.net

Sampling Parameters

Fall-out dust and PM10

Results

JDR Beukes report results electronically every second month.

Reporting

These results are reported at the management review session.

Actions

Suspend mining activities if risk is high.

(*Appendix 3

Potable Water Sampling Protocol at Namaqualand Mines

Water sampling procedure for Drinking water (Potable water)
Frequency: Quarterly
ISO Reference Procedure NM-PR-17-SHHE

Position no	Monitoring Position	Responsible Person
1	Willem Cockrell	E17
2	Port Nolloth Road tap off	E17
3	Fellman Wells Pump Station	E17
4	Uitsight Single Hydrant	E17
5	Kleinzee Sewage plant	E17

Sampling Positions

Samples are taken from taps situated at the above mentioned sampling positions.

Sampling Methodology

Sample taps should be fully opened and allowed to run freely for about 30 seconds prior to sampling.

Two x 200 ml sample bottles should be filled completely and caps replaced immediately. Bottles should be rinsed three times with the running water to be sampled prior to filling.

For bacteriological analysis, aseptic procedures should be followed. This involves ensuring that neither the inner part of the screw top nor the neck of the bottle contacts anything but the water during sampling. No rinsing should take place. Cap to be removed immediately prior to filling and replaced as soon as the bottle is full. Sterile bottles must be used. One 200 ml bottle will suffice.

Samples are to be stored in a refrigerator at 4°C until collected by A.L. Abbott & Associates.

Ideally, taps should be flamed prior to sampling and free- and total- chlorine measured at the same time a sample is drawn.

Sampling Equipment

200ml Sample Bottles

Sampling Frequency
Samples are taken every three months.

Laboratory

T.R. Davies
AL Abbott and Associates (PTY) LTD
No 1 Vine Park
Vine Rd
Woodstock
Cape Town
7925
Tel: (021) 448 6340
alabbott@iafrica.com

Sampling Parameters

pH, Langelier Saturation Index (at 25 deg.C), Conductivity (mS/m) (at 25 deg.C), Turbidity (NTU), Colour (mg/l as Pt), Total Alkalinity (mg/l as $CaCO_3$), Total Hardness (mg/l as $CaCO_3$), Calcium (mg/l as $CaCO_3$), Magnesium (mg/l as $CaCO_3$), Chloride (mg/l as Cl), Fluoride (mg/l as F), Iron (µg/l as Fe), Manganese (µg/l as Mn), Aluminium (µg/l as Al), Calcium Carbonate Precipitation Potential, Free Chlorine (mg/l), Sodium (mg/l as Na), Potassium (mg/l as K), Zinc (mg/l as Zn), Nitrate Nitrogen (mg/l as N), Nitrite Nitrogen (mg/l as N), Nitrate & Nitrite Nitrogen (mg/l as N), Ammonia (mg/l as N), Sulphate (mg/l as SO4), Total Dissolved Solids, E.Coli (organisms per 100 ml), Coliforms (organisms per 100 ml) and Total Plate Count (organisms per ml).

Results

Al Abbott Laboratories report the results electronically and in hard copy.

Reporting

The results are reported at the management review session.

*) Appendix 4

Summary of Monitoring at Namaqualand Mines

SUMMARY OF MONITORING ON NAMAQUALAND MINE								
Monitored Item	**Sampling Point**	**Type of Analysis**	**Frequency**	**Person/ Section Responsible for Sampling/Analysis & Interpretation**	**Standard to be Used to indicate limits**	**Record Location**	**Retention Period**	**Persons to whom Interpretation of Results Should be Sent**
Fine Residue Deposit (FRD)	AK3, Tweepad, Koingnaas, Michells Bay, Dikgat and Langhoogte	Water quality	Quarterly	Ore Processing	SANS	A7	Life of Mine + 10 years	SHE Department (DWEA)
Swartlintjies Seepage	Koingnaas FRD	Water quality	Quarterly	SHE Department Section - AL Abbott	SANS SABS	Y1	Life of Mine + 10 years	SHE Department (DWEA)
Separator water	E44 , K17 / K46 Wash bays	Hydrocarbons	Annually	SHE Department Section - AL Abbott	SANS / SABS	Y1	Life of Mine + 10 years	SHE Department (DWEA)
Jetsumps	Koingnaas	Hydrocarbons	Annually	SHE Department Section - AL Abbott	SANS / SABS	Y1	Life of Mine + 10 years	SHE Department (DWAF)

Monitored Item	Sampling Point	Type of Analysis	Frequency	Person/ Section Responsible for Sampling/Analysis & Interpretation	Standard to be Used to indicate limits	Record Location	Retention Period	Persons to whom Interpretation of Results Should be Sent
Dust Analysis - possible risk to human health	Traffic test area, West-end Washbay, Junior School, B-band flats, Koingnaas Town	Fall out dust	Bi-monthly as required	SHE Department - Johann Beukes	SANS 1929	Y1	Life of Mine + 10 years	SHE Department (DWEA / DMR)
Nuisance Noise in town close to mining	Kleinzee Town	Nuisance noise	Annually – as Required	SHE Department - Johann Beukes	SABS 0103 for Urban areas	Y1	Life of Mine + 10 years	SHE Department (DWEA / DMR)
Asbestos fibre risk assessment	All Namaqualand Mines	Asbestos fibre risk	Annually	SHE Department - Johann Beukes	Asbestos Regulation	Y1	Life of Mine + 10 years	SHE Department (DWEA / DMR)
Waste sites volumes	22 licensed - see file	Waste volumes	Annually	See responsibilities - NM-PR-10-SHHE	DWAF requirements	Y1	Life of Mine + 10 years	SHE Department (DWEA)
Energy Consumption	All Namaqualand Mines	Energy consumption	Annually	Technical Support - E11	ESKOM	E11	Life of Mine + 10 years	SHE Department (CHQ)
EPRA	All Namaqualand Mines	NM sustainability	Annually	SHE Department - Involve all Sections	DBCM Template	Y1	Life of Mine + 10 years	SHE Department (CHQ)
Performance Assessment	All Namaqualand Mines	Conformance to EMP	Annually	SHE Department - Involve all Sections	Audit EMP commitments	Y1	Life of Mine + 10 years	SHE Department (DMR)

APPENDIX C

De Beers Identification of Environmental Awareness and Competency Training

Golder Associates

Document no:	NM-PR-05-SHHE	Compiler/Reviewer:	EM Co-ordinator
Issue no:	04	Head of Department:	SHE Manager
Page:	1 of 4	Authorised by:	Operations Manager
Revision date:	8 October 2011	Issue date:	8 October 2008

IDENTIFICATION OF ENVIRONMENTAL AWARENESS AND COMPETENCY TRAINING

(* denotes change from previous issue

1. OBJECTIVE

The objective of this procedure is to ensure the environmental training needs as periodically identified, including general environmental awareness and job-specific environmental requirements of De Beers NM employees (including contractors) are met.

2. SCOPE

This procedure applies to all employees responsible for the implementation of the EMS at Namaqualand Mines.

3. RESPONSIBILITY

(* The **SHE Manager / Environmental Management Co-ordinator** is responsible for assessing environmentally specific training needs based on the information in the Isometrix database and requests from Line Management.

(* **Line Management** is responsible to forward all training needs identified to the SHE Manager / Environmental Management Co-ordinator.

Supervisors / Line Managers are responsible for providing on-the-job training.

Relevant employees implementing the environmental policy are responsible for participating in the processes set out in this procedure.

(* **Training and Development** is responsible to book attendees and dates on SAP.

4. LEGISLATION

- Occupational Health and Safety Act 85 of 1993 - GN Regulation 1179 of 25/08/1995; Section 3
- Skills Development Act 97 of 1998
- National Environmental Management Act 107 of 1998, Section 2
- Mineral and Petroleum Resources Development Act 28 of 2002, Section 39, 51

5. REFERENCES

The following Namaqualand Mines policy manuals and procedures and other documents are also relevant:

NM-PM-01-SHHE ENV	Environment Policy Manual
NM-PR-31-HR	Training and Development
SANS ISO 14001:2004	Element: 4.4.2

6. PROCEDURE

6.1 TRAINING REQUIRED

All employees are to receive general environmental awareness training including:

- an understanding of the environmental policy,
- awareness that an EMS exists to manage aspects, and
- the importance of conformance with the policy and relevant procedures, as listed in the EMS Manual (NM-PM-01-SHHE ENV).

All new employees are to receive the above during Induction Training as well as on-the-job training where necessary.

All employees with activities that can have a significant impact on the environment shall:

- understand the environmental impacts of their activities and the consequences of departure from specified procedures,
- know how to respond to emergencies which can cause environmental damage,
- be able to recognise potential environmental impacts in their work area,
- understand the environmental benefits of improved performance, and
- be competent to undertake the procedures. In this case, based on activities and associated procedures, decide whether formal training, communication or re-orientation is required.

6.2 ASSESSMENT AND IDENTIFICATION OF TRAINING COURSES AND NEEDS

In the First Quarter of each year, and on an ad hoc basis, the Environmental Management Co-ordinator shall:

- conduct a review of training needs - based mainly on an assessment of the effectiveness of previous training, the results of audits, recommendations from non-conformances, needs identified by line management and availability of new courses - to enhance environmental understanding ensuring that:
  - the relevant persons have received or are to receive appropriate training as identified above, and
  - any employees that require re-training or refresher courses are identified.

- update the environmental training by :
  - identifying the target group to receive a particular type of training,
  - identifying the training courses for each target group,
  - detail the outputs from the course i.e. the form of understanding, skill or training capacity that will be gained from the course, and
  - detail the form of Evaluation that will take place to assess effectiveness of the course e.g. sample survey to assess the learning points in relation to the outputs of the course, examination etc.

- forward courses to Training Department to budget for the training.

(* On an ongoing basis, the SHE Manager / Environmental Management Co-ordinator is to:

- assess new courses that become available and assess the necessity for employees or contractors to attend these, and
- identify training needs based on non-conformances and audit results.

The person designated as responsible for each course is to ensure that all certificates and/or attendance records from the training courses are forwarded to the Snr HR Clerk – Training and Development for employee records.

Training Department will make course bookings on SAP, where necessary. Human Resources maintain employee training records for the length of service of each employee.

6.3 EFFECTIVENESS OF TRAINING

The effectiveness of training is determined by means of internal audit findings, incidents reported and legal compliance audit results as well as feedback received. Additional to this, some of the external environmental courses e.g. legal course presented by the North-West University/ South African Bureau of Standards provides for competency testing.

(*

7. RECORDS

Description	Responsible	Location	Retention	Status*
Attendance records	P29	SAP / Training department	LOM	A
Employee training records	P29	SAP	Current	A

* A = Archive; D= Destroy

8. AMENDMENT RECORD SHEET

Recorded below are all the amendments which have been made to this document and the date the amendment was effected.

Issue no	Page no	Section	Subject	Date
01	All	Complete	NM-PR-03-ENV replaces PR-18-60-03, issue 3	01/08/01
01	3	6.3	Add paragraph 6.3. See SABS audit Finding R03. This document replaces NM-PR-03-ENV.	07/11/02
02	All	All	Update legislation, references and the Procedure to include new SANS ISO 14001:2004 standard requirements and current practice.	07/11/05
03	1, 3 & 4	3, 6.2 & 7	Change responsibilities and recordkeeping	03/09/07
04	All	All	Reviewed, changes as per (*	08/10/08

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APPENDIX D

Emergency Preparedness and Response

Golder Associates

Document no:	NM-PR-22-SHHE	Compiler/Reviewer:	SHE Lead
Issue no:	03	Head of Department:	SHE Lead
Page:	1 of 9	Authorised by:	Operations Manager
Revision date:	18 June 2012	Issue date:	18 June 2009

ENVIRONMENTAL EMERGENCY PREPAREDNESS AND RESPONSE

(* Denotes change from previous issue

1. OBJECTIVE

The purpose of this procedure is to document the process in the event of an occurrence of an environmental emergency in order to ensure timely response that plays an important role in mitigating the effects of such an emergency. This procedure will indicate the best practice in order to manage the negative environmental impacts resulting from identified environmental emergencies and the success of the recovery operation as well as the management of the negative aspects and impacts resulting from identified emergencies.

2. SCOPE

This procedure applies to all operations or activities/services performed by all employees and contractors at Namaqualand Mines.

3. DEFINITIONS, PRINCIPLES AND LEGISLATION

3.1 DEFINITIONS

The following definitions will assist in the interpretation of this procedure:

3.1.1 Environment
The surroundings in which the organisation operates, including air, water, land, natural resources, flora, fauna, humans and their interaction.

3.1.2 Environmental Impact
Any change to the environment, whether adverse or beneficial, wholly or partially resulting from the organisation's activities, products or services.

3.1.3 Pollution
Any change in the environment caused by:

a. Chemical substances
b. Radioactive substances
c. Noise, odours, heat, light or
d. Mechanical land disturbance

3.1.4 Emergency

a. Any unplanned or uncontrolled event that requires immediate action to prevent extensive environmental damage resulting from a major environmental incident.
b. Any significant wastage of resources or unplanned physical damage to the environment.

Note: Depending on the toxicity of the substance, any spill of one litre or more can be seen as an emergency.
As a general rule of thumb any oil, petrol or diesel spill onto soil larger than five litres is an emergency (as far as possible, all spills should be cleaned).

A major environmental incident is a reportable environmental incident associated with widespread long term irreversible negative ecological or social impact, with a high risk of legal liability.

Negative Impact:
An impact that may result in :

- Negative public's perception;
- Non-compliance with legislation;
- Complete disruption of a natural system;
- A high likelihood of prosecution;
- A high degree of irreversibility (5+ years);
- Complete disruption of our mining process; and
- Is reportable to a national authority in terms of national legislation

(* 3.2 LEGAL AND OTHER REQUIREMENTS

SANS ISO 14001: 2005 (4.4.7)
SANS ISO 14004: 2005 (4.4.7)
Hazardous Substances Act, 1973 (Act No. 15 of 1973)
National Water Act, 1998 (Act No. 36 of 1998), Section 20
National Environmental Management Act, 1998 (Act No 107 of 1998) Section 30
Environmental Conservation Act No. 73 of 1989
Minerals Act No. 50 of 1991
Mineral and Petroleum Resources Development Act No. 29 of 2002
Atmospheric Pollution Prevention Act No. 45 OF 1965
Other legislation and requirements as identified in NM-PR-04-SHHE

4. RESPONSIBILITY

It is the responsibility of :

4.1 The **Line Manager** to communicate and enforce this procedure.
(* 4.2 The **SHE Lead / Environmental Co-ordinator** to initiate environmental emergency response procedures for all identified environmental emergencies as identified in the aspect register.
4.3 **Line Management** is responsible to ensure that emergency drills are conducted, recorded and forwarded to the Environmental Management Section.
4.4 **All employees** are responsible to comply with all environmental emergency procedures.
4.5 The **Operations Manager** and his authorised designates, are responsible for ensuring that this procedure is adhered to.

5. REFERENCES

This procedure must be read in conjunction with the following:

NM – PR – 13 – SHHE	Fire Risk Management and Fire Fighting Facilities
NM – PR – 14 – SHHE	Fuel and Lubricant Pollution Prevention and Remediation Procedure
NM – PR – 15 – SHHE	Environmental Incidents: Reporting and Investigation
NM – PR – 04 – SHHE	Identification of and access to Environmental Legal and Other Requirements
MAN – DP – 01 – KNC	Emergency Procedure for Koingnaas Mining Complex
MIN-DP-01-BMC	Emergency Procedure for Buffels Marine Complex – Mining
MIN-DP-08-BMC	Preparedness for handling an emergency associated with Fine Residue Deposit facility failure - BMC
MET-DP-01-BMC	Preparedness for handling an emergency associated with Fine Residue Deposit facility failure - BMC

Other: Code of Practice for Fines Residue Deposits - Intranet
Code of Practice for Fall of Ground - Intranet
Reporting of an Emergency – Intranet

6. PROCEDURE

6.1 REPORTING

6.1.1 Originator (The first person to witness an emergency incident e.g. fire)

a. Reports the matter immediately and verbally to his/her supervisor or the responsible person of the area or to the Security Control Room as soon as possible. (BMC – 3333 and KNC – 7399)

6.1.2 The security official should ensure that the relevant stakeholders are notified (see Reporting an Emergency on the intranet)

Note: *Once the emergency incident is reported to Security, the requirements as stated in the relevant procedure/plan must be carried out.*

6.1.3 Responsible Person (for relevant area)

a. Acts on the emergency incident report immediately and implements preventative and/or corrective measures.
b. Follows the steps in the prescribed incident reporting system to report the environmental incident.

Note: A serious event that could lead to danger to the public or the environment (e.g. **potential** death or a sustaining impact on the environment) must be externally reported to-

(i) the Department of Environmental Affairs;
(ii) the South African Police Service;
(iii) the relevant Municipality;
(iv) all persons whose health may be affected by the event and
(v) the Department of Water Affairs (in the event of water resource pollution only)

(*

The following information must be reported:

- Nature of the incident
- Substances and quantities involved and risks posed to public health, safety, property and environment
- Initial measures taken to minimise impacts
- Causes of the incident
- Avoidance measures

Note: The Operations Manager must approve all ***external*** communications.

6.1.3 SHE Lead/Environmental Co-ordinator/Alternate

a. Follows-up on environmental emergency incidents and reports it to the Namaqualand Mines Operations Committee **(OPCO)**.

b. Evaluates the success of the remedial action taken and reports this to OPCO.

6.2. EMERGENCY DRILLS

6.2.1 Emergency preparedness procedures, where practical must be practiced at least once per annum according to schedule. A schedule for these drills, in line with NM-PR-14-SHHE, must be compiled by the SHE Lead/Environmental Co-ordinator. The scheduling of all other emergency drills will be done by the Safety Section. The responsible person will keep records of such drills.

6.2.2 The emergency preparedness drills can either be in the form of a desktop study, or a physical exercise.

6.2.3 After each practice drill or actual emergency, the effectiveness of the procedure will be evaluated and revised where necessary.

6.2.4 A report of the emergency, the actions taken and the effectiveness thereof will be presented to management for the more serious emergencies, at the discretion of the SHE Lead/Environmental Co-ordinator.

6.2.5 The less serious emergencies will only be reported via the incident reporting system. The seriousness of an emergency will be decided on at the discretion of the environmental section and section heads.

6.3 POTENTIAL ENVIRONMENTAL EMERGENCY TABLE

The table includes all the potential environmental emergency situations for Namaqualand Mines that may lead to serious pollution or degradation of the environment, whether immediate or delayed.

Table 1: Environmental Emergency Incidents

DESCRIPTION	ASPECT	IMPACT	REFERENCE TO EMS	DRILL	RESP.
Fossil fuel:					
Old oil bulk tanks /containers /pipelines	Burst /Major leak	Soil and water pollution	NM-PR-14-SHHE MAN-DP-01-KNC MIN-DP-01-BMC MIN-DP-08-BMC	Annually	E21, E22, K17, K48
Bulk Diesel tanks and pipelines	Burst / pipe damage		MET-DP-01-BMC		S1, T1,S1, K1
Underground Petrol tanks	Rupturing of fuel tank				E21, E22, K17, K48
EMV Hydraulic hoses (200l)	Rupturing of hydraulic hoses and Burst /Major leak				E21, E22, K17, K48
Fuel tanker	Loading and off loading spills				S1, K1
Plant Thickeners	Cracking or rupturing of walls	Soil and water pollution	MET-DP-01-BMC	Annually	T1, K1
FRD	Wall failure	Soil and water pollution	COP.FRD	Annually	T1, K1
Flammable material	Uncontrollable fires	Air, soil and water pollution Damage to surrounding environment	NM-PR-13-SHHE MAN-DP-01-KNC MIN-DP-01-BMC MIN-DP-08-BMC MET-DP-01-BMC	Bi-annual	S1, K1
High tension Sub Station	Rupturing of walls and uncontrollable fires	Air, soil and water pollution. Possible damage to surrounding environment	NM-PR-13-SHHE MAN-DP-01-KNC MIN-DP-01-BMC MIN-DP-08-BMC MET-DP-01-BMC	Annually	E11
High rainfall/Floods	Access to mining areas	Wet roads and Buffels River flow		Annually, if possible	M1, K1, N1

7. TRAINING

Section Heads / line managers are responsible for training and testing of emergency procedures. The procedures must be tested, at least, once per annum. These emergency procedures must be reviewed and revised after the occurrence of an emergency incident.

8. RECORDS

Description	Responsible	Location	Retention	Status*
Incident reports	Y10	IsoMetrix	6 years	A
Drill reports (environment)	Y10	Files	6 years	A
Drill reports (safety)	Y1	Files	6 years	A

* A=Archive; D=delete

9. AMENDMENT RECORD SHEET

Recorded below are all the amendments which have been made to this document and the date the amendment was effected.

Issue no	Page no	Section	Subject	Date
01	All	Complete	New Procedure	16/10/2006
02	All	Complete	As per (*	03/09/2007
03	2, 4 & 6	3.2, 4, 6.1 6.2	Included governmental reporting requirements as per legislation	18/06/2009

PA Sparks
OPERATIONS MANAGER
am/mvw

NR Williams
SHE LEAD

ENVIRONMENTAL EMERGENCY PREPAREDNESS DRILL CHECKLIST

NATURE OF EXERCISE: _____ DATE: _____

PROCEDURE(S) USED IN EMERGENCY DRILL: _____

ATTENDANCE REGISTER

NAME AND SURNAME	COMPANY NO	SIGNATURE

Scenario (Include points of consideration of the "Note" below):

_____

_____

_____

INSPECTION LIST

ASPECT OF COMPLIANCE	YES	NO	N/A	COMMENTS
Doors & Windows closed?				
First Aid Kit available?				
Attempt to extinguish fire?				
Fire extinguishers available?				
Alarm sound?				
Emergency Numbers phoned?				
Emergency numbers correct?				
All electrical appliances switched off?				
Proceeded to assembly point/Refuge bay?				
Waste procedure followed?				
Reaction time? (**comment on reaction time**)				Time:
Spill contained?				
Source mitigated/eliminated (e.g. valve closed?)				
Correct clean-up according to procedure?				
PPE Used?				

OBSERVATIONS AND RECOMMENDATIONS

_____

_____

Note:
- What was the perceived cause of the emergency?
- What equipment/process caused the emergency?

Corrective action	Isometrix incident no.	Resp.	Date

_____

SUPERVISOR/OFFICIAL/SENIOR PERSONNEL

FORWARD COPY TO SHE DEPARTMENT AFTER COMPLETION

APPENDIX E

Rehabilitation and Restoration Procedure

Golder Associates

Document no:	NM-PR-26-SHHE	Compiler/Reviewer:	Rehabilitation Officer
Issue no:	02	Head of Department:	Operations Manager
Page:	1 of 20	Authorised by:	Operations Manager
Revision date:	1 November 2013	Issue date:	1 November 2010

REHABILITATION AND RESTORATION PROCEDURE

1. OBJECTIVE

The objective of this procedure is to establish and maintain an effective process to reduce the NM financial liability through the sign off of assumptions and restored / rehabilitated areas.

2. SCOPE

This procedure applies to all employees and other persons at Namaqualand Mines (NM) involved in the rehabilitation, restoration and NM liability activities. The document also provides a framework for the sign off process by the Department of Mineral Resources.

3. LEGISLATION

- Constitution of The Republic of South Africa Act 108 of 1996; Section 24;
- Minerals and Petroleum Resources Development Act no 28 of 2002; and
- National Environmental Management Act No. 107 of 1998

4. DEFINITIONS

Reclamation:	The re-instatement of a disturbed area into a usable state (not necessarily its pre-mining state) as defined by broad land use and related performance objectives.
Remediation:	To assist in the reclamation process by enhancing the quality of an area through specific actions to improve especially bio-physical site conditions.
Rehabilitation:	The return of a disturbed area to its original state, or as close as possible to this state.
Scheduled closure:	Closure that happens at the planned date and/or time horizon.

Unscheduled Closure: Immediate closure of a site, representing decommissioning and reclamation of the site in present state.

Decommissioning: This relates to the situation after cessation of operations involving the deconstruction/removal and/or transfer of surface infrastructure and the initiation of general site reclamation.

Care & maintenance: This involves the maintaining and corrective action as required as well as conducting the required inspection and monitoring to demonstrate achievement of success of the implemented measures.

Closure: This involves the application for closure certificate and initiation of transfer of ongoing care and maintenance to third parties.

Site relinquishment: Receipt of closure certificate and handover to third parties for ongoing care and maintenance, if required.

Post-closure The period of ongoing care and maintenance, as per arrangement with third parties.

Preliminary and Generals (P&Gs) This is a key cost item which is directly related to whether third party contractors are employed for site reclamation. This cost item comprises both fixed and time-related charges. The former makes allowance for establishment (and de-establishment) of contractors on site, as well as covering their operational requirements for their offices (electricity/water/communications, latrines), etc. Time-related items make allowance for the running costs of the fixed charged items for the contract period.

Contingencies This is used for making reasonable allowance for possible oversights/omissions and possible work not foreseen at the time of compilation of the closure costs. Allowance of between 10 percent and 20 percent would usually be made based on the accuracy of the estimations. The South African Department of Minerals and Energy Guideline (January 2005) requires an allowance of 10 percent.

5. RESPONSIBILITY

5.1 The **Rehabilitation Manager** is responsible for administering this procedure.

5.2 The **Rehabilitation Officer** is responsible for contractors involved with restoration to ensure compliance to the procedure and addenda.

6. REFERENCES

The following Namaqualand Mines policy manuals and procedures and other documents are also relevant:

- NM-PM-01-SHHE ENV Environmental Policy Manual
- SANS ISO 14001:2004 Element: 4.5.1
- De Beers Group Environmental Dictionary (EPRA)

7. PROCEDURE

Rehabilitation of mine area at NM consists of three different aspects:
- Land forming, the earthmoving and shaping of a disturbed area
- Restoration, the ecological interventions for disturbed areas
- Sign off, the sign off and removal of an area from the mine's closure liability.

7.1 LANDFORMING

a) Predetermine the shape:
The Rehabilitation Manager and Officer determine the level of landforming and shape of a specific area.

b) Predetermine the earthmoving machine requirements:
The types of earthmoving machines that are used for this may vary from site to site, depending on factors such as the size of the area, the depth of the cut and or the type of area. The earthmoving requirements are determined by the Rehabilitation Manager.

c) Backfill mine dumps and cuts:
Overburden is backfilled into existing mine cuts and the resulting dumps profiled using the predetermined earthmoving equipment.

d) Profile dumps:
Backfilled overburden is profiled to the predetermined shape as was decided upon by the Rehabilitation Manager and the environmental officer.

e) Cover profiled area with topsoil or growth medium:
For optimal restoration results the profiled areas are covered with topsoil or suitable growth medium where available. The topsoil or growth medium is deposited at an approximate thickness of 30cm. Areas should only be covered with growth medium or topsoil if it can be netted and restored in the same restoration year.

7.2 RESTORATION

Restoration includes the ecological intervention to ensure that a disturbed area is recovered to a self-sustainable ecosystem.

The restoration is done in accordance with specifications set out by an independent ecologist. The following steps form part of the restoration process: netting, seed collecting and processing, restoration packs, transplants and broadcast seeding.

Strict methods have to be followed for each of the restoration activities (see attached addenda for methodology).

a) Netting:
Netting is erected on areas that have received topsoil or growth medium in order to stabilize the movement of the soil. The use of nets mimics the effect of larger plant in the natural ecosystems. The nets are set up in such a way that it is perpendicular to the dominant wind direction of the area in order to minimize wind erosion.

b) Seed collecting and processing:
Collecting and processing seeds are in accordance with the specifications as set out by the ecologist. This entails physically going out into the field and collecting seeds from naturally occurring plants. The seeds are dried and processed to get them out of their protective shields and enable germination. Further more the processed seeds are put into seed-packs to ensure a mixture of seeds from different species.

c) Restoration packs:
Restoration packs consist of planting cardboard boxes in the field and planting the processed seed-packs inside. The restoration packs are planted in patches of ten. These patches have two different seed-pack recipes planted together, five of each, to form the ten individual packs per patch. The boxes mimic the smaller to medium sized plants in the field, and provide protection against the wind for the seeds planted inside them. The specifications for the combination of seeds needed for restoration packs are determined by the ecologist depending on what species occur naturally in the area.

d) Transplants:
Transplants are plants that are removed from the field and planted in patches of ten between the restoration packs. These plants are removed from the natural veldt and/or from areas that are earmarked to be stripped for mining within the next year.

*) e) Broadcast Seeding:
Broadcast seeding is the physical sowing of seeds mixed with nutrients over large areas.

7.3 DEMOLITION AND REHABILITATION OF INFRASTRUCTURE

The demolition and rehabilitation of infrastructure, e.g. plants and workshops, will be handled within the mine closure plan. If infrastructure will be demolished,

the same steps of land forming and restoration will be followed after the demolition has occurred.

*) 7.4 SIGN OFF

The presentation of rehabilitated areas to the DMR for sign-off and removal from the Closure Liability Costing model occurs annually during the third quarter. During this process the DMR are invited to visit the mine to ensure that the areas that are presented for sign-off are of the accepted ecological standard.

Areas are presented in the form of a locality map that includes the name of the area as well as the costs associated with it. The map will have an attached signature page for the various levels of sign-off as required per area.

Maps as the above mentioned can be reproduced for the different stages in the rehabilitation and restoration process. It is possible to produce a map for an area that have been completed in terms of safety and stability as well as another map for the area relating to the ecological restoration of the area.

8. RECORDS

Description	Responsible	Location	Retention	Status*
Reports	Y6	SHE Department	LOM	A
CAD / Maps	G1 / M1	MRM Department	LOM	A

* A = Archive; D= Destroy

9. AMENDMENT RECORD SHEET

Recorded below are all the amendments which have been made to this document and the date the amendment was effected.

Issue no	Page no	Section	Subject	Date
01	All	Complete	New	09/07/2009
02		7.2 7.4 Annexures E & F	Broadcast Seeding Sign Off process	25/01/2011

WG MACDONALD
SITE MANAGER: NAMAQUALAND MINES

W Nel
REHABILITATION OFFICER

ANNEXURE A

RESTORATION NETTING METHODOLOGY

1. MATERIAL SPECIFICATIONS (NETS, DROPPERS, ANCHORS AND WIRE)

- Net height: 0.75m
- Net length: 225m
- Net material: 40% density, green shade, Eyelets top and bottom, pockets every 2.5m
- Droppers length: 1.2m
- Dropper diameter: 10 mm
- Dropper material: steel (reinforced steel or normal farm dropper)
- Anchor material: Steel
- Anchor length: 1.4m and 0.7m
- Anchor type (Post fence, Y or K type)
- Wire type for droppers: 1.6mm galvanised
- Wire type for anchors: 2.5mm galvanised

2. NET ERECTION

Intervals: 5-6m (a maximum of 6m intervals) in an east-west direction on all restoration areas (topsoil and overburden).

Direction: Running east-west direction (Perpendicular to predominant southerly wind)

Method:

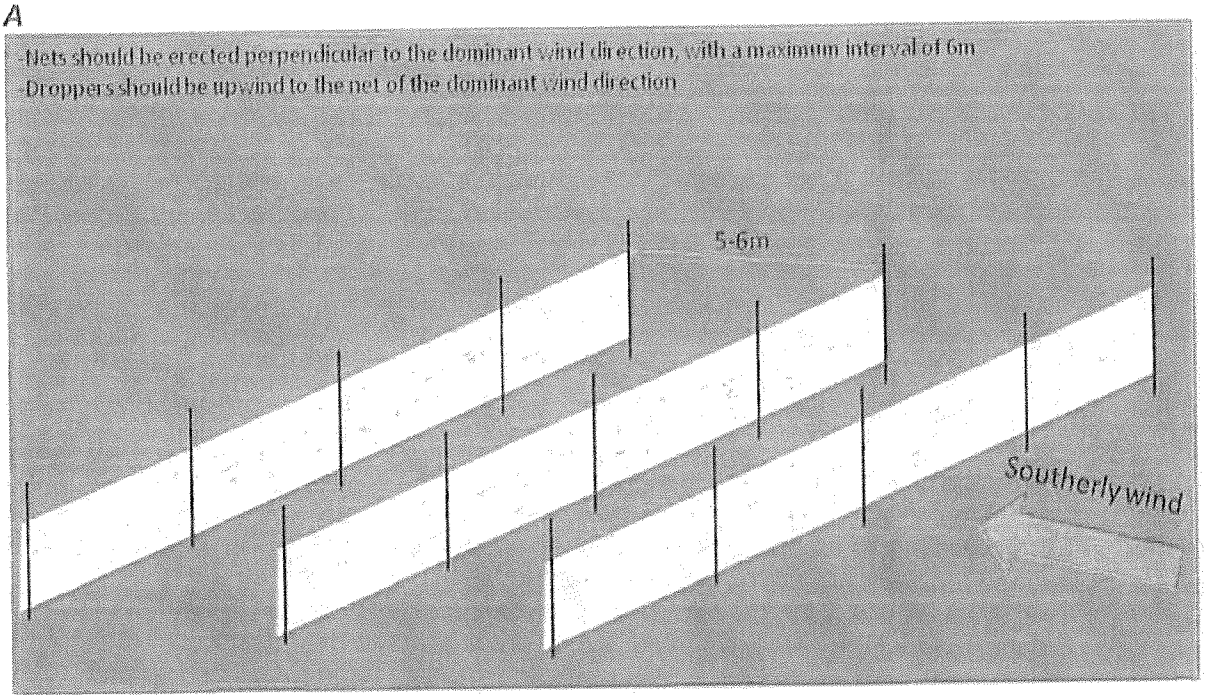
- Use anchor poles at each end of every net to anchor netting (y-poles, K- poles or old thicker droppers).
- Wrap net around the top of the 1.4m anchor pole 3 or 4 times to prevent tearing. Hit this anchor into ground in an upright position until net touches ground.
- In case of unstable conditions (very loose sand or shallow cover) insert a short 0.7m anchor at a 45° angle into the soil and use 2.5mm bind wire to tie to upright anchor.
- Insert droppers every 2.5m along the length of the net in the sleeves provided for this purpose.
- Pull netting tight and drive dropper into soil (Do not cut dropper off if not deep enough)
- Do not cut nets at the end of the line. Rather wrap the net at 90° to the start of the next line, and then use the rest of the roll for the next line (see figure 1).
- Ensure that the dropper sleeve is always facing south (i.e. the droppers are to the south of the net). Twist the net upside down at the end of the line where it is wrapped to the next line, thereby ensuring that the droppers are to the south of the net on the next line (see figure 1).
- Where the restoration site is wider than 225m in the east-west direction, gaps in the netting should be left for access roads every 225m (i.e. the length of one net). These access roads are to be used for setting out restoration packs, watering of restoration packs and maintenance of netting. There should be no access roads around the perimeter of the site, as this will prevent seeds from surrounding natural vegetation to be dispersed into the restoration site. Access roads (gaps in netting) should be a maximum of 5m wide, and should not run directly downslope, in order to avoid erosion. The road should not run directly north-south, in order to avoid the formation of a wind channel.

- Take netting about 3 to 5 meters into the undisturbed vegetated area. There should be no gap (or road) around the outer perimeter of the restoration areas, since this will limit the influx of seeds from the surrounding undisturbed areas.

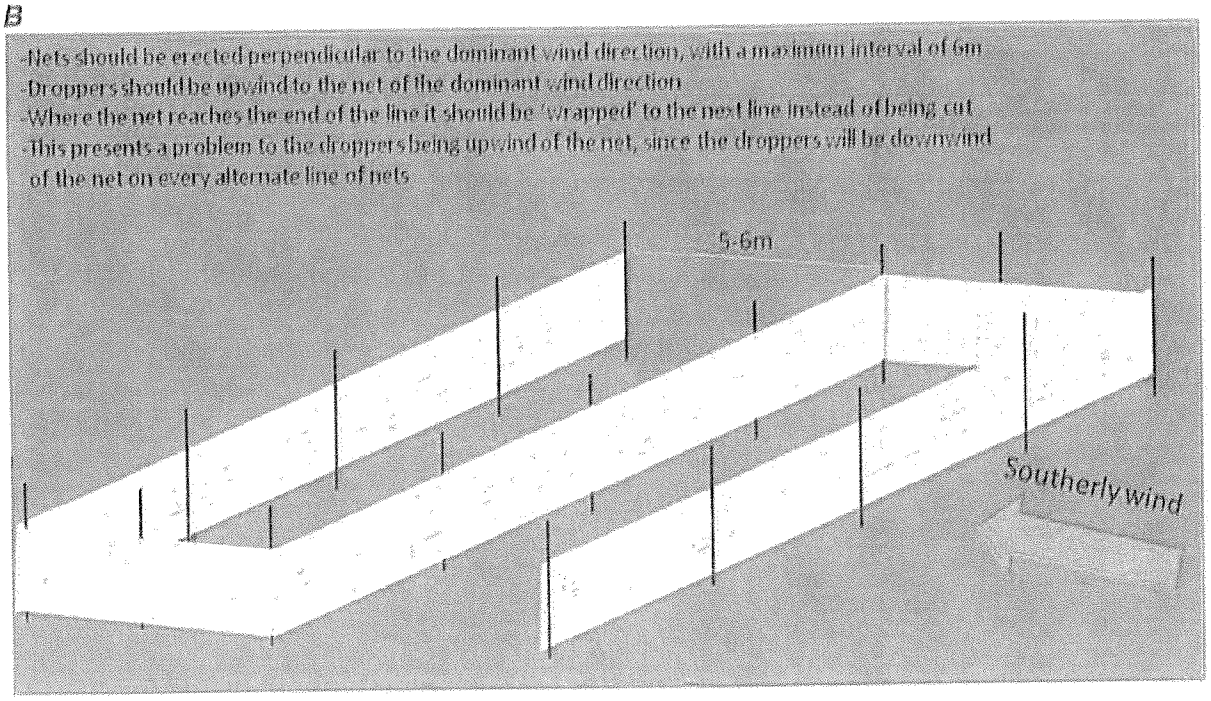
Figure 1

A) Nets should be place perpendicular to the predominant wind, and the droppers should face into the wind (to the south of the nets). *B*) Nets should not be cut at the end of a line, but 'wrapped' to the next line, and *C*) 'twisted' at the same time so that the droppers remain to the south of the net on the next line.

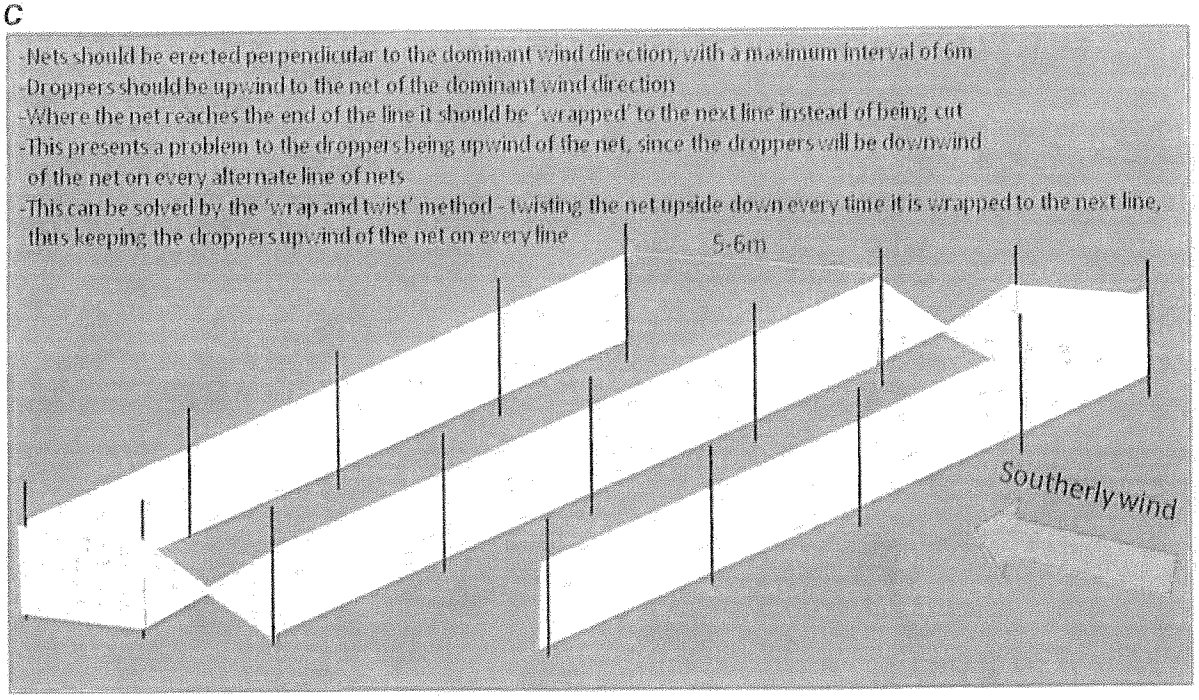
A



B



C



3. NET MAINTENANCE

Do maintenance checks on all nets at monthly intervals, and include the following:

- **Lift up netting** (& droppers) where soil has accumulated against the nets. Ensure the net and droppers are on top of the new soil level.
- The 'eyes' (holes) along the top edge of the nets are to be hooked around the droppers where the nets have stretched, in order to **make them tight.**
- Where nets have sagged down along the dropper, they need to be lifted up and tightened, as described above.
- Scoop away heavy sand built up with spades and level away from netting.
- Repair torn netting.

4. NET REMOVAL

Remove netting in areas where no longer needed as per request of the rehabilitation manager.

- Remove netting in such a way as not to damage it so it can be reused
- Reuse netting where possible
- Neatly stack material in grouped heaps for removal

ANNEXURE B:

SEED COLLECTION, STORAGE, CLEANING AND PREPARATION METHODS

1. PURPOSE OF SEEDS

The collection of seeds of perennial species is a necessary step towards the Restoration Pack (RP) intervention method, as described in the NRI Restoration Pack Methods document. Once seeds have been collected, they need to be stored appropriately in order to maintain their viability and value. Prior to using seeds in RP's, the seeds need to be extracted from the plant covering bodies that surround them (capsules, wings, fruit bodies etc), so that they will be able to germinate in the field.

This document will describe the generic methods of collecting, storing, cleaning and preparing all the possible species that are to be used in RP's, bearing in mind that the specifications for each restoration will be set by the NRI, and will therefore differ. The relevant sections of this document can be consulted based on the seed requirements provided in the specifications for each area.

2. SEED COLLECTION

2.1 Which species should be collected?

Only common perennial (long-lived) species of the following plant functional groups (as described in the NRI training manual / the NRI book) should be collected:

- Sprawling Mesembs (Mesembryanthemaceae)
- Upright Mesembs (Mesembryanthemaceae)
- Shrubs
- Large Shrubs

2.2 When can seeds be collected?

Seeds can be collected from about 2 weeks to 3 months after flowering – depending on the species. It should be noted when a population of a target species is flowering, so that collection can done there once the seeds are ready for collection.

Seeds should only be collected once they are ripe and fully formed. For Mesembs this means that the capsules have dried out and become hard and woody. For most other species it means that the fruit body or flower remnant must be fully dried out, and the seeds are hard and fully formed (often turning a darker colour when they are ready).

Seeds should be collected as soon after they have ripened as possible, since seeds are dispersed once they are ready (Mesembs release seeds every time it rains, wind-dispersed seeds are blown off the bushed with mild to strong winds), or lost by seed predation (beetles, insect larvae, birds, rodents).

2.3 How should seed be collected?

Seeds should be collected in hessian bags, paper bags or in cardboard boxes. As little plant material as possible should be collected with the seeds, since this will increase the moisture levels and the likelihood of mould or rotting occurring. They should never be collected in plastic bags, and should never be stored in a car or in the back of a bakkie with a canopy – since the heat can destroy the seeds very rapidly.

2.4 How much seed should be collected?

Enough seeds should be collected for the designated number of RP's in the target restoration area.

The necessary permits for seed collection should be obtained from the authorities. These deem that no more than 20% of the seeds of a population may be collected in the same year (by law).

3. SEED STORAGE

Seeds should always be dried prior to storage. Seeds and the associated plant material can be dried by placing them in open, shallow cardboard boxes or similar shallow containers. These boxes should be place indoors in a well ventilated place that is safe from rodents or other granivores. Seeds should also be fumigated as soon as possible after collection to eliminate any beetles or larvae that are already inside the seed storage bodies, as well as being treated with anti-mould treatments. This is best done during the drying time since seeds are spread in thin layers.

Once seeds and all the plant material that is amongst the seeds has been completely dried out, the seeds can be stored in bigger, closed cardboard boxes or similar containers that will allow them to 'breathe' (not plastic bags or containers). These boxes should be kept in a granivore-safe place that is cool, dry and preferably dark.

4. SEED CLEANING

Seeds should be removed from the coverings that surround them prior to being used in RP's.

The following methods are recommended by the NRI:

4.1 Cement Mixer

Seeds with hard capsules or coverings can be placed in a cement mixer together with 5 to 10 pieces of hard, heavy firewood (more, larger pieces for hard seed coverings; fewer, smaller pieces for soft seed coverings). The mixer bowl should not be filled more than half, otherwise it will not be efficient. Once the mixer is on, the pieces of wood will fall on the capsules or coverings and break them open, thus releasing the seeds.

The released seeds should be sieved out (see below) periodically to avoid them being damaged by the wood. For soft seed coverings this can be done every 20-30 minutes, and for hard seed coverings this can be done every 1 to 1.5 hours *e.g. Tetragonia, Zygophyllum, Lebekia, Tetragonia, Didelta, most of the Mesembryanthemaceae*

4.2 Sieves

Seeds that have been released by the cement mixer process can be separated from the remaining plant material by using an appropriate sieve mesh size or set of sieves with varying mesh sizes. This is useful to gain a more accurate estimate of the numbers of seeds, as well as reducing the volume for storage and packaging purposes.

Seeds with soft or leathery seed coverings, soft seeds or small seed coverings can often not be broken by the cement mixer, or may be damaged by the cement mixer. These seeds can be ground through an appropriately sized mesh sieve, so that the seeds fall through, but the

unbroken coverings do not. A wooden or rubber block can be used to grind the seed coverings through the sieve.
e.g. *Jordaaniella, Drosanthemum, Psilocaulon, Pharnaceum, Amphibolia*

4.3 Beating

Some early pioneer species are collected by removing part of the bush with the seeds on. These should be dried thoroughly, and once dry the seeds will be easily dislodged from the bush. This can be achieved by beating the bush with a stick, or hitting the bush against a sieve or flat surface. The seeds and leaves that come off can be sieved to remove any small branches or sticks that may have been removed during the process.
e.g. Atriplex

4.4 Other

Seeds of certain species do not need to be cleaned. These are seeds with thin or small seed coverings that do not inhibit germination, or do not result in seeds being clumped together once sown in a RP.
e.g. Manoclamys,

Seeds of certain species cannot be cleaned efficiently using any of the above methods, and should be left as is until they are sown into the RP's. These are mostly species of the Asteraceae that have seeds forming in 'cones' with plumes attached to the seeds. These should be broken up by hand during the process of sowing them into RP's. The seeds should be removed from the cones so that the seeds are spread out evenly over the area of the RP, and the plumes should be removed to prevent them from being blown around in the RP or being blown out of the RP.
e.g. Pteronia, Othonna, Arctotis

5. SEED PACK PREPARATION

Once seeds have been cleaned (and stored if necessary), they should be prepared for being used in RP's according to the specifications set out for the target restoration area by the NRI. Small seeds (all the Mesembryanthemaceae, and others with similar-sized seeds, like Pharnaceum and Galenia) are to be used in separate RP's to large seeds (all the remaining species), and should thus be put in different packets. Each packet (of small or large seeds) should contain the correct number of seeds of each species that is to be used in one RP. The number of seeds per pack can be determined on a weight basis, once the number of seeds per gram has been determined for each species.

ANNEXURE C:

RESTORATION PACK (RP) METHODOLOGY:

6. PURPOSE OF RESTORATION PACKS

Restoration packs are a cost-effective method to rehabilitate an area that maximizes the effectiveness of seeds, and facilitates the rehabilitation of a degraded area to:

- Introduce and establish natural and preferred species to an area in order to have better balanced species diversity in the area.
- Improve the ecological stability of the area, for instance stabilizing and preventing sand movement and the creation of sand plumes.
- Re-establish the ecological structure of an area, which will allow natural plant and animal establishment in the future
- Increase the natural and preferred species abundance, cover & biomass to a specific area

7. RESTORATION PACK TYPES

If small seeds are covered to deep they will not germinate. For this reason restoration packs are divided into two types: **large seed** and **small seed** restoration packs.

Each **large seed restoration pack** should contain the following species and seed number:

Large seed restoration pack

Othonna cylindrica	4
Pteronia glabrata	250
Pteronia onobromoides	250
Tripteris oppositifolium	22
Didelta carnosa carnosa	20
Arctotis scullyi	14
Tetragonia fruticosa	70
Atriplex semibaccata	100
Manochlamys albicans	160
Zygophyllum morgsana	50
TOTAL	940

Each **small seed restoration pack** should contain the following species and seed numbers:

Small seed restoration pack

Amphibolia laevis	1000
Drosanthemum hispidum	500
Psilocaulon spp	500
Jordaaniela spongiosa	1000
Ruschia aggregata	2000
Stoeberia beetzii	150
TOTAL	6150

8. RESTORATION PACK MATERIALS SPECIFICATIONS (BOXES, SEEDS AND FERTILISER)

- **Boxes: corrugated cardboard box** (approximate dimensions of 400 x 500mm and 300mm deep)
- **"Veg" 6:3:4 Slow Release VITA Organic Fertilizer**, from Talborne Products.
- **"skommeltjies"** (plant material collected from under bushes)

9. RESTORATION PACK APPLICATION

Restoration packs are to be set out during the winter months from April to May as per the following Namaqualand Restoration Initiative's standards:

- Dig a hole slightly larger than the box and **insert corrugated cardboard box 10-15cm into the soil.** (To protect the growing seedlings)
- Replace the soil inside the box and follow these steps:
  - Add 35g of the 'Veg' 6:3:4 Slow Release VITA Organic Fertilizer to each restoration pack, and **mix into the top 5cm of the soil.**
  - Add approximately 3 large handfuls (roughly equivalent to 3 large coffee mugs) of 'skommeltjies' to each restoration pack, **and mixed into the top 5 cm of the soil** (this can be done at the same time as the nutrients).
  - Level and compact refilled mixture:
    - Compact softly on clay or overburden soils (push down with hand palms)
    - Compact well on sandy soils (step on it with one foot)
  - Lastly, add seeds:

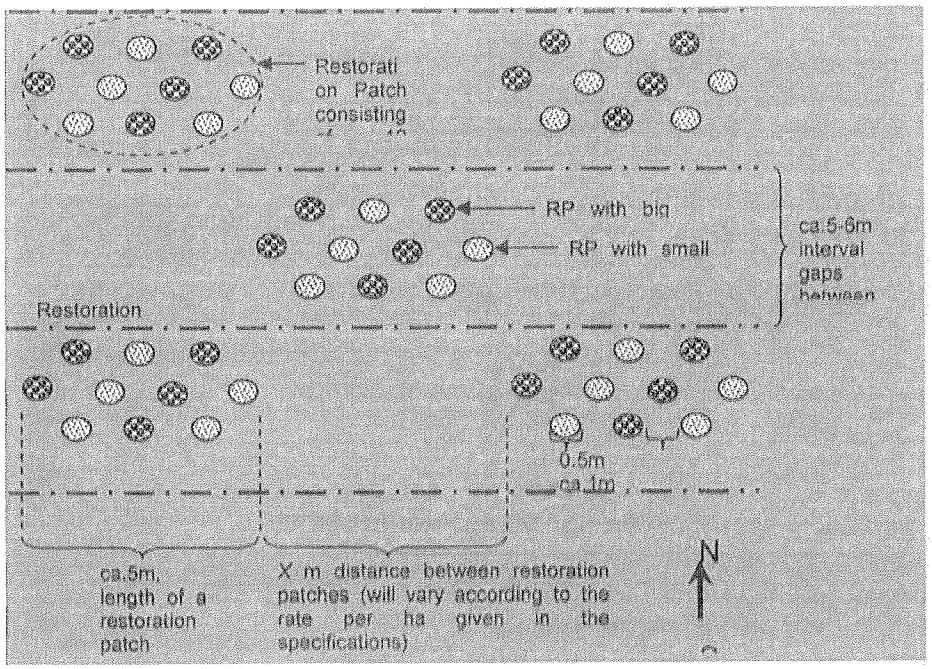
<u>Large seeds:</u>
- **Empty the seeds** from the envelope or bag **into one hand.**
- **Add a hand full of sand** to the seed in your hand palm.
- **Rub this mixture vigorously** between the palms, **while sowing** it **evenly** across the area of the restoration pack.
- Take care to **remove all seeds from** remaining **capsules** or seed coverings (e.g. *Pteronia*).
- Spread **3 or 4 handfuls of soil** over the seeds (cover seeds 1-2cm deep), and patted down with the palm of the hand.

<u>Small seeds</u>
- Sow evenly on the soil surface of the restoration pack.
- **Add a scoop of sand** to the seed in your hand palm
- Gently rub **this mixture** between your hand palms
- Lightly pat into the soil with the palm of the hand.
- **Do not place handfuls of soil on top of the small seeds** since these seeds will not be able to grow through even a shallow soil layer.
- (Note: the manual suggests using 1 handful of soil – we do not recommend this now as it has resulted in confusion when implemented in the field)

- <u>As a final step do the following:</u>
- **Soil inside the box must be 5cm higher than the soil outside the box** after everything has been added to the box
- **Soil within the box must be level** and not at an angle.
- **Soil outside the box must be sloped away** from the box. (The restoration pack must be in a slight depression, in order to increase the water input to the restoration packs)
- **Fill in any soil gaps ± 40 cm away from and around the outside of the box,** and stamp down this soil around the box.

- Any left over soil further than **± 40 cm** can be left in piles as uneven surfaces are good for restoration.

- Group restoration packs into patches of 10 and leave a slightly gap between each patch of 10 restoration packs.
- Ensure patches are spaced well across the area in order to cover the full extent of each ha (Do not cramp all RP's into one corner). Space the RP's evenly over the restoration site. The distance *X* between restoration pack patches will vary between restoration sites, and will be determined by density of RPs / ha. This will be set out in the specifications for each particular site.



10. RESTORATION PACK MAINTENANCE

In order to prevent seedlings from dying during a dry period the RP's need to be monitored and watered as explained:

- Monitor restoration packs on a two-weekly basis for the winter and spring season:
  - Monitored rainfall - if there has been no a rainfall event of greater than **4mm** in a 2 week period, the restoration packs should be watered. (1.5-2 litres of water per pack). This only applies until the end of October.
  - Where a box has collapsed entirely, cut the box off at the base and remove it from the site if it can not be lifted and kept opened.

ANNEXURE D:

TRANSPLANT (TP) METHODS:

1. PURPOSE OF TRANSPLANTS

Transplanting is the process of digging up established plants in undisturbed veld, usually from an area that is designated for mining, and transplanting these on restoration areas. The benefit of transplanting is that it is an easy and cheap way to establish a rapid vegetation cover on new restoration areas and also helps to improve topsoil retention. It is an especially useful technique to use for plant species that do not establish easily or cheaply from seed and in Namaqualand many plant species survive transplanting well because of the stored water in their leave and stems. In cases where transplants are removed from pristine (natural) sites, it is important that the right species and not too large a proportion of these species are removed so as not to disturb the ecological balance at the pristine site. Plants that do not have succulent leaves or stems do not survive transplanting, and should not be used. To ensure that transplant activity does not impact on indigenous, undisturbed areas, these protocols should be adhered to very strictly. Removing transplants poses is a danger of creating new degraded areas in pristine sites (studies are ongoing to make sure this doesn't happen), and the contractor or the mine could be liable for prosecution by the governing authorities if the correct protocols are not followed.

2. EQUIPMENT AND MATERIALS

- Spades
- Bags / crates / boxes (for carrying the transplants)
- Bakkie (to transport the transplants)
- Nutrients
- Watering equipment

3. CHOOSING THE SITE WHERE TRANSPLANTS SHOULD BE TAKEN FROM

In choosing sites from where transplants can be collected, one needs to consider the future plan for the site.

3.1 Sites that are designated for mining in the near future

The most suitable sites to remove transplants from are areas that are designated to be mined in the near future. For such sites, the impact of removing transplants does not matter since the entire site is destroyed when the topsoil is removed.

3.2 Sites that are not destined to be mined in the near future

In some instances no sites that are destined to be mined in the near future will be available or more transplants than what these sites can provide are required. **Only** in such circumstances can transplants be taken from undisturbed / pristine sites. In such instances it is preferable to choose sites that are destined to be mined in the long term, or from pristine sites that fall within the mining area. **At no time should plants be taken from a previously disturbed / restored site,** no matter how well it has been restored.

4. HOW MANY TRANSPLANTS CAN BE REMOVED?

4.1 Sites that are destined for mining in the near future (less than 3 months)

Since the entire ecosystem will be completely transformed during the mining process, it is feasible to remove **all** individuals of suitable plant species before mining for use in transplanting. Suitable plants have one or more the following characteristics:

- **Succulent leaves** (e.g. Mesembryanthemaceae, some Asteraceae, some Asphodelaceae, Crassulas)

- **Succulent stems** (e.g. Euphorbiaceae, some Asteraceae, few Mesembryanthemaceae)
- **Underground storage organs** (e.g. Amaryllidaceae, most Iridaceae, some Hyacinthaceae)

[Also refer to *Best practice guidelines for minimizing impacts on the flora of the southern Namib* by Antje Burke for further information on which plants are suitable for transplanting.]

Middle and late succession species should be used preferentially to early succession species. Unsuitable species should not be transplanted, since they will not survive transplanting, or benefit the restoration site. If these species are transplanted, they will not be paid for.

4.2 Pristine / undisturbed sites within the mining area:

Collect only 10% of the approved transplant species' individuals located in the demarcated area. This means that in a given population of the target species, a team should only collect 1 out of every 10 plants of that species. Transplants should be removed evenly throughout the site. One way to ensure systematic collection would be to line up transplant collectors standing a few meters apart on one side of the site. As each collector walks towards the opposite end of the site, they focus on collecting transplants only in the area ahead of them (on their 'line') (Figure 1). Once their bag / box is full of transplants, they should leave a marker (a spade or something else) where they have stopped, allowing them to return to and start from the same spot again after they have taken the full box / bag back to the bakkie.

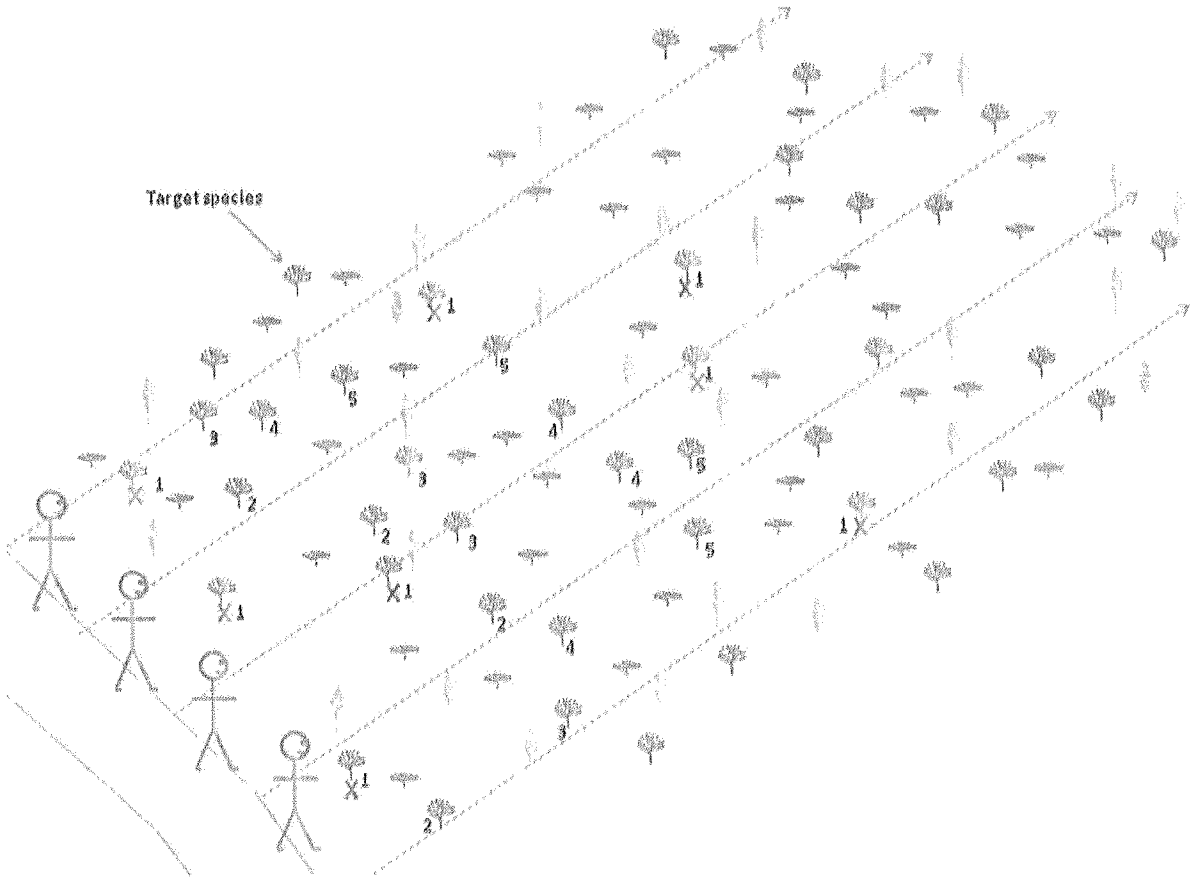


Figure 1. Transplant collectors should walk in straight lines in a collection area, and should be between 5 and 10m apart. Only every 10th plant of the target species should be taken out.

5. HOW OFTEN CAN TRANSPLANTS BE TAKEN FROM A SITE?

It is advisable that transplants are removed from a particular area of undisturbed or pristine veld only **every 5 years or longer**. Good record keeping of transplant collection should prevent more than one collection from the same site within 5 years.

Recording transplant collection activities should include the date (year and month) the transplant collection was made as well as the size and location of the collection area. The location of the collection site from which transplants are to be removed should be clearly defined e.g. between road 'a' and 'b', starting at 'place c', next to 'd', up to 'place e', approximately 'f'km^2. It would be most useful to get GPS co-ordinates for the perimeter of the area from which the collection was made.

6. WHICH PLANT SPECIES CAN BE COLLECTED FOR TRANSPLANTING?

Plant species collected for transplanting should be common generalist species (i.e. occur in a wide area, and in a variety of habitats), be abundant at both the site from which transplanting is done and in the type of soils into which they will be transplanted, survive transplanting well and have high recruitment rates. High recruitment rates would ensure that the population can readily recover once a collection has been completed.

The **only** species that are approved for transplanting from pristine areas are:
Ruschia rariflora
Amphibolia rupis-arcuatae
Aphiboilia laevis
Othonna cylindrica
Othonna sedifolia

7. WHAT SIZE SHOULD THE PLANTS BE THAT ARE USED FOR TRANSPLANTS?

Plant individuals that are too small or too big generally do not survive transplanting well. In general, plant individuals smaller than 10cm high and bigger than 30cm high (= height of the blade of a spade) survive transplanting less well. These heights are more applicable to *Othonna cylindrica*, since they grow much larger. Most adults of the other species fall within the 10 – 30cm size range.

8. WHEN SHOULD TRANSPLANTING BE DONE?

- Transplants should be done in winter (May to August), so that there is an increased likelihood of them still receiving follow-up rain, which allows the transplants to establish properly at the new site before the hot summer months.
- It is **very important** that transplants are **transplanted the same day** to reduce the amount of time the roots are exposed.
- Transplanting should never be done in the late winter (September) or in summer (Ocotber to April).

9. HOW SHOULD TRANSPLANTS BE TAKEN OUT OF THE NATURAL VELD?

- Care should be taken **not to damage the major roots** when transplants are pulled out. A spade is needed to remove the transplants. Insert the spade vertically (not at an angle) about 15 – 20cm from the base of the plant. Then lever the spade so that the

transplant is pushed up by the blade, without damaging the major root system and put the plant gently out of the soil holding on to the base of the plant's stem.

- Place the transplants in a box or hessian bag (streepsak). Transplants can be kept cool on hot days by wetting the bag, or by placing a wet bag on top of the transplants in a box.
- Where more than one species is removed, they should be kept in different boxes / bags. Never leave transplants inside a vehicle, or exposed to full sun as this will dry them out.

9. HOW SHOULD TRANSPLANTS BE PLANTED INTO A RESTORATION SITE?

- Transplants should **always** be planted into the restoration site **on the same day** as they were removed from the natural veld.
- Select an area which is already in a **natural depression or dip** (this collects water when it rains, giving the plant a greater chance of survival) (Figure 2).
- Dig a hole that is about twice the size of the roots of the transplant in the depression.
- Place one plant in the hole. While holding the plant up slightly, spread the roots out in the hole and fill the hole with soil in such a way that some soil is placed in between the roots and there are no air spaces left around the roots.
- Before the final soil is replaced in the hole, add the appropriate amount of nutrients evenly around the transplant (35g).
- Place the last bit of soil around the transplant, and press down firmly with the palm of your hand to compact the soil (overburden should not be overly compacted).
- Creating a slight depression around the transplant will aid catching additional water and nutrients (Figure 2).
- The transplant should then be **watered the same day as being planted** (1.5 liters of water per transplant) to ensure that the roots settle well and all the roots are in contact with the soil (there are no air spaces). This prevents the roots from drying out, allows the roots to take up water and nutrients from the soil immediately, and the plant to rapidly develop and replace the small roots damaged during transplanting (these responsible for nutrient and water uptake).
- Do not plant the transplants in rows or grids, but plant them in mixed species patches of 10 transplants per patch.

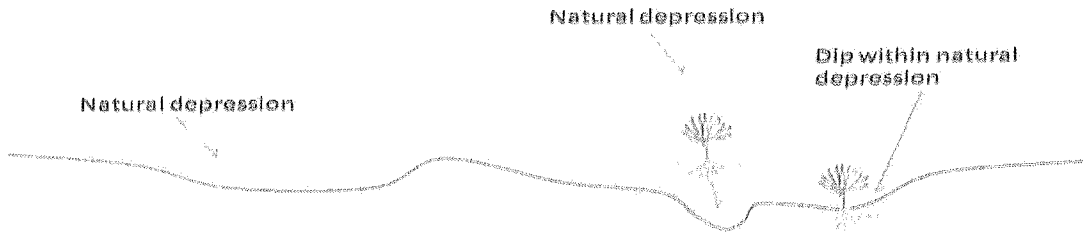


Figure 2. Transplants should be planted in natural depressions in the restoration site. A dip should be made within the natural depression to maximize the amount of water that the transplant gets when it rains.

ANNEXURE E:

BROADCAST-SEEDING METHOD:

Purpose of broadcast-seeding

- For the rapid stabilization of the soil on restoration sites (where high levels of soil loss are likely due to wind or water erosion)
- As an effective means of ameliorating soils across large areas; as a step in creating a soil a soil medium in which plants can establish and grow; a means to input and trap organic material and nutrients and create conditions suitable for perennial plant establishment (where soils need amelioration before mixed species perennial plants will establish).
- Broadcast seeding can be applied very rapidly to large areas.
- But very large quantities of seed are needed, and therefore only seeds that can be collected easily in large quantities should be used (annual and early-succession species).
- Broadcast seeding areas require netting to prevent soil and seed loss to wind erosion.

Requirements for broadcast-seeding

- Seeds should be broadcast into loose soil e.g. very soon after it has been profiled or ploughed by earth-moving machinery.
- Seeds need to broadcast (by hand or mechanically) at an even density (according to the specifications for the site) across the entire area.
- Broadcast seeding can take place before or after the erection of wind-nets, but if done before netting, nets must be erected immediately after seeding.
- Fertilizers (soil nutrients) frequently need to be applied across the entire site together with the broadcast seeding. This should take place at the same time.

Broadcast-seeding application

- Apply to loose (not compacted) soil; very soon after it has been profiled or ploughed by earth-moving machinery, or if necessary, by loosening the soil with rakes and hoes. Very small scale soil surface roughness is beneficial, e.g. small grooves in the soil created by rakes or branches.
- Spread seeds evenly across the entire area at the specified density (by hand or mechanically).
- If specified, spread all the specified soil nutrients (fertilizers) evenly across the entire site in the quantity specified (usually kg/ha).
- Lightly smooth over the seeded soil surface immediately after broadcast seeding by e.g. dragging leafy branches or lightly raking the soil after seeding. Soil smoothing must follow immediately after broadcast seeding, or at least take place on the same day.
- If wind-nets were not erected before broadcast seeding, they need to be erected the same day or the day following the application of broadcast seeds.

ANNEXURE F:

REHABILITATION AND RESTORATION SIGN OFF				
Area name:			Date:	
LEVEL	LANDFORM	SAFE & STABLE	RESTORED	ECOLOGICAL STABLE
ON MINE				
SENIOR REHABILITATION SUPERVISOR				
REHABILITATION OFFICER				
SITE MANAGER				
GROUP LEVEL				
LEAD: SHHE				
PRINCIPLE: ENVIRONMENT				
EXTERNAL				
SPECIALIST				
ECOLOGIST				
SLOPE ANGLE				
GOVERNMENT				
DMR – LOCAL				
DMR – NATIONAL				

APPENDIX F

Closure Liability Report

DE BEERS
A DIAMOND IS FOREVER

Namaqualand Mines: Closure Cost Estimate 2010

NAMAQUALAND MINES

Executive Summary

The closure costs reflected in this report are for both scheduled and unscheduled situations. The closure costs are structured and presented in the format that is routinely used for the presentation of the closure costs for mining sites, reflecting the costs in terms of the following categories:

- Infrastructural areas;
- General surface reclamation;
- Water management;
- Post-closure aspects; and
- Additional allowances.

The cost estimate quantities were taken from available plans and maps as well as from previous closure cost estimates for the site. Unit rates were obtained from NM actual rehabilitation rates as well as from Golder & Associates' existing data base and/or in consultation with demolition practitioners.

The estimated scheduled and unscheduled closure costs for Namaqualand Mines as at October 2010 amounts to approximately R 179 million and R 24.5 million respectively, as summarised in the table below:

De Beers Namaqualand Mines- Scheduled and Unscheduled Closure costs - October 2010			
	Closure Components	Scheduled	Unscheduled
	INFRASTRUCTURE AND RELATED ASPECTS		
1	Infrastructural aspects	R 75,000.00	R 75,000.00
2	Mining aspects	R 0.00	R 0.00
3	General surface reclamation	R 14,785,418.78	R 147,456,152.00
4	Water management	R 0.00	R 0.00
	SUB-TOTAL 1 (Infrastructure and related aspects)	**R 14,860,418.78**	**R 147,531,152.00**
5	Post closure aspects	**R 7,969,577.71**	**R 7,969,577.71**
	SUB-TOTAL 2 (Post-closure aspects)	**R 7,969,577.71**	**R 7,969,577.71**
6	**ADDITIONAL ALLOWANCES**		
6.1	Preliminary and general (6 percent)	R 891,625.13	R 8,851,869.12
6.2	Contingencies (10 percent)	R 1,486,041.88	R 14,753,115.20
6.3	Engineering & project management (0 percent)	R 0.00	R 0.00
6.4	Management/staff cost	R 0.00	R 0.00
	SUB-TOTAL 3 (Additional allowances)	**R 2,377,667.00**	**R 23,604,984.32**
	GRAND TOTAL (Sub-total 1+2+3)	**R 25,207,663.49**	**R 179,105,714.03**

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List of terms used

Reclamation	The re-instatement of a disturbed area into a usable state (not necessarily its pre-mining state) as defined by broad land use and related performance objectives.
Remediation	To assist in the reclamation process by enhancing the quality of an area through specific actions to improve especially bio-physical site conditions.
Rehabilitation	The return of a disturbed area to its original state, or as close as possible to this state.
Scheduled closure	Closure that happens at the planned date and/or time horizon.
Unscheduled closure	Immediate closure of a site, representing decommissioning and reclamation of the site in its present state.
Decommissioning	This relates to the situation after cessation of operations involving the deconstruction/removal and/or transfer of surface infrastructure and the initiation of general site reclamation.
Care and maintenance	This involves the maintaining and corrective action as required as well as conducting the required inspection and monitoring to demonstrate achievement of success of the implemented measures.
Closure	This involves the application for closure certificate and initiation of transfer of ongoing care and maintenance to third parties.
Site relinquishment	Receipt of closure certificate and handover to third parties for ongoing care and maintenance, if required.
Post-closure	The period of ongoing care and maintenance, as per arrangement with third parties.
Preliminary and Generals (P&Gs)	This is a key cost item which is directly related to whether third party contractors are employed for site reclamation. This cost item comprises both fixed and time-related charges. The former makes allowance for establishment (and de-establishment) of contractors on site, as well as covering their operational requirements for their offices (electricity/water/communications, latrines), etc. Time-related items make allowance for the running costs of the fixed charged items for the contract period.
Contingencies	This is used for making reasonable allowance for possible oversights/omissions and possible work not foreseen at the time of compilation of the closure costs. Allowance of between 10 percent and 20 percent would usually be made based on the accuracy of the estimations. The South African Department of Minerals and Energy Guideline (January 2005) requires an allowance of 10 percent.

1.0 INTRODUCTION

De Beers' Namaqualand Mines (Namaqualand Mines), located within the Northern Cape Province of South Africa, is gradually reducing its operational activities by scaling down physical mining and/or selling-off of the mining areas to third parties. Final decommissioning and closure is planned for the end of life of mine, and it is currently estimated that the mining operations will operate profitably until 2024 (this assumes a 10 year life of mine and the resumption of production activities from 2014). The mine is currently undertaking the necessary studies/investigations to inform the development of a preliminary mine closure plan according to best practice and the Anglo American Mine Closure Toolbox (AAplc toolbox).

Golder Associates Africa (Pty) Ltd (Golder) was appointed to update the closure costs during 2004 specifically focusing on updating the physical closure component. The information gathered in 2004 was refined to greater detail during 2007, 2008 & 2009, where Golder assisted with the volumetric earthmoving quantum, required to estimate the rehabilitation cost

2.0 APPROACH TO COST DETERMINATION

The cost determination was completed in several phases, the basis of which was established during 2004 and refined during 2009.

The approach followed in 2004 can be summarized as follows:

- Execution of a week-long site visit by Golder to the mine, during which each of the mining areas were visually inspected and the information listed. No physical measurements and/or surveys of mining components/areas were conducted.
- Compilation and/or obtaining of quantities for closure cost estimates from mine survey data.
- Collation of the provided information into closure cost spreadsheets for each of the listed mining areas. The spreadsheet includes all the closure cost items as stipulated in the Department of Minerals and Energy closure cost guidelines.

The approach followed to determine the 2010 closure costs following on the 2004 estimate were as follows:

- Various site visits were conducted by Golder and during these visits the approach to surface reclamation was developed and refined;
- The original 2004 conceptual design for surface profiling was refined to provide clear materials movement boundaries, referred to as the *profiled model* completed for the 2010 closure costing;
- Visits to the Golder offices in Pretoria by Mr Johan van Zyl from the mine, to assist with further refinement of the respective areas to be included in the closure costing, and to integrate the refined profiling model with the survey categories provided by the mine. The data sets were interrogated utilizing a GIS package to deliver area and volume outputs according to which the costing was implemented;
- Buildings on each complex were surveyed and demolition and reclamation quantities determined during a site visit;
- Determination /verification of unit rates

Following on from the 2009 closure cost review carried out by Golder, further adjustments / exclusions were made by NM during the 2010 review (using the previous work completed by Golder as the base case).

3.0 AVAILABLE INFORMATION

The closure costs for the mine were mainly based on drawings, previous closure costs conducted by Golder in 2004 and 2009, reflecting both the scheduled and unscheduled closure situation.

The information listed in the table below was utilised for the costing as applicable.

Table 1: Information utilised for the closure costing of Namaqualand Mines

Drawing/report title	Drawing/report number	Date
Namaqualand Mines Closure Cost Estimates November 2004	6951-6567-1-E	November 2004
Environmental Management Programme for the various complexes of NM: ▪ Buffels Marine Complex; ▪ Buffels Inland Complex; ▪ Dikgat Complex; ▪ Brand-se-Baai Complex; ▪ Samson's Bak Complex; ▪ Koingnaas Complex; and ▪ Groenrivier Complex.	Various report numbers: ▪ 6951-9374-3-E; ▪ 6951-9376-4-E; ▪ 6951-9377-5-E; ▪ 6951-9378-6-E; ▪ 6951-9379-7-E; ▪ 6951-9380-8-E; ▪ 6951-10280-9-E.	September 2007
General arrangement drawings of the mine site from reclamation planning		
Rehabilitation designs of the mass earth works that were done based on the 2007 survey of the entire mine. The conceptual designs completed in 2007 were refined to detailed design level (in terms of volume movement only) to produce the profiling model. The volumes were re-calculated according to the new inclusion/ exclusion boundaries provided by the mine assessment.		
The aerial assessment based on the mines GIS information conducted by the mine and the integration thereof with the profiling model.		

4.0 BATTERY LIMITS

Closure costing for NM covered the specific mine related closure components listed below. In addition those associated areas possibly disturbed and/or contaminated by mining and ore processing were also considered in the closure costing.

The site comprises the following complexes:

- Buffels Marine Complex (BMC);
- Buffels Inland Complex (BIC);
- Dikgat Complex (DGC);
- Koingnaas Complex (KNC); and
- Samson's Bak Complex (SBC), this complex costing is included under KNC closure cost sheets.

The Brand-se-Baai Complex and Groenrivier Complex do not have items affecting the physical closure costing and therefore are not included in the costing sheets and this report.

As part of the reclamation planning, areas within the above complexes were identified as either included for closure or excluded for closure. Included areas will be profiled according to the mass earth works designs (profiling model) and have the remaining work defined by the survey categories. The excluded areas will be reclaimed according to the survey categories only and the volumes indicated by the rehabilitation designs for those areas will not be moved. The difference between the two approaches is reported in the excluded column, therefore the monetary values reflect the savings made due to having certain areas marked as excluded.

The following closure components have been removed from the costing:

- The towns and their related infrastructure (roads, powerlines, water infrastructure etc.) that are currently being proclaimed through a separate project.
- The main haul roads will not be decommissioned, at the request of the local authorities and will form part of a planned West Coast road.
- The associated borrow pits will also not be closed and will be used for future maintenance of the roads.
- The redundant processing plants and their related infrastructure that are in the process of being removed by a demolition contractor on a "cost neutral" basis.
- Coarse Tailings and Fine Tailings Mineral Resource Deposits
- Pre March 1980 areas not already rehabilitated
- Areas already restored, either naturally or as a result of NM's rehabilitation programme
- Areas identified as having an alternative land use requirement, these are:
  - The marine aqua-culture area
  - The Dreyerspan prison facility
  - BMC hazardous waste site
  - Wind farm development sites

Other initiatives for alternative land uses being considered include the Living Edge of Africa project. These projects could lead to further areas being excluded from the reclamation liability at a later stage.

4.1 Division of complexes

The mining complexes have been divided into included and excluded categories according to their reclamation requirements and their relation to the profiling model. These areas are particularly applicable to the mining aspects of each of the complexes mentioned above.

Similar to the 2008 closure cost estimates the entire NM area has been sub-divided into various categories based on the survey database for purposes of reclamation. These areas have assumptions which indicate the work required for each area.

4.1.1 Areas affected by profiling/reclamation modelling

These are areas that fit into the profiling model compiled by Golder. These are the areas that have been identified as areas to be included for closure.

The conceptual profiling model completed has been refined to remove all materials movement less that 0.1m in depth (inherent "noise" in the model). The removal of the "noise" in the profiling model defined clear materials movement clusters. The portions of the survey categories covered by the profiling model have been removed from that specific category and reported on as excluded. The clusters of profiling identified by the model then take priority as the reclamation activity to be completed. The remaining surface area covered by the category is then reported on as included (see 4.1.3). Small pockets of one or two points of profiling indicated by the model were not given the status of a cluster, the survey category according to which the area is classified as, and then received precedence above the profiling model.

4.1.2 Virgin areas affected by profiling/ reclamation modelling

There was no specific survey information for this category. It was indicated through combining the survey categories and the materials movement boundaries of the Golder profiling model. These are areas that were not disturbed by the mining operations but would be disturbed while profiling disturbed areas during reclamation operations. Given the slow growth rate and the natural revegetation of the majority of dumps, it has been decided to preserve the growth surrounding dumps by adjusting various profiles and limiting the amount of damage to surrounding areas. These adjustments have been made to the final model.

5.0 ASSUMPTIONS AND QUALIFICATIONS

5.1 General

- The closure cost estimate is aligned to the generic Guideline Document for the Evaluation of the Quantum of Closure Related Financial Provision Provided by a Mine, by the DME (January, 2005).

- In line with the MPRDA regulations for mine closure, the guideline is interpreted with emphasis being placed on cost efficiency and practicability. This has lead to the inclusion of site specific standards relating to rehabilitation methodology for Namaqualand mines
- In line with the point above, discussions were held with the DMR (DME at the time) in 2006, during which it was agreed that site conditions essentially dictate the rehabilitation requirements, e.g. the agreed upon slope angles were 18 degrees as it was deemed unnecessary and impractical to slope to a lesser angle.
- Allowance has also been made for third party contractors and consultants to conduct post-closure care and maintenance work as well as compliance monitoring.
- Fixed ratios for P&Gs and contingencies as generally accepted for this type of costing have been applied.

5.2 Site specific

- Namaqualand Mines are running down its operational activity and are concurrently busy with a dedicated effort to rehabilitate the disturbed areas of the mine towards eventual mine closure. This rehabilitation forms a substantial portion of the mine's current routine operational activity, with a notable portion of its resources and equipment devoted to this effort. Hence, for the purpose of this closure cost estimate, it has been assumed that a dedicated work force and equipment fleet which is adequately resourced, is currently actively involved with mine site rehabilitation;
- Normally the unit rates used with the determination of rehabilitation and closure costs are based on independent third party contractor rates, which are largely determined by market forces and related conditions, albeit normalisation/ moderation is required to take cycles in construction activity and/or site specific considerations into account. Owing to the fact that these rates are normally in the public domain they could also be independently verified. However, in the case of Namaqualand Mines, with a portion of the mines work force and construction fleet fully committed to mine site rehabilitation, dedicated costs for these activities could be obtained and documented.
- The major cost component of rehabilitation operations is the cost associated with earth moving activities. The earth moving cost contributes significantly to the overall calculation of rehabilitation liability associated with any mine and for the most part these costs are determined with reference to prevailing market related contractor rates. The NM mining operation is an earth moving intensive operation and as a result thereof, NM has its own fleet of earth moving machinery including a dragline.
- It is foreseen that the mine legacy rehabilitation which NM is currently conducting could take about a decade to complete and therefore a substantial portion of the rehabilitated areas would have been finally rehabilitated for a period up to at least a decade. Moreover, some of the areas could even have exceeded this period. Thus, with the unscheduled situation the allowance for care and maintenance of rehabilitated areas as well as the monitoring of these areas for only three years post closure has been costed.
- Owing to the sensitive nature of the local ecological system and especially the local vegetation, it has been assumed with this closure costing that only readily available growth medium would be utilised for rehabilitation. Virgin areas would not be disturbed for the purpose of obtaining growth medium. This "shortfall" in growth medium could result in bed rock areas as well as other swept areas not being covered by growth medium and vegetated.
- Concrete footings and bases would be demolished to 1 000 mm below the final surface topography.

Reclamation requirements for specific closure components are listed below:

Table 2: Survey categories for Namaqualand Mines

Category	Description
Roads ripped	Roads that have already been ripped. Allowance has been made for general shaping and levelling, salt/salinity remediation, monitoring and maintenance in these areas.
Roads	No reclamation conducted on these roads to date. Allowance has been made for ripping, general shaping and levelling, salt/salinity remediation, monitoring and maintenance in these areas.
Profiled	Areas already profiled in reclamation activities. Allowance has been made for, netting, seeding, monitoring and maintenance. **No allowance has currently been made for replacing growth medium.**
Borrow pits	This category of borrow pits exclude those next to the roads, which are assumed to be left to remain operational. These are borrow pits in the mining areas that require reclamation, therefore allowance has been made for minor shaping and levelling, netting, seeding, monitoring and maintenance.
Damaged areas	Areas around plant and mining activities which have been disturbed, but where topsoil was not removed but compacted. Allowance has been made for light agricultural ripping, monitoring and maintenance. Not requiring vegetation.
Dumps	These are small dumps that are assumed not to require profiling. Allowance has been made for netting, seeding, monitoring and maintenance. **Some of these dumps will be classified as topsoil storage facilities and utilized as growth medium according to the growth medium identification and quantification exercise to be done in the near future.**
Highwalls	These are assumed to be shallow high walls ranging from 1 to 3 m in height. Allowance has been made for topsoil removal, shaping, replacing of topsoil, netting, seeding and monitoring and maintenance.
Stripped Ore	It is assumed that all piles of stripped ore would be processed by closure. Allowance has been made for netting, seeding, monitoring and maintenance
Green areas	Areas that have been fully reclaimed and signed off as such by the mine. Allowance has been made for monitoring and maintenance.
Naturally reclaimed areas	Areas that have over time been reclaimed naturally. Allowance has been made for supplementing a portion of the area with vegetation packs, monitoring and maintenance.
Netted areas	Areas that have been netted.

Category	Description
	Allowance has been made for seeding, monitoring and maintenance.
Planted areas	Areas that have been planted already. Allowance has been made for monitoring and maintenance.
Seeded areas	Areas that have been seeded already. Allowance has been made for monitoring and maintenance.
Topsoiled areas	Areas where topsoil/growth medium has been replaced. Allowance has been made for netting, seeding, monitoring and maintenance.
Swept areas	Areas to be treated similar to bedrock, an average cover depth supplied by the mine survey department is used to calculate a volume to be covered. Allowance has been made for netting, seeding, monitoring and maintenance.

- The reclamation measures conceptualised and applied on the closure costing were as far as possible aligned to the latest Environmental Management Plans (EMPs) for the various mine complexes.
- A combination of final land uses was considered. These include extensive livestock farming, ecotourism and Mariculture.
- Profiling of opencast spoils to a minimum slope of 1:3.
- No water management structures have been devised and costed for erosion prevention since the areas where erosion protection could be required is mostly the saline spoil material within the deeper sections of the BMC. These saline soils cannot be used for the construction of the above water management structures since their integrity is questionable, being highly dispersive. In view of this, it has been assumed that if material has to be imported it would be more beneficial to import growth medium and establish vegetation to combat erosion.
- Mined out areas suitable for alternative land use with the aim of promoting sustainable development, will remain un-reclaimed and applied for this purpose.

6.0 UNIT RATES

With a portion of the mine's work force and construction fleet fully committed to mine site rehabilitation, dedicated costs for these activities have been established and documented. Since NM is already actively involved and committed to mine site rehabilitation, it has been assumed the above motivation for the site specific unit rates applies to both the scheduled and unscheduled situations.

Barring the earthmoving rates which NM has determined through years of rehabilitation experience in Namaqualand, all other unit rates were obtained from the Golder's database. Unit rates for determination of closure costs by Golder were obtained from the following sources:

- Consultation with the following reputable industry specialists:
- Reclamation specialists, with special reference to soil amelioration and re-vegetation;

- Civil engineers involved in shaping/profiling as well as stabilisation of areas disturbed by the removal of mining- and manufacturing-related facilities; and
- Demolition practitioners, focussing on the mechanical costs and associated professional fees required to dismantle and/or demolish steel, brick and concrete infrastructure.

Based on the above, Golder compiled a unit rate-specific database that is utilised for the overall determination of closure costs. This database and relevant unit rates are updated quarterly.

6.1 General surface shaping

It has been assumed that general surface shaping would be required over most of the areas where surface infrastructure had been removed, as well as fugitive disturbed areas, as part of the overall surface reclamation. For this purpose it has been assumed that shaping would involve the movement of material at about 500 to 700 mm average thickness.

6.2 Establishment of vegetation (see Appendix D for full restoration method)

6.2.1 Planting of restoration packs

No allowance has been made for growth medium amelioration prior to the establishment of vegetation. The cost of planting restoration packs, including labour, amounts to R 3 846/ha. This is assuming that the restoration packs are planted in block formations and every alternate block is planted, therefore in a 2 ha area, 1 ha is planted with restoration packs.

6.2.2 Netting

The latest cost of the nets is R 6/m, the netting is used three times, therefore the cost of netting is R 4 000/ha. The cost of droppers is R 8/each, which are also used three times therefore the cost of droppers is R 2667/ha. Further cost include anchors at R 520/ha, bind wire at R 60/ha and boxes at 1893/ha. The total cost for netting amounts to R 9 140/ha. This cost includes maintenance of the netting. Total costs for netting and seeding 1ha is R16,833.27

6.3 Surface water monitoring

It has been assumed that surface water quality monitoring at ten locations has to continue at a quarterly frequency for at least three years post-closure.

If it is assumed that three man-days would be required to conduct a monitoring event (including travelling), this would equate to R12,000. Allowance has also been made for chemical sample analysis at R1,500/sample. Hence, these costs amount to R 27,000 per sampling event which can be rounded to

R30,000 including travelling expenses. If sampling is to be conducted at a quarterly frequency, the annual costs amount to R120,000.00/year.

6.4 Reclamation monitoring

It has been assumed that five man-days would be required to conduct the reclamation monitoring. Assuming a consultant rate of R500/hr this would equate to R 20,000 per event. If it is assumed that this has to be conducted twice a year, the annual costs would amount to R 40,000 or roughly R400/ha if assumed about 100 ha would require monitoring. If an additional R50/ha is added for travelling and accommodation, the overall rate is about R450/ha/year. It has been assumed that reclamation monitoring will have to continue for about three years, which amounts to R 1,350.00/ha.

6.5 Care and maintenance of reclaimed areas

Based on the findings of the reclamation monitoring and/or other inspections, corrective action on the reclaimed areas could be required. If it is assumed that this would require six weeks per year of a team of 20 workers and two JCB's as supporting equipment, this equates to about R1600/ha, provided it is assumed that active care and maintenance also has to be conducted over roughly 100 ha. It has been assumed that the hourly rate of the workers is R15 and the equipment R3 000/d. If accommodation and travelling of R50/ha is also added, the overall rate is about R1650/ha/year. It has been assumed that the workers and equipment could be sourced locally.

7.0 APPLICATION OF MEASURES AND TOOLS

7.1 Profiling model

A dedicated reclamation model was set up and run to determine the mass volume of material that will have to be moved to achieve the specified maximum allowable slope. The model was applied to the full mine site during 2007 to reflect the required surface profile and associated material requirements to achieve this profile at a conceptual level. The particular profile is dependant on the site conditions, taking into consideration the soil stability vegetation, shape etc. Generally slopes will be profiled to a gradient of 1:3 and 1:5 where required.

The concept was taken to detailed design level for an area in the BMC referred to as the test area, covering 722 ha. The detailed design removed the "noise" in the model by eliminating all areas where shaping takes place at a depth shallower than 100 mm. The volume of material to be handled and moved was in this way reduced by approximately 20 percent across the test area.

The same exercise was completed for the full mine site, reducing the volumes of material requiring handling and movement as follows:

- By approximately 37 percent from 66,4 million m^3 to 42,1 million m^3 for included areas.

The mining areas were divided into various categories according to the survey database that enabled general reclamation requirements to be listed for each category

7.2 Exclusion of Pre 1980 areas

The regulations to the Mines and Works Act ("Mines and Works Regulations") were amended on 21 March 1980. The amended regulations required that a rehabilitation programme be submitted to the Inspector of Mines if requested by the Inspector of Mines and that rehabilitation of the surface at any open cast mine shall form an integral part of the mining operations. As from 21 March 1980 the Mines and Works Act enforced rehabilitation of the surface of land at mines. The Mines and Works Regulations imposed a positive obligation for the rehabilitation of the environment disturbed by mining operations and this obligation was carried through to the Minerals Act. Based on the promulgation of these regulations in March 1980, NM is therefore only obligated to rehabilitate environmental disturbances caused by mining operations as from 21 March 1980.

Having said this NM has already committed significant resources to the rehabilitation and making safe of these areas, the latter of which, will continue to ensure a safe area post closure.

7.3 Site clean-up

In all areas that were disturbed during operation, site clean-up would be necessary. In accordance with the EMP's, the following assumptions have been made regarding measures to be taken for site clean-up:

- Site inspections will be conducted to determine possible sources of soil contamination. Specific attention will be given to areas that have been exposed to possible soil contamination during the operational life of the tailings storage facility and surrounding areas.
- Soil tests to identify the possible nature of contamination will be conducted (i.e., organic or inorganic contamination).
- If the contamination is primarily of an organic nature, the following will be done:
- Conduct sampling at two horizons (0-150 mm and greater than 150 mm).
- Conduct shake-flask or other appropriate tests and analyse for Total Petroleum Hydrocarbons (TPH). In the cases where the TPH standard of 1 000 mg/kg is not applicable, other appropriate standards such as the Dutch Intervention Values for Soil Contaminants or US EPA Risk Based Concentrations or action levels for Industrial Soil Remedial Goals (PRGs) for Direct Contact Exposure Pathways or other procedures considered as best practice at the time of closure, must be applied.
- Interpret chemical analysis results and assess the potential for contamination.
- If the TPH concentrations are below 1 000 mg/kg, no remediation is required. If the TPH concentrations are above 1 000 mg/kg, the contaminated soil will be removed if it is in manageable volumes. The collected soil will be taken to a bioremediation facility for reclamation. Reclamation will continue until the TPH analyses of three composite samples indicate that the average TPH concentration is below 1 000 mg/kg.
- Note: If large volumes of organically contaminated soil and/or small areas with organic contamination other than normal petroleum products such as diesel, petrol (gasoline), and lubrication oil are found, the area will be assessed by a suitably qualified person and an appropriate remediation strategy devised.
- Collect composite soil samples within the identified contaminated area and analyze for total petroleum hydrocarbons (TPH). If the TPH concentrations are below 500 milligrams per kilogram, no decontamination is required. If the TPH concentrations are above 500 milligrams per kilogram, the

contaminated soil will be removed if it is in manageable volumes. The collected soil will be deposited onto a dedicated on-site bioremediation facility. The reclamation of the soil will be successful if the TPH analyses of three composite samples indicate that the average TPH concentration is below 500 milligrams per kilogram.

- In the cases of large volumes of organically contaminated soils, a suitably qualified person will conduct an assessment and prepare an appropriate reclamation strategy.
- In the cases where the TPH standard of 500 milligrams per kilogram is not applicable, other appropriate standards such as United States Environmental Protection Agency (US EPA) risk based concentrations or action levels for industrial soil remedial goals for direct contact exposure pathways will be used.
- If the contamination is primarily of an inorganic nature, the following will be done:
- Collect composite soil samples in the identified contaminated areas and analyze for total concentrations of the appropriate chemicals of concern (COC). The selection of COCs will be dictated by the historical activities that were conducted within or nearby the contaminated area(s).
- Compare the results of the chemical analyses with the USEPA Preliminary Remediation Goals (PRGs) for industrial sites. If the values are not exceeded, no reclamation is required. If the values are exceeded, a suitably qualified specialist will assess the situation and devise an appropriate reclamation strategy for implementation, including the recycling of these soils to recover any copper and/or cobalt metals.

7.4 Topsoil/growth medium

- Due to the arid West Coast climate in the Namaqualand region, topsoil is extremely scarce. The incorporation of environmental legislation post significant periods of mining meant that historically topsoil was not saved for rehabilitation purposes. Post the incorporation of the legislation, all topsoil which was made available as part of the pre-stripping process was used to rehabilitate areas mined within the same period. As a result there is no topsoil available to use as growth medium for the legacy areas. In areas where natural restoration is expected to take significantly longer, NM has made provision for induced restoration. This does however come at a significant cost and is therefore only applied where absolutely necessary.

7.5 Induced Vegetation

- Establishing vegetation on rehabilitated areas, characteristic of the surrounding environment, where it is anticipated that no growth will occur over an extended time period, the process includes netting, seeding and monitoring.
- Prepare the shaped areas for re-vegetation and vegetate.
- It is currently assumed that netting and seeding will only be done on half the area, effectively every alternate hectare, making provision for the natural spreading of the induced vegetation areas
- In-fill vegetation will be conducted as required to ensure that predetermined basal cover and species mix are achieved.
- It is assumed that if the width of the disturbed area is < 50 m and adjacent to natural vegetation, natural dispersal and succession is sufficient for restoration.

7.6 Demolition and removal of infrastructure

- All non-usable buildings will be demolished, including plant and related surface infrastructure. This will be completed by a contractor on a cost neutral basis
- General demolition waste will be safely disposed of by the responsible contractor in accordance with the required regulation.
- Asbestos waste will be safely removed in accordance with regulations and disposed off-site in an appropriate waste disposal facility.
- Resultant demolition waste and any other inert non-hazardous materials that cannot be reused or recycled as stipulated in the initial reclamation and closure plan and/or subsequent plans.
- Any hazardous material that accumulated on components of the buildings, machinery and equipment will be identified and removed for safe off-site disposal.
- Machinery, equipment, and storage tanks will be cleaned and disposed of as above.
- Concrete structures, foundations and slabs will be removed to 1 m below final ground level.
- Buried support infrastructures (tanks, pipes, underground services etc.) will be decommissioned and removed in a safe, acceptable manner. Buried infrastructure remaining on site will be identified on site closure maps.
- Decommissioned septic tanks will be filled with inert material and cover.
- Steel and scrap metal will be decontaminated for salvaging and recycling, if valuable.
- Hazardous material will be encapsulated or disposed of off-site.
- An assessment of contaminated soils will be conducted and will be ameliorated and/or disposed of accordingly.
- Areas from which buildings and surface infrastructure have been removed will be cleaned-up.
- Areas from which surface infrastructure has been removed will be checked for organic contamination and remediated.
- Areas from which buildings, plant and surface infrastructure have been removed will be shaped to roughly emulate the natural surface topography, especially terraces and hard stand areas.
- NM has outsourced the demolition of these infrastructural aspects as per the description above, and has proven it can be done cost neutrally. In essence the contractor will demolish free of charge and his profit will be derived from the sale of equipment and scrap steel.

7.7 Fugitive tracks

In accordance with the EMP's, the following assumptions have been made:

- Barriers that would prevent access by vehicles will be erected.
- The road will be allowed to colonise naturally. If the width of the disturbed area <50 m and adjacent to natural vegetation, natural dispersal and succession is sufficient for restoration.

7.8 Haul roads and access roads

The following assumptions have been made:

- The road surface and related areas would be deep ripped, unless ripping has already occurred.
- A general shaping and levelling cost has been allowed for, which should cover loading and hauling a portion of the ripped material for disposal in available mining voids. If possible, the material will be dozed into nearby voids (where it is covered by the profiling model), or cleared areas will be shaped to emulate the natural surface topography as far as possible.
- Cuttings and embankments will be suitably shaped to ensure safety and decrease erosion potential.
- Earth embankments associated with access roads and haul roads that could impede long term surface drainage will be breached and shape as above.
- Areas with high salt/salinity will be identified and receive amelioration, it is assumed that 10% of the indicated surface area of roads will receive treatment with gypsum.
- No growth medium replacement has been allowed for.
- It is assumed that if the width of the disturbed area is <50 m and/or adjacent to natural vegetation, natural dispersal and succession is sufficient for reclamation.

7.9 Coarse Tailings Mineral Resources (CTMR)

The following assumptions have been made.

- The CTMR's would remain in place post closure and are considered mineral resources. As such, they potentially play a crucial role in the establishment of small mining businesses post closure. The capping or profiling of these deposits will dilute the value, reducing the possibility of profitable treatment in the future.
- The CTMR's are stable and do not pose an environmental risk for the foreseeable future
- The CTMR's will be fenced off to "make safe" and restrict access.
- Following this methodology ensures the surrounding undisturbed areas are not destroyed by the profiling of the CRD's in order to obtain a required slope angle, which may not be required.

7.10 Fine Tailings Mineral Resources (FTMR)

The following assumptions have been made:

- The FTMR's would remain in place post closure and too are considered mineral resources. Current indications are that the FTMR's contain significant value in heavy minerals and any capping or profiling would, like the CTMR scenario, dilute the inherent value of the resource.

- The FTMR's are also considered assets to any future small mining operations, as the establishment and permitting of a new facility would come at significant cost. This would reduce the profitability of future mining operations, negatively impacting on sustainable development.
- The FTMR's are stable, but provision is made for the netting of areas which may be affected by dust plumes in extreme cases.
- FTMR's will be fenced off to "make safe" and to restrict access.

7.11 Overburden and spoil

In accordance with the EMP's, and the profiling model, the following assumptions have been made:

- Spoils will be dozed, loaded and hauled into the existing voids according to the profiling model to achieve a 1:3 or 1:5 slope. The volume to be moved is split into 75% dozing and 25% load and haul based on rehabilitation experience in the area.
- The mine has identified areas where the dragline could be effectively utilized to do reclamation according to the profiled model. The volume of material to be moved in the specified areas was split into 80% dragline work and 20% conventional dozing and load and haul methods costed in accordance with the weighted averages attached to the three scenarios. The following is noteworthy regarding the dragline use as specified:
- Of the total volume to be moved (about 42 million m^3 included areas), 28,5 million m^3 has to be moved in the BMC alone (67.5%). The volume assigned to the dragline for this exercise is 9,7 million m^3. If the current planning is implemented then the dragline will move 34.11% of the BMC total volume and 23.04% of the total NM volume.
- The total volume to be moved in the areas indicated for dragline utilization amounts to approximately 12 million m^3. The 80% dragline utilization and 20% load and haul split of this volume yields a 47.35%, 49.81% and 50.91% saving on the 90%-10%, 80%-20% and 75%-25% scenarios respectively (materials movement costs only).
- Seeds, seedlings and transplants of indigenous species will be added and the soil ameliorated in a manner that benefit from ecological dynamics. Specifications to be determined by soil type and habitat.

7.12 Virgin areas

In the virgin areas, which are adjacent to the areas being profiled, and would be disturbed during profiling, it is assumed that the growth medium would be dozed at a depth of 0.5 m and stockpiled. It is further assumed that the growth medium would be replaced at a depth of 0.3 m The shaping and levelling, netting, seeding, monitoring and maintenance of these areas is covered under the profiling model as the surface area falls within the materials movement boundaries.

7.13 Shallow and deep swept bedrock areas

In accordance with the EMP's, discussions with the mine and the profiling and GIS system analysis, the following assumptions have been made:

- The swept bedrock areas that are covered by the profiling model will be removed from the equation.
- It is assumed that half the surface area will be netted and seeded, as per the specifications discussed in the section on netting and seeding but only where the site conditions require it.

7.14 Transfer of infrastructure and land

In accordance with the EMP's, the following assumptions have been made:

- Suitable surface infrastructure and land for beneficial reuse will be selected, based on predetermined criteria below.
- The criteria for the selection of infrastructure for re-use will be developed, taking cognisance of the following:
- Possible heritage sites.
- Suites of final land uses, as these are evolving.
- Mine areas suitable for the transfer to responsible/ suitable third parties.
- Suitable third parties for transfer.
- Long-term health and safety considerations.
- Ongoing regulatory requirements.
- Commercial value to NM.
- Re-zoning requirements.
- A business case for each cluster of surface infrastructure identified for beneficial reuse will be developed for decision-making and if feasible, implemented.
- It will be ensured that the sale of land and/or the transfer of surface infrastructure will be preferably to parties who are empowered towards efficient farming, chosen land use practices as well as capable to utilise and maintain transferred infrastructure.
- In the event that the above can not be achieved the fall back position will be that the disturbed areas would be reclaimed for subsistence grazing and where possible key biodiversity areas would be re-instated.

7.15 Alternative Land Use

Although the general aim of the entire rehabilitation process if to return the land to its original state where practical and cost effective to do so, it must be said that there is a very strong drive toward creating a sustainable socio-economic environment post mining. It is for this reason that a number of development projects have been embarked upon with this exact intention. Various synergies have been identified which have led to the cost effective establishment of sustainable businesses. Some redundant mining infrastructure like sea water intakes, pumping stations and mined out pits, have provided the opportunity to explore marine aqua-culture activities in an area where it previously would probably have been too expensive.

Many other opportunities have arisen, creating win-win scenarios for the future communities and NM. These include the following projects, many of which have progressed to a significant level:

- Marine Aqua-culture – Oysters and Abalone
- Wind Energy
- Correctional Services Training and Rehabilitation facility
- Hazardous Waste Site

7.16 Other

In accordance with the EMP for the BMC, the following assumptions have been made:

- Regular monitoring and measurement relating to dust will be conducted after reclamation is complete.
- To prevent surface erosion, it is assumed the following will be done:
- Slopes will be stabilised by shaping and contouring, emulating local stable land forms providing suitable conditions for sustaining vegetation.
- Create suitable conditions (growth medium, vegetation mix, etc) for sustainable vegetation cover to contribute/assist with the prevention of surface erosion.
- Over and above the other measures that would protect the surface water bodies, local drainage lines will also be reinstated as far as possible as part of site reclamation as stated in the initial reclamation and closure plan and/ or subsequent plans.
- Remaining chemicals, reagents and hydrocarbon products will be consumed during mine decommissioning and/or returned to their respective suppliers.
- No product of the above nature would be disposed of on the mine site.
- Throughout the operational life certain areas would have been progressively reclaimed. In these areas the following actions will still take place:
- Confirm that the area under consideration is suitably reclaimed.
- Confirm the planned land use and alignment with regional developmental initiatives.
- Confirm alignment with sustainable development initiatives
- Compile business plan to confirm feasibility if transferred to third party, especially if to be used for commercial farming.
- Compile progressive closure plan, obtain approval and implement

8.0 REMEDIATION COST ASSESSMENT

The sub-sections following below give an overview of the specific actions considered and allowed for as part of the closure costing.

The closure cost estimate represents the scheduled and unscheduled costs utilizing the weighted average for moving material according to the profiled model assuming a 75:25 split between dozing as opposed to loading and hauling within a 1 km free haul distance. The summary of the costs for included areas is indicated below.

8.1 Infrastructural areas

Closure cost component	Remediation cost assessment	
	Unscheduled (Jan 2010)	Scheduled
Processing plants, steel structures, reinforced concrete structures, offices, workshops, residential buildings and related structures	▪ The demolition of plant infrastructure will be done as per current contract. The current contract allows for this to be completed at no cost to NM. All plant infrastructure will be removed in the same fashion	▪ The demolition of infrastructure will be conducted as for the unscheduled scenario. Most of the infrastructure will however have been removed by scheduled closure and the costs have been reduced accordingly.

8.2 Mining areas

Description of these components has been included under general surface reclamation given below.

8.3 General surface reclamation

Closure cost component	Remediation cost assessment	
	Unscheduled (Jan 2010)	Scheduled
Rehabilitation of Opencast areas (including final voids, ramps) overburden and spoils.	▪ Allowance was made for shaping of the outer slopes of the pits to 1:3 or 1:5 should site requirements dictate as well as the netting and seeding of the disturbed areas where soil conditions dictate.	▪ Allowances are the same as for the unscheduled scenario except that a significant number of opencast areas will have been rehabilitated by scheduled closure.
Rehabilitation of processing waste deposits and evaporation ponds	▪ No rehabilitation will take place as per 7.8 ▪ FRD's: No rehabilitation	▪ Same as for unscheduled scenario.

	Remediation cost assessment	
	will take place as per 7.9 ▪ CRD's and FRD's will be fenced and netted where required to ensure they are safe and stable.	
Virgin areas affected by profiling	▪ Allowance is made for the stripping of 500 mm of soil from the area before the shaping and replacing 300 mm after shaping. Where possible virgin areas will not be destroyed to make way for profiling	▪ Allowances are the same as for the unscheduled scenario
Areas outside the profiling/reclamation model boundary	**Roads ripped** Allowance has been made for the following: ▪ Shaping and levelling of disturbed areas; and ▪ Salt and salinity remediation with gypsum.	▪ Allowances are the same as for the unscheduled scenario except that a significant number of areas will have been rehabilitated by scheduled closure.
	Roads Allowance have been made for the following: ▪ Ripping of compacted areas ▪ Shaping and levelling of disturbed areas; and ▪ Salt and salinity remediation with gypsum.	▪ Allowances are the same as for the unscheduled scenario except that a significant number of areas will have been rehabilitated by scheduled closure..
	Profiled areas Allowance has been made for the following: ▪ Netting and seeding of profiled areas where required	▪ Allowances are the same as for the unscheduled scenario except that a significant number of areas will have been rehabilitated by scheduled closure.
	Borrow pits Allowance has been made for the	▪ Allowances are the same as for the unscheduled

Remediation cost assessment	
following: ▪ Minor shaping and levelling of disturbed areas; and ▪ Netting and seeding of shaped and levelled areas.	scenario.
Damaged areas	
Allowances have been made for ripping of the area.	Allowances are the same as for the unscheduled scenario except that a significant number of areas will have been rehabilitated by scheduled closure.
Dumps	
Allowances have been made for the following: ▪ Netting and seeding of profiled areas where required	▪ Allowances are the same as for the unscheduled scenario except that a significant number of areas will have been rehabilitated by scheduled closure.
Highwalls	
Allowances have been made for the following: ▪ Removal of growth medium in undisturbed areas to a depth of 0.5 m; ▪ Shaping and levelling of highwalls; ▪ Dozing of growth medium back to a depth of 0.3 m; and ▪ Netting of highwalls.	▪ No allowances have been made as this will be completed by scheduled closure.
Stripped ore	
Allowances have been made for the following: ▪ Replace of growth medium in undisturbed areas to a depth of 0.3 m	▪ No allowances have been made as this will be completed by scheduled closure.

Remediation cost assessment	
Naturally reclaimed areas	
Allowances have been made for the following ▪ Supplementing areas assumed to establish vegetation naturally with vegetation pockets.	▪ No allowances have been made as this will be completed by scheduled closure.
Netted area	
Allowances have been made for the seeding of netted areas.	▪ Allowances are the same as for the unscheduled scenario except that a significant number of areas will have been rehabilitated by scheduled closure.
Swept areas	
Allowances have been made for the following ▪ Netting and seeding of swept areas where required	▪ Allowances are the same as for the unscheduled scenario except that a significant number of areas will have been rehabilitated by scheduled closure.

8.4 Water management

Closure cost component	Remediation cost assessment	
	Unscheduled (Jan 2010)	**Scheduled**
	▪ No provision was made as there is little or no ground water.	▪ No provision was made as there is little or no ground water.

8.5 Post-closure aspects

Closure cost component	Remediation cost assessment

Closure cost component	Remediation cost assessment	
	Unscheduled (Jan 2010)	**Scheduled**
Surface water quality monitoring	Allowance has been made for the monitoring of surface water for a three year period post closure.	▪ Allowances are the same as for the unscheduled scenario.
Groundwater quality monitoring	Allowance has been made for the monitoring of groundwater for a three year period post closure.	▪ Allowances are the same as for the unscheduled scenario.
Monitoring	Allowances have been made for monitoring for a three year period post closure in the following areas: ▪ Reclamation monitoring of reclaimed areas, these include pit areas, dumps, other areas ▪ Virgin areas affected by profiling; ▪ Areas outside the profiling/reclamation model boundary which include: roads ripped, roads, profiled areas, borrow pits, damaged areas, dumps, highwalls, stripped ore, green area, naturally reclaimed areas, netted areas, planted areas, seeded areas, topsoil areas, and swept areas.	▪ Allowances are the same as for the unscheduled scenario.
Care and Maintenance	▪ Allowance has been made for care and maintenance for a third of the area over a three year period.	▪ Allowances are the same as for the unscheduled scenario.
Management/staff costs	▪ Management costs have been included in the operational costing	▪ These costs are form part of the operational costs and are excluded here.
Specialist studies	▪ These have been excluded from the closure cost estimate.	▪ These have been excluded from the closure cost estimate.

8.6 Additional allowances

Closure cost component	Remediation cost assessment	
	Unscheduled (Jan 2010)	Scheduled
Contingencies	▪ An additional allowance of 10 percent has been made in the total infrastructure and related aspects to allow for contingencies.	▪ An additional allowance of 10 percent has been made in the total infrastructure and related aspects to allow for contingencies.
Preliminary and General (P&G's)	▪ An allowance of 6% has been made.	▪ An allowance of 6% has been made.

9.0 ASPECTS REQUIRING FURTHER ATTENTION

Since the closure planning and associated costing for Namaqualand Mines is well advanced, limited (if any), aspects are outstanding that could require intermediate attention to improve future closure costing. The roll-out and implementation of the conceptualised land use plan and the transfer of responsibilities within this plan to third parties is the main aspect that will influence the costing.

Another aspect is the rate and nature of surface rehabilitation currently being conducted and the process of obtaining sign-off / approval from the regulatory authorities for areas as these are rehabilitated. If acceptably rehabilitated and the associated vegetation is self-sustaining, the closure costs for these areas can be omitted from the closure costs. This process has been established in conjunction with a third party ecology consultant and the DMR and future closure cost updates will take any such sign-off / approval.

10.0 CONCLUSION

The closure costs as reflected in this report were based on the closure costing compiled by Golder and adjusted as per information gathered during the actual rehabilitation process over the past three years. These changes are confirmed by site specialists in a third party capacity. In those cases where the required information was not available, estimates were made based on experience. Unit rates for the costing were obtained from Golder's database and specific input from Namaqualand Mines to reflect site-specific conditions and associated rates.

Within the above context, the reflected remediation costs as at January 2010 provide a good basis for the provisions to be made in the De Beers Consolidated Mines Limited – Namaqualand Mines financial statements.

APPENDIX A

Summary of Scheduled and Unscheduled Closure Costs

De Beers Namaqualand Mines- Scheduled Summary Spreadsheet - December 2010

Unscheduled closure

	INFRASTRUCTURE AND RELATED ASPECTS	BIR	BMR	DGR	KNR	SBR	BSBR	TOTAL
1	Infrastructural aspects	R 0.00	R 62,500.00	R 0.00	R 12,500.00	R 0.00	R 0.00	**R 75,000.00**
2	Mining aspects	R 0.00	R 0.00	R 0.00	R 0.00			**R 0.00**
3	General surface reclamation	R 6,777,035.00	R 75,249,124.00	R 1,904,793.00	R 60,652,819.38	R 2,872,380.62	R 0.00	**R 147,456,152.00**
4	Water management	R 0.00	R 0.00	R 0.00	R 0.00			**R 0.00**
	SUB-TOTAL 1 (Infrastructure and related aspects)	R 6,777,035.00	R 75,311,624.00	R 1,904,793.00	R 60,665,319.38	R 2,872,380.62	R 0.00	**R 147,531,152.00**
5	Post closure aspects	R 366,092.90	R 4,068,305.79	R 102,896.21	R 3,277,117.89	R 155,164.93	R 0.00	R 7,969,577.71
	SUB-TOTAL 2 (Post-closure aspects)	**R 366,092.90**	**R 4,068,305.79**	**R 102,896.21**	**R 3,277,117.89**	**R 155,164.93**	**R 0.00**	**R 7,969,577.71**
6	**ADDITIONAL ALLOWANCES***							
6.1	Preliminary and general (6 percent)	R 406,622.10	R 4,518,697.44	R 114,287.58	R 3,639,919.16	R 172,342.84	R 0.00	R 8,851,869.12
6.2	Contingencies (10 percent)	R 677,703.50	R 7,531,162.40	R 190,479.30	R 6,066,531.94	R 287,238.06	R 0.00	R 14,753,115.20
6.3	Engineering & project management (0 percent)							R 0.00
6.4	Management/staff cost (0 percent)							R 0.00
	(Additional allowances)	**R 1,084,325.60**	**R 12,049,859.84**	**R 304,766.88**	**R 9,706,451.10**	**R 459,580.90**	**R 0.00**	**R 23,604,984.32**
	GRAND TOTAL (Sub-total 1+2+3)	**R 8,227,453.50**	**R 91,429,789.63**	**R 2,312,456.09**	**R 73,648,888.36**	**R 3,487,126.45**	**R 0.00**	**R 179,105,714.03**

De Beers Namaqualand Mines- Scheduled Summary Spreadsheet - December 2010

Scheduled closure

	INFRASTRUCTURE AND RELATED ASPECTS	BIR	BMR	DGR	KNR	SBR	BSBR	TOTAL
1	Infrastructural aspects	R 0.00	R 62,500.00	R 0.00	R 12,500.00	R 0.00	R 0.00	**R 75,000.00**
2	Mining aspects	R 0.00	R 0.00	R 0.00	R 0.00			**R 0.00**
3	General surface reclamation	R 1,382,694.39	R 6,756,046.80	R 537,159.58	R 6,109,518.01	R 0.00	R 0.00	**R 14,785,418.78**
4	Water management	R 0.00	R 0.00	R 0.00	R 0.00			**R 0.00**
	SUB-TOTAL 1 (Infrastructure and related aspects)	**R 1,382,694.39**	**R 6,818,546.80**	**R 537,159.58**	**R 6,122,018.01**	**R 0.00**	**R 0.00**	**R 14,860,418.78**
5	Post closure aspects	R 741,532.97	R 3,656,756.88	R 288,076.34	R 3,283,211.53	R 0.00	R 0.00	R 7,969,577.71
	SUB-TOTAL 2 (Post-closure aspects)	**R 741,532.97**	**R 3,656,756.88**	**R 288,076.34**	**R 3,283,211.53**	**R 0.00**	**R 0.00**	**R 7,969,577.71**
6	**ADDITIONAL ALLOWANCES***							
6.1	Preliminary and general (6 percent)	R 82,961.66	R 409,112.81	R 32,229.57	R 367,321.08	R 0.00	R 0.00	R 891,625.13
6.2	Contingencies (10 percent)	R 138,269.44	R 681,854.68	R 53,715.96	R 612,201.80	R 0.00	R 0.00	R 1,486,041.88
6.3	Engineering & project management (0 percent)	R 0.00	R 0.00	R 0.00	R 0.00	R 0.00	R 0.00	R 0.00
6.4	Management/staff cost (0 percent)	R 0.00	R 0.00	R 0.00	R 0.00	R 0.00	R 0.00	R 0.00
	(Additional allowances)	**R 221,231.10**	**R 1,090,967.49**	**R 85,945.53**	**R 979,522.88**	**R 0.00**	**R 0.00**	**R 2,377,667.00**
	GRAND TOTAL (Sub-total 1+2+3)	**R 2,345,458.46**	**R 11,566,271.16**	**R 911,181.45**	**R 10,384,752.42**	**R 0.00**	**R 0.00**	**R 25,207,663.49**

APPENDIX B

Closure Costing Amendments

Amendment	BIC	BMC	DGC	KNC	Total	
Plants and Infrastructure	**R 1,973,927.00**	**R 48,505,698.00**		**R 12,433,147.00**	**R 62,912,772.00**	
Subtotal Infrastructural Aspects						R 62,912,772.00
CTMRs	**R 2,469,657.20**	**R 21,605,649.50**		**R 7,279,825.92**	**R 31,355,132.62**	
FTMRs		**R 34,183,399.13**		**R 15,420,340.03**	**R 49,603,739.16**	
Naturally Rehabilitated areas	**R 2,089,157.00**	**R 30,500,000.00**	**R 307,229.00**	**R 22,966,270.00**	**R 55,862,656.00**	
Altenative Land use	*R 0.00*	*R 44,273,825.17*	*R 0.00*	*R 632,282.22*	**R 44,906,107.39**	
Mariculture		R 627,126.90		R 632,282.22	R 1,259,409.12	
Dreyerspan Correctional Facility		R 93,426.58			R 93,426.58	
Windfarms		R 8,416,635.00			R 8,416,635.00	
Hazardous Waste Disposal Site		R 35,136,636.69			R 35,136,636.69	
Salt water remediation on Roads @ BIC	**R 14,000.00**				**R 14,000.00**	
Pre 1980 Footprint	**R 0.00**	**R 22,813,198.92**	**R 0.00**	**R 33,419,274.29**	**R 56,232,473.21**	
Slope Angle change to 1:3	**R 1,617,193.00**	**R 15,292,008.00**	**R 553,006.00**	**R 17,232,947.00**	**R 34,695,154.00**	
Subtotal General Surface Reclamation						R 272,669,262.38
Post Closure Aspects					**R 28,157,551.00**	
Subtotal Post Closure Aspects						R 28,157,551.00
Management Cost					**R 32,842,315.60**	
Subtotal Management Cost						R 32,842,315.60
Preliminary and General					**R 5,592,965.00**	
Contingencies					**R 33,388,833.00**	
Subtotal Finance Costs						R 38,981,798.00

APPENDIX C

Unit rates used for Demolition, Reclamation and Related Work

UNIT RATES FOR SCHEDULED DEMOLITION, RECLAMATION AND RELATED WORK - October 2010						
Ref no	Cost Item		Currency	Unit Rate	Unit	Notes
1	**Concrete**					
1.1	Heavy concrete thickness greater than 750 mm	:	Rands	R 1,100.00	/m³	
1.2	Medium concrete thickness between 750 and 250 mm	:	Rands	R 550.00	/m³	
1.3	Light concrete thickness less than 250 mm	:	Rands	R 350.00	/m³	
1.4	Strip footing	:	Rands	R 125.00	/m	
1.5	Column footing	:	Rands	R 850.00	no	
1.6	Bases and floors after removal of super structures	:	Rands	R 150.00	/m²	
1.7	Heavy duty floors and bases after removal of super structure	:	Rands	R 550.00	/m²	(500 mm thickness)
2	**Steel structures**					
2.1	Super structures, steel buildings and related infrastructure					
2.1.1	Cables/pipe racks	:	Rands	R 48.00	/m²	
2.1.2	Light plant buildings	:	Rands	R 96.00	/m²	
2.1.3	Medium plant buildings	:	Rands	R 180.00	/m²	Buildings with dynamic equipment
2.1.4	Medium/heavy plant buildings	:	Rands	R 1,200.00	/m²	
2.1.5	Heavy plant buildings	:	Rands	R 1,800.00	/m²	
2.2	Steelstructures (permanent shed type structures)					
2.2.1	0m – 5m high	:	Rands	R 50.00	/m²	
2.2.2	5m – 10m high	:	Rands	R 80.00	/m²	
2.2.3	10m – 15m high	:	Rands	R 100.00	/m²	
2.2.4	15m – 20m high	:	Rands	R 120.00	/m²	
2.4	Sorting and screening	:	Rands	R 2.50	%	
2.5	Disposal of demolition waste					
2.5.1	Disposal of demolition waste - benign, general waste	:	Rands	R 300.00	/m³	100 km away
2.5.2	Disposal of demolition waste - benign, general waste	:	Rands	R 88.00	/m³	10 km away
2.5.3	Disposal of demolition waste - hazardous waste	:	Rands	R 1,000.00	/m³	Such as tar
2.6	Cladding/sheeting (steel)	:	Rands	R 18.00	/m²	
2.7	Crane hire and use	:	Rands	R 22,000.00	/d	120 t crane
2.8	Steel tanks with rubber lining					
2.8.1	0-5m	:	Rands	R 10,000.00	/no	Diameter
2.8.2	5-10m	:	Rands	R 25,000.00	/no	Diameter
2.8.3	10-15m	:	Rands	R 35,000.00	/no	Diameter
2.8.4	15-20m	:	Rands	R 50,000.00	/no	Diameter
2.9	Decontamination of equipment					
2.9.1	Decontamination of equipment	:	Rands	R 2.50	%	Of overall dismantling of steel structures
2.9.2	Decontamination of equipment	:	Rands	R 5.00	%	
3	**Brick buildings and structures**					
3.1	Normal one storey brick buildings	:	Rands	R 275.00	/m²	
3.2	Normal double storey brick buildings	:	Rands	R 475.00	/m²	
3.4	Single brick wall (110mm)	:	Rands	R 10.00	/m²	
3.5	Double brick wall (220mm)	:	Rands	R 15.00	/m²	
3.6	Temporary Buildings	:	Rands	R 130.00	/m³	
3.7	Permanent Shed type (large)	:	Rands	R 128.00	/m³	
3.8	Substations	:	Rands	R 450.00	/m²	
3.9	Car ports (excluding paving)	:	Rands	R 85.00	/m²	***Note:*** *This relates to floor/surface area*
3.10	Ceilings					
3.10.1	Ceilings (Bord)	:	Rands	R 20.00	/m²	
3.10.2	Ceilings (Asbestos)	:	Rands	R 200.00	/m²	
3.11	Timber structures	:	Rands	R 5.00	/m³	
3.12	Cladding (Asbestos)	:	Rands	R 200.00	/m²	R125 for removal
4	**Plant and related equipment**					
4.1	Overland conveyors	:	Rands	R 150.00	/m	
4.2	Suspended conveyors	:	Rands	R 300.00	/m	Includes footings, etc
4.3	Overland power lines	:	Rands	R 25.00	/m	
4.4	Sub-stations	:	Rands	R 450.00	/m²	
4.5	Plant equipment	:	Rands	13.50 to 22	/m³	
4.5.1	Plant/steel superstructures: light	:	Rands	R 850.00	/t	
4.5.2	Plant/steel superstructures: light	:	Rands	R 900.00	/t	
4.5.3	Plant/steel superstructures: heavy	:	Rands	R 1,000.00	/t	
4.5.4	Plant/steel superstructures: heavy	:	Rands	R 1,200.00	/t	
4.6	Pipework	:	Rands	R 15.00	/m	
4.7	Pipework-elevated	:	Rands	R 25.00	/m	
5	**Roads, paving and walkways**					
5.1	Remove tar roads with 500mm layerworks	:	Rands	R 45.00	/m²	Excluding disposal of tar material
5.2	Gravel road with engineered surface	:	Rands	R 28.00	/m²	

APPENDIX D

NM Rehabilitation and Restoration Procedure

REHABILITATION AND RESTORATION

1. OBJECTIVE

The objective of this procedure is to establish and maintain an effective rehabilitation and restoration method.

2. SCOPE

This procedure applies to all employees and other persons at Namaqualand Mines (NM) involved in the rehabilitation and restoration activities.

3. LEGISLATION

- Constitution of The Republic of South Africa Act 108 of 1996; Section 24;
- Minerals and Petroleum Resources Development Act no 28 of 2002; and
- National Environmental Management Act No. 107 of 1998

4. DEFINITIONS

Disturbed area: An area that was previously mined and is stripped of natural vegetation. These areas include bedrock sites, mine dumps, exploration trenches and open pits.

5. RESPONSIBILITY

5.1 The **Rehabilitation Manager** is responsible for administering this procedure.

5.2 The **Rehabilitation Officer** is responsible for contractors involved with restoration to ensure compliance to the procedure and addenda.

6. REFERENCES

The following Namaqualand Mines policy manuals and procedures and other documents are also relevant:

- NM-PM-01-SHHE ENV Environmental Policy Manual
- SANS ISO 14001:2004 Element: 4.5.1
- De Beers Group Environmental Dictionary (EPRA)

7. PROCEDURE

Rehabilitation of mine area at NM consists of two different aspects:
- Landforming - the earthmoving and shaping of a disturbed area; and
- Restoration, the ecological interventions for disturbed areas.

7.1 LANDFORMING

a) Predetermine the shape:
The Rehabilitation Manager and Officer determine the level of landforming and shape of a specific area.

b) Predetermine the earthmoving machine requirements:
The types of earthmoving machines that are used for this may vary from site to site, depending on factors such as the size of the area, the depth of the cut and or the type of area. The earthmoving requirements are determined by the Rehabilitation Manager.

c) Backfill mine dumps and cuts:
Overburden is backfilled into existing mine cuts and the resulting dumps profiled using the predetermined earthmoving equipment.

d) Profile dumps:
Backfilled overburden is profiled to the predetermined shape as was decided upon by the Rehabilitation Manager and the environmental officer.

e) Cover profiled area with topsoil or growth medium:
For optimal restoration results the profiled areas are covered with topsoil or suitable growth medium where available. The topsoil or growth medium is deposited at an approximate thickness of 30cm. Areas should only be covered with growth medium or topsoil if it can be netted and restored in the same restoration year.

7.2 RESTORATION

Restoration includes the ecological intervention to ensure that a disturbed area is recovered to a self-sustainable ecosystem.

The restoration is done in accordance with specifications set out by an independent ecologist. The following steps form part of the restoration process: netting, seed collecting and processing, restoration packs and transplants.
Strict methods have to be followed for each of the restoration activities (see

attached addenda for methodology).

a) Netting:
Netting is erected on areas that have received topsoil or growth medium in order to stabilize the movement of the soil. The use of nets mimics the effect of larger plant in the natural ecosystems. The nets are set up in such a way that it is perpendicular to the dominant wind direction of the area in order to minimize wind erosion.

b) Seed collecting and processing:
Collecting and processing seeds are in accordance with the specifications as set out by the ecologist. This entails physically going out into the field and collecting seeds from naturally occurring plants. The seeds are dried and processed to get them out of their protective shields and enable germination. Further more the processed seeds are put into seed-packs to ensure a mixture of seeds from different species.

c) Restoration packs:
Restoration packs consist of planting cardboard boxes in the field and planting the processed seed-packs inside. The restoration packs are planted in patches of ten. These patches have two different seed-pack recipes planted together, five of each, to form the ten individual packs per patch. The boxes mimic the smaller to medium sized plants in the field, and provide protection against the wind for the seeds planted inside them. The specifications for the combination of seeds needed for restoration packs are determined by the ecologist depending on what species occur naturally in the area.

d) Transplants:
Transplants are plants that are removed from the field and planted in patches of ten between the restoration packs. These plants are removed from the natural veldt and/or from areas that are earmarked to be stripped for mining within the next year.

7.3 DEMOLITION AND REHABILITATION OF INFRASTRUCTURE

The demolition and rehabilitation of infrastructure, e.g. plants and workshops, will be handled within the mine closure plan. If infrastructure will be demolished, the same steps of landforming and restoration will be followed after the demolition has occurred.

8. RECORDS

Description	Responsible	Location	Retention	Status*
Reports	Y6	SHE Department	LOM	A
CAD / Maps	G1 / M1	MRM Department	LOM	A

* A = Archive; D= Destroy

9. AMENDMENT RECORD SHEET

Recorded below are all the amendments which have been made to this document and the date the amendment was effected.

Issue no	Page no	Section	Subject	Date
01	All	Complete	New	09/07/2009

PA Sparks
OPERATIONS MANAGER
/mvw

NR Williams
SHE LEAD

W Nel
REHABILITATION OFFICER

ANNEXURE A

RESTORATION NETTING METHODOLOGY

1. MATERIAL SPECIFICATIONS (NETS, DROPPERS, ANCHORS AND WIRE)

- Net height: 0.75m
- Net length: 225m
- Net material: 40% density, green shade, Eyelets top and bottom, pockets every 2.5m
- Droppers length: 1.2m
- Dropper diameter: 10 mm
- Dropper material: steel (reinforced steel or normal farm dropper)
- Anchor material: Steel
- Anchor length: 1.4m and 0.7m
- Anchor type (Post fence, Y or K type)
- Wire type for droppers: 1.6mm galvanised
- Wire type for anchors: 2.5mm galvanised

2. NET ERECTION

Intervals: 5-6m (a maximum of 6m intervals) in an east-west direction on all restoration areas (topsoil and overburden).

Direction: Running east-west direction (Perpendicular to predominant southerly wind)

Method:

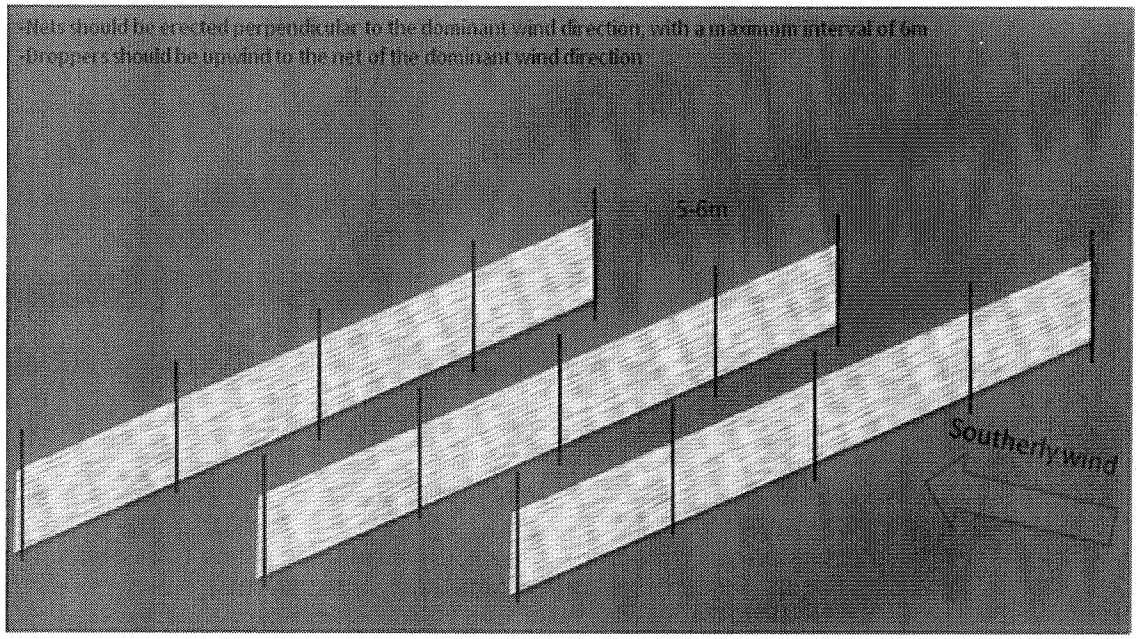
- Use anchor poles at each end of every net to anchor netting (y-poles, K- poles or old thicker droppers).
- Wrap net around the top of the 1.4m anchor pole 3 or 4 times to prevent tearing. Hit this anchor into ground in an upright position until net touches ground.
- In case of unstable conditions (very loose sand or shallow cover) insert a short 0.7m anchor at a 45° angle into the soil and use 2.5mm bind wire to tie to upright anchor.
- Insert droppers every 2.5m along the length of the net in the sleeves provided for this purpose.
- Pull netting tight and drive dropper into soil (Do not cut dropper off if not deep enough)
- Do not cut nets at the end of the line. Rather wrap the net at 90° to the start of the next line, and then use the rest of the roll for the next line (see figure 1).
- Ensure that the dropper sleeve is always facing south (i.e. the droppers are to the south of the net). Twist the net upside down at the end of the line where it is wrapped to the next line, thereby ensuring that the droppers are to the south of the net on the next line (see figure 1).
- Where the restoration site is wider than 225m in the east-west direction, gaps in the netting should be left for access roads every 225m (i.e. the length of one net). These access roads are to be used for setting out restoration packs, watering of restoration packs and maintenance of netting. There should be no access roads around the perimeter of the site, as this will prevent seeds from surrounding natural vegetation to be dispersed into the restoration site. Access roads (gaps in netting) should be a maximum of 5m wide, and should not run directly downslope, in order to avoid erosion. The road should not run directly north-south, in order to avoid the formation of a wind channel.

- Take netting about 3 to 5 meters into the undisturbed vegetated area. There should be no gap (or road) around the outer perimeter of the restoration areas, since this will limit the influx of seeds from the surrounding undisturbed areas.

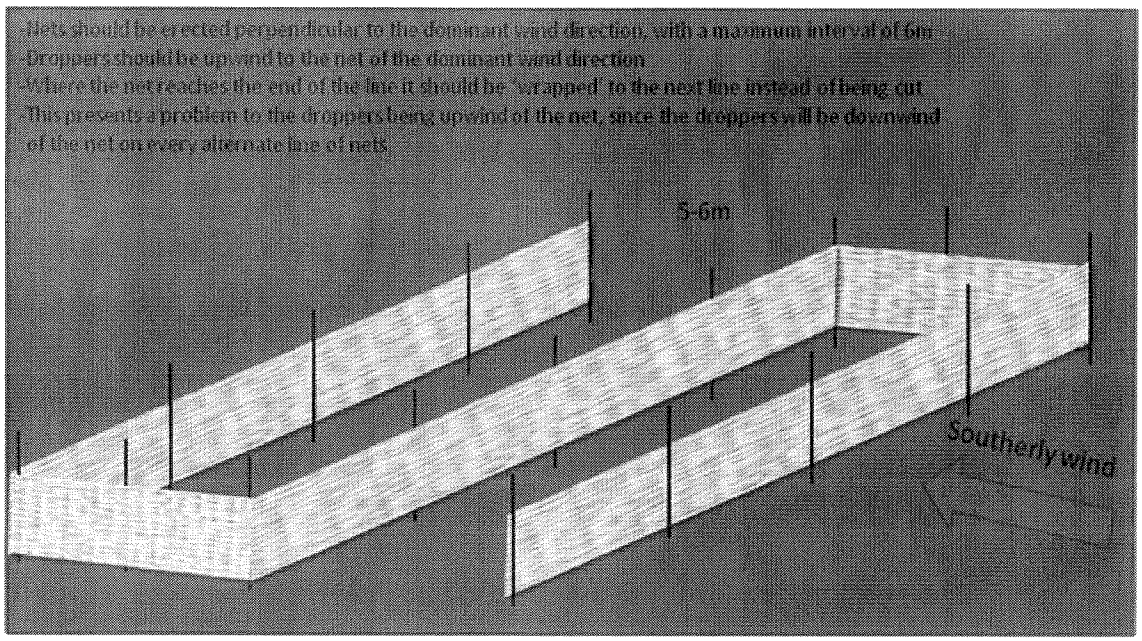
Figure 1

A) Nets should be place perpendicular to the predominant wind, and the droppers should face into the wind (to the south of the nets). ***B***) Nets should not be cut at the end of a line, but 'wrapped' to the next line, and ***C***) 'twisted' at the same time so that the droppers remain to the south of the net on the next line.

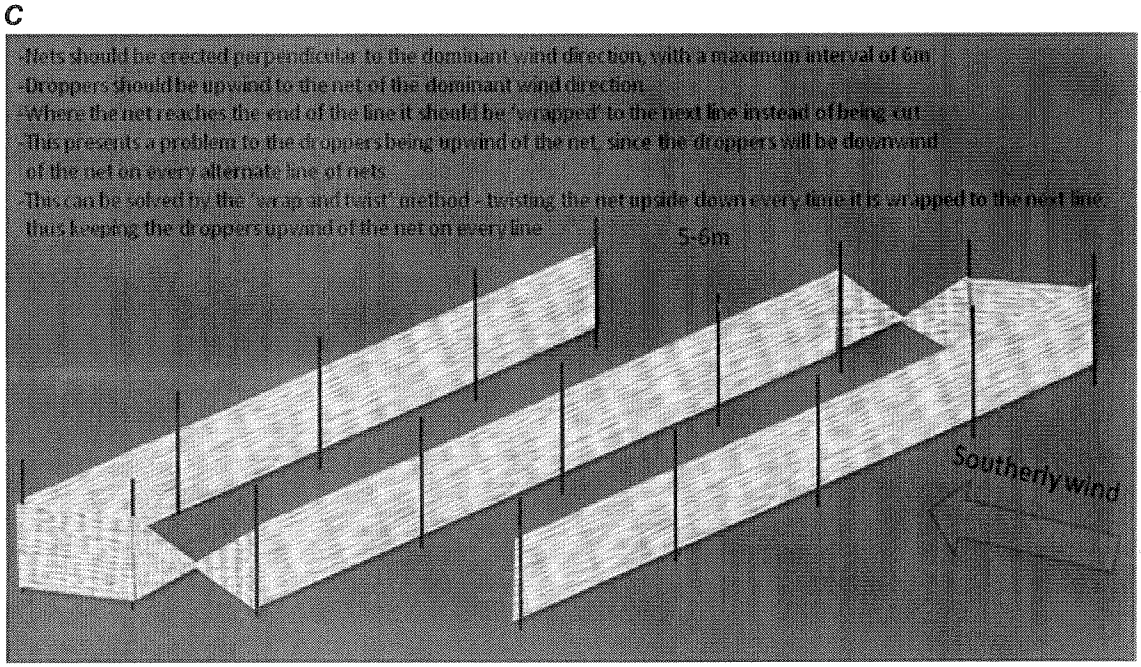
A



B



C



3. NET MAINTENANCE

Do maintenance checks on all nets at monthly intervals, and include the following:

- **Lift up netting** (& droppers) where soil has accumulated against the nets. Ensure the net and droppers are on top of the new soil level.
- The 'eyes' (holes) along the top edge of the nets are to be hooked around the droppers where the nets have stretched, in order to **make them tight.**
- Where nets have sagged down along the dropper, they need to be lifted up and tightened, as described above.
- Scoop away heavy sand built up with spades and level away from netting.
- Repair torn netting.

4. NET REMOVAL

Remove netting in areas where no longer needed as per request of the rehabilitation manager.

- Remove netting in such a way as not to damage it so it can be reused
- Reuse netting where possible
- Neatly stack material in grouped heaps for removal

ANNEXURE B:

SEED COLLECTION, STORAGE, CLEANING AND PREPARATION METHODS

1. PURPOSE OF SEEDS

The collection of seeds of perennial species is a necessary step towards the Restoration Pack (RP) intervention method, as described in the NRI Restoration Pack Methods document. Once seeds have been collected, they need to be stored appropriately in order to maintain their viability and value. Prior to using seeds in RP's, the seeds need to be extracted from the plant covering bodies that surround them (capsules, wings, fruit bodies etc), so that they will be able to germinate in the field.

This document will describe the generic methods of collecting, storing, cleaning and preparing all the possible species that are to be used in RP's, bearing in mind that the specifications for each restoration will be set by the NRI, and will therefore differ. The relevant sections of this document can be consulted based on the seed requirements provided in the specifications for each area.

2. SEED COLLECTION

2.1 Which species should be collected?

Only common perennial (long-lived) species of the following plant functional groups (as described in the NRI training manual / the NRI book) should be collected:
- Sprawling Mesembs (Mesembryanthemaceae)
- Upright Mesembs (Mesembryanthemaceae)
- Shrubs
- Large Shrubs

2.2 When can seeds be collected?

Seeds can be collected from about 2 weeks to 3 months after flowering – depending on the species. It should be noted when a population of a target species is flowering, so that collection can done there once the seeds are ready for collection.

Seeds should only be collected once they are ripe and fully formed. For Mesembs this means that the capsules have dried out and become hard and woody. For most other species it means that the fruit body or flower remnant must be fully dried out, and the seeds are hard and fully formed (often turning a darker colour when they are ready).

Seeds should be collected as soon after they have ripened as possible, since seeds are dispersed once they are ready (Mesembs release seeds every time it rains, wind-dispersed seeds are blown off the bushed with mild to strong winds), or lost by seed predation (beetles, insect larvae, birds, rodents).

2.3 How should seed be collected?

Seeds should be collected in hessian bags, paper bags or in cardboard boxes. As little plant material as possible should be collected with the seeds, since this will increase the moisture levels and the likelihood of mould or rotting occurring. They should never be collected in plastic bags, and should never be stored in a car or in the back of a bakkie with a canopy – since the heat can destroy the seeds very rapidly.

2.4 How much seed should be collected?

Enough seeds should be collected for the designated number of RP's in the target restoration area.

The necessary permits for seed collection should be obtained from the authorities. These deem that no more than 20% of the seeds of a population may be collected in the same year (by law).

3. SEED STORAGE

Seeds should always be dried prior to storage. Seeds and the associated plant material can be dried by placing them in open, shallow cardboard boxes or similar shallow containers. These boxes should be place indoors in a well ventilated place that is safe from rodents or other granivores. Seeds should also be fumigated as soon as possible after collection to eliminate any beetles or larvae that are already inside the seed storage bodies, as well as being treated with anti-mould treatments. This is best done during the drying time since seeds are spread in thin layers.

Once seeds and all the plant material that is amongst the seeds has been completely dried out, the seeds can be stored in bigger, closed cardboard boxes or similar containers that will allow them to 'breathe' (not plastic bags or containers). These boxes should be kept in a granivore-safe place that is cool, dry and preferably dark.

4. SEED CLEANING

Seeds should be removed from the coverings that surround them prior to being used in RP's.

The following methods are recommended by the NRI:

4.1 Cement Mixer

Seeds with hard capsules or coverings can be placed in a cement mixer together with 5 to 10 pieces of hard, heavy firewood (more, larger pieces for hard seed coverings; fewer, smaller pieces for soft seed coverings). The mixer bowl should not be filled more than half, otherwise it will not be efficient. Once the mixer is on, the pieces of wood will fall on the capsules or coverings and break them open, thus releasing the seeds.

The released seeds should be sieved out (see below) periodically to avoid them being damaged by the wood. For soft seed coverings this can be done every 20-30 minutes, and for hard seed coverings this can be done every 1 to 1.5 hours
e.g. Tetragonia, Zygophyllum, Lebekia, Tetragonia, Didelta, most of the Mesembryanthemaceae

4.2 Sieves

Seeds that have been released by the cement mixer process can be separated from the remaining plant material by using an appropriate sieve mesh size or set of sieves with varying mesh sizes. This is useful to gain a more accurate estimate of the numbers of seeds, as well as reducing the volume for storage and packaging purposes.

Seeds with soft or leathery seed coverings, soft seeds or small seed coverings can often not be broken by the cement mixer, or may be damaged by the cement mixer. These seeds can be ground through an appropriately sized mesh sieve, so that the seeds fall through, but the unbroken coverings do not. A wooden or rubber block can be used to grind the seed coverings through the sieve.

e.g. *Jordaaniella, Drosanthemum, Psilocaulon, Pharnaceum, Amphibolia*

4.3 Beating

Some early pioneer species are collected by removing part of the bush with the seeds on. These should be dried thoroughly, and once dry the seeds will be easily dislodged from the bush. This can be achieved by beating the bush with a stick, or hitting the bush against a sieve or flat surface. The seeds and leaves that come off can be sieved to remove any small branches or sticks that may have been removed during the process.
e.g. Atriplex

4.4 Other

Seeds of certain species do not need to be cleaned. These are seeds with thin or small seed coverings that do not inhibit germination, or do not result in seeds being clumped together once sown in a RP.
e.g. Manoclamys,

Seeds of certain species cannot be cleaned efficiently using any of the above methods, and should be left as is until they are sown into the RP's. These are mostly species of the Asteraceae that have seeds forming in 'cones' with plumes attached to the seeds. These should be broken up by hand during the process of sowing them into RP's. The seeds should be removed from the cones so that the seeds are spread out evenly over the area of the RP, and the plumes should be removed to prevent them from being blown around in the RP or being blown out of the RP.
e.g. Pteronia, Othonna, Arctotis

5. SEED PACK PREPARATION

Once seeds have been cleaned (and stored if necessary), they should be prepared for being used in RP's according to the specifications set out for the target restoration area by the NRI. Small seeds (all the Mesembryanthemaceae, and others with similar-sized seeds, like Pharnaceum and Galenia) are to be used in separate RP's to large seeds (all the remaining species), and should thus be put in different packets. Each packet (of small or large seeds) should contain the correct number of seeds of each species that is to be used in one RP. The number of seeds per pack can be determined on a weight basis, once the number of seeds per gram has been determined for each species.

ANNEXURE B:

RESTORATION PACK (RP) METHODOLOGY:

6. PURPOSE OF RESTORATION PACKS

Restoration packs are a cost-effective method to rehabilitate an area that maximizes the effectiveness of seeds, and facilitates the rehabilitation of a degraded area to:

- Introduce and establish natural and preferred species to an area in order to have better balanced species diversity in the area.
- Improve the ecological stability of the area, for instance stabilizing and preventing sand movement and the creation of sand plumes.
- Re-establish the ecological structure of an area, which will allow natural plant and animal establishment in the future
- Increase the natural and preferred species abundance, cover & biomass to a specific area

7. RESTORATION PACK TYPES

If small seeds are covered to deep they will not germinate. For this reason restoration packs are divided into two types: **large seed** and **small seed** restoration packs.

Each **large seed restoration pack** should contain the following species and seed number:

Large seed restoration pack

Othonna cylindrica	4
Pteronia glabrata	250
Pteronia onobromoides	250
Tripteris oppositifolium	22
Didelta carnosa carnosa	20
Arctotis scullyi	14
Tetragonia fruticosa	70
Atriplex semibaccata	100
Manochlamys albicans	160
Zygophyllum morgsana	50
TOTAL	940

Each **small seed restoration pack** should contain the following species and seed numbers:

Small seed restoration pack

Amphibolia laevis	1000
Drosanthemum hispidum	500
Psilocaulon spp	500
Jordaaniela spongiosa	1000
Ruschia aggregata	2000
Stoeberia beetzii	150
TOTAL	6150

8. RESTORATION PACK MATERIALS SPECIFICATIONS (BOXES, SEEDS AND FERTILISER)

- **Boxes: corrugated cardboard box** (approximate dimensions of 400 x 500mm and 300mm deep)
- **"Veg" 6:3:4 Slow Release VITA Organic Fertilizer**, from Talborne Products.
- **"skommeltjies"** (plant material collected from under bushes)

9. RESTORATION PACK APPLICATION

Restoration packs are to be set out during the winter months from April to May as per the following Namaqualand Restoration Initiative's standards:

- Dig a hole slightly larger than the box and **insert corrugated cardboard box 10-15cm into the soil.** (To protect the growing seedlings)
- Replace the soil inside the box and follow these steps:
  - Add 35g of the 'Veg' 6:3:4 Slow Release VITA Organic Fertilizer to each restoration pack, and **mix into the top 5cm of the soil.**
  - Add approximately 3 large handfuls (roughly equivalent to 3 large coffee mugs) of 'skommeltjies' to each restoration pack, **and mixed into the top 5 cm of the soil** (this can be done at the same time as the nutrients).
  - Level and compact refilled mixture:
    - Compact softly on clay or overburden soils (push down with hand palms)
    - Compact well on sandy soils (step on it with one foot)
  - Lastly, add seeds:

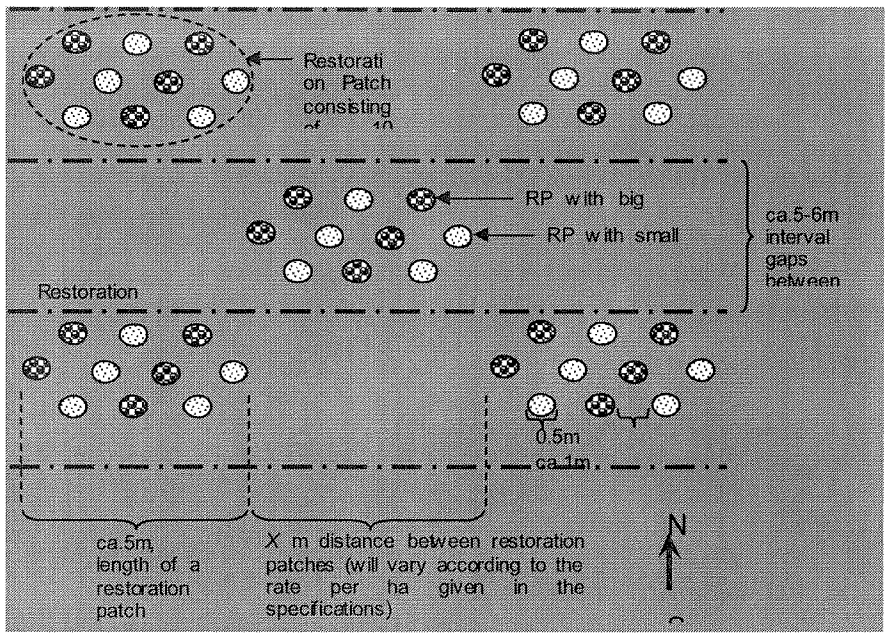
<u>Large seeds:</u>
- **Empty the seeds** from the envelope or bag **into one hand.**
- **Add a hand full of sand** to the seed in your hand palm.
- **Rub this mixture vigorously** between the palms, **while sowing** it **evenly** across the area of the restoration pack.
- Take care to **remove all seeds from** remaining **capsules** or seed coverings (e.g. *Pteronia*).
- Spread **3 or 4 handfuls of soil** over the seeds (cover seeds 1-2cm deep), and patted down with the palm of the hand.

<u>Small seeds</u>
- Sow evenly on the soil surface of the restoration pack.
- **Add a scoop of sand** to the seed in your hand palm
- Gently rub **this mixture** between your hand palms
- Lightly pat into the soil with the palm of the hand.
- **Do not place handfuls of soil on top of the small seeds** since these seeds will not be able to grow through even a shallow soil layer.
- (Note: the manual suggests using 1 handful of soil – we do not recommend this now as it has resulted in confusion when implemented in the field)

<u>As a final step do the following:</u>
- **Soil inside the box must be 5cm higher than the soil outside the box** after everything has been added to the box
- **Soil within the box must be level** and not at an angle.
- **Soil outside the box must be sloped away** from the box. (The restoration pack must be in a slight depression, in order to increase the water input to the restoration packs)
- **Fill in any soil gaps ± 40 cm away from and around the outside of the box,** and stamp down this soil around the box.

- Any left over soil further than **± 40 cm** can be left in piles as uneven surfaces are good for restoration.

- Group restoration packs into patches of 10 and leave a slightly gap between each patch of 10 restoration packs.
- Ensure patches are spaced well across the area in order to cover the full extent of each ha (Do not cramp all RP's into one corner). Space the RP's evenly over the restoration site. The distance *X* between restoration pack patches will vary between restoration sites, and will be determined by density of RPs / ha. This will be set out in the specifications for each particular site.



10. RESTORATION PACK MAINTENANCE

In order to prevent seedlings from dying during a dry period the RP's need to be monitored and watered as explained:

- Monitor restoration packs on a two-weekly basis for the winter and spring season:
  - Monitored rainfall - if there has been no a rainfall event of greater than **4mm** in a 2 week period, the restoration packs should be watered. (1.5-2 litres of water per pack). This only applies until the end of October.
  - Where a box has collapsed entirely, cut the box off at the base and remove it from the site if it can not be lifted and kept opened.

ANNEXURE C:

TRANSPLANT (TP) METHODS:

1. PURPOSE OF TRANSPLANTS

Transplanting is the process of digging up established plants in undisturbed veld, usually from an area that is designated for mining, and transplanting these on restoration areas. The benefit of transplanting is that it is an easy and cheap way to establish a rapid vegetation cover on new restoration areas and also helps to improve topsoil retention. It is an especially useful technique to use for plant species that do not establish easily or cheaply from seed and in Namaqualand many plant species survive transplanting well because of the stored water in their leave and stems. In cases where transplants are removed from pristine (natural) sites, it is important that the right species and not too large a proportion of these species are removed so as not to disturb the ecological balance at the pristine site. Plants that do not have succulent leaves or stems do not survive transplanting, and should not be used. To ensure that transplant activity does not impact on indigenous, undisturbed areas, these protocols should be adhered to very strictly. Removing transplants poses is a danger of creating new degraded areas in pristine sites (studies are ongoing to make sure this doesn't happen), and the contractor or the mine could be liable for prosecution by the governing authorities if the correct protocols are not followed.

2. EQUIPMENT AND MATERIALS
   - Spades
   - Bags / crates / boxes (for carrying the transplants)
   - Bakkie (to transport the transplants)
   - Nutrients
   - Watering equipment

3. CHOOSING THE SITE WHERE TRANSPLANTS SHOULD BE TAKEN FROM
In choosing sites from where transplants can be collected, one needs to consider the future plan for the site.

3.1 Sites that are designated for mining in the near future
The most suitable sites to remove transplants from are areas that are designated to be mined in the near future. For such sites, the impact of removing transplants does not matter since the entire site is destroyed when the topsoil is removed.

3.2 Sites that are not destined to be mined in the near future
In some instances no sites that are destined to be mined in the near future will be available or more transplants than what these sites can provide are required. **Only** in such circumstances can transplants be taken from undisturbed / pristine sites. In such instances it is preferable to choose sites that are destined to be mined in the long term, or from pristine sites that fall within the mining area. **At no time should plants be taken from a previously disturbed / restored site,** no matter how well it has been restored.

4. HOW MANY TRANSPLANTS CAN BE REMOVED?

4.1 Sites that are destined for mining in the near future (less than 3 months)
Since the entire ecosystem will be completely transformed during the mining process, it is feasible to remove **all** individuals of suitable plant species before mining for use in transplanting. Suitable plants have one or more the following characteristics:
   - **Succulent leaves** (e.g. Mesembryanthemaceae, some Asteraceae, some Asphodelaceae, Crassulas)

- **Succulent stems** (e.g. Euphorbiaceae, some Asteraceae, few Mesembryanthemaceae)
- **Underground storage organs** (e.g. Amaryllidaceae, most Iridaceae, some Hyacinthaceae)

[Also refer to *Best practice guidelines for minimizing impacts on the flora of the southern Namib* by Antje Burke for further information on which plants are suitable for transplanting.]

Middle and late succession species should be used preferentially to early succession species. Unsuitable species should not be transplanted, since they will not survive transplanting, or benefit the restoration site. If these species are transplanted, they will not be paid for.

4.2 Pristine / undisturbed sites within the mining area:
Collect only 10% of the approved transplant species' individuals located in the demarcated area. This means that in a given population of the target species, a team should only collect 1 out of every 10 plants of that species. Transplants should be removed evenly throughout the site. One way to ensure systematic collection would be to line up transplant collectors standing a few meters apart on one side of the site. As each collector walks towards the opposite end of the site, they focus on collecting transplants only in the area ahead of them (on their 'line') (Figure 1). Once their bag / box is full of transplants, they should leave a marker (a spade or something else) where they have stopped, allowing them to return to and start from the same spot again after they have taken the full box / bag back to the bakkie.

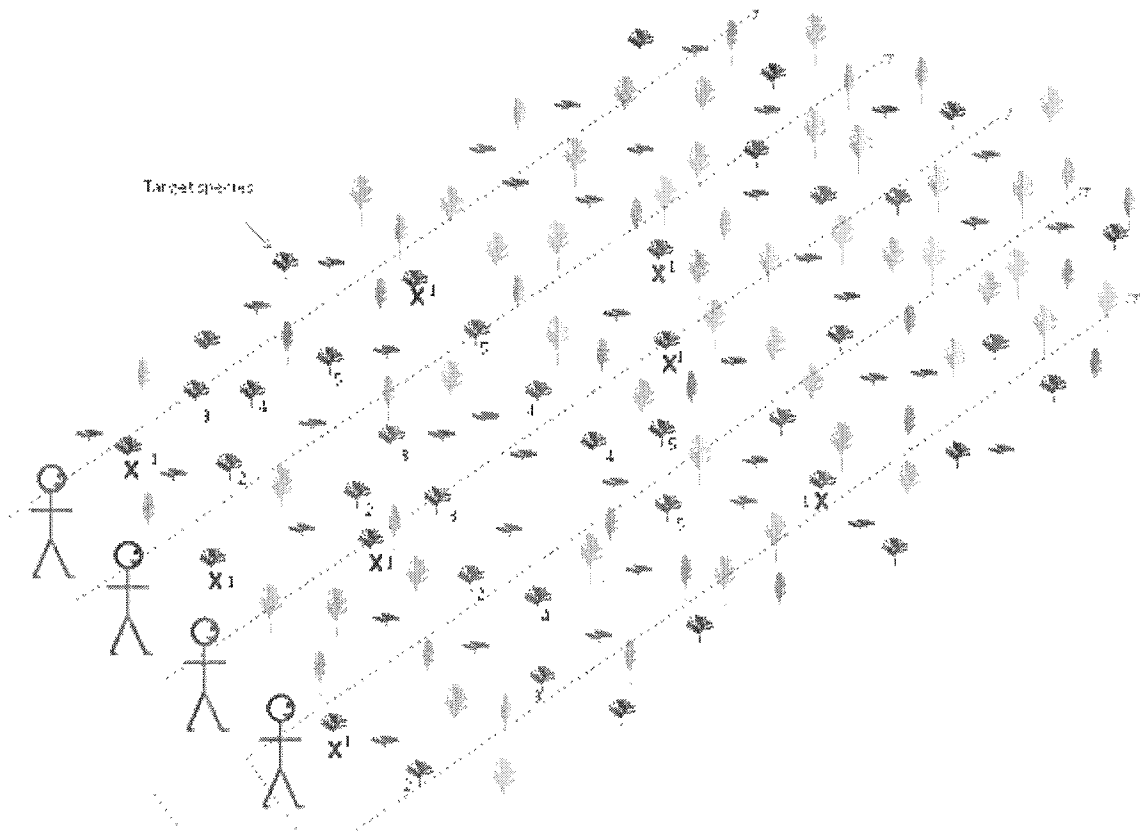


Figure 1. Transplant collectors should walk in straight lines in a collection area, and should be between 5 and 10m apart. Only every 10th plant of the target species should be taken out.

5. HOW OFTEN CAN TRANSPLANTS BE TAKEN FROM A SITE?

It is advisable that transplants are removed from a particular area of undisturbed or pristine veld only **every 5 years or longer**. Good record keeping of transplant collection should prevent more than one collection from the same site within 5 years.

Recording transplant collection activities should include the date (year and month) the transplant collection was made as well as the size and location of the collection area. The location of the collection site from which transplants are to be removed should be clearly defined e.g. between road 'a' and 'b', starting at 'place c', next to 'd', up to 'place e', approximately 'f' km^2. It would be most useful to get GPS co-ordinates for the perimeter of the area from which the collection was made.

6. WHICH PLANT SPECIES CAN BE COLLECTED FOR TRANSPLANTING?

Plant species collected for transplanting should be common generalist species (i.e. occur in a wide area, and in a variety of habitats), be abundant at both the site from which transplanting is done and in the type of soils into which they will be transplanted, survive transplanting well and have high recruitment rates. High recruitment rates would ensure that the population can readily recover once a collection has been completed.

The **only** species that are approved for transplanting from pristine areas are:
Ruschia rariflora
Amphibolia rupis-arcuatae
Aphiboilia laevis
Othonna cylindrica
Othonna sedifolia

7. WHAT SIZE SHOULD THE PLANTS BE THAT ARE USED FOR TRANSPLANTS?

Plant individuals that are too small or too big generally do not survive transplanting well. In general, plant individuals smaller than 10cm high and bigger than 30cm high (= height of the blade of a spade) survive transplanting less well. These heights are more applicable to *Othonna cylindrica*, since they grow much larger. Most adults of the other species fall within the 10 – 30cm size range.

8. WHEN SHOULD TRANSPLANTING BE DONE?

- Transplants should be done in winter (May to August), so that there is an increased likelihood of them still receiving follow-up rain, which allows the transplants to establish properly at the new site before the hot summer months.
- It is **very important** that transplants are **transplanted the same day** to reduce the amount of time the roots are exposed.
- Transplanting should never be done in the late winter (September) or in summer (Ocotber to April).

9. HOW SHOULD TRANSPLANTS BE TAKEN OUT OF THE NATURAL VELD?

- Care should be taken **not to damage the major roots** when transplants are pulled out. A spade is needed to remove the transplants. Insert the spade vertically (not at an angle) about 15 – 20cm from the base of the plant. Then lever the spade so that the transplant is pushed up by the blade, without damaging the major root system and put the plant gently out of the soil holding on to the base of the plant's stem.

- Place the transplants in a box or hessian bag (streepsak). Transplants can be kept cool on hot days by wetting the bag, or by placing a wet bag on top of the transplants in a box.
- Where more than one species is removed, they should be kept in different boxes / bags. Never leave transplants inside a vehicle, or exposed to full sun as this will dry them out.

9. HOW SHOULD TRANSPLANTS BE PLANTED INTO A RESTORATION SITE?

- Transplants should **always** be planted into the restoration site **on the same day** as they were removed from the natural veld.
- Select an area which is already in a **natural depression or dip** (this collects water when it rains, giving the plant a greater chance of survival) (Figure 2).
- Dig a hole that is about twice the size of the roots of the transplant in the depression.
- Place one plant in the hole. While holding the plant up slightly, spread the roots out in the hole and fill the hole with soil in such a way that some soil is placed in between the roots and there are no air spaces left around the roots.
- Before the final soil is replaced in the hole, add the appropriate amount of nutrients evenly around the transplant (35g).
- Place the last bit of soil around the transplant, and press down firmly with the palm of your hand to compact the soil (overburden should not be overly compacted).
- Creating a slight depression around the transplant will aid catching additional water and nutrients (Figure 2).
- The transplant should then be **watered the same day as being planted** (1.5 liters of water per transplant) to ensure that the roots settle well and all the roots are in contact with the soil (there are no air spaces). This prevents the roots from drying out, allows the roots to take up water and nutrients from the soil immediately, and the plant to rapidly develop and replace the small roots damaged during transplanting (these responsible for nutrient and water uptake).
- Do not plant the transplants in rows or grids, but plant them in mixed species patches of 10 transplants per patch.

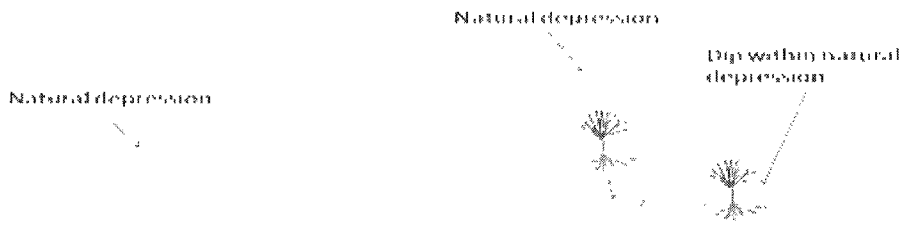


Figure 2. Transplants should be planted in natural depressions in the restoration site. A dip should be made within the natural depression to maximize the amount of water that the transplant gets when it rains.

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