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DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

for

BOESMANLAND SOLAR FARM

on

Portion 6, a portion of Portion 2, of Farm 62 Zuurwater, Aggeneys, Northern Cape

In terms of the

National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended & Environmental Impact Regulations 2010

Prepared for Applicant: Boesmanland Solar Farm (Pty) Ltd

By: *Cape EAPrac*

Report Reference: KHA131/28

Department Reference: 12/12/20/2602

Case Officer: Sindiswa Dlomo

Date: 26 October 2012

APPOINTED ENVIRONMENTAL ASSESSMENT PRACTITIONER:

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PURPOSE OF THIS REPORT:

For implementation

APPLICANT:

Boesmanland Solar Farm (Pty) Ltd

CAPE EAPRAC REFERENCE NO:

KHA131/28

DEPARTMENT REFERENCE:

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SUBMISSION DATE

26 October 2012

TO BE CITED AS:

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ENVIRONMENTAL MANAGEMENT PROGRAMME

in terms of the

National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended &
Environmental Impact Regulations 2010

Boesmanland Solar Farm

Portion 6, a portion of Portion 2, of Farm 62 Zuurwater, Aggeneys, Northern Cape

Submitted for:

Stakeholder Review & Comment

Report Issued by:

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TABLE OF CONTENTS

TABLES

FIGURES

ABBREVIATIONS

AC	Alternating Current
Alt.	Alternative
BGIS	Biodiversity Geographic Information System
ºC	Degree Centigrade
CARA	Conservation of Agricultural Resources Act (43 of 1983)
CBA	Critical Biodiversity Area
cctv	Closed Circuit Television (camera)
CDSM	Chief Directorate Surveys and Mapping
cm	Centimetre
DAFF	Department of Agriculture, Forestry & Fisheries
DEA	Department of Environmental Affairs (national)
DEA&DP	Department of Environmental Affairs & Development Planning (Western Cape)
DEANC	Department of Environmental Affairs & Nature Conservation (Northern Cape)
DEIR	Draft Environmental Impact Report
DME	Department of Minerals and Energy
DoE	Department of Energy
DWA	Department of Water Affairs
EA	Environmental Authorisation
EAP	Environmental Impact Practitioner
ECA	Environmental Conservation Act (73 of 1989)
ECO	Environmental Control Officer
ECR	Environmental Control Report
EHS	Environmental, Health & Safety
EIA	Environmental Impact Assessment
EIP	Environmental Implementation Plan
EIR	Environmental Impact Report
ELC	Environmental Liason Committee
ER	Engineer Representative
ESA	Environmental Site Agent / Ecological Support Area

EMPr	Environmental Management Programme
FPA	Fire Protection Association
GPS	Global Positioning System
GWh	Giga Watt hour
ha	Hectare
HIA	Heritage Impact Assessment
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IFC	International Finance Corporation
IPP	Independent Power Producer
ISO	International Organisation for Standardisation (ISO 9001)
Kl / Klt	Kilo Litre
Km	Kilometre
Km/h	Kilometres per hour
KNP	Karoo National Park
kV	Kilo Volt
LLRC	Low Level River Crossing
lt	Litre
LUDS	Land Use Decision Support
LUPO	Land Use Planning Ordinance
m	Metre
m²	Metres squared
m³	Metres cubed
MW	Mega Watt
NCHRA	Northern Cape Heritage Resources Authority
NCNCA	Northern Cape Nature Conservation Act (9 of 2009)
NEMA	National Environmental Management Act (107 of 1998, as amended in 2006)
NEMBA	National Environmental Management: Biodiversity Act (10 of 2004)
NERSA	National Energy Regulator of South Africa
NFA	National Forest Act (84 of 1998)
NHRA	National Heritage Resources Act (25 of 1999)
No.	Number
NSBA	National Spatial Biodiversity Assessment
NVFFA	National Veld and Forest Fire Act (101 of 1998)
NWA	National Water Act (36 of 1998)
pH	Potential of Hydrogen
PIA	Paleontological Impact Assessment
PM	Post Meridiem; “Afternoon”
PV	Photovoltaic
PVC	Polyvinyl Chloride (piping)
REDs	Road Environmental Dust Suppressant
SACAA	South African Civil Aviation Authority
SAHRA	South African National Heritage Resources Agency
SANBI	South Africa National Biodiversity Institute
SANS	South Africa National Standards
SDF	Spatial Development Framework
S&EIR	Scoping & Environmental Impact Reporting
SAPD	South Africa Police Department
WULA	Water Use Licence Application

Environmental Management Programme (EMPr) REQUIREMENTS

Table 1 below serves to confirm the content requirements of the EMPr, as specified in the Acceptance of the Final Scoping Report & Plan of Study for the Environmental Impact Assessment, issued by the national Department of Environmental Affairs on 7 August 2012.

Table 1: EMPr Content Requirements

EMPr PROVISION	Report Reference
All **recommendations and mitigation measures** to the recorded in the Final EIR.	Throughout EMPr
The **final site layout plan**.	Draft pg. 2
Measures as dictated by the **final site layout plan and micro-siting**.	Pg. 2 & 8
An **environmental sensitivity map** indicating environmental sensitive areas and features identified during the EIA process.	Section 3.3, pg. 8
A map combining the **final layout plan superimposed (overlain) on the environmental sensitivity map**.	Section 3.3, pg. 8
An **alien invasive management plan** to be implemented during construction and operation of the facility. The plan must include mitigation measures to reduce he invasion of alien species and ensure that the continuous monitoring and removal of alien species is undertaken.	Section 5.21, pg. 37
A **plant rescue and protection plan** which allows for the maximum transplant of conservation important species from areas to be transformed. This plan must be compiled by a vegetation specialist familiar with the site in consultation with the ECO and be implemented prior to commencement of the construction phase.	Section 5.19, pg. 35
An **open space management plan** to be implemented during the construction and operation of the facility.	Sec 5.22, pg. 37
A **re-vegetation and habitat rehabilitation plan** to be implemented during the construction and operation of the facility including timeframes for restoration which must indicate rehabilitation within the shortest possible time after completion of the construction activities to reduce the amount converted at any one time and to speed up the recovery to natural habitats.	Section 5.20, pg. 36
A **storm water management plan** to be implemented during the construction and operation of the facility. The plan must ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion. The plan must include the construction of appropriate design measures that allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows. Drainage measures must promote the dissipation of storm water run-off.	Section 5.13, pg. 29
An effective **monitoring system to detect any leakage or spillage of all hazardous substances** during their transportation, handling, use and storage. This must include precautionary measures to limit the possibility of oil and other toxic liquids from entering the soil or storm water systems.	Sections 5.17 (pg. 33) & 5.14 (pg. 31)
An **erosion management plan** for monitoring and rehabilitating erosion events associated with the facility. Appropriate erosion mitigation must form part of this plan to prevent and reduce the risk of any potential erosion.	Section 5.13, pg. 29
A **traffic management plan** for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan must include measures to minimise impacts on local commuters e.g. limiting construction vehicles traveling on public roadways during the morning & late afternoon commute time and avoid using roads through densely populated built-up areas to not disturb existing retail & commercial operations.	Section 5.3 pg. 21
A **transportation plan** for the transport of PV components, main assembly cranes and other large pieces of equipment.	Section 5.3 pg. 21
Measures to protect hydrological features such as streams, rivers, pans, wetlands, dams and their catchments, and other environmental sensitive areas from construction impacts including the direct or indirect spillage of pollutants.	Sections 5.14 (pg. 31) & 6.2 (pg. 39)

1. INTRODUCTION

Cape EAPrac has been appointed by the Applicant, Boesmanland Solar Farm (Pty) Ltd., as the independent **Environmental Assessment Practitioner** (EAP) responsible for compilation of the **Environmental Management Programme** (EMPr).

This EMPr is submitted in compliance with the National Environmental Management Act (NEMA, Act 107 of 1998, as amended) for the proposed development of the Boesmanland Solar Farm near Aggeneys, Northern Cape.

Boesmanland Solar Farm (Pty) Ltd. has sub-leased a portion of Farm 62 Zuurwater from the landowner, Blommeland Boerdery BK, for the purposes of developing the proposed solar facility. The total generation capacity of the solar facility will not exceed 75MW Alternating Current (AC) for input into the national Eskom grid, at the local Aggeneis Eskom Substation.

The key purpose of this EMPr is to ensure that the remedial and mitigation requirements identified during the Scoping & Environmental Impact Reporting process are implemented during the lifespan of the project (design to decommissioning). The EMPr is thus a management tool used to minimise and mitigate the potential environmental impacts, while maximising the benefits.

A detailed description of the proposed project and a description of the affected environment are provided in the Environmental Impact Report (EIR) to which this EMPr is annexed.

1.1 EMPr Approval & Revisions

This EMPr will be authorised as part of the Environmental Authorisation (EA) process. Once authorised, this document becomes a legally binding document.

The EMPr may however require amendment at certain stages through the lifespan of the project. The incidences which may require the amendment of this document include:

- Incorporation of conditions of approval contained in the Environmental Authorisation (if not already addressed in the document);
- Changes in environmental legislation;
- Results of post-construction monitoring (if required);
- Per instruction from the competent authority; and
- Changes in technology and best practice principles.

Should a significant amendment to this EMPr be required, an application for this must be submitted to the competent authority and approved before such changes are implemented.

1.2 Contractual Obligation

This EMPr must be included in ALL tender and contract documentation associated with this project. It must be noted that this EMPr is relevant and binding not only on the activities associated with the construction of the solar project, but also for all associated infrastructure upgrades required in order for this development to be undertaken, namely access road, substation, auxiliary buildings and power lines etc.

1.3 Organisational Requirements

In order to ensure effective implementation of the EMPr, it is necessary to identify and define the organisational structure for the implementation of this document.

The proposed organisational structure during **construction** is as follows:

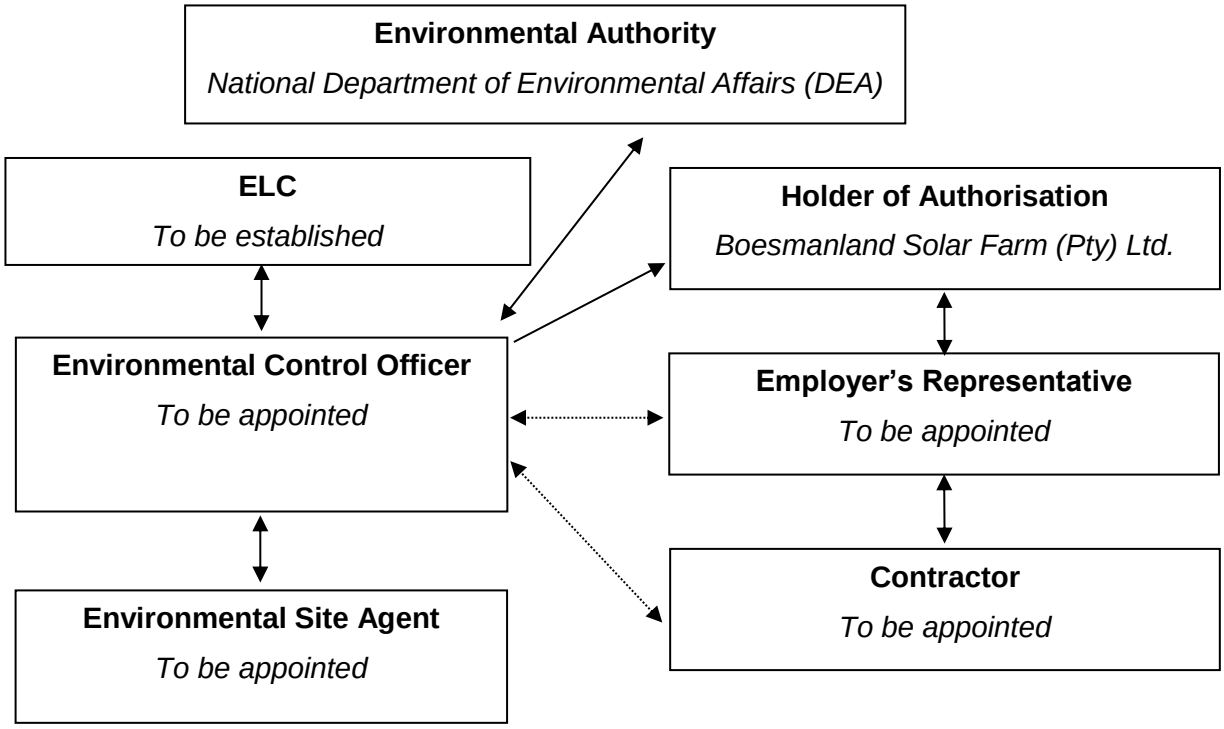


Figure 1: EMPr organisational structure during the construction phase

The proposed organisational structure during the **operation** of the facility is as follows:

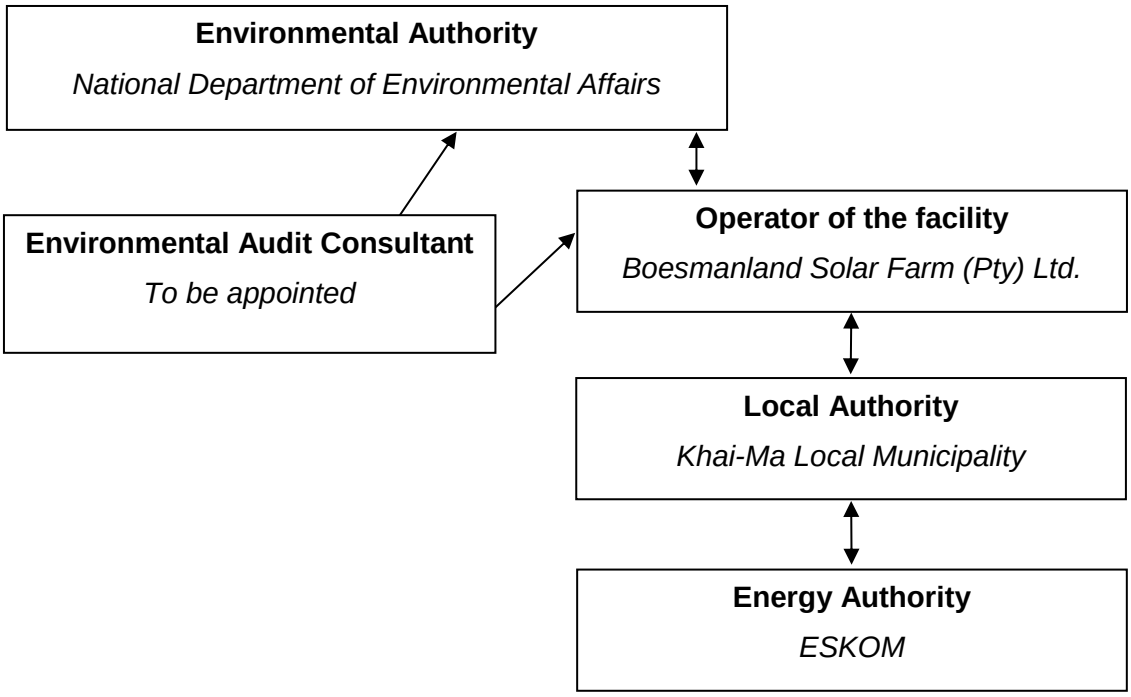


Figure 2: EMPr organisational structure during the operation phase.

Details regarding the roles and responsibilities of the various parties in these organisational structures are included in Section 2 below.

1.4 PROJECT PROPOSAL

The Boesmanland Solar Farm is to consist of a **Photovoltaic System** (PV), mounted onto a tracker module, which uses a **single-axis tracking system** to follow the sun's movement. This system ensures that sunlight is always directly onto the cells.

The **single-axis tracker modules will be approximately 2m in height and spaced approximately 5m apart** to avoid shading each other, while minimizing the footprint of the facility. The trackers will be **oriented at a tilt, facing approximately North**, to maximize annual solar energy yield. The total solar facility, including tracker spacing and associated infrastructure, will occupy a **footprint of not exceeding 270ha**. See Preferred Layout Plan as Figure 3 below.

Associated infrastructure, with an approximate footprint of 13ha, will typically include to the following:

- approximately **75 x inverter stations** (built within transporter containers, 25m² in size);
- an **on-site substation** (including a transformer to allow the generated power to be connected to Eskom's electricity grid);
- an overhead **transmission power line** to distribute the generated electricity from the on-site substation to the existing Aggeneis Eskom substation (approximately 6km to the south-east);
- **auxiliary buildings**, including:
  - administration / security offices,
  - ablution & workshop and
  - storage area.
- an **internal electrical reticulation network** (underground cabling);
- an **access road** and **internal road / track network**;
- 10 x 10kLt **rainwater tanks;** and
- **parameter fencing** around the solar facility.

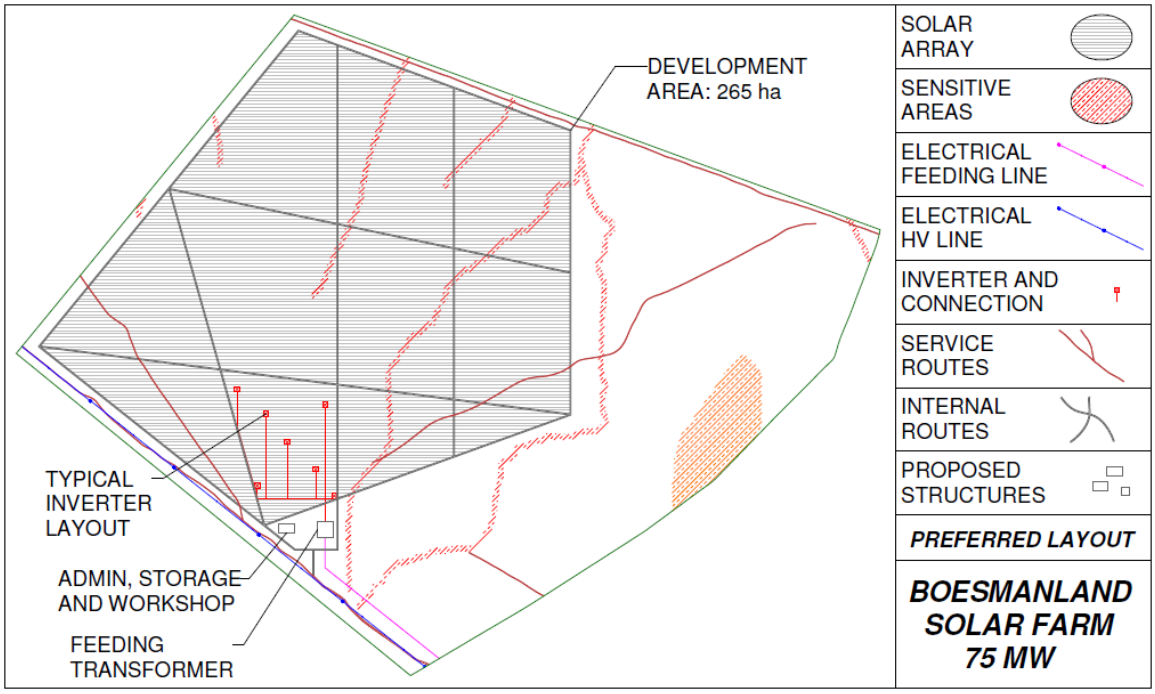


Figure 3: Preferred Layout Plan

1.5 APPROACH TO THE EMPR

This EMPr addresses the environmental management of the four key phases of the project, namely:

- The design and pre-construction phase;
- The construction phase;
- The operation phase; and
- The closure and decommissioning phase.

1.5.1 Pre-construction Phase

The pre-construction phase of the development refers to the final layout design considerations and the site preparation (fine-scale design and placement, survey of development site and associated infrastructure, demarcation of no-go areas, establishment of site camp, vegetation clearing etc.)

1.5.2 Construction Phase

The construction phase of the development refers to the earthworks and the actual construction of the civil works (installation of the PV panel arrays, construction of internal roads, stormwater structures and auxiliary buildings etc.), as well as the external infrastructure such as power lines and access roads. The construction phase will end with the parameter fencing of the facility, landscaping and re-vegetation / rehabilitation of the site and surrounding areas.

1.5.3 Operation Phase

The operational phase commences once the facility starts providing power into the national grid. There may be a stage where both construction and operation activities overlap i.e. occur on site at the same time. The operation phase included the monitoring and maintenance activities required for the efficient functioning of the facility (e.g. cleaning and repair of solar panels, brush-cutting of large vegetation etc.), as well as health and integrity of the surrounding environment (e.g. removal alien vegetation, removal of obstacles from drainage lines, management of erosion etc.).

1.5.4 Closure and Decommissioning Phase

Closure and decommissioning refers the decommissioning of the panel arrays at the end of their operational lifespan. For the purpose of this report, two possible scenarios are considered, namely:

- The re-use, repair &/ upgrade of the facility for alternative power generation;
- The total decommissioning of the solar facility.

Solar panels that are found to be in good working order after the upgrade or decommissioning of the facility should be donated to local schools and clinics.

2. ROLES AND RESPONSIBILITIES

Throughout the lifespan of this project, a number of individuals and entities will fulfil various roles and responsibilities to ensure the effective implementation of this EMPr. The key roles and responsibilities are detailed in the table below.

Table 2: Roles and responsibilities with regard to the implementation of this EMPr.

Role	Responsibility
Environmental Authority – National Department of Environmental Affairs.	
The National Department of Environmental Affairs (DEA) is the **competent / delegated authority** responsible for compliance with the relevant environmental legislation.	• Ensure overall compliance with the Environmental Authorisation (EA) & EMPr. • Review this document and any revisions thereof. • Undertake site audits at their discretion. • Review ECO Reports. • Review Audit Reports • Review Incident Reports. • Enforce legal mechanisms for contraventions of this EMPr and EA.
Holder of the Authorisation – Boesmanland Solar Farm (Pty) Ltd.	
The holder of the Authorisation is generally responsible for ensuring compliance with all statutory	• Ensuring compliance with the conditions set out in the Environmental Authorisation issued in terms of the NEMA, as well as those prescribed by other relevant legislation and

Role	Responsibility
requirements relating to the Solar facility.	guidelines. • Compliance with the requirements set out in this EMPr. • Ensuring all other permits, permissions and licences from all other statutory departments are in place. E.g.: Permit from provincial Department of Environmental Affairs & Nature Conservation (DEANC) to translocate or remove *Hoodia gordonii* plants.
Environmental Control Officer (ECO) – To be appointed	
The ECO fulfils an advisory role to monitor, guide and report compliance with the EMPr.	• Revise, update and amend the EMPr if necessary and submit the amendments to the competent authority for consideration. • Ensure all relevant persons have a copy of the EMPr and any amendments thereof. • Advise the employer's representative on any additional environmental authorisations and permits that may be required. • Facilitate the Environmental Education / Induction Training with the contract staff. • Review and comment on Method Statements relevant to environmental management and make recommendations to the employer's representative. • Report any non-compliance with the EMPr or EA to the employer's representative and competent authority if necessary. • Undertake regular site inspections in compliance with this EMPr. • Monitor, audit and verify that all works comply with the EA and the EMPr. • Keep record of EMPr implementation, monitoring and audits, including a full photographic record of works. • Comply and submit regular Environmental Control Reports to the competent authority, as well as employer's representative &/ holder of the authorisation. • Report any environmental incidents or environmental impacts immediately to the employer's representative and the competent authority if necessary. • Assist the contractor and employer's representative planning for and implementing environmentally sensitive problem solving. • Advise the employer's representative on suggested "stop work" orders.
Environmental Site Agent (ESA) – To be appointed	
To assist the ECO with the day to day implementation and monitoring of the environmental management actions that are taking place on site.	• Day to day environmental control of contractors on site during the construction phase. • Monitoring of construction management activities during the construction phase. • Weekly reporting to the ECO.
Employers Representative – SOLEK Renewable Energy Engineers	
The Employer's representative role is likely to be fulfilled by the **project engineer** and assumes overall responsibility for compliance with this EMPr, the EA, the conditions of the LUPO Approval and all applicable legislation for the duration of the construction phase.	• Issue site instructions to the contractor based on the advice of the ECO. • Ensure that all detailed design incorporates the requirements of the EMPr and EA. • Ensure that the EMPr is included in all tender documents issued to prospective contractors and sub-contractors. • Ensure the EMPr is included in final contract documents. • Ensure that the Tenderers/Contractors adequately provide for compliance with the EMPr in their submissions. • Ensure that the EMPr is fully implemented by the relevant persons. • Ensure the contractor provides the necessary method statements. • Be accountable, to the competent authority for any

Role	Responsibility
	contravention or non-compliance by the Contractor. • Assist the contractor with input from the ECO in finding environmentally responsible solutions to problems. • Undertake regular site audits, site visits and inspections to ensure that the requirements of the EMPR are implemented • Give instructions on any procedures and corrective actions on advice from the ECO. • Report environmental incidents or non-compliance with the EA or EMPR to the environmental authority. • Issue spot fines, penalties or 'stop-work' orders for contravention of the EMPR and give instructions regarding corrective action.
Contractor – To be appointed	
The Contractor (main contractor) is responsible for the implementation of all construction activities associated with the Solar Facility.	• Overall project delivery for the construction of the Solar Facility to the satisfaction of the authorities and consultants. • Ensuring compliance with the Health & Safety requirements for the project. • Ensuring compliance with this Environmental Management Programme. • Promoting job safety and environmental awareness with Employees. • Ensure that all sub-contractors comply with this EMPr and all other statutory requirements.
Landowner - Blommeland Boerdery BK	
The landowner is responsible for compliance with legislation applicable to the management of the property as a whole.	• E.g.: In terms of the National Veld & Forest Fires Act (101 of 1998) - an owner on whose land is subject to a risk of veldfire or whose land or part of it coincides with the border of the Republic, must prepare and maintain a firebreak on his or her land as close as possible to the border.

3. LEGISLATIVE FRAMEWORK

Several pieces of legislation were considered during the development of this EMPr. These include, but are not limited to the following:

3.1 THE CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA

The Constitution of the Republic of South Africa (Act 108 of 1996) states that everyone has a right to a non-threatening environment and that reasonable measures are applied to protect the environment. This includes preventing pollution and promoting conservation and environmentally sustainable development, while promoting justifiable social and economic development.

3.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NEMA, ACT 107 OF 1998, AS AMENDED)

The National Environmental Management Act (NEMA, Act 107 of 1998, as amended), makes provision for the identification and assessment of activities that are potentially detrimental to the environment and which require authorisation from the competent authority (in this case, the national Department of Environmental Affairs) based on the findings of an Environmental Impact Assessment (EIA). It also embraces the notion of sustainable development as contained in the Constitution of South Africa (Act 108 of 1996) in that everyone has the right:

- to an environment that is not harmful to their health or well-being; and
- to have the environment protected for the benefit of present and future generations through reasonable legislative and other measures.

NEMA requires that measures are taken that "*prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*." In addition:

- That the disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be altogether avoided, are minimised and remedied;
- That a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

NEMA aims to provide for co-operative environmental governance by establishing principles for decision-making on all matters relating to the environment and by means of Environmental Implementation Plans (EIP) and Environmental Management Programmes (EMPr).

The Applicant may not undertake activities listed in terms of the NEMA without prior authorisation.

In compliance with **Section 24N** of NEMA, this EMPr must contain the following (over and above the content requirements listed in the Table 1 above):

Table 3: Compliance with Section 24N of NEMA

EMPr Provision	Report Reference
Information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address the environmental impacts that have been identified in a report contemplated in subsection 24(1A), including environmental impacts in respect of **planning & design.**	This is addressed in **Sections 4, 5, 6, 7** of this EMPr
Information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address the environmental impacts that have been identified in a report contemplated in subsection 24(1A), including environmental impacts in respect of **pre-construction and construction activities.**	This is addressed in **Sections 4 & 5** of this EMPr.
Information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address the environmental impacts that have been identified in a report contemplated in subsection 24(1A), including environmental impacts in respect of the **operation** or **undertaking** the activity in question.	This is addressed in **Sections 4 & 6** of this EMPr.
Information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address the environmental impacts that have been identified in a report contemplated in subsection 24(1A), including environmental impacts in respect of the **rehabilitation** of the environment.	This is addressed in **section 7** of this EMPr – It has been dealt with under construction requirements for the specific reason that these works must take place during the construction phase.
Information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address the environmental impacts that have been identified in a report contemplated in subsection 24(1A), including environmental impacts in respect of **closure**, if applicable	This is dealt with in **Sections 5.13, 5.14, 5.19 & 5.20** of the EMPr.
Details and **expertise** of the person who prepared the EMPr.	These details are included at the beginning of the report (after cover page and report conditions).
A detailed description of the **aspects** of the activity that are covered by the EMPr.	This is dealt with under the introduction in **Sections 1, 4, 5, 6 & 7** this EMPr.
Information identifying the persons who will be **responsible** for the implementation of the measures addressed in the EMPr.	This is dealt with in **Section 2, Table 2** of this EMPr.
Information in respect of mechanisms proposed for **monitoring** compliance with the EMPR and for **reporting** on the compliance.	This is dealt with in **Section 8** of this EMPr.
Measures to **rehabilitate** the affected environment.	This is dealt with in **Sections**

EMPr Provision	Report Reference
	5.13, 5.14, 5.19 & 5.20 of this EMPr.
Description of the manner in which **pollution** will be **prevented** and remedied.	This is dealt with throughout the EMPr, but specifically in **Sections 4.7, 5.4, 5.14, 5.16, 5.17, 6.2 & 6.3**
The EMPR must furthermore, where appropriate;	
Set out **time periods** within which measures must be implemented.	This is dealt with in **Sections 5.19, 5.20, 5.21 & 12** of the EMPr.
Contain measures regulating responsibilities for any environmental damage.	This is dealt with is **Sections 1, 2, 12 & 13** of this EMPr.
Develop an **environmental awareness plan** describing the manner in which the applicant intends to inform his or her Employees of any environmental risks and how to deal with these risks in order to avoid pollution or degradation of the environment.	This is dealt with in **Sections 4.2 & 4.3** of the EMPr.

In addition to the above, the Holder of the Authorisation is bound by "Duty of Care", as described in Section 28 of NEMA (107 of 1998, as amended), which "…*obliges every person who causes, has caused or may cause significant environmental degradation to take reasonable measures to prevent such degradation from occurring, continuing or recurring*". Thus, all mitigation measures recommended by the relevant authorities and specialists must be implemented to avoid occurrence, continuation or repeat of environmental degradation.

3.3 NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT (NEMBA) (ACT 10 OF 2004)

This Act controls the management and conservation of South African biodiversity within the framework of NEMA. Amongst others, it deals with the protection of species and ecosystems that warrant national protection, as well as the sustainable use of indigenous biological resources. Sections 52 & 53 of this Act specifically make provision for the protection of critically endangered, endangered, vulnerable and protected ecosystems (under the ToPS Regulations - Threatened or Protected Species Regulations), that have undergone, or have a risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention through threatening processes. The conservation status and sensitivity of the ecosystem within which the proposed Boesmanland Solar Farm is proposed is discussed as follows:

The site falls within the planning domain of the Namakwa Biodiversity Sector Plan (Desmet & Marsh 2008). This biodiversity assessment identifies Critical Biodiversity Areas (CBAs) which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to meet national biodiversity objectives. . The CBA map for the general area surrounding the site is depicted in Figure 4, below. The map illustrates that the southern corner of the proposed development area falls within an Ecological Support Area (ESA). Although Ecological Support Areas should be maintained in a natural to near-natural state, the extent to which the development impinges on the ESA is minimal and it would be highly unlikely to disrupt the ecological functioning of the ESA and is not viewed as being significant.

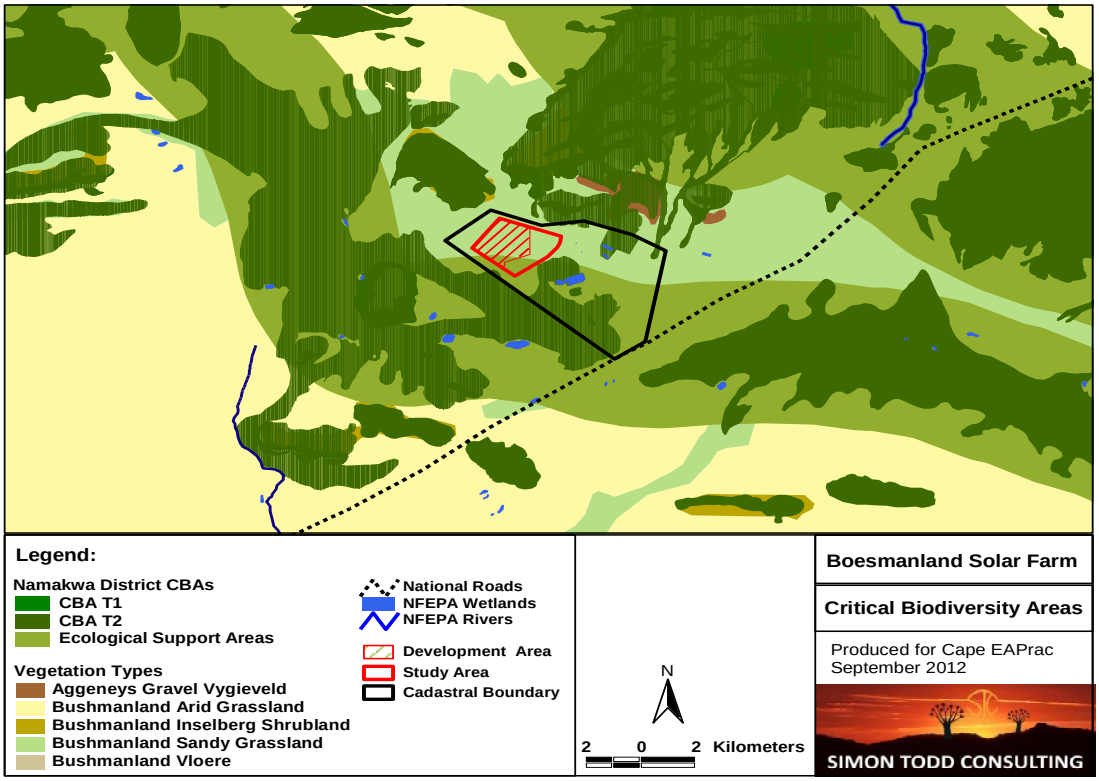
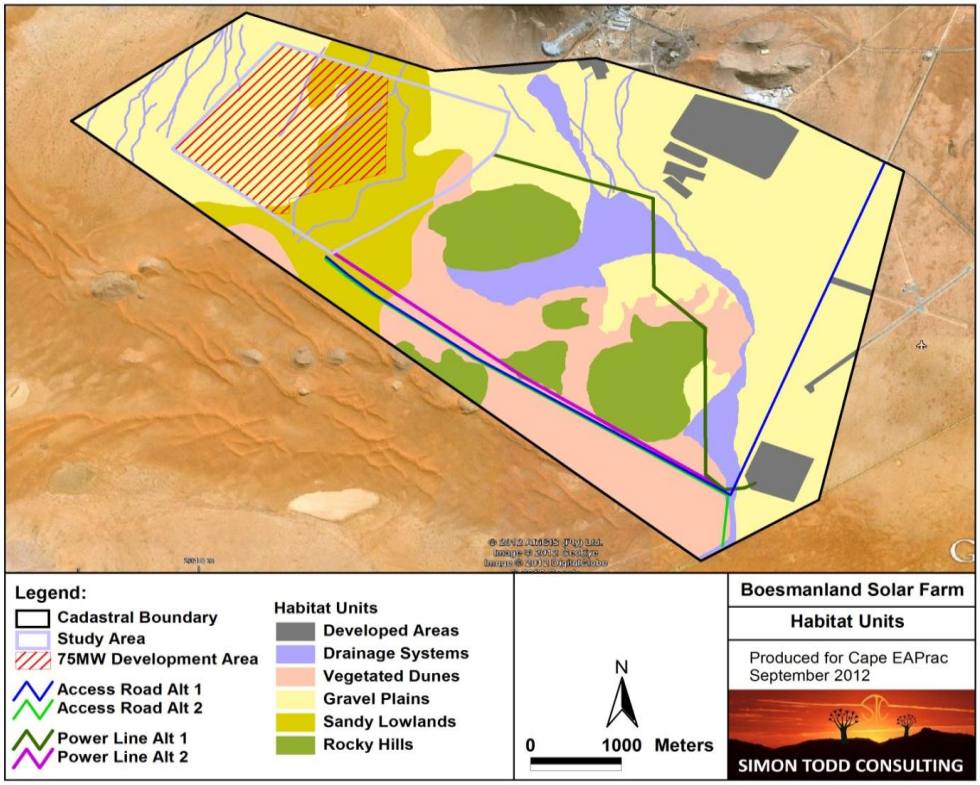


Figure 4: CBA Map

In terms of the National Spatial Biodiversity Assessment (NSBA), the Terrestrial Ecosystem Status of the entire property, Farm 62 Zuurwater, and thus the 75MW solar development site, is classified as **Least Threatened.**



Sensitive drainage lines and low dunes (sandy lowlands) cover a portion of the proposed 75MW Boesmanland Solar Farm development site, while a highly sensitive drainage line (associated with the Black Mountain Mine), as well as a series of tall vegetated red dunes and rocky outcrops are located outside of the development area, to the south-east (see **Figure 5**: Habitat Map adjacent).

The preferred access road (Alt.1) and power line (Alt.2) options traverse the CBA along the western boundary of the site. There is however already a power line and associated service road in this area and the new overhead line required for the development will run adjacent to the existing line. The service road for the existing ESKOM power line will be upgraded to provide access to the site. This route was assessed in the field during the site visits and is not likely to

generate any significant direct impacts on biodiversity. Furthermore, the total habitat loss that would result from the road construction is low and the impacts on the ecological functioning and biodiversity potential of the CBA would be minimal.

A detailed aerial and topographical was undertaken to inform the siting of the proposed solar facility development footprint and associated infrastructure, while an ecological impact assessment was undertaken to provide recommendations to avoid and mitigate potential negative impacts associated with the development. The **rocky-hill / koppie areas outside the development site must be maintained as a NO-GO area at all times**.

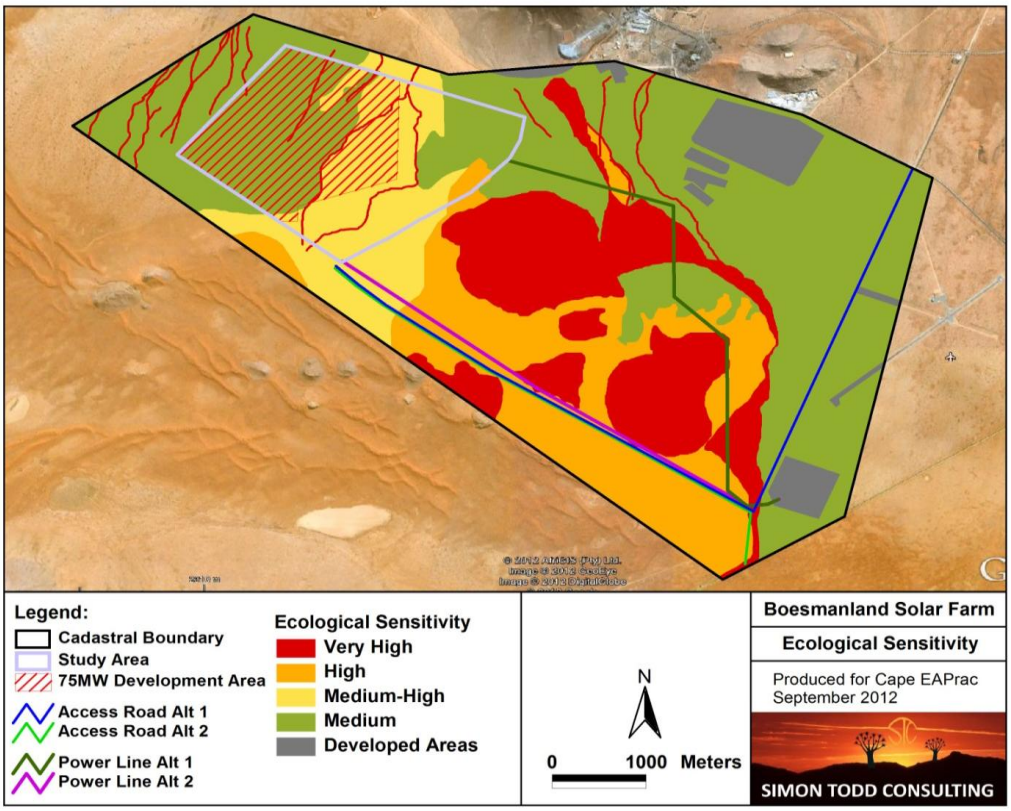


Figure 6: Ecological Sensitivity Map (Todd, 2012)

The only plant species of conservation concern observed within the development area was ***Hoodia gordonii***, which is a nationally protected species, but not rare or threatened. A number of provincially protected species occur within the site including ***Boscia foetida*** and several ***Euphorbia*** species. A preconstruction survey of the final development footprint will need to be conducted to ascertain the identity and exact number of individuals of protected species affected by the development. Species such as *Euphorbia* and *Hoodia* are suitable for translocation and should be translocated to a similar habitat outside the development footprint prior to the commencement of construction (see Sections 5.19 & 5.20 for details of the Plant Rescue, Re-vegetation and Rehabilitation Plans).

A ToPS permit is required for any activities impacting on any ToPS listed plant species. In the Northern Cape this takes the form of an Integrated Permit which meets both national and provincial permitting requirements (see Section 3.4 below).

3.4 NORTHERN CAPE NATURE CONSERVATION ACT (NCNCA) (NO. 9 OF 2009)

This Act provides *inter alia* for the sustainable utilisation of wild animals, aquatic biota and plants, as well as permitting and trade regulations regarding wild fauna and flora within the province. The following section may be relevant to the parameter security fencing proposed as part of the solar development:

Manipulation of boundary fences

19. No Person may –

(a) erect, alter remove or partly remove or cause to be erected, altered removed or partly removed, any fence, whether on a common boundary or on such person's own property, in such a manner that any wild animal which as a result thereof gains access or may gain access to the property or a camp on the property, cannot escape or is likely not to be able to escape therefrom;

It is recommended that only the facility itself should be fenced-off by the proposed parameter fencing which should be constructed in manner to **allow for the passage of small and medium sized mammals**, at least at strategic places, such as along drainage lines or other areas of dense vegetation. **No electrified strands may be within 20cm of the ground** (tortoises retreat into their shells when electrocuted and eventually succumb from repeated shocks) (Todd, 2012).

The Act also lists protected fauna and flora under 3 schedules ranging from Endangered (Schedule 1), Protected (Schedule 2) to Common (Schedule 3). The majority of mammals, reptiles and amphibians are listed under Schedule 2. A permit is required for any activities which involve species listed under Schedule 1 or 2.

Of relevance for the Boesmanland Solar Farm development is the fact that several plant families and genera are listed in their entirety as protected, these include, *inter alia* *Mesembryanthemaceae*, *Amaryllidaceae*, *Apocyanceae*, *Asphodeliaceae*, *Crassulaceae*, *Iridaceae* and *Euphorbia*. Although some of these listed species may occur at the site, most are associated with inselbergs (koppies) and quartzite patches and are therefore not likely to occur at the site, but may be present on the adjacent mountains (Todd, 2012).

As mentioned above, a number of provincially protected plant species were found within the site (*Boscia foetida* & *Euphorbia* species). A preconstruction survey of the final development footprint will need to be conducted to ascertain the identity and exact number of individuals of protected species affected by the development. A single integrated permit, which covers nationally or provincially listed species permitting requirements, as well as meets TOPS regulations, must be obtained from the DENC permit office in Kimberly prior to the any vegetation removal or plant translocation activities (see Sections 5.19 & 5.20 for details of the Plant Rescue, Re-vegetation and Rehabilitation Plans).

3.5 NATIONAL FORESTS ACT (NFA) (NO. 84 OF 1998):

The National Forests Act provides for the protection of forests as well as specific tree species, quoting directly from the Act: "*no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated".*

No protected tree species were observed at the site or within the development area, although the site lies within the distribution range of protected species such as *Boscia albitrunca* (Todd, 2012).

3.6 NATIONAL VELD & FOREST FIRE ACT (NVFFA) (ACT 101 OF 1998)

The purpose of the National Veld and Forest Fire Act is to **prevent and combat veld, forest and mountain fires** throughout the Republic of South Africa and to provide institutions, methods and practices for achieving this purpose. Institutions include the formation bodies such as **Fire**

Protection Associations (FPA's) and Working on Fire. The Act provides the guidelines and constitution for the implementation of these institutions, as well as their functions and requirements.

Every owner on whose land a veldfire may start or bum or from whose land it may spread must prepare and **maintain a firebreak on his or her side of the boundary between his or her land and any adjoining land.** The procedure in this regard and the role of adjoining owners and the fire protection association are dealt with within this Act. An owner on whose land is subject to a risk of veldfire or whose land or part of it coincides with the border of the Republic, must prepare and maintain a firebreak on his or her land as close as possible to the border.

The proposed solar site is arid and given the sparse, succulent nature of the vegetation, it is highly unlikely that fires are a normal occurrence in the area, and thus fires at the site are not considered to be a significant risk. However, under exceptional circumstances, such as following years of very high rainfall, sufficient biomass may build up to carry fires, especially in the fenced-off areas. Therefore, **management of plant biomass within the site** should be part of the management of the facility. Given the risk that this would pose to the development, it would be in the operators' interests to manage plant cover at an acceptable level through grazing or alternative management practice (brush-cutting). Grazing by livestock is the simplest and most ecologically sound way to manage plant biomass and is recommended the preferred method to manage plant biomass at the site (Todd, 2012).

3.7 CONSERVATION OF AGRICULTURAL RESOURCES ACT – CARA (ACT 43 OF 1983):

CARA provides for the regulation of control over the utilisation of the natural agricultural resources in order to promote the maintenance of ecological health of land, combating and preventing erosion and weakening or destruction of water resources, protecting vegetation and combating weeds and invader plant species i.e. conservation of soil, water & vegetation.

The hydrological features, which occur within the Boesmanland Solar Farm development area, include washes and small drainage lines. These drainage lines have their origin in the rocky hills outside of the site, and are generally wide and open, with a flat sandy bed. The drainage lines are dominated by grasses and scattered shrubs. The construction of the solar facility will require limited disturbance of vegetation or soil (rammed / driven piers) and thus minimal impact on these washes. Measures will be put in place to avoid drainage line obstruction, impeding surface and subsurface water flow and soil erosion, as well as to promote conservation of these resources (see Section 5.13 for details of the Storm Water Management Plan and the Erosion Management Plan).

The Conservation of Agricultural Resources Act defines different categories of alien plants:

- Category 1 - prohibited and must be controlled;
- Category 2 – must be grown within a demarcated area under permit; and
- Category 3 - ornamental plants that may no longer be planted, but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the floodlines of water courses and wetlands.

The Boesmanland Solar Farm development site is relatively free of alien plant species, which can be ascribed firstly to the aridity of the site, as well as the low rainfall in the period preceding the site visit. Alien plants are however likely to become an issue if the site is highly disturbed during construction or if water runoff is not properly managed. Mitigation measures have been recommended to avoid the risk of increased alien invasion during construction and operation phases of the solar facility (Todd, 2012) (see Section 5.21 for details of the Alien Invasive Management Plan).

3.8 NATIONAL HERITAGE RESOURCES ACT (NHRA) (ACT 25 OF 1999)

The protection and management of South Africa's heritage resources are controlled by the National Heritage Resources Act (Act No. 25 of 1999), with the South African National Heritage Resources Agency (SAHRA) as the enforcing authority.

In terms of Section 38 of the National Heritage Resources Act, SAHRA required a Heritage Impact Assessment (HIA) be undertaken as part of the S&EIR process, as this renewable energy project triggered certain categories of development applicable to the Act:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length (access and internal road network, underground cabling & transmission line);
- any development or other activity which will change the character of a site exceeding 5 000 m² in extent (PV panel arrays covering an approximate area less than 270ha, including auxiliary buildings);
- the re-zoning of a site exceeding 10 000m² in extent (re-zoning of approximately 350ha of land from Agricultural to Special Zone to allow for the renewable energy facility).

Furthermore, in terms of Section 34(1), no person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit issued by the SAHRA, or the responsible resources authority (no buildings or ruins of historical or cultural significance occur within proximity to the solar development area, or will be disturbed by any activity related to the solar facility).

Nor may anyone destroy, damage, alter, exhume or remove from its original position, or otherwise disturb, any grave or burial ground older than 60 years, which is situated outside a formal cemetery administered by a local authority, without a permit issued by the SAHRA, or a provincial heritage authority, in terms of Section 36 (3) (no graves or burial grounds were found to occur is proximity to the solar facility (De Kock, 2012).

In terms of Section 35 (4), no person may destroy, damage, excavate, alter or remove from its original position, or collect, any archaeological material or object, without a permit issued by the SAHRA, or the responsible resources authority (from an archaeological and paleontological perspective, that there would be no inhibitors to construction of the Boesmanland solar facility (Smith, 2012 & Almond, 2012).

The archaeologist, Smith (2012) stated that the distinct lack of any concentration of cultural material across the property implies that this is not a rich archaeological environment, and would be similar to observations by Beaumont et al. (1995: 264), who state that in this dry environment: "Surveys of large areas...have failed to yield any signs of human occupation, except around the granite inselbergs extruding above the peneplain". However, the scattered heritage occurrences or sites that are considered to be sensitive (inselbergs) have been identified and mapped. The solar facility layout has been informed by identified heritage related constraints. Please see Sections 4.1.2 and 9 below for further details.

3.9 NATIONAL WATER ACT (NWA), NO 36 OF 1998

This Act controls / regulates the utilization of natural water resources and provides provisions to safe-guard the integrity of these water resources.

It is estimated that approximately 11 200kl or 24m³ per day of water in total should be required during the 18 month construction phase (an average of kl per day when construction is calculated at 6 days a week). In addition, 10 - 18kl of water per day (or 500 kl per month) should be required for the cleaning of solar panels (twice a month) and for other operational phase requirements.

The preferred source of water required for the construction and operation of the Solar Facility is from **three existing boreholes near the solar development site**. An additional option is the borehole at the Witputs farmstead (on adjacent farm) owned by the same farmer and is situated 20km from the proposed solar site. The borehole at the farmstead can pump 2.5kl per hour, of which only 1.5kl is currently used. It will therefore also be able to supply the daily quantity required. If this option is put into action, the water will either be transported by 20kl water trucks, or via a pipeline constructed from the farmstead to the proposed site.

The town of Aggeneys (managed by the Khai-Ma Municipality) receives water from the Orange River, via the Pella pipeline, which is currently running at full capacity. Although capacity upgrades are being investigated, there will only be implemented in the next three years. In the meantime, the Nama Khoi Municipality has agreed to provide the Boesmanland Solar Farm with the necessary water via standard water trucks, until the Khai-Ma capacity has been expanded.

To supplement the abovementioned water source options, a rainwater collection (off the on-site substation and axillary building roofs) and storage system (10 x 10lt tanks) will be installed.

Due to the quaternary area within which the proposed solar facility is to be situated, authorisation is required from the Department of Water Affairs (DWA) for the use of the borehole water, by way of a **full Water Use Licence Application (WULA)**. The alternative water supply on the Farm Witputs will require a separate WULA, as it is on a different property and will not be included in the water use licence for Portion 6, a portion of Portion 2, Farm 62 Zuurwater. The assessment of this WULA will only be undertaken by the DWA once DEA and DAFF have issued the Environmental Authorisation (EA) and the project has been appointed as a preferred bidder by the Department of Energy (DoE). The DWA have provided the following recommendations to inform the abovementioned WULA authorisation for the Boesmanland Solar Farm:

- A **24-hour pump test** must be undertaken on each borehole to determine the amount of water each can deliver. These pump test results must be submitted to the DWA when the application is submitted.
- The existing farm **boreholes must be fitted with flow meters** to measure the volumes of water abstracted (and keep record of such);
- That the water level of the **boreholes be monitored on a monthly basis** (and records kept);
- Water used for dust suppression on gravel roads must be of a quality compliant with the General Special Effluent Standards (31/03/2009): Temperature: max.25^{0}C, pH: between 5.5 & 7.5 and conductivity: not be increased more than 15% above the intake water & not exceed 250 milli-Siemens per metre (determined at 25^{0}C). The water used for dust suppression is likely to be borehole water / municipal water, and not treated effluent. However the water quality standards mentioned will be taken note of.

These recommendations must be implemented in furtherance of and support of the Water Use Licence Application for this solar project.

3.10 GUIDELINES & STRATEGIC DOCUMENTS

The following guidelines and strategic documents were considered during the compilation of this EMPr.

3.10.1 National Waste Management Strategy

The National Waste Management Strategy presents the South African government's strategy for integrated waste management for South Africa. It deals among others with: Integrated Waste

Management Planning, Waste Information Systems, Waste Minimisation, Recycling, Waste Collection and Transportation, Waste Treatment, Waste Disposal and Implementing Instruments.

3.10.2 Waste Minimisation Guideline Document for Environmental Impact Assessment Review (May 2003)

This guideline, although compiled on a provincial level, was considered pertinent to this EMPr. This Guideline raises awareness to waste minimisation issues and highlights waste and wastage minimization practices. Part B of this document is of particular importance, as it addresses issues of general waste and wastage minimization during construction activities.

3.10.3 National Building Regulations

The National Building Regulations and Building Standards Act as amended must be complied with. This act addresses, inter alia:

- Specifications for draftsmen, plans, documents and diagrams;
- Approval by local authorities;
- Appeal procedures;
- Prohibition or conditions with regard to erection of buildings in certain conditions;
- Demolition of buildings;
- Access to building control officers;
- Regulations and directives; and
- Liability.

3.10.4 Other Guidelines considered

In addition to those described above, the following guidelines were also considered during the compilation of this EMPr.

- DEADP (2003). Waste Minimisation Guideline for Environmental Impact Assessment reviews. NEMA EIA Regulations Guideline & Information Series, Department Environmental Affairs & Development Planning.
- DEAT (2004). Environmental Management Plans, Integrated Environmental management, Information Series 12, Department Environmental Affairs & Tourism
- DEADP (2010). Guideline for Environmental Management Plans. NEMA EIA Regulations Guideline & Information Document Series, Department of Environmental Affairs & Development Planning.

4. DESIGN & PRE CONSTRUCTION PHASE

The following management considerations are to be adopted and implemented during the design and pre-construction phase.

4.1 PV PANEL - MICRO-SITING

Micro-siting of the individual panels within the solar facility should occur when the layout is nearing its final configuration during the detailed design phase (in approximation to the layout authorised by DEA). This micro-siting exercise involves assessing the exact footprints of the PV panels in each array row in turn on site, so that all technical and environmental features can be considered with input from the participating specialists and the ECO.

The following recommendations made by the various specialists must be considered in the micro-siting exercise.

4.1.1 Ecological

The ecological specialist, Simon Todd (2012), recommended that an ecological specialist be contracted to assist with the micro-siting of PV panels and undertake a preconstruction survey of the final development footprint to ascertain the identity and exact number of individuals of protected species affected by the development. A single integrated permit, which covers nationally or provincially listed plant species permitting requirements, as well as meets TOPS regulations, must be obtained from the Department of Environmental Affairs & Nature Conservation (DEANC) permit office in Kimberly prior to the any plant rescue / transplant and/or removal activities.

4.1.2 Heritage

The Heritage (De Kock, 2012), Archaeological (Smith, 2012) and Paleontological (Almond, 2012) specialists recommend that the **inselbergs / koppies** and the area surrounding them, must be **demarcated as NO-GO areas and be avoided at all times**. In addition, areas with quartz scatters must be avoided as far as possible (please see Section 9 below).

4.2 PRE-CONSTRUCTION ENVIRONMENTAL COMPLIANCE WORKSHOP

It is recommended that a pre-construction environmental compliance workshop be undertaken before any construction commences on site. This workshop can be combined with a site handover meeting, but must take place before any activities take place on site and before any plant is moved onto site. The purpose of this workshop is to ensure that all relevant personnel are familiar with the provisions of the EMPr, as well as the conditions of the Environmental Authorisation.

The following people must be present at this Environmental Compliance Workshop:

- The ECO;
- The Main Civil Contractor (including contract manager, site agent and foreman);
- The Electrical Contractor (including contract manager, site agent and foreman);
- The Consulting Engineers (electrical, civil and structural, whichever applicable); and
- Project Management.

Provision should be made in contract and tender documentation to attend a 6 hour workshop that will be chaired by the ECO.

4.3 ENVIRONMENTAL INDUCTION TRAINING & ENVIRONMENTAL EDUCATION

The ECO, in consultation with the contractor and engineer, shall ensure that all construction workers receive an induction presentation, as well as on-going environmental education & awareness, on the importance and implications of the EMPr and the environmental requirements it

prescribes. The presentation shall be conducted, as far as is possible, in the Employees' language of choice. The contractor should provide a translator from their staff for the purpose of translating, should this be necessary.

There are a number of protected and conservation-worthy plant species on and in proximity to the solar development site, including ***Hoodia gordonii*****,** ***Euphorbia sp.*** **and** ***Boscia sp.*** Further plant species may well be identified by the ecological specialist to occur within the proposed development area during the pre-construction survey. It is important that the ECO and all construction staff be made aware of these species and how to identify them, so that they can be suitably avoided and/or protected were possible (see Section 15 of the EMPr for photographs and description of important plant species). Section 16 provides details of the alien plant species, *Prosopis,* that will need to be removed from site on a systematic basis. It is the ECO's responsibility to print enlarged posters of these photographs and descriptions for use in the Environmental Induction / Education training sessions. It is also the ECO's responsibility to ensure that the required permit be obtained from the Kimberly DEANC office prior for the transplant and/or removal of protected plant species, as well as to provide instruction on and guide all plant rescue, transplant and rehabilitation activities (i.e. *Hoodia* plants must be carefully removed and transplanted outside the development area in proximity to other *Hoodia* plants).

As further plant species of conservation value, as well as archaeological occurrences, are likely to occur in proximity of the **koppies** nearby, these must **be demarcated as NO-GO** areas and must be avoided by all staff.

As a minimum, induction training should include:

- Explanation of the importance of complying with the EMPr;
- Explanation of the importance of complying with the Environmental Authorisation;
- Discussion of the potential environmental impacts of construction activities;
- The benefits of improved personal performance;
- Employees' roles and responsibilities, including emergency preparedness (this should be combined with this induction, but presented by the contractors Health and Safety Representative);
- Explanation of the mitigation measures that must be implemented when carrying out their activities;
- Explanation of the specifics of this EMPr and its specification (no-go areas, etc.); and
- Explanation of the management structure of individuals responsible for matters pertaining to the EMPr.

Furthermore, the induction training must ensure that construction workers/staff understand that **no form of wildlife poaching, collecting (plant or animal) or other form of disturbance will be permitted** on the construction site or the adjacent areas.

Should the staff turnover be high and with additional appointment of sub-contractors, it may be necessary to conduct additional induction training sessions, as well as regular environmental education debriefings. This is at the discretion of the ECO.

The contractor must keep records of all environmental training sessions, including names, dates and the information presented. Details of the environmental induction are also to be included in the environmental control reports.

4.4 DEMARCATION OF NO-GO AREAS

The demarcation of no-go areas is of extreme importance to ensure that disturbance is restricted to the future developed area and that areas outside this demarcated area are protected and not damaged unnecessarily.

The process for this is as follows:

- The exact footprint of the construction area, including panel foundations and all roads (including access, haul and internal roads which must make use of the final road layout) and infrastructure are to be surveyed and pegged before any physical construction commences on site.
- The contractor, in conjunction with the ECO, must walk the areas determined and mark the full extent of the area to be disturbed (allowing sufficient space for the construction activity);
- All areas beyond these demarcated areas are considered as “no-go” areas (i.e. the drainage lines and rock-outcrops / koppies) ; and,
- Construction staff must be briefed as part of the environmental induction on the requirements regarding the no-go areas.

4.5 CONSTRUCTION PHASING

There are a number of important aspects of the construction phasing that must be implemented to ensure that the potential impact on the environment is kept to a minimum. The contractor must consider the following requirements regarding phasing, when developing the construction programme. This construction programme must be approved by the engineer’s representative with input from the ECO.

- The road network to access the panel arrays should be established first and then all vehicular movement must be restricted to within this road network - This will minimise the impact of construction traffic on the undeveloped portion of the property.
- Sites that will be temporarily disturbed by the construction activities (e.g. material loading, temporary storage, turning circles, etc.) must also be included in the road access network.

4.6 ESTABLISHMENT OF CONTRACTORS SITE CAMP

The Contractors Site Camp must be established in consultation with the ECO. The site camp may not be erected on any areas considered sensitive as defined by the participating specialists. The following points are applicable:

- The Contractors Site Camp must be situated within the development area. Site Camps that are allowed off-site may only be erected once written permission from the landowner is obtained and any other necessary authorisations are in place;
- Topsoil from the site camp area must be stripped and stockpiled for re-use during rehabilitation. This must be done to ensure no contamination of the topsoil while the site camp is in use;
- The site camp must be fenced off with shade netting;
- All construction material must be stored in the site camp, unless otherwise approved by the ECO. This may excludes PV panel mounting structures and panel components which will be stored at each of the assembly point, as per the manufacturer plans;
- No personnel may overnight in the site camp, except in the case of a night watchman / security;
- Fires for cooking and/or heating are only allowed within the site camp after consultation with the Health and Safety Representative;
- Fuel may only be stored in the camp site;
- Storage of waste must take place within the site camp and must be removed on a regular basis; and
- The site camp must be provided with sufficient ablution facilities (chemical toilets and potable water) of which the content must be disposed of regularly and at the suitable facilities.

4.7 WATER CONSERVATION IN INFRASTRUCTURE

The following recommendations must be considered in the design of the associated structures / infrastructure (on-site substation, auxiliary buildings etc.) to be constructed as part of the PV solar development:

4.7.1 Ablution / Sanitation Facilities

The on-site substation, control and workshop buildings should be fitted with rainwater collection and storage systems to supply water to the all taps and toilets in these buildings, as well as any outdoor requirements (landscaping, washing etc.).

All toilets should be fitted with dual flush systems. Conservative estimates have shown that a saving of more than 22 000 litres per household (this could apply to the workshops that are occupied by day and night staff) can be achieved annually with the installation of dual flush toilets (Aquanotion, 2008).

All taps to be installed in the control / substation / workshop buildings must be fitted with low-flow faucets. Low flow faucets use aerators to reduce the flow of the water. These can either be built into the faucet or added as an aftermarket product. The faucets in bathrooms should have a peak flow of less than 10 litres per minute.

4.8 ECOLOGICAL CONTROL OFFICER

An Environmental Control Officer (ECO) must be appointed for this project. The appointed ECO must be suitably qualified and have experience of environmental monitoring and control on similar scale projects.

The responsibilities of the ECO include but are not limited to the following:

- Provide environmental induction training to contractors on site prior to commencing of construction activities;
- Review, maintenance and update of the EMPr;
- Liaison between the Project Proponent, Contractors, Authorities and other lead stakeholders on all environmental concerns, including the implementation of the EMPr;
- Compilation of Environmental Control Report/s (ECR) to ensure compliance with the EMPr and authorisations. Reports should be submitted to the relevant authority on a monthly basis;
- Compilation of the Environmental Audit Report or Environmental Completion Statement, six months after completion of construction or at a frequency in compliance with the Environmental Authorisation. Reports should be submitted to the relevant authority and the Project Proponent;
- Monitor compliance with this EMPr;
- Monitor compliance with the Environmental Authorisation once issued;
- Monitor implementation of the mitigation and rehabilitation measures and recommendations referred to in the Environmental Authorisation, Final Basic Assessment Report, participating specialists and this EMPr.
- Recommend the issuing site instructions to the Contractor for corrective actions required (formal site instructions are to be issued by the Engineers Representative with input from the ECO);
- ECO site inspections to be undertaken once a month to ensure compliance with the EMPr. The duration of these visits may be increased or decreased at the discretion of the ECO in consultation with the Engineers Representative;
- Attendance of contractors site meetings;

- Maintain a record of environmental incidents (e.g. spills, impacts, legal transgressions etc.) as well as corrective and preventative measures taken. This information must also be included in the ECR;
- Maintain a public complaints register in which all complaints and action taken / responses must be recorded. This information must also be included in the ECR; and
- Engineers Representative (with input from the ECO) has the authority to stop work on site if he / she consider that any actions of excessive non-compliance of the EMPr, authorisations or General Duty of Care are taking place.

4.8.1 Environmental Site Agent (ESA)

An environmental site agent should be appointed for the duration of the construction period of the solar project. The Terms of Reference for the Environmental Site Agent (ESA) include, but are not limited to the following:

- To ensure compliance with the Environmental Management Plan and Environmental Authorisation;
- The ESA is required to be on site for an estimated 4 hours per day, which may be reviewed by the ECO, ESA and the applicant as construction requirements dictate;
- Assisting the contractor with environmental induction of the contractors;
- Attending all on site construction meetings (including, but not limited to, technical and contractors meetings);
- Providing the ECO with a weekly compliance report in a format defined by the ECO;
- Developing and maintaining a detailed photographic site record throughout the construction phase of the project;
- Maintaining a register of all site instructions;
- Maintaining file records of all method statements provided by the contractors;
- Management and ensuring contractor implementation with the environmental rehabilitation plan (still to be developed);
- Revision and updating the EMPR in conjunction with the ECO, if and when required;
- Maintain a record of environmental incidents (e.g. spills, impacts, legal transgressions etc.) as well as corrective and preventative measures taken. This information must also be included in the weekly reports;
- Maintain a public complaints register in which all complaints and action taken / responses must be recorded. This information must also be included in the ECR;
- In the event that the ESA observes non-compliance that requires a “stop work” order, the ECO must immediately be informed and will request the Engineers Representative to issue such an order.

4.8.2 ECO and ESA competency

The ECO must have a minimum of a tertiary level qualification in the natural sciences field, as well as at least 3 years’ experience and proven competency as an ECO, preferably with experience on similar scale Developments.

The ESA must have a minimum of a tertiary level qualification, as well as at least 2 years’ experience and proven competency as an ESA. The role of ESA need not be fulfilled by an external consultant and the role may be undertaken by the engineer’s representative.

5. CONSTRUCTION PHASE

The items contained in this section of the EMPr must be implemented during the construction phase of the development of the Boesmanland Solar Farm Facility.

5.1 WATER SUPPLY

The contractor must ensure a supply of water is available on site for sanitation, drinking, dust suppression etc. It is estimated that approximately 11 200kl of water in total should be required during the 18 month construction phase (an average of 24kl per day when construction is calculated at 6 days a week).

Water used for dust suppression on gravel roads must be of a quality compliant with the General Special Effluent Standards (31/03/2009): Temperature: max.25^{0}C, pH: between 5.5 & 7.5 and conductivity: not be increased more than 15% above the intake water & not exceed 250 milli-Siemens per metre (determined at 25^{0}C). The water used for dust suppression is likely to be borehole water / municipal water, and not treated effluent. This item is specific to water supply during the construction phase. Water supply for the washing of panels is discussed under the operational phase requirements.

5.2 TOPSOIL HANDLING

In terms of best practice and for rehabilitation purposes, it is essential that a 150mm layer of topsoil from the building and road footprints (i.e. the on-site substation, auxiliary buildings and contractor's site camp) be stripped and stockpiled prior to the commencement of construction activities in each area. Topsoil is of utmost importance for use in rehabilitation of disturbed areas and should therefore under no circumstances be mixed with sub-soils. Since the panels are to be installed using low impact pile installation, topsoil from underneath the panel arrays must be left in situ.

The following requirements regarding topsoil handling must be considered:

- A minimum 150mm layer of topsoil from the access and internal roads, on-site substation, auxiliary buildings and contractors site camp;
- The topsoil stockpile site must be approved by the ECO and may not be within the sensitive areas as defined by the participating specialists;
- The topsoil may not be stockpiled within any of the remaining natural areas. A existing disturbed area should rather be chosen for this purpose;
- The topsoil stockpile must be protected from erosion and dust as indicated by the ECO and this EMPR; and
- The topsoil must be replaced into disturbed areas (road verges, cable trenches and contractors site camp) on completion of construction.

5.3 TRANSPORT & TRAFFIC MANAGEMENT PLAN

5.3.1 Access Road / Routes & Required Upgrades

The access roads to the site will be from Upington or Springbok, along the N14 national highway. From the N14, the Aggeneys turn-off is taken.

Figure 7: Aggeneys turn off the N14

The preferred access route to the solar site is via the existing tarred Aggeneys Road, then 4.1km via the existing gravel road behind the Aggeneys airstrip and Aggeneis Substation (old Springbok-Pofadder road on the Black Mountain Mine property), and then along a 7.9km stretch of the existing service track parallel to the Eskom 220kV transmission line between Harib and Aggeneis (on Mine and Maasdorp farm properties).

The N14 and Aggeneys Road are tarred and no alterations should be necessary to handle construction traffic and traffic involved in the operation phase. The 4.1km stretch of gravel road behind the airstrip is in superb condition and would only need minor works (grading). The first 1.8km of the track parallel to the Eskom powerline traverses an area characterised by sand dunes and the incline necessitates more serious upgrades. It is recommended that this part of the road be cleared, ripped and thoroughly compacted. As the road is expected to carry laden heavy vehicles, a selected gravel layer will be needed to compensate for the underlying layers. A gravel layer of 200 – 300mm and at least 3,5 meters wide, will have to be imported and compacted to at least 93% MOD AASHTO. This material will be transported from the Mines existing borrow pit located near the access gate or a registered borrow pit in the nearby vicinity. The remaining 3.8km of this track is relatively level and will also have to be cleared and compacted as the main composition of the material is sandy. Additional gravel material of a thickness between 200 and 250mm should also be imported for this section and be compacted to 93% MOD AASTHO.

5.3.2 Trip Generation

The PV panels will be transported to site by means of normal 2x40ft container trucks. Less than 30 containers will be required per installed MW. This will typically include all solar PV components and additional construction equipment. It is expected that approximately 1125 2x40ft container trucks will be required to deliver the approximate 2250 containers during the construction period of 16-18 months. The PV components are brought in as they are needed and thus the delivery of equipment will be spread out over this 18 month period. Roughly estimated this will amount to **two 2x40ft container trucks visiting the site per day, which equates to approximately four truck trips spread over an eight hour day.**

It is estimated that approximately 50 people could be employed during the construction period. It can be expected that the bulk of these workers will commute to/from the construction site via minibus taxis from Aggeneys, and/or nearby communities. With an average occupancy of 12 passengers per minibus taxi this equates to **approximately 4 taxis visiting the site in the morning and afternoon peak hours (8 taxi trips)**. (It is expected that approximately 6 permanent staff members will be employed at the proposed development during the operational phase. Should they all travel to work with their private vehicles, it would amount to 12 trips a day - 6 trips in morning peak hour and 6 trips out during afternoon peak hour).

Normal construction traffic will also need to be taken into account: civil engineering construction equipment will need to be transported to the site (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.), as well as components required for the establishment of the onsite substation power line. Some of this power station equipment may be defined as abnormal loads in terms of the Road Traffic Act (Act No.29 of 1989). Much of this equipment will be kept in

the site camp during the construction phase, thus a conservative estimate of **10 construction vehicles a day (20 trips).**

In total, it is estimated that there will be **approximately 32 vehicle trips to and from the solar development site per day**, 16 in the morning and 16 in the afternoon, over the estimated 18 month construction period. Based on the expected number of construction trips generated by the proposed development the existing road network has sufficient capacity to accommodate the additional trips from an operational perspective.

5.3.3 Traffic & Delivery Requirements

The proposed access route for construction traffic associated with the Boesmanland Solar Farm removes vehicles from the main access into the Mine and the public roadway into the town of Aggeneys, and thus potential traffic impacts on these industrial, commercial /retail and residential areas will be avoided. All construction and delivery traffic must be **restricted to the designated and approved access, haul and internal roads** and no vehicle may drive anywhere else on site. No construction vehicles should be allowed to drive over the vegetation – should a situation arise where a vehicle need access an area where no cleared roads are available, only a single track should be used with approval from the ECO and resident engineer i.e. multiple paths should not be formed.

The PV panels and associated equipment / material must be delivered to a central point on the site and then moved to their assemble point / final position using smaller vehicles (i.e. forklifts or bakkies). This **temporary laydown area** would be used during the construction period to store equipment and construction material before it is installed or used during the development stage of the project. The area must be near the site access, in proximity to the workshop and office areas, to avoid excessive traffic during this period while conveying equipment and materials.

The **traveling speed of all vehicles** (construction, delivery, taxi or private) must be defined and enforced in terms of the Health & Safety requirements, to minimise the generation of dust and minimise impacts on local commuters (particularly on the tarred Aggeneys Road). In general, vehicle speeds shall not exceed 40km/h along dust roads or 20km/h when traversing unconsolidated and non-vegetated areas. See Section 5.9 on dust control for further mitigations in this regard.

Vehicles leaving site must be free from excess mud on the wheels and underside of the vehicle. Every effort should be made to brush this excess mud off with a hard brush/broom before water is used for this purpose.

As required by SANRAL, a visual inspection of the existing Aggeneys / N14 intersection must be undertaken by a road engineer prior to and post construction.

During the construction & delivery period, landowners and land-occupiers along the access route must be informed of the expected extent and duration of the increase in traffic. The engineer must keep a photographic record of the condition of the road prior to the increase in heavy construction vehicles. If any damage is caused to the road by the delivery traffic, the contractor should be responsible for the reinstatement.

It is recommended that construction activities be confined to **normal working hours** (08:00 - 17:00 on workdays). Should the Contractor / Engineer wish to deviate from these work hours, this must be discussed during the Pre-Construction / Initial Environmental Compliance Workshop with the ECO and recorded in the necessary Method Statements.

5.4 CONCRETE MANAGEMENT

Proper concrete management is of utmost importance. Concrete works are likely to be limited to the construction of the on-site sub-station and auxiliary buildings, and are not likely to be extensive (the preferred alternative for the panel support structures will make use of a technology that does not require concrete footings, due to rammed piers/earth screws/rock anchors).

Cement powder has a high alkaline pH that may contaminate and adversely affect both soil pH and water pH negatively. A rapid change in pH can have consequences on the functioning of soil and water organisms, as well as on the botanical component.

The use of ready-mix trucks delivering concrete directly to site is recommended. Mass batching of concrete on site should be limited as far as possible.

The following must be implemented regarding the delivery of concrete to site:

- Trucks should deliver pre-mixed concrete to the site and pour the concrete directly into the prepared excavations.
- When concrete trucks have unloaded, there is a requirement to wash out the inside of the concrete drum. Water can be provided to the trucks for this purpose (at the discretion of the contractor). Concrete suppliers may **NOT** dispose of this wash water anywhere on site. Trucks should return to their depot for this purpose; and
- Any spillages of concrete outside of the excavations (including haulage routes) must be cleaned up immediately by the supplier.

Where small batching of concrete or plaster takes place on site, the following must be implemented:

- Concrete batching may only take place in areas approved by the ECO (preferably in the Site Camp);
- Concrete mixing areas must have bund walls or a settling pond in order to prevent cement run off;
- Once the settling ponds dry out, the concrete must be removed and dispatched to a suitable disposal site. Ideally, all concrete batching should take place on an area that is to be hard surfaced as part of the development (building floor, road or paved area);
- In order to avoid resource contamination, concrete batching should not be located within 60m of a drainage line / watercourse, within a watercourse flood plain, near a wetland area or where there is a potential for any spilled concrete to enter a watercourse or groundwater (boreholes).
- If an area outside of the site camp is identified for batching it must first be approved by the ECO and all topsoil must be stripped and stockpiled for re-use.
- Batching at satellite sites must be done on a batching plate i.e. wood or metal sheet, to prevent soil contamination.

5.5 CABLE TRENCHES

Electric cables required to connect the PV Panels to the on-site substation within the boundaries of the Boesmanland Solar Farm development area will be installed underground, **within or parallel to the internal road network and/or paths between the panel rows**, as far as possible.

Cable trench excavation, cable laying and backfill must be carried out in a systematic and continuous operation, **minimising the length of trench open at any one time** in order to reduce the risk of runoff. Cable trenches must be backfilled in such a manner as to prevent the trench from acting as a ditch or a conduit for water flow. In this regard, cable trenches, as with the internal road network, should follow the contours of the land as far as possible.

The following measures must be implemented by the contractor:

- Trenching shall be kept to a minimum through the use of single trenches for multiple service provision;
- The planning and selection of trench routes shall be undertaken in liaison with the ER and cognisance shall be given to minimising the potential for soil erosion;
- Trench routes with permitted working areas shall be clearly defined and marked with prior to excavation;
- The stripping and separation of topsoil and subsoil shall occur as stipulated by the ER. Soil shall be stockpiled for use as backfilling as directed by the ER with input from the ECO;
- Trench lengths shall be kept as short as practically possible before backfilling and compacting;
- Trenches shall be backfilled to the same level as (or slightly higher to allow for settlement) the surrounding land surface to minimise erosion. Excess soil shall be stockpiled in an area approved by the ER with input from the ECO;
- Stockpiled topsoil must be replaced at the top of excavated trenches; and
- The ER with input from the ECO may require the planting of additional vegetation along trench routes in order to speed up rehabilitation (particularly in areas that may be prone to erosion).

5.6 OVERHEAD TRANSMISSION LINE

Electricity transmitted to the on-site step-up substation will be transmitted via new overhead transmission power line to the existing Aggeneis Eskom substation, located approximately 5.3km south-east of the development site. The proposed distribution line will run parallel with the existing 220kV transmission line running between the Aggeneis substation and Harib (along the south-western boundary of the proposed solar development area). The existing line has a registered servitude of 47m (23,5m on either side). The minimum separation distance between this line and the proposed line is 32m. The **proposed line will thus run parallel to the existing 220kV Eskom line, with a separation distance of approximately 50m between them**. The installed length of the new power line should be kept to a minimum.

Collisions and electrocution of birds from power-line infrastructure are significant causes of mortality for bustards, flamingos, eagles and vultures. The construction of new power lines is therefore a potentially significant source of impact for these species. These impacts can to a large degree be mitigated by configuring the infrastructure in a bird-friendly manner, **fitting bird flappers to the new line to reduce collisions, as well as insulating the live infrastructure to avoid electrocution**. Although the solar development area is just outside one of Birdlife South Africa's Important Bird Areas, the eastern section of the site falls within an Important Bird Area, which is related to the presence of the endemic Red Lark *Calendulauda burra* in the area (Birdlife International 2012).

5.7 MANAGEMENT OF ARCHAEOLOGICAL RESOURCES

From a heritage, archaeological and paleontological perspective, there would be no inhibitors to construction of the Boesmanland solar facility. The archaeologist, Smith (2012) stated that the distinct lack of any concentration of cultural material across the property implies that this is not a rich archaeological environment. However the **inselbergs / koppies** outside the solar development area have been identified as potentially sensitive archaeological areas, and should be avoided during construction activities. In addition, dense **quartz scatter** areas must be avoided during the period of construction as far as possible. The dense scatters of white quartz stand out (white stones), so they are easily recognisable. The **Environmental Control Officer should be made**

aware of the potential occurrence of archaeological resources associated with these koppies and quartz patches, so that they can be safeguarded during construction

Should any archaeological and/or paleontological remains, including (but not limited to) fossil bones, fossil shells, coins, indigenous ceramics, colonial ceramics, marine shell heaps, stone artefacts, bone remains, rock art, rock engravings and any antiquity be discovered during construction, the ECO should safeguard these (preferably *in situ*) and report the find immediately to the South African Heritage Resources Council (SAHRA) and the Northern Cape Heritage Resources Authority (NCHRA), so that they are not disturbed further until the necessary guidance and approval have been obtained and the appropriate action (*e.g.* recording, sampling or collection) can be taken by a professional archaeologist or palaeontologist.

5.8 NOISE MANAGEMENT

Although the proposed development is located outside the urban edge, the following noise management requirements are applicable to the construction phase of the Boesmanland Solar Farm:

- It is recommended that noise generation be kept to a minimum and that construction activities be confined to normal working hours (08:00 - 17:00 on workdays). Should the Contractor / Engineer wish to deviate from these work hours, this must be discussed during the Pre-Construction / Initial Environmental Compliance Workshop with the ECO and recorded in the necessary Method Statements;
- Provide baffle and noise screens on noisy machines as necessary;
- Provide absorptive linings to the interior of engine compartments;
- Ensure machinery is properly maintained (fasten loose panels, replace defective silencers);
- Switch off machinery immediately when not in use; and
- Reduce impact noise by careful handling.

The Contractor shall be responsible for compliance with the relevant legislation with respect to noise *inter alia* Section 25 of ECA (73 of 1989) and standards applicable to noise nuisances in the Occupational Health and Safety Act (No. 85 of 1993).

5.9 DUST CONTROL & MANAGEMENT

Every effort to minimize dust pollution on the site must be undertaken. The contractor must implement the following measures with regards to the management of dust on site:

The most important dust control measure is achieved by maintaining as much of the vegetative cover as possible (the method of securing panels with minimal excavations supports this measure). The recommendations made with regards to the demarcation of no-go areas are important in this regard.

- Construction vehicles must adhere to speed limits and minimization of haul roads must be implemented;
- During dry, dusty periods haul roads should be kept dampened to prevent excess dust. No potable water may be used for damping haul roads;
- All vehicles used to deliver or remove loose material (sand, soil, gravel etc.) to and from site must be covered with a 60% shade cloth to avoid dust blowing from the vehicle.
- As an alternative, products such as Road Environment Dust Suppressants (REDS) would be recommended in order to minimize the use of water to control dust pollution. This is to be determined by the ECO during construction as required; and

- Exposed stockpile materials must be adequately protected against wind (covered), and should be sited in consideration of the prevailing wind conditions.

Apart from those measures detailed above, the following additional measures must be implemented:

- Dust nuisances shall comply with the applicable standards according to the Occupational Health and Safety (Act No. 85 of 1993)The contractor shall be solely responsible for the control of dust arising from the contractor's operations and for any costs against the Employer for damages resulting from dust;
- The contractor shall take all reasonable measures to minimise the generation of dust as a result of construction activities to the satisfaction of the Engineer's Representative (ER);
- Removal of vegetation shall be avoided until such time as soil stripping is required and similarly exposed surfaces shall be re-vegetated or stabilised as soon as is practically possible;
- Excavation, handling and transport of erodible materials shall be avoided under high wind conditions or when a visible dust plume is present;
- During high wind conditions the site manager, with input from the ECO, must evaluate the situation and make recommendations as to whether dust damping measures are adequate, or whether work should cease altogether until the wind speed drops to an acceptable level.
- Where possible, soil stockpiles shall be located in sheltered areas where they are not exposed to the erosive effects of the wind. Where erosion of stockpiles becomes a problem, erosion control measures shall be implemented at the discretion of the site manager.
- Vehicle speeds shall not exceed 40km/h along dust roads or 20km/h when traversing unconsolidated and non-vegetated areas.
- Appropriate dust suppression measures shall be used when dust generation is unavoidable, e.g. dampening with water or use of REDS, particularly during prolonged periods of dry weather in summer. Such measures shall also include the use of temporary stabilising measures (e.g. chemical soil binders, straw, brush packs, clipping etc.).
- Straw stabilisation shall be applied at a rate of one bale per 10m² and harrowed into the top 100mm of top material for all completed earthworks (i.e. all those areas that are not hard surfaced as part of the Solar Facility). This is only relevant to areas disturbed through the construction activities (such as cable trenches) and not areas where vegetation remains intact.
- Should water be used for dust suppression on gravel roads, it must be of a quality compliant with the General Special Effluent Standards (31/03/2009): Temperature: max.25^{0}C, pH: between 5.5 & 7.5 and conductivity: not be increased more than 15% above the intake water & not exceed 250 milli-Siemens per metre (determined at 25^{0}C). The water used for dust suppression is likely to be borehole water / water from Southern Farms, and not treated effluent. However the water quality standards mentioned will be taken note of.

5.10 SECURITY FENCING

During construction it may be necessary to fence in the Contractor's Site Camp (to avoid theft of construction equipment and materials) and the PV Laydown Area/s (to avoid theft of the solar panels and associated infrastructure). These temporary fencing will be restricted to these areas and be removed at the end of the construction phase. The completed solar facility will be fenced with a permanent parameter electrified fence in order to prevent theft of infrastructure during operation. Recommendations made by the ecologist applicable to the erection of this permanent fence are as follows:

- The fencing should be constructed in manner which allows for the passage of small and medium sized mammals, at least at strategic places, such as along drainage lines or other

areas of dense vegetation. Steel palisade fencing (20cm gaps minimum) is a good option in this regard as it allows most medium-sized mammals to pass between the bars, but remains an effective obstacle for humans. Alternatively, the lowest strand or bottom of the fence should be elevated to 15 cm above the ground at least at strategic places to allow for fauna to pass under the fence.

- Electrified strands should not be within 20cm of the ground, because tortoises retreat into their shells when electrocuted and eventually succumb from repeated shocks.
- Only the facility itself should be fenced-off.
- Any security lighting associated with the fencing should be kind to a minimum and be of the low-UV emitting kind that attracts less insects.

The final fencing plan should be submitted to the ECO for comments and approval.

5.11 BLASTING

Due to the fact that the PV panel mountings will be drilled / rammed into the earth and will thus not require extensive excavation for foundations, it is unlikely that blasting will be required. Should blasting however be required, the following measures must be implemented:

- No blasting may take place within 50m of a borehole without approval of a suitably qualified engineering geologist. Preventative mitigation actions could include installing PVC casing and screens in potentially affected boreholes before blasting, while damaged boreholes will have to be re-drilled (this scenario is however highly unlikely, as blasting will probably not take place);
- A current and valid authorisation shall be obtained from the relevant authorities and copied to the ER prior to any blasting activity;
- A method statement shall be required for any blasting related activities;
- All laws and regulations applicable to blasting activities shall be adhered to at all times;
- A qualified and registered blaster shall supervise all blasting and rock splitting operations at all times;
- The contractor shall ensure that appropriate pre-blast monitoring records are in place (i.e. photographic and inspection records of structures in close proximity to the blast area);
- The contractor shall allow for good quality vibration monitoring equipment and record keeping on site at all times during blasting operations;
- The contractor shall ensure that emergency services are notified, in writing, a minimum of 24 hours prior to any blasting activities commencing on site;
- The contractor shall take necessary precautions to prevent damage to special features and the general environment, which includes the removal of fly-rock. Environmental damage caused by blasting / drilling shall be repaired at the contractor's expense to the satisfaction of the ER and the ECO;
- The contractor shall ensure that adequate warning is provided immediately prior to all blasting. All signals shall also be clearly given;
- The contractor shall use blast mats for cover material during blasting. Topsoil may not be used as blast cover;
- During demolition, the contractor shall ensure, where possible, that trees in the area are not damaged;
- Appropriate blast shaping techniques shall be employed to aid in the landscaping of blast areas, and a method statement to be approved by the ER, shall be required in this regard; and
- At least one week prior to blasting, the relevant occupants/owners of surrounding land shall be notified by the contractor and any concerns addressed. Buildings within the potential

damaging zone of the blast shall be surveyed, preferably with the owner present and any cracks or latent defects pointed out and recorded either using photographs or video. Failing to do so shall render the contractor fully liable for any claim of whatsoever nature, which may arise. The contractor shall indemnify the employer in this regard.

5.12 RAMMING OPERATIONS

It is envisioned that ramming will be the preferred method of installing the panel support structures. The following measures must be implemented in this regard. Please refer to the engineering report for further detail in this regard.

- The contractor shall submit a method statement detailing his proposals to prevent pollution (from hydraulic fluids, fuel or oil leaks) during ramming operations. This shall be approved by the ER (with input from the ECO) prior to the onset of any ramming operations;
- The contractor shall take all reasonable measures to limit dust generation as a result of ramming operations (also see Section 5.9 addressing management of dust);
- Noise and dust nuisances shall comply with the applicable standards according to the Occupational Health and Safety (Act No. 85 of 1993);
- Any areas or structures damaged by the ramming and associated activities shall be rehabilitated by the contractor to the satisfaction of the ER with input from the ECO.

5.13 STORMWATER MANAGEMENT & EROSION CONTROL PLAN

Although the proposed development site is not steep, the ecological specialist, Todd (2012) identified erosion as being one of the major environmental concerns associated with the construction of the Boesmanland Solar Farm. However, provided that reasonable mitigation measures to reduce erosion are implanted, then the development of the site as a solar energy facility is not likely to result in long-term degradation of the receiving environment or significant net loss of biodiversity.

Stormwater management is covered under the construction phase management, but aspects thereof will also be **applicable to the Operational Phase**. It is important that the engineers responsible for the detailed design of the Stormwater Systems must take requirements of this EMPr into consideration, as well as the recommendations by the participating specialists.

Due to the extremely low annual rainfall experienced in the Aggeneys area, the risk of water erosion is relatively low. The ground condition in the Aggeneys area is such that any surface water is very quickly absorbed into the soil, which avoids water build up on the surface and practically eliminates any water flow which might cause water erosion. **Wind erosion** is highlighted as a potential significant concern in the areas of red sands, which are stabilized by natural vegetation, but could become mobilized if the vegetation is disturbed.

The preferred method of installing the panel mounting structure via ramming / drilling results in a small disturbance footprint, and thus **allows arrays to be constructed over the wash lines and high sensitivity areas**, while having a minimal effect on the vegetation, mitigating the chances of erosion. It is however important to recognise that any plant removal and soil disturbance during construction may result in erosion. In addition, the presence of the solar arrays, buildings and associated hard surfaces would potentially generate a large amount of runoff, which could impact the drainage patterns of the site and increase the risk of erosion. This may impact downstream riparian and wetland habitats if a lot of silt enters the drainage systems. Although the effects would probably only become apparent during the operational phase, the impact stems from the construction phase and suitable mitigation measures will also need to be applied at this stage.

Cumulative impacts relating to erosion would only occur if alien plants are not controlled and if regular erosion monitoring and timeous rectification methods are not applied.

All buildings must be fitted with guttering to **capture all rainwater runoff off roofs to be stored in rainwater tanks**. Stormwater which cannot be captured via this system will be channelled into energy dissipating structures to spread the water and slow it down to allow infiltration into the soil and reduce the risk of erosion. Such dissipation structures may be temporary or permanent and be either moulded from precast concrete, loosely packed rock or perforated bags filled with stone.

Rainfall onto the solar panels will be welcomed due to its cleaning effect. The panel surfaces will be installed at a relatively high incline with gaps between panels, which will reduce the energy of falling raindrops, while avoiding water build up on the panel surfaces. In addition, the tracking system on which the panels will be mounted, will ensure that raindrops leaving the solar panel surfaces will not drop onto the same ground surface / area all this time.

The following requirements/recommendations must be considered/implemented for stormwater management and erosion control (as well as those details under Topsoil Handling (Section 5.2), Cable Trenching (Section 5.5) and Dust Control & Management (Section 5.9) above, as well as Protection of Hydrological Resource (Section 5.14) and the Rehabilitation Plan (Section 5.20):

- Particularly on the **red sands and drainage lined on the site** - precautions should be taken to avoid excessive disturbance and re-vegetation should take place as soon as possible after construction to avoid wind erosion;
- Wherever possible, roads and tracks should be constructed so as to **run along land contours**;
- All roads and tracks running down the slope must have **water diversion structures** present to redirect runoff and dissipate the energy of the water so as to reduce erosion potential;
- Sections of the access and internal road network that are to cross these minor drainage line, should do so by way of **Low-Level-River-Crossing structures** (causeways or drifts);
- Any extensive cleared areas that are no longer or not required for construction activities should be **re-seeded with locally-sourced seed of locally-occurring indigenous species**. Bare areas can also be packed with brush removed from other parts of the site to encourage natural vegetation regeneration and limit erosion;
- All **construction vehicles should remain on properly demarcated roads**. No construction vehicles should be allowed to drive over the vegetation except where no cleared roads are available. In such cases a single track should be used and multiple paths should not be formed;
- A **method statement** shall be developed and submitted to the engineer to deal with erosion mitigation and prevention prior to bulk earthworks operations commencing.
- The concentration of stormwater run-off must be avoided at all costs;
- All storm water **runoff drains** alongside the access road and internal road network which may channel runoff into nearby drainages must be constructed with “erosion-proof” outlets as designed by the engineer with input from the ECO – the engineer is to determine whether formal drainage is in fact necessary;
- During construction the contractor shall protect areas susceptible to erosion by installing **necessary temporary and permanent drainage works**, as well as anti-erosion measures in areas susceptible to erosion (drainage line and dune areas) as soon as possible and by taking other measures necessary to prevent the surface water from being concentrated in streams and from scouring the slopes, banks or other areas.
- Any **erosion channels** that develop during the construction period or during the vegetation establishment period shall be backfilled and compacted and the areas restored to a proper condition.

- The principles of **sustainable urban drainage systems** should be followed for all panel footings and hard surfaces, namely:
  - the runoff should not be concentrated by piped systems or similar, and
  - runoff should preferably be directed towards soak-aways or depressions in the ground.
- No goods, building material or equipment shall be stored in proximity to the washes / drainage lines;
- Protective measures must be installed where there are possibilities of surface water sheet flow causing erosion (compacted areas etc.);
- **Stabilisation of cleared areas to prevent and control erosion** shall be actively managed. The method of stabilisation shall be determined in consultation with the ECO and the ER. Consideration and provision must be made for the following methods (or a combination thereof):
  - Brush cut packing and/or mulch or chip cover;
  - Straw stabilising;
  - Watering;
  - Re-vegetation and/or sodding;
  - Hand seed-sowing and/or hydro seeding of locally-occurring indigenous species (see plant species list attached);
  - Soil binders and anti-erosion compounds;
  - Gabion bolsters & mattresses for flow attenuation;
  - Geofabric and/or hessian covers;
  - Log / pole fencing.
- Traffic and movement over stabilised areas shall be restricted and controlled and damage to stabilised areas shall be repaired and maintained to the satisfaction of the ECO.
- Anti-erosion compounds consist of all organic or inorganic material to bind soil particles together, and shall be environmentally friendly and effective products able to suppress dust and erosion. The application rate shall conform to the manufacturer's recommendations. The material used shall be approved by the ER with input from the ECO.
- During operation, regular monitoring for erosion must be undertaken (particularly in the drainage line and red dune areas) to ensure that no erosion problems are occurring at the site as a result of the roads and other infrastructure. All erosion problems observed should be rectified as soon as possible;
- All maintenance vehicles to remain on the demarcated roads.

5.14 PROTECTION OF HYDROLOGICAL RESOURCES

There are no significant / large drainage lines within the proposed development area itself, although these features are present to the south east of the development property in association with the Mine. Due to the high infiltration capacity of the dune sands which characterize a large proportion of the solar site, there are few minor drainage lines within the proposed development area. These drainage lines have their origin in the rocky hills outside of the site, and are generally wide and open, with a flat sandy bed.

The following requirements are applicable to the protection of the minor drainage lines (please refer to Section 5.13 above as well):

- Sections of the access and internal road network that are to cross these minor drainage line, should do so by way of **Low-Level-River-Crossing structures** (causeways or drifts);
- Apart from within the PV development area (as per the preferred layout plan) where the developer intends installing solar arrays to span over the minor drainage lines, drainage lines and other no-go areas should be demarcated at the site by an ecologist as no-go areas, as part of the pre-construction activities for the site;

- The parameter fencing should be constructed in manner which allows for the passage of small and medium sized mammals, at least at strategic places, such as along drainage lines;
- Implement practices to reduce water use during construction;
- Any wastewater generated during construction should be discharged to a temporary holding tank for disposal, and not into the drainage lines. The method of disposal of construction wastewater must be approved by the ECO;
- The spillage of fuels, lubricants and other chemicals should be prevented by providing bunded and impervious storage areas, located well away from the drainage lines;
- Temporary and permanent ablution / sanitation facilities may not be located in proximity to the on-site drainage line;
- During Operation the drainage lines within the solar facility must be regularly inspected and any impediments / obstructions removed immediately to allow natural water flow beneath the installed solar frames.
- In terms of the protection groundwater resource infrastructure, no blasting may take place within 50m of any borehole without approval of a suitably qualified engineering geologist.

5.15 FIRE MANAGEMENT AND PROTECTION

As mentioned above in Section 3.5 above, it is the landowner's responsibility to develop and maintain firebreaks as well as be sufficiently prepared to combat veld fires.

The solar development site is arid, with sparse vegetation cover and fires are not a natural phenomenon in the area. However, under exceptional circumstances, such as following years of very high rainfall, sufficient biomass may build up to carry fires. Therefore, management of plant biomass within the site should be part of the management of the facility. Grazing by livestock is the simplest and most ecologically sound way to manage plant biomass and is recommended the preferred method to manage plant biomass at the site. Alternative management practices include brush-cutting.

The following points must however be considered with regards to fire protection on site:

- Fires should **only be allowed within fire-safe demarcated areas** (preferably within the site camp);
- **No fuelwood collection** should be allowed on-site;
- The **total removal of all invasive alien vegetation** should take place in order to decrease the fire risk – Although there were no invasive plants identified at this stage, these may establish to a degree as a result of site disturbance;
- Cigarette butts may not be thrown in the veld, but must be disposed of correctly. The contractor, with input from the ECO, must **designate smoking areas** (in compliance with the Tobacco Products Control Amendment Act 63 of 2008) with suitable receptacles for disposal;
- In case of an emergency, the **contact details of the local fire and emergency services** must be readily available;
- Contractors must ensure that **basic fire fighting equipment and suitably qualified/experienced personal** are available on site at all times, as per the specifications defined by the health and safety representative / consultant;
- The fire risk on site is a point of discussion that must take place as part of the pre-construction compliance workshop and the environmental induction training prior to commencement of construction; and
- The contractor must also comply with the requirements of the Occupational Health and Safety Act with regards to fire protection.

5.16 SANITATION DURING CONSTRUCTION

Portable chemical ablution facilities must be made available for the use by construction staff for the duration of the construction period. The following must be implemented in this regard:

- Toilet and washing facilities must be available to the site personnel at all times;
- These facilities must be situated within the site camp;
- One toilet for every 15 personnel is required;
- The facilities must be serviced on a regular basis to prevent any overflow or spillage;
- The servicing contractor must dispose of the waste in an approved manner (e.g. via the municipal waste water treatment system);
- The ECO must be provided with the service providers' details and the service schedule for the site;
- The toilets should be secured to ensure that they do not blow over in windy conditions;
- All toilet facilities must be removed from site on completion of the contract period, and;
- Should the construction period be interrupted by a builders break, the toilets should be emptied prior to the break.

Sanitation during operation is discussed above in Section 4.7.

5.17 FUEL STORAGE & WASTE MANAGEMENT

The above ground storage of fuel is subject to authorization in terms of the National Environmental Management Act (NEMA as amended 2006) if more than 30m³ is stored on site at any one time.

Should a temporary storage of hazardous or toxic materials / liquids (chemicals, fuels, lubricants and oils) be required, the Contractor must ensure that he/she complies with legislation and that the following measures are in place:

- Temporary fuel storage must take place within the contractors site camp in an area approved by the ECO;
- No storage of fuel may take place on any other portion of the site;
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up immediately in the appropriate manner, as related to the nature of the spill.
- Mobile fuel units used to refuel plant on site must make use of drip trays when refuelling;
- Storage facilities may not be located within 60m of a the on-site drainage lines or where there is a potential for any spilled fuel to enter a watercourse or groundwater;
- Fuel storage facilities should be located on flat ground. No cut and fill should take place immediately on or adjacent to fuel storage areas;
- All storage tanks should be double lined and be ISO 9001 certified;
- All storage tanks must be enclosed by bund walls;
- Bund walls must be constructed to contain at least 110% of the total capacity of the storage tanks;
- Bund walls must be constructed of impermeable material or lined to ensure that petroleum products cannot escape;
- A suitable material should be placed in the base of the bund walls to soak up any accidental spillages;
- The tanks should be locked and secured when not in use;
- Automatic shut-off nozzles are required on all dispensing units;
- Storage tanks should be drained within one week of completion of activities (only unused fuel can be used by the contractor on other work sites or returned to the supplier). If the

construction program extends over the Christmas shutdown, the contractor must ensure that storage tanks are emptied prior to this period;
- All storage tanks, containers and related equipment should be regularly maintained to ensure safe storage and dispensing of material. The Engineer is to sign off on the condition and integrity of the storage tanks;
- Defective hoses, valves and containment structures should be promptly repaired;
- Vehicle and equipment fuelling should be undertaken on a hard impermeable surface, over drip pans or bund walls to ensure spilled fuel or toxic liquids is captured and cleaned up, and;
- The area must be totally rehabilitated on completion of the contract and all contaminated material must be carefully removed and disposed of at a licensed dumping site for that purpose.

5.17.1 Construction Waste Management

Litter management

Wind and scavenger proof bins must be installed at the Contractor Site Camp and must be emptied on a weekly basis.

Construction Rubble and Waste

All construction rubble must be disposed of at an approved site established and registered for this purpose (no construction rubble may be spoiled anywhere on site). NO construction rubble may be used as fill in landscaping or any other areas on site.

Scrap Metal

Recycling of scrap metal is recommended. Scrap metal must be disposed of off-site at suitable facilities (e.g. municipal dump registered for this purpose).

Hazardous Waste

All hazardous waste (including chemicals, bitumen, fuel, lubricants, oils, paints etc.) shall be disposed of at an approved / registered hazardous-waste landfill site. The Contractor shall provide disposal certificates to the ECO.

Used oil and grease must be removed from site to an approved used oil recycling company.

Under NO circumstances may any hazardous waste be spoiled on the site.

Where possible, the maintenance of construction and delivery vehicles should take place off-site.

5.18 THEFT AND OTHER CRIME

An increase in crime during the construction phase is often a concern. In the case of the Boesmanland Solar Farm, this is likely to be negligible due to the extremely remote nature of the site. Theft and other crime associated with construction sites is not only a concern for surrounding residents, but also the developer and the contractor. Considering this, contractors need to be proactive in order to curtail theft and crime on and resulting from the construction site. It is recommended that the contractor develop a **jobsite security plan** prior to commencement of construction. This jobsite security plan should take into account protection of the construction site from both internal and external crime elements, as well as the protection of surrounding communities from internal crime elements. All incidents of theft or other crime should be reported the South African Police Service, no matter how seemingly insignificant. A copy of the jobsite **security plan should be included in the first environmental control report to be submitted to the competent authority.**

It is likely that the Contractor's Site Camp and the PV Laydown area/s will be fenced with a temporary fence to avoid theft during construction. Additional security measures during construction will include cctv camera surveillance and one/two security guards.

The following considerations are relevant in this regard (refer to Section 5.10 above details of the facility permanent fencing):

- All portable construction equipment and material must be locked away within the Contractor's Site Camp overnight and during holiday periods;
- Fuel storages tanks must be locked when not in use;
- All unassembled / un-installed PV materials must be locked within the fenced Laydown areas overnight and during holiday periods.
- The minimum amount of lighting should be used at night and this should be of the low-UV emitting kind that attracts less insects.

It must be noted the **collection, hunting or harvesting of any plants or animals** at the site is strictly forbidden, and thus any person found undertaking any of these actions will be considered guilty of committing a crime. Any incidents of such crimes on nature must be reported to the ECO immediately.

5.19 VEGETATION CLEARING & PLANT RESCUE PLAN

5.19.1 Vegetation Clearing

The objective of mitigation for any development is to firstly avoid and minimise impacts where possible and where these cannot be completely avoided, to compensate for the negative impacts of the development on vegetation and animal habitats, and to maximise re-vegetation and rehabilitation of disturbed areas. Some loss of vegetation is an inevitable consequence of the development of the Boesmanland Solar Farm and vegetation clearing required for the PV panel laydown area, roads, buildings etc. could impact listed plant species, as well as high-biodiversity plant communities. Vegetation clearing will also lead to habitat loss for fauna and potentially the loss of sensitive faunal species, habitats and ecosystems.

A number of nationally and provincially protected species occur within the site, including *Hoodia gordonii, Boscia foetida* and several *Euphorbia* species (see photos in Section 15). A preconstruction survey of the final development footprint will need to be conducted to ascertain the identity and exact number of individuals of protected species affected by the development.

The following recommendations apply to vegetation clearing activities for the solar facility:

- A single integrated permit, which covers the removal of nationally or provincially listed species permitting requirements, as well as meets TOPS regulations, must be obtained from the Northern Cape Department of Environmental Affairs & Nature Conservation (DEANC) permit office in Kimberly prior to the any vegetation removal or plant translocation activities;
- Vegetation clearing must be kept to a minimum. If possible, the ground grass layer should be left intact and only the larger woody plants cleared or trimmed. All areas to be cleared should be clearly demarcated, prior to the commencement of clearing activities;
- Vegetation cleared / removed as part of the site clearing activities must be stockpiled for use during the re-vegetation and rehabilitation stage for brush-packing. The location of the vegetation stockpile can be in the same area as the topsoil stockpile, as designated in consultation with the ECO;
- Only those individuals of protected plant species directly within the development footprint should be cleared. Those which can be safely left intact (e.g. below or between the solar panel arrays) must not be disturbed;

- Any vegetation clearing that needs to take place as part of maintenance activities (during construction and operation phases) should be done in an environmentally friendly manner, using the most effective methodology suited to the target species (herbicides and/or manual clearing).

5.19.2 Plant and Animal Rescue & Protection

Considering the relatively high number of national and provincially protected plant species that may occur within the solar development area, a search and rescue operation for protected species, which could survive translocation such as *Hoodia*, *Euphorbia* and *Aloe,* should be conducted prior to construction (see Section 15 for photographs on important spcies) .

The abovementioned integrated permit application, to be obtained from the DEANC office, must make provision for the translocation of the abovementioned listed plant species.

Rescue operations should ensure that translocatable plant species are carefully removed from the ground with their root systems intact, before being translocated and planted to a similar habitat outside the development footprint, as designated in consultation with the ecological specialist and ECO.

Any animals (including snakes, tortoises and lizards) directly threatened by the clearing or construction activities should be removed to a safe location outside of the construction area by the ECO or other suitably qualified person.

5.20 RE-VEGETATION & HABITAT REHABILITATION PLAN

Re-vegetation and rehabilitation activities should commence at the end of the construction phase and continue into the operation phase. A rehabilitation plan must be developed within 6 months of commencement of construction and must define the rehabilitation of natural areas in the construction, operation, as well as decommissioning phases of the project. This rehabilitation plan must be developed by a suitably experienced consultant in consultation with the ecological specialist and ECO. This plan must include a detailed programme / action timeframes for the implementation of the rehabilitation plan.

This rehabilitation plan should also take the climatic and area-related water-restrictions into account, as well as conditions of the authorisation, the provisions of this EMPr and the recommendations made by all participating specialists.

The plan must make provision for the rehabilitation of all areas of the site not affected by the proposed solar facility and the long term maintenance thereof. This plan must include the following recommendations, which should be updated based on site conditions and construction progress at the time:

- Bare soil should be kept to a minimum, and at least some grass or low shrub cover should be encouraged under the panels, and surrounding auxiliary buildings;
- Areas of the red sands on the site are particularly prone to wind erosion, and thus precautions should be taken to avoid excessive disturbance. **Any cleared areas within the development footprint that are no longer or not required during construction** activities should covered be with a layer of topsoil (from the topsoil stockpile) and be **brush-packed with vegetation from the vegetation stockpile** (see Section 5.19 above) and/or re-seeded with locally-sourced seed of suitable species. Brush-packing with locally cleared indigenous vegetation will allow local plant seed to enter the topsoil and allow the re-establishment / re-generation of vegetation on these bare areas, as well as limit erosion (see Section 5.13 above for further details);

- The verges of completed roads and tracks must be covered with a layer of topsoil and brush-packed to encourage vegetation re-generation and limit erosion;
- Regular monitoring for erosion must be conducted across the site (particularly near constructed roads and infrastructure) to ensure that no erosion problems are occurring. Rectification of erosion problems should include the brush-packing and re-vegetation methods as far as possible;
- Due to the remote nature of the facility the screening of the facility with vegetation to minimise visual impacts / intrusion is not deemed necessary;
- Regular monitoring to ensure that alien plants do not establish or increase as a result of the disturbance.

5.21 ALIEN PLANT MANAGEMENT PLAN

As confirmed by the ecological specialist (Todd, 2012), the abundance of alien plant species at the solar development site is very low, which can be ascribed firstly to the aridity of the site, as well as the low rainfall in the area.

Disturbance created at the site during construction could leave the site vulnerable to alien plant invasion. The invasion of alien vegetation could result in the decrease in biodiversity of indigenous species, as well as affect ecosystem function and hydrology, especially in cases where species such as *Prosopis* reach dense levels of infestation (see attached annexure for photograph and description of this alien species for easy identification).

The following recommendations apply to the management of alien vegetation:

- Soil disturbance and vegetation clearing should be kept to minimum i.e. bare soil should be kept to a minimum and at least some grass or low shrub cover should be encouraged under the panels.
- Cleared areas that are not going to be used should be brush-packed with indigenous vegetation (clearing and stockpiled during site preparation activities) and/or re-vegetated with indigenous species.
- Regular monitoring must be conducted to ensure that alien plants are not establishing or increasing as a result of the disturbance that has taken place. Monitoring and alien clearing programme / timeframes should be as follows:
  - 8 months after start of construction;
  - Follow-up at 3 months before end of construction, and then
  - Once annually during the operation phase.
- All alien plants found to be present at the site should be controlled using the best practice methods for the specific species present, as determined with guidance from the ecological specialist and ECO.

5.22 OPEN SPACE MANAGEMENT PLAN

The solar facility development has been designed to be as concentrated / condensed as possible to keep it as small as is viably possible, and thereby limit the disturbance area associated with its construction and operation. As such, there is no open space areas designated within the solar facility footprint.

All areas outside of the solar development footprint however, must be considered as no-go open space areas and avoided, to maintain the integrity of ecological and agriculture resources.

Any impacts arising from within or associated with the development footprint i.e. erosion or invasion of alien vegetation etc., and entering the open space areas outside the solar facility, must

be rectified immediately. The parameter of the solar facility must be monitored on a regular basis to ensure that these impacts are timeously identified and not allowed to re-occur.

6. OPERATIONAL PHASE

The following environmental requirements are to be adopted and implemented during the operation phase:

6.1 PV PANEL MAINTENANCE REQUIREMENTS

Due to their nature, once installed, the photovoltaic panels will not require intensive maintenance other than periodic cleaning, greasing of bearings and inspection. The key maintenance activity is the cleaning / washing of the panels in order to remove dust and maintain optimum power generation.

6.1.1 Cleaning of PV Panels

Any rainfall on the solar panels would be welcomed due to its cleaning effect, but as mentioned before, the annual predicted rainfall is very low. An estimated 10 - 18kl of water per day should be required for the cleaning of solar panels and for other operational phase requirements. This should take place using water from lawful sources on site or from the rainwater collection and storage systems. To further reduce the use of water at the solar facility, the use of alternative panel cleaning methods is also being investigated. The use of use of robotic PV cleaners or high-pressure / compressed air can be considered, should the technology become commercially viable and available during the lifespan of the project.

No detergents may be used for washing purposes. Care should be taken that the wash-water does not cause any erosion.

As mentioned above, it is recommended that bare soil be kept to a minimum and at least some grass or low shrub cover be left intact between tracks and under and between the solar panel arrays and rows.

Indeed, water used in the cleaning process is likely to encourage the growth of natural vegetation around the panel arrays and rows, which will require routine brush-cutting / trimming to avoid vegetation shading the panels, interfering with tracking mechanisms or the risk of fires. Under no circumstances should vegetation beneath or around the panel arrays and rows be cleared / removed entirely, as this will result in significant erosion and associated sand-blasting of infrastructure. Due to stunted nature of the xerophytic vegetation, it is unlikely that this will need to be done often. Biomass produced from these trimming activities could be chipped and used as mulch under the PV panels (to increase stormwater infiltration and reduce erosion).

6.1.2 Other Operation / Maintenance Requirements

- Lubricants used to grease bearing of panel tracking systems should be conservatively used to avoid leakage or spills. Any **leaks or spills** that occur during maintenance operations must be cleaned up immediately and the contaminated soil / material disposed on at a registered disposal site for hazardous materials.
- The **tracks / pathways** (<4m width) between the PV panel rows used for cleaning and maintenance of the panels, should be maintained as single tracks and regularly brush-cut and/or mowed to allow reasonable access.
- **Access roads and the internal road network** must be maintained in a condition that allows for reasonable access and minimised erosion potential. All drainage, stormwater management and erosion control structures must be maintained to ensure their proper functioning.

- **Regular monitoring for erosion** to ensure that no erosion problems are occurring at the site as a result of the roads and other infrastructure. All erosion problems observed should be rectified as soon as possible.
- All maintenance vehicles to remain on the demarcated roads.
- The **septic tank**, associated with the ablution facilities at the on-site sub-station / maintenance buildings, must be maintained in full working condition.
- The **parameter security fence** should be routinely patrolled to ensure that is still allows for the passage of small and medium sized mammals, at least at strategic places (drainage lines etc.), and that the electrified strands are not causing animal electrocution.
- No unauthorized persons should be allowed onto the site.
- The **maintenance on the transmission line infrastructure** must retain the bird-friendly design features (bird-flappers and insulation). Any **bird electrocution and collision events** that occur should be recorded, including the species affected and the date. If repeated collisions occur within the same area, then further mitigation and avoidance measures may need to be implemented.
- Staff present during the operational phase should receive environmental education so as to ensure that that **no hunting, killing or harvesting of plants and animals** occurs.
- All **alien plants present at the site should be controlled** at least annually using the best practice methods for the species present.
- **Bare soil should be kept to a minimum**, and at least some grass or low shrub cover should be encouraged under the panels.
- **No pets** (cats and dogs) should be allowed within the solar facility.

6.2 MAINTENANCE OF HYDROLOGICAL RESOURCES DURING OPERATION

The following management measures associated with the on-site water resources should be implemented during the operational phase of the PV facility:

- The minor drainage lines that traverse the solar facility and are straddled by the solar arrays/rows must be inspected on a regular, routine basis to remove any obstructions which could impede natural water flow or damage the solar infrastructure. Any evidence of erosion found during this inspections must be rectified immediately and the cause of erosion pro-actively sought and remedied to avoid recurrence;
- Implement practices to reduce water use i.e. conservation use of water used to clean panels etc.;
- Any wastewater generated during operation should be disposed of in an efficient septic tank or conservancy tank system and removed to a registered Wastewater Treatment Works on a regular basis; and
- The spillage of fuels, lubricants and other chemicals should be prevented by providing bunded and impervious storage areas. These will however be extremely limited, if any, due to the nature of Photovoltaic Power generation.

6.3 OPERATION WASTE MANAGEMENT

The following items are to be implemented with regard to waste management during the operational phase of the project.

Litter management

Wind and scavenger proof bins must be installed at the maintenance / control buildings and on-site substation and must be emptied on a weekly basis.

Scrap Metal

Recycling of scrap metal is recommended. Scrap metal must be disposed of off-site at suitable facilities.

Hazardous Waste

All hazardous waste (including bitumen, fuel, oils, paints etc.) used during the operation and maintenance of the solar facility shall be disposed of at an approved/registered hazardous-waste landfill site. The Contractor shall provide disposal certificates to the Site Manager.

Used oil and grease must be removed from site to an approved used oil recycling company.

Under NO circumstances may any hazardous waste be spoiled on the site.

Where possible, the servicing of operation/maintenance vehicles should take place off-site.

7. CLOSURE & DECOMMISSIONING PHASE

Within a period of at least 12 months prior to the decommissioning of the site a Decommissioning Method Statement or Plan must be prepared and submitted to the Local Planning Authority (Khai-Ma Municipality), as well as the Provincial and National Environmental Authorities (the Northern Cape Department of Environmental Affairs & Nature Conservation (DEANC) and the Department of Environmental Affairs (DEA)) for input and approval. This method statement must provide detail pertaining to site restoration, soil replacement, landscaping, pro-active conservation, and a timeframe for implementation. Furthermore, this Method Statement / Plan must comply with any legislation and guidelines that may be applicable at the time.

Two possible scenarios are considered for this decommissioning phase, as follows:

7.1 SCENARIO 1: TOTAL CLOSURE & DECOMMISSIONING OF SOLAR FACILITY

If the decision is taken at the end of the project lifespan to totally decommission the solar facility i.e. make the land available for an alternative land use, the following should take place:

- All concrete and solar infrastructure etc. must be removed from the solar site i.e. panels, support structures etc.;
- The holes where the panel support structures are removed must be levelled and covered with subsoil and topsoil;
- Tracks that are to be utilised for the future land use operations should be left in-situ. The remainder of the tracks to be removed (ripped), topsoil replaced and brush-packed to encourage re-vegetation and minimise erosion;
- All auxiliary buildings and access points should be demolished and rubble removed, unless they can be used for/by the future land use. The competent authority may prescribe that the landscaping and underground infrastructure i.e. foundations be left *in situ;*
- The underground electric cables must be removed, if they cannot be used in the future land use;
- All material (cables, PV Panels etc.) must be re-used or recycled wherever possible. Functional panels that still produce sufficient output should be donated to local schools and clinics upon facility closure and decommissioning; and
- The site must be brush-packed, replanted and/or seeded with locally sourced indigenous vegetation (as prescribed by the competent authorities) to allow re-vegetation and rehabilitation of the site (see plant species list attached).

7.2 SCENARIO 2: PARTIAL DECOMMISSIONING / UPGRADE OF SOLAR FACILITY

Should more advanced technology become available it may be decided to continue to use the site as a renewable energy / photovoltaic / solar facility. Should this be the case, it is likely that much of the existing infrastructure will be re-used in the upgraded facility.

All infrastructure that will no longer be required for the upgraded facility must be removed as described in Scenario 1 above. The remainder of the infrastructure should remain in place or upgraded depending on the requirements of the new facility. As described for Scenario 1 above, the function PV panels that are still capable of producing sufficient output, could be donated to local schools and clinics. Any upgrades to the facility at this stage must comply with relevant legislation and guidelines.

8. MONITORING AND AUDITING

Environmental audits are fundamental in ensuring the implementation of the management actions contained within this EMPr, environmental sustainable development and maintenance of the Boesmanland Solar Farm. The number and reporting periods for these environmental audits will likely be prescribed by national Department of Environmental Affairs, should the Boesmanland Solar Farm be authorised.

The results of these audits must be submitted to:

- The operators of the facility;
- The local authority (Khai-Ma Municipality);
- The provincial environmental authority: Department of Environmental Affairs & Nature Conservation (DEANC);
- The national environmental authority: Department of Environmental Affairs (DEA); and
- Eskom.

The results of the audit must be recorded in an environmental audit report and any non-compliance must be formally recorded, along with the response-action required or undertaken. Each non-compliance incident report must be issued to the relevant person(s), so that the appropriate corrective and preventative action is taken within an agreed upon timeframe.

8.1 GENERAL CONSTRUCTION MONITORING

The ECO is responsible for environmental monitoring during construction as per the requirements of this EMPr. The monthly environmental monitoring reports compiled by the ECO, as well as the photographic record of works, must be submitted to the operators of the facility, the local authority, the provincial environmental authority, the national environmental authority and Eskom.

8.2 ADDITIONAL MONITORING REQUIREMENTS DURING OPERATION

The following additional monitoring should be undertaken during the operational phase of the facility:

- Monitoring of washes for obstruction and diversion (any obstructions and diversions should be rectified immediately);
- The emergence invasive vegetation should be monitored. Any invasive vegetation established should be removed immediately.
- Monitoring of overhead lines for bird collisions – All bird collisions must be recorded and reported to the provincial environmental authority and Birdlife Africa;

The first two points should be monitored on a 6 monthly basis and the final point monitored on a bi-weekly basis. The results of this monitoring should be summarised in an annual audit report that should be submitted to the Provincial Environmental Authority and the Local Municipality.

9. METHOD STATEMENTS

Method statements are written submissions by the Contractor to the Engineer and ECO in response to the requirements of this EMPr or in response to a request by the Engineer or ECO. The Contractor shall be required to prepare method statements for several specific construction activities and/or environmental management aspects.

The Contractor shall not commence the activity for which a method statement is required until the Engineer and ECO have approved the relevant method statement.

Method statements must be submitted at least five (5) working days prior to the proposed date of commencement of the activity. Failure to submit a method statement may result in suspension of the activity concerned until such time as a method statement has been submitted and approved.

An approved method statement shall not absolve the Contractor from any of his obligations or responsibilities in terms of the contract. However, **any damage caused to the environment through activities undertaken without an approved method statement shall be rehabilitated at the contractor's cost**.

Additional method statements can be requested at the ECO's discretion at any time during the construction phase.

The method statements should include relevant details, such as:

- Construction procedures and location on the construction site;
- Start date and duration of the specific construction procedure;
- Materials, equipment and labour to be used;
- How materials, equipment and labour would be moved to and from the development site, as well as on site during construction;
- Storage, removal and subsequent handling of all materials, excess materials and waste materials;
- Emergency procedures in case of any potential accident / incident which could occur during the procedure;
- Compliance / non-compliance with an EMPr specification and motivation for proposed non-compliance.

9.1 METHOD STATEMENTS REQUIRED

Based on the specifications in this EMPr, the following method statements are likely to be required as a minimum (more method statements may be requested at any time as required under the direction of the ECO):

- Vegetation clearing & topsoil stripping, and associated stockpiling;
- Hazardous substances declaration of use, handling and storage – e.g. for fuels, chemicals, oils and any other harmful / toxic / hazardous materials;
- Cement and concrete batching;
- Traffic, transport & delivery accommodation e.g. need for traffic diversion/turning circles etc.;
- Solid waste management / control procedures;
- Stormwater and wastewater management / control systems;

- Erosion remediation and stabilisation;
- Fire control and emergency procedures;
- Job site security plan;
- Blasting activities (if necessary);
- Ramming and jack hammering;
- Re-vegetation, rehabilitation and re-seeding.

10. HEALTH AND SAFETY

The Occupational Health and Safety Act (No. 85 of 1993) aims to provide for / ensure the health and safety of persons at work or in connection with the activities of persons at work and to establish an advisory council for occupational health and safety.

The main Contractor must ensure compliance with the Occupational Health and Safety Act, as well as that all subcontractors comply with the Occupational Health and Safety Act.

The following is of key importance (Section 8 of the aforesaid Act):

General duties of employers to their employees

(1) *Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees.*

(2) *Without derogating from the generality of an employer's duties under subsection (1), the matters to which those duties refer include in particular-*

(a) *the provision and maintenance of systems of work, plant and machinery that, as far as is reasonably practicable, are safe and without risks to health;*

(b) *taking such steps as may be reasonably practicable to eliminate or mitigate any hazard or potential hazard to the safety or health of employees, before resorting to personal protective equipment;*

(c) *making arrangements for ensuring, as far as is reasonably practicable, the safety and absence of risks to health in connection with the production, processing, use, handling, storage or transport of articles or substances;*

(d) *establishing, as far as is reasonably practicable, what hazards to the health or safety of persons are attached to any work which is performed, any article or substance which is produced, processed, used, handled, stored or transported and any plant or machinery which is used in his business, and he shall, as far as is reasonably practicable, further establish what precautionary measures should be taken with respect to such work, article, substance, plant or machinery in order to protect the health and safety of persons, and he shall provide the necessary means to apply such precautionary measures;*

(e) *providing such information, instructions, training and supervision as may be necessary to ensure, as far as is reasonably practicable, the health and safety at work of his employees;*

(f) *as far as is reasonably practicable, not permitting any employee to do any work or to produce, process, use, handle, store or transport any article or substance or to operate any plant or machinery, unless the precautionary measures contemplated in paragraphs (b) and (d), or any other precautionary measures which may be prescribed, have been taken;*

(g) *taking all necessary measures to ensure that tire requirements of this Act are complied with by every person in his employment or on premises under his control where plant or machinery is used;*

(h) *enforcing such measures as may be necessary in the interest of health and safety;*

(i) *ensuring that work is performed and that plant or machinery is used under the general supervision of a person trained to understand the hazards associated with it and who have the authority to ensure that precautionary measures taken by the employer are implemented; and*

(j) *causing all employees to be informed regarding the scope of their authority as contemplated in section 37 (1) (b).*

11. CONTRACTORS CODE OF CONDUCT

The Contractor's Code of Conduct is a document to be drawn up by the solar facility Developer and provided to all contractors or subcontractors that undertake any service on site. This code of conduct should include generic conduct rules for construction and operation activities on the Boesmanland Solar Farm site and must be signed by all contractors. **This code of conduct does not exonerate contractors from complying with this EMPr and must not be viewed as a stand-alone document**.

The following general template is suggested for this Code of Conduct document and must be adapted and updated to include the provisions of this EMPr, recommendations of participating specialists, conditions of approval of the Environmental Authorisation, conditions imposed by the Local Authority (as part of the rezoning and consent use), as well as the all service agreements.

11.1 OBJECTIVES

To ensure compliance with the Conditions of the Environmental Authorisation, the Environmental Management Programme (EMPr), recommendations of participating specialists, conditions imposed by the Local Authority as part of the rezoning and subdivision, as well as the service agreements.

- To ensure the least possible damage to:
  - Existing infrastructure on and adjacent to the site;
  - Indigenous flora and fauna (biophysical environment); and
  - Water quality of surface and groundwater on and surrounding the site. Particularly the water quality entering and exiting the on-site washes/minor drainage lines;
- Construction and development are undertaken with due consideration to all environmental factors;
- Where such damage occurs, provision is made for re-instatement and rehabilitation;

11.2 ACCEPTANCE OF REQUIREMENTS

In order to achieve these objectives, the Developer and Contractor bind themselves jointly and severally to fulfil and comply with all the obligations contained herein, as well as prescriptions and obligations contained in other documents controlling the development of the Boesmanland Solar Farm.

11.3 CONTRACTOR'S PRE-CONSTRUCTION OBLIGATIONS

Contractors may not commence any construction on the Boesmanland Solar Farm until:

- The Contractor and the ECO have carried out a joint site inspection (this is to be done as part of the pre-construction compliance workshop as detailed in the EMPr);
- A qualified ecologist has undertaken an inspection of the final development footprint and determined the number, species and extent of protected / listed plant species within this area;

- A permit for the removal or relocation-and-transplant of these protected / listed plant species has been obtained from the Kimberly office of the Northern Cape Department of Environmental Affairs & Nature Conservation (DEANC);
- Search and rescue of sensitive plants, particularly *Hoodia gordonii* and *Euphorbia sp.,* within the development footprint has been carried out and signed off by the ECO (where this is necessary);
- The construction and no-go areas are suitably demarcated to the satisfaction of the ECO;
- Where necessary, approval of Building / Construction Plans has been obtained from the local authority (Khai-Ma Municipality); and
- All contract staff has attended the required environmental induction training and on-going environmental education sessions, as necessary.

11.4 CONTRACTOR'S OBLIGATIONS DURING CONSTRUCTION

- The Contractor is required to comply with the necessary Health and Safety requirements as required by the Occupational Health and Safety Act of 1993;
- The Contractor must comply with the construction requirements as detailed in the EMPr, including the following plans detailed therein:
    - Transport & Traffic Management Plan,
    - Stormwater and Erosion-Control Management Plan,
    - Vegetation Clearing & Plant Rescue Plan,
    - Re-vegetation & Rehabilitation Plan,
    - Alien Management Plan
    - Open Space Management Plan;
- The contractor must comply with all the requirements detailed in the Environmental Authorisation;
- All conditions, processes and fees as prescribed by the Local Authority must be complied with; and
- The Contractor shall only be permitted to erect a single signboard which must comply with legislative requirements.

12. IMPLEMENTATION

The following table is provided to assist the developer, design team, engineer and contractor with the effective implementation of this EMPr. The Table 4 below serves as a quick reference guide to the EMPr, but must be read in conjunction with the entire document.

Item	Management Action	Timing	Responsible Party	Monitoring
Design & Pre-Construction Phase				
Familiarisation with the contents of the EMPr & EA.	Attendance of a pre-construction environmental compliance workshop	Prior to commencement of site clearing & earthworks.	ECO, Engineers, Contractor & Project Management.	ECO to include details of this in the first environmental control Report.
	Environmental induction of all staff.	Prior to commencement of earthworks.	ECO and all contract staff.	Contractor to keep records of all staff attending inductions.
Demarcation of Development Areas and No-Go Areas.	All areas outside of the construction / development area to be clearly demarcated. Koppie areas, and all sensitive drainage lines & vegetation outside development area are considered no-go.	Prior to commencement of site clearing & earthworks.	Contractor with input from the Engineer, ECO and participating specialists where necessary. Contractor responsible for maintaining demarcation throughout the construction phase.	ECO to maintain photographic record of demarcation.
Obtain Permit for removal / translocation of protected plant species.	Permit application to be informed be list of protected plant species found by the ecological specialist within the final facility development footprint. Permit requirements & list to inform updated plant rescue plan.	Prior to plant rescue and vegetation clearing.	ECO, ESA, Ecological Specialist & Contractor	ECO & Ecological specialist to provide photographic record of protected plant species (to be used in on-going Environmental Education) and of plant rescue & translocation operation.
Panel and Powerline Pylon micro-siting	As defined in the EMPr	Prior to finalisation of detailed design.	Developer with input from ECO, Engineer and relevant participating specialists	ECO to include details in monthly reports.
Environmental Induction Training	As defined in the EMPr	Prior to commencement of site clearing & earthworks.	ECO & Contractor	Contractor to provide details to ECO. ECO to provide details in monthly reports.
Construction Phase				
Minimise impact of construction vehicles	Implementation of recommendations of Transport & Traffic Plan defined in EMPr.	Throughout construction phase	Contractor	Engineer
Prevent concrete contamination	Use of delivered ready-mix concrete. Control at batching sites	Throughout construction phase	Contractor	Engineer, ESA and ECO.
Prevention of erosion of	Implementation of recommendations of	During detailed design and	Contractor	Engineer, ESA and ECO.

Item	Management Action	Timing	Responsible Party	Monitoring
cable trenches	Erosion Management Plan defined in EMPr.	throughout the construction phase.		
Protection of Archaeological Resources	Avoidance of inselbergs / koppies outside development area and quartz patches as far as possible. Report archaeological occurrences found during earthworks to NCHRA & SAHRA.	Demarcation of sites prior to commencement of earthworks. Other mitigations throughout the construction phase.	Contractor	ESA, ECO & archaeologist.
Protection of hydrological resources (surface & underground).	As per the requirements of the EMPr.	Throughout the construction phase.	Contractor	ECO
Protection of all topsoil resources on site.	As per the requirements of the EMPr i.e. brush/straw packing & re-seeding	Throughout the construction phase.	Contractor	ECO
Construction of Cable Trenches	As per the requirements of this EMPr.	Throughout the construction phase	Contractor	ECO
Limiting damage caused by the installation of overhead lines.	As per the requirements of this EMPr.	Design phase and throughout the construction phase.	Design Team & Contractors	ECO & ER
Limiting Noise Impact	As per the requirement of the EMPr.	Design, throughout the construction and operation phase	Contractor, ER	ECO & ER
Reduction of dust generation as a result of construction activities.	As per the requirements of the EMPr.	Throughout the construction phase	Contractor	ECO & ER.
Providing for effective ecological corridors	Implementing the fencing requirements as defined by the ecological specialist and this EMPr.	Design and construction phases.	ER & Contractor	ECO & ER.
Limit environmental damage from blasting, drilling, jackhammering and trenching activities including that on existing boreholes.	Implementing the requirements for blasting detailed in this EMPr.	Throughout the construction phase.	Contractor	ECO & ER.
Preventing of Erosion and siltation of the wash / drainage lines.	Implementation of Stormwater Management and Erosion Control Measures detailed in this EMPr, as well as those made by the ecological	Design phase and throughout the construction phase	Design Team, Engineer and Contractors	ECO & ER.

Item	Management Action	Timing	Responsible Party	Monitoring
	specialists.			
Protection of protected plant species and on-going re-vegetation & rehabilitation.	Implementation of Plant Rescue, Re-vegetation & Rehabilitation Plan, as well as recommendation of ecological specialist.	Design phase and throughout the construction phase.	Design Team, Engineer and Contractors	ECO & ER.
Prevention of theft and other crime.	Development of a job site security plan.	Before commencement of construction.	Contractor	ER
On-going Environmental Education	As defined in the EMPr.	During construction.	ECO & Contractor	Contractor to provide details to ECO. ECO to provide details in monthly reports.
Prevent pollution resulting from oil and fuel storage and handling.	Implement correct fuel and oil handling procedures. Implement emergency spill response plan.	Duration of the project lifespan.	ECO & Contractor	ECO, ER & Contractor
Operational Phase				
Prevent pollution resulting from oil and fuel storage and handling.	Implement correct fuel and oil handling procedures. Implement emergency spill response plan.	Duration of the project lifespan	Facility operator	Facility manager and Environmental Authority.
Manage vegetation growth	Trimming of vegetation under panels to avoid overshadowing and fire risk.	Throughout operation	Operation & Maintenance staff.	Operation staff to report to Operator.
Prevent & manage erosion / obstruction of washes / drainage lines	Regular monitoring of wash to remove obstructions and repair erosion.	Throughout operation	Operation & Maintenance staff.	Operation staff to report to Operator.
Control of alien plants	Regular monitoring and removal of alien invasive plant species.	Throughout operation	Operation & Maintenance staff.	Operation staff to report to Operator.
On-going Environmental Education	As defined in the EMPr	During maintenance and operation.	Operation & Maintenance staff.	Operation staff to report to Operator.
Closure & Decommissioning Phase				
Items, management, responsibilities and monitoring as per construction phase, as above.				
Decommissioning of Solar facility.	Closure of facility in compliance with legislation and this EMPr.	After lifespan of project.	Facility operator & Khai-Ma local municipality.	Local, provincial and national Authorities
On-going Environmental Education	As defined in the EMPr	During decommissioning.	ECO & Contractor	Contractor report to ECO. ECO to provide details in monthly reports.

13. NON-COMPLIANCE

Should any person commit an action of non-compliance he/she may be convicted of an offence, in terms of Sub-regulation (1) of the National Environmental Management Act, to imprisonment for a period not exceeding two years or to a fine not exceeding an amount prescribed in terms of the Adjustment of Fines Act, 1991 (Act No. 101 of 1991).

Apart from a fine resulting from any legal mechanism, the ECO may advise the ER to impose a penalty for non-compliance in terms of this Environmental Management Programme (EMPr). The procedure detailed below is for a spot fine in terms of this EMPr and does not detail the procedure for fining in terms of any other legal mechanism.

13.1 PROCEDURES

The contractor shall comply with the environmental specifications and requirements of this EMPr, the Environmental Authorisation (EA) and Section 28 of NEMA, on an on-going basis and any failure on his part to do so will entitle the ER to impose a penalty.

In the event of non-compliance the following recommended process shall be followed:

- The ECO shall issue a notice of non-compliance to the ER, stating the nature and magnitude of the contravention. A copy shall be provided to the Project Developer / Proponent.
- The ER will issue this notice to the Contractor.
- The Contractor shall act to correct the transgression within the period specified by the ER.
- The Contractor shall provide the ER with a written statement describing the actions to be taken to discontinue the non-compliance, the actions taken to mitigate its effects and the expected results of the actions. A copy shall be provided to the Project Developer / Proponent.
- In the case of the Contractor failing to remedy the situation within the predetermined time frame, the ER shall impose a monetary penalty (spot fine) based on the conditions of contract.
- Should the transgression be a blatant disregard of conditions of the EMPr or EA, the ER (on advice from the ECO) can at their discretion immediately issue a fine and require the remediation (without first giving the contractor a chance to remediate)
- In the case of non-compliance giving rise to physical environmental damage or destruction, the ER shall be entitled to undertake or to cause to be undertaken such remedial works as may be required to make good such damage and to recover from the Contractor the full costs incurred in doing so.
- In the event of a dispute, difference of opinion, etc. between any parties in regard to or arising out of interpretation of the conditions of the EMPr, disagreement regarding the implementation or method of implementation of conditions of the EMPr or EA etc. any party shall be entitled to require that the issue be referred to specialists for determination.
- The ER on advice from the ECO shall at all times have the right to stop work and/or certain activities on site in the case of non-compliance or failure to implement remediation measures.

13.2 OFFENCES AND PENALTIES

Any avoidable non-compliance with the conditions of the EMPR shall be considered sufficient ground for the imposition of a penalty.

Possible offences, which should result in the issuing of a contractual penalty, include, but are not limited to:

- Unauthorised entrance into no-go areas;

- Catching and killing of wild animals, and removal or damage to conservation-worthy plant species;
- Open fires outside of the contractor camp site and insufficient fire control;
- Unauthorised damage to natural vegetation;
- Unauthorised camp establishment (including stockpiling, storage, etc.);
- Hydrocarbons / hazardous material: negligent spills / leaks and insufficient storage;
- Ablution facilities: non-use, insufficient facilities, insufficient maintenance;
- Insufficient solid waste management (including clean-up of litter, unauthorised dumping etc.;
- Erosion due to negligence / non-performance;
- Excessive cement / concrete spillage / contamination;
- Non-induction of staff.

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15. PHOTOGRAPHS & DESCRIPTIONS OF PROTECTED PLANT SPECIES

Species of conservation concern are illustrated below. The list includes species listed as threatened under the South African Red Data List of Plants, as well as those species which are provincially protected and are either significant or suitable for search and rescue. Common species within protected genera are not illustrated, but will nevertheless need to be listed on the permit application to clear the site.

These photographs can be used for environmental education purposes during the construction phase of the project to ensure that all construction staff are made aware of the protected status of these species. This photographic record of protected plant species, particularly those suitable for rescue and translocation, will have to be updated after the pre-construction survey by the ecologist.

15.1 BOSCIA FOETIDA

Status	Provincially Protected
Suitable for search rescue	No
Abundance at site	Occasional
Description	Small tree, usually with white stems. Produces small green flowers and small round fruits.

Figure 8: *Boscia foetida*

15.2 HOODIA GORDONII

Figures 9 & 10: *Hoodia gordonii*

Status	Nationally Protected

Suitable for search rescue	Yes
Abundance at site	Occasional
Description	Stem succulent up to 1m tall, but usually lower. Has spiny upright stems 5-10 cm wide. Produces large brownish flowers.

15.3 EUPHORBIA BRAUNSII


Figures 11 & 12: *Euphorbia braunsii*

Status	Provincially Protected
Suitable for search rescue	Yes
Abundance at site	Occasional
Description	Small stem succulent usually 10-25cm high, with somewhat spiny stems. Exudes milky late when injured.

15.4 EUPHORBIA MULTICEPS

Status	Provincially Protected
Suitable for search rescue	Yes
Abundance at site	Occasional
Description	Small stem succulent usually 10-25cm high, with a single stem covered in protrusions and spines. Exudes milky latex when injured.

Figure 13: *Euphorbia multiceps*

16. PHOTO & DESCRIPTION OF ALIEN PLANT SPECIES ON SITE

16.1 PROSOPIS GLANDULOSA

Medium to large tree with pinnate leaves and usually thorny. Usually associated with drainage lines, but may grow anywhere. Occasional at the site, but can increase rapidly as a result of disturbance.

When cut down the tree resprouts, so herbicides are usually needed in combination with cutting. The appropriate techniques and herbicides can be obtained from the DAFF website.

Figure 14: *Prosopis glandulosa*

17. CHECKLIST OF PLANT SPECIES

Checklist of plant species observed to occur on the site, as well as those species known to occur in the general area, according to the SANBI SIBIS database (accessed & records downloaded 10 February 2012). It is important to note that only the observed species can be confirmed to occur within the site and even this list includes several species that will not occur within the final development footprint. Protected species which are likely to occur with the development footprint are illustrated above.

Family	Species	Observed	Family	Species	Observed
Acanthaceae	*Acanthopsis hoffmannseggiana*	1	Fabaceae	*Hoffmannseggia lactea*	1
Acanthaceae	*Barleria rigida*		Funariaceae	*Funaria clavata*	
Acanthaceae	*Barleria sp.*		Funariaceae	*Goniomitrium africanum*	
Acanthaceae	*Blepharis capensis*	1	Geraniaceae	*Monsonia parvifolia*	
Acanthaceae	*Blepharis mitrata*	1	Geraniaceae	*Pelargonium adriaanii*	
Acanthaceae	*Blepharis sp.*		Geraniaceae	*Pelargonium carnosum subsp. carnosum*	
Acanthaceae	*Justicia thymifolia*		Geraniaceae	*Pelargonium crithmifolium*	
Acanthaceae	*Monechma incanum*	1	Geraniaceae	*Pelargonium spinosum*	
Acanthaceae	*Monechma saxatile*		Geraniaceae	*Pelargonium xerophyton*	
Acanthaceae	*Monechma spartioides*	1	Geraniaceae	*Sarcocaulon ciliatum*	
Acanthaceae	*Petalidium setosum*		Geraniaceae	*Sarcocaulon crassicaule*	1
Aizoaceae	*Aizoon asbestinum*		Gigaspermaceae	*Chamaebryum pottioides*	
Aizoaceae	*Aizoon canariense*		Gisekiaceae	*Gisekia africana var. africana*	
Aizoaceae	*Galenia africana*	1	Gisekiaceae	*Gisekia pharnacioides var. pharnacioides*	
Aizoaceae	*Galenia crystallina var. crystallina*		Hyacinthaceae	*Albuca namaquensis*	
Aizoaceae	*Galenia fruticosa*		Hyacinthaceae	*Albuca setosa*	
Aizoaceae	*Galenia papulosa*		Hyacinthaceae	*Albuca spiralis*	
Aizoaceae	*Galenia sarcophylla*		Hyacinthaceae	*Bowiea gariepensis*	
Aizoaceae	*Tetragonia acanthocarpa*		Hyacinthaceae	*Bowiea volubilis subsp. gariepensis*	
Aizoaceae	*Tetragonia arbuscula*	1	Hyacinthaceae	*Dipcadi ciliare*	
Aizoaceae	*Tetragonia reduplicata*		Hyacinthaceae	*Drimia intricata*	

Aizoaceae	*Trianthema parvifolia*	1
Aizoaceae	*Trianthema parvifolia var. parvifolia*	
Aizoaceae	*Trianthema parvifolia var. rubens*	
Aizoaceae	*Mesembryanthemum latipetalum*	
Aizoaceae	*Mesembryanthemum lignescens*	
Aizoaceae	*Mesembryanthemum schenckii*	
Aizoaceae	*Schwantesia rüdebuschii*	
Amaranthaceae	*Amaranthus capensis subsp. capensis*	
Amaranthaceae	*Amaranthus praetermissus*	
Amaranthaceae	*Amaranthus thunbergii*	
Amaranthaceae	*Calicorema capitata*	
Amaranthaceae	*Hermbstaedtia glauca*	1
Amaranthaceae	*Sericocoma avolans*	1
Amaranthaceae	*Sericocoma pungens*	
Amaryllidaceae	*Brunsvigia bosmaniae*	
Amaryllidaceae	*Brunsvigia comptonii*	
Amaryllidaceae	*Brunsvigia herrei*	
Amaryllidaceae	*Brunsvigia namaquana*	
Amaryllidaceae	*Brunsvigia sp.*	
Amaryllidaceae	*Haemanthus coccineus*	
Amaryllidaceae	*Haemanthus sp.*	
Amaryllidaceae	*Hessea speciosa*	
Amaryllidaceae	*Hessea stenosiphon*	
Anacardiaceae	*Ozoroa dispar*	
Anacardiaceae	*Rhus burchellii*	
Anacardiaceae	*Searsia burchellii*	
Anacardiaceae	*Searsia populifolia*	
Apiaceae	*Anginon jaarsveldii*	
Apocynaceae	*Ectadium virgatum*	
Apocynaceae	*Gomphocarpus filiformis*	
Apocynaceae	*Hoodia alstonii*	
Apocynaceae	*Hoodia gordonii*	1
Apocynaceae	*Huernia clavigera*	
Apocynaceae	*Microloma incanum*	
Apocynaceae	*Microloma sagittatum*	
Apocynaceae	*Pachypodium namaquanum*	
Apocynaceae	*Sarcostemma pearsonii*	
Apocynaceae	*Sarcostemma viminale subsp. thunbergii*	
Apocynaceae	*Sarcostemma viminale subsp. viminale*	
Apocynaceae	*Stapelia similis*	
Asparagaceae	*Asparagus asparagoides*	1
Asparagaceae	*Asparagus ovatus*	
Asparagaceae	*Asparagus retrofractus*	1
Asphodelaceae	*Aloe dabenorisana*	
Asphodelaceae	*Bulbine ophiophylla*	
Asphodelaceae	*Bulbine striata*	
Asphodelaceae	*Haworthia venosa subsp. tessellata*	
Asphodelaceae	*Trachyandra divaricata*	
Asphodelaceae	*Trachyandra jacquiniana*	
Hyacinthaceae	*Lachenalia giessii*	
Hyacinthaceae	*Lachenalia polypodantha*	
Hyacinthaceae	*Lachenalia sp.*	
Hyacinthaceae	*Lachenalia undulata*	
Hyacinthaceae	*Ledebouria cooperi*	1
Hyacinthaceae	*Ledebouria undulata*	
Hyacinthaceae	*Massonia bifolia*	
Hyacinthaceae	*Ornithogalum glandulosum*	
Hyacinthaceae	*Ornithogalum pruinosum*	
Hyacinthaceae	*Ornithogalum subcoriaceum*	
Hyacinthaceae	*Ornithogalum stapffii*	1
Hyacinthaceae	*Whiteheadia bifolia*	
Hypoxidaceae	*Empodium sp.*	
Hypoxidaceae	*Spiloxene scullyi*	
Iridaceae	*Ferraria variabilis*	
Iridaceae	*Gladiolus orchidiflorus*	
Iridaceae	*Gladiolus saccatus*	
Iridaceae	*Gladiolus sp.*	
Iridaceae	*Hesperantha rupicola*	
Iridaceae	*Lapeirousia littoralis subsp. littoralis*	
Iridaceae	*Lapeirousia plicata subsp. plicata*	
Iridaceae	*Moraea unguiculata*	
Iridaceae	*Tritonia karooica*	
Juncaceae	*Juncus rigidus*	
Lamiaceae	*Acrotome pallescens*	
Lamiaceae	*Salvia garipensis*	
Lamiaceae	*Stachys flavescens*	
Lamiaceae	*Stachys linearis*	
Lamiaceae	*Stachys rugosa*	
Loasaceae	*Kissenia capensis*	
Lophiocarpaceae	*Lophiocarpus polystachyus*	1
Loranthaceae	*Septulina glauca*	
Malvaceae	*Abutilon pycnodon*	
Malvaceae	*Hermannia abrotanoides*	
Malvaceae	*Hermannia affinis*	1
Malvaceae	*Hermannia burchellii*	
Malvaceae	*Hermannia cernua*	
Malvaceae	*Hermannia confusa*	
Malvaceae	*Hermannia disermifolia*	
Malvaceae	*Hermannia gariepina*	
Malvaceae	*Hermannia grandiflora*	
Malvaceae	*Hermannia minutiflora*	
Malvaceae	*Hermannia sp.*	
Malvaceae	*Hermannia spinosa*	1
Malvaceae	*Hermannia stricta*	1
Malvaceae	*Hermannia tomentosa*	1
Malvaceae	*Hibiscus elliottiae*	
Melianthaceae	*Melianthus comosus*	
Menispermaceae	*Antizoma miersiana*	

Asphodelaceae	*Trachyandra laxa var. laxa*	
Aspleniaceae	*Asplenium cordatum*	
Asteraceae	*Amphiglossa tomentosa*	
Asteraceae	*Anisopappus pinnatifidus*	
Asteraceae	*Arctotis hirsuta*	
Asteraceae	*Arctotis leiocarpa*	
Asteraceae	*Arctotis leiocarpa Harv. x A. fastuosa Jacq.*	
Asteraceae	*Arctotis venusta*	
Asteraceae	*Berkheya canescens*	
Asteraceae	*Berkheya fruticosa*	
Asteraceae	*Berkheya spinosissima subsp. namaensis var. namaensis*	
Asteraceae	*Berkheya spinosissima subsp. spinosissima*	1
Asteraceae	*Chrysocoma longifolia*	
Asteraceae	*Chrysocoma microphylla*	
Asteraceae	*Chrysocoma sparsifolia*	
Asteraceae	*Cineraria canescens var. canescens*	
Asteraceae	*Dicoma capensis*	1
Asteraceae	*Dimorphotheca polyptera*	
Asteraceae	*Dimorphotheca sinuata*	
Asteraceae	*Doellia cafra*	
Asteraceae	*Eriocephalus africanus*	1
Asteraceae	*Eriocephalus merxmuelleri*	
Asteraceae	*Eriocephalus microphyllus var. pubescens*	
Asteraceae	*Eriocephalus scariosus*	
Asteraceae	*Eriocephalus spinescens*	1
Asteraceae	*Euryops subcarnosus subsp. vulgaris*	
Asteraceae	*Felicia clavipilosa*	1
Asteraceae	*Felicia hirsuta*	
Asteraceae	*Felicia muricata*	
Asteraceae	*Felicia muricata subsp. cinerascens*	
Asteraceae	*Felicia muricata subsp. muricata*	
Asteraceae	*Felicia namaquana*	
Asteraceae	*Felicia sp.*	
Asteraceae	*Foveolina albida*	
Asteraceae	*Foveolina dichotoma*	
Asteraceae	*Gazania lichtensteinii*	
Asteraceae	*Geigeria pectidea*	
Asteraceae	*Geigeria vigintisquamea*	
Asteraceae	*Gorteria corymbosa*	
Asteraceae	*Gymnodiscus linearifolia*	
Asteraceae	*Helichrysum gariepinum*	
Asteraceae	*Helichrysum herniarioides*	
Asteraceae	*Helichrysum micropoides*	
Asteraceae	*Helichrysum pulchellum*	
Asteraceae	*Helichrysum pumilio*	1
Asteraceae	*Helichrysum zeyheri*	
Asteraceae	*Hirpicium alienatum*	
Mesembryanthemaceae	*Amphibolia rupis-arcuatae*	
Mesembryanthemaceae	*Antimima nordenstamii*	
Mesembryanthemaceae	*Antimima tuberculosa*	
Mesembryanthemaceae	*Antimima vanzylii*	
Mesembryanthemaceae	*Arenifera stylosa*	
Mesembryanthemaceae	*Aridaria noctiflora subsp. straminea*	1
Mesembryanthemaceae	*Aspazoma amplectens*	
Mesembryanthemaceae	*Brownanthus arenosus*	
Mesembryanthemaceae	*Brownanthus ciliatus subsp. schenkii*	
Mesembryanthemaceae	*Brownanthus nucifer*	
Mesembryanthemaceae	*Brownanthus schenckii*	
Mesembryanthemaceae	*Cephalophyllum fulleri*	
Mesembryanthemaceae	*Cephalophyllum parvibracteatum*	
Mesembryanthemaceae	*Cephalophyllum staminodiosum*	
Mesembryanthemaceae	*Cheiridopsis denticulata*	
Mesembryanthemaceae	*Cheiridopsis sp.*	
Mesembryanthemaceae	*Conicosia elongata*	
Mesembryanthemaceae	*Conophytum achabense*	
Mesembryanthemaceae	*Conophytum burgeri*	
Mesembryanthemaceae	*Conophytum calculus subsp. vanzylii*	
Mesembryanthemaceae	*Conophytum ectypum subsp. ectypum*	
Mesembryanthemaceae	*Conophytum fulleri*	
Mesembryanthemaceae	*Conophytum limpidum*	1
Mesembryanthemaceae	*Conophytum marginatum var. haramoepense*	
Mesembryanthemaceae	*Conophytum maughanii subsp. maughanii*	
Mesembryanthemaceae	*Conophytum praesectum*	
Mesembryanthemaceae	*Conophytum rarum*	
Mesembryanthemaceae	*Conophytum ratum*	
Mesembryanthemaceae	*Conophytum sp.*	
Mesembryanthemaceae	*Conophytum subfenestratum*	
Mesembryanthemaceae	*Dinteranthus microspermus subsp. puberulus*	
Mesembryanthemaceae	*Dinteranthus puberulus*	
Mesembryanthemaceae	*Dorotheanthus bellidiformis subsp. hestermalensis*	
Mesembryanthemaceae	*Drosanthemum albens*	
Mesembryanthemaceae	*Drosanthemum diversifolium*	
Mesembryanthemaceae	*Drosanthemum godmaniae*	
Mesembryanthemaceae	*Drosanthemum hispidum*	
Mesembryanthemaceae	*Drosanthemum karrooense*	1
Mesembryanthemaceae	*Drosanthemum luederitzii*	
Mesembryanthemaceae	*Drosanthemum schoenlandianum*	1
Mesembryanthemaceae	*Drosanthemum sp.*	
Mesembryanthemaceae	*Ebracteola fulleri*	
Mesembryanthemaceae	*Hereroa hesperantha*	
Mesembryanthemaceae	*Hereroa pallens*	
Mesembryanthemaceae	*Ihlenfeldtia excavata*	
Mesembryanthemaceae	*Ihlenfeldtia vanzylii*	
Mesembryanthemaceae	*Lapidaria margaretae*	

Asteraceae	*Hirpicium echinus*	
Asteraceae	*Hirpicium integrifolium*	
Asteraceae	*Ifloga molluginoides*	
Asteraceae	*Kleinia cephalophora*	
Asteraceae	*Kleinia longiflora*	1
Asteraceae	*Lopholaena cneorifolia*	
Asteraceae	*Nidorella resedifolia subsp. resedifolia*	
Asteraceae	*Oncosiphon piluliferum*	
Asteraceae	*Osteospermum armatum*	
Asteraceae	*Osteospermum karrooicum*	
Asteraceae	*Osteospermum muricatum subsp. longiradiatum*	
Asteraceae	*Osteospermum muricatum subsp. muricatum*	
Asteraceae	*Osteospermum pinnatum var. pinnatum*	
Asteraceae	*Othonna abrotanifolia*	
Asteraceae	*Othonna arbuscula*	
Asteraceae	*Othonna furcata*	
Asteraceae	*Othonna quercifolia*	
Asteraceae	*Othonna sedifolia*	
Asteraceae	*Pegolettia retrofracta*	
Asteraceae	*Pentatrichia petrosa*	
Asteraceae	*Pentzia argentea*	
Asteraceae	*Pentzia lanata*	
Asteraceae	*Pentzia pinnatisecta*	
Asteraceae	*Pteronia glabrata*	
Asteraceae	*Pteronia glauca*	
Asteraceae	*Pteronia lucilioides*	
Asteraceae	*Pteronia mucronata*	1
Asteraceae	*Pteronia scariosa*	
Asteraceae	*Pteronia unguiculata*	
Asteraceae	*Rosenia humilis*	
Asteraceae	*Senecio bulbinifolius*	
Asteraceae	*Senecio eenii*	
Asteraceae	*Senecio flavus*	
Asteraceae	*Senecio niveus*	1
Asteraceae	*Senecio pinguifolius*	
Asteraceae	*Senecio piptocoma*	
Asteraceae	*Senecio sarcoides*	
Asteraceae	*Senecio sisymbriifolius*	
Asteraceae	*Tripteris microcarpa subsp. microcarpa*	
Asteraceae	*Tripteris sinuata var. linearis*	
Asteraceae	*Tripteris sinuata var. sinuata*	1
Asteraceae	*Ursinia nana subsp. nana*	
Asteraceae	*Ursinia speciosa*	
Asteraceae	*Vernonia cinerascens*	
Asteraceae	*Vernonia obionifolia subsp. obionifolia*	
Asteraceae	*Arctotis dimorphocarpa*	
Asteraceae	*Othonna daucifolia*	
Aytoniaceae	*Plagiochasma rupestre var. rupestre*	
Mesembryanthemaceae	*Leipoldtia pauciflora*	
Mesembryanthemaceae	*Lithops dinteri subsp. frederici*	
Mesembryanthemaceae	*Lithops julii subsp. fulleri*	
Mesembryanthemaceae	*Lithops olivacea*	
Mesembryanthemaceae	*Lithops olivacea var. nebrownii*	
Mesembryanthemaceae	*Malephora lutea*	
Mesembryanthemaceae	*Mesembryanthemum crystallinum*	
Mesembryanthemaceae	*Mesembryanthemum guerichianum*	
Mesembryanthemaceae	*Mesembryanthemum inachabense*	
Mesembryanthemaceae	*Mesembryanthemum sp.*	
Mesembryanthemaceae	*Mesembryanthemum subnodosum*	
Mesembryanthemaceae	*Phyllobolus latipetalus*	
Mesembryanthemaceae	*Phyllobolus lignescens*	
Mesembryanthemaceae	*Phyllobolus nitidus*	
Mesembryanthemaceae	*Prenia tetragona*	
Mesembryanthemaceae	*Psilocaulon articulatum*	
Mesembryanthemaceae	*Psilocaulon coriarium*	1
Mesembryanthemaceae	*Psilocaulon sp.*	
Mesembryanthemaceae	*Psilocaulon subnodosum*	
Mesembryanthemaceae	*Ruschia axthelmiana*	
Mesembryanthemaceae	*Ruschia centrocapsula*	
Mesembryanthemaceae	*Ruschia cradockensis subsp. triticiformis*	
Mesembryanthemaceae	*Ruschia divaricata*	
Mesembryanthemaceae	*Ruschia ferox*	1
Mesembryanthemaceae	*Ruschia muricata*	
Mesembryanthemaceae	*Ruschia robusta*	
Mesembryanthemaceae	*Ruschia sp.*	
Mesembryanthemaceae	*Ruschia spinosa*	
Mesembryanthemaceae	*Ruschia vulvaria*	
Mesembryanthemaceae	*Schwantesia marlothii*	
Mesembryanthemaceae	*Schwantesia ruedebuschii*	
Mesembryanthemaceae	*Schwantesia sp.*	
Mesembryanthemaceae	*Schwantesia triebneri*	
Mesembryanthemaceae	*Stomatium fulleri*	
Mesembryanthemaceae	*Titanopsis hugo-schlechteri*	
Mesembryanthemaceae	*Trichodiadema littlewoodii*	
Mesembryanthemaceae	*Trichodiadema obliquum*	
Mesembryanthemaceae	*Trichodiadema setuliferum*	
Mesembryanthemaceae	*Trichodiadema sp.*	
Molluginaceae	*Hypertelis salsoloides*	1
Molluginaceae	*Hypertelis salsoloides var. salsoloides*	
Molluginaceae	*Limeum aethiopicum subsp. aethiopicum var. aethiopicum*	1
Molluginaceae	*Limeum arenicolum*	
Molluginaceae	*Limeum myosotis var. myosotis*	
Molluginaceae	*Limeum sulcatum var. gracile*	
Molluginaceae	*Mollugo cerviana var. cerviana*	
Molluginaceae	*Pharnaceum croceum*	
Molluginaceae	*Pharnaceum sp.*	

Bartramiaceae	*Philonotis dregeana*	
Bignoniaceae	*Rhigozum trichotomum*	1
Boraginaceae	*Codon royenii*	1
Boraginaceae	*Ehretia rigida subsp. rigida*	
Boraginaceae	*Heliotropium ciliatum*	1
Boraginaceae	*Heliotropium tubulosum*	
Boraginaceae	*Trichodesma africanum*	1
Boraginaceae	*Wellstedia dinteri subsp. dinteri*	
Brassicaceae	*Coronopus integrifolius*	
Brassicaceae	*Heliophila carnosa*	
Brassicaceae	*Heliophila deserticola var. deserticola*	
Brassicaceae	*Heliophila deserticola var. micrantha*	
Brassicaceae	*Heliophila lactea*	
Brassicaceae	*Heliophila trifurca*	
Brassicaceae	*Lepidium trifurcum*	
Bryaceae	*Bryum argenteum*	
Burseraceae	*Commiphora gracilifrondosa*	
Burseraceae	*Commiphora kraeuseliana*	
Campanulaceae	*Wahlenbergia annularis*	
Campanulaceae	*Wahlenbergia divergens*	
Campanulaceae	*Wahlenbergia meyeri*	
Campanulaceae	*Wahlenbergia prostrata*	
Capparaceae	*Boscia foetida subsp. foetida*	1
Capparaceae	*Cleome angustifolia subsp. diandra*	
Capparaceae	*Cleome foliosa var. lutea*	
Capparaceae	*Cleome oxyphylla var. oxyphylla*	
Capparaceae	*Cleome paxii*	
Caryophyllaceae	*Dianthus micropetalus*	
Caryophyllaceae	*Dianthus namaensis*	
Caryophyllaceae	*Dianthus namaensis var. dinteri*	
Celastraceae	*Gymnosporia heterophylla*	
Chenopodiaceae	*Salsola aphylla*	1
Chenopodiaceae	*Salsola barbata*	
Chenopodiaceae	*Salsola columnaris*	
Chenopodiaceae	*Salsola kalaharica*	1
Chenopodiaceae	*Salsola rabieana*	1
Chenopodiaceae	*Salsola namibica*	1
Chenopodiaceae	*Salsola tuberculata*	
Colchicaceae	*Ornithoglossum dinteri*	
Colchicaceae	*Ornithoglossum viride*	
Colchicaceae	*Ornithoglossum vulgare*	
Convolvulaceae	*Convolvulus sagittatus*	
Crassulaceae	*Adromischus diabolicus*	
Crassulaceae	*Adromischus nanus*	
Crassulaceae	*Adromischus schuldtianus subsp. schuldtianus*	
Crassulaceae	*Adromischus trigynus*	
Crassulaceae	*Cotyledon orbiculata var. orbiculata*	
Crassulaceae	*Crassula brevifolia subsp. brevifolia*	
Crassulaceae	*Crassula campestris*	
Molluginaceae	*Pharnaceum viride*	
Molluginaceae	*Suessenguthiella scleranthoides*	
Montiniaceae	*Montinia caryophyllacea*	1
Montiniaceae	*Montinia sp.*	
Moraceae	*Ficus cordata subsp. cordata*	
Moraceae	*Ficus ilicina*	
Neuradaceae	*Grielum humifusum var. humifusum*	
Neuradaceae	*Grielum sinuatum*	
Ophioglossaceae	*Ophioglossum sp.*	
Orobanchaceae	*Hyobanche rubra*	
Oxalidaceae	*Oxalis annae*	
Oxalidaceae	*Oxalis pes-caprae var. pes-caprae*	
Oxalidaceae	*Oxalis sp.*	
Passifloraceae	*Adenia repanda*	
Pedaliaceae	*Rogeria longiflora*	1
Plumbaginaceae	*Dyerophytum africanum*	
Poaceae	*Aristida adscensionis*	1
Poaceae	*Aristida congesta subsp. barbicollis*	
Poaceae	*Aristida congesta subsp. congesta*	
Poaceae	*Aristida engleri var. engleri*	
Poaceae	*Brachiaria glomerata*	
Poaceae	*Cenchrus ciliaris*	
Poaceae	*Cladoraphis spinescens*	1
Poaceae	*Danthoniopsis ramosa*	
Poaceae	*Digitaria eriantha*	
Poaceae	*Ehrharta calycina*	
Poaceae	*Ehrharta pusilla*	
Poaceae	*Enneapogon cenchroides*	
Poaceae	*Enneapogon desvauxii*	1
Poaceae	*Enneapogon scaber*	1
Poaceae	*Eragrostis homomalla*	
Poaceae	*Eragrostis nindensis*	
Poaceae	*Eragrostis procumbens*	
Poaceae	*Eragrostis rotifer*	
Poaceae	*Leucophrys mesocoma*	1
Poaceae	*Melinis repens subsp. grandiflora*	
Poaceae	*Oropetium capense*	1
Poaceae	*Panicum arbusculum*	
Poaceae	*Schismus barbatus*	
Poaceae	*Schmidtia kalahariensis*	
Poaceae	*Schmidtia pappophoroides*	
Poaceae	*Sporobolus nervosus*	
Poaceae	*Stipagrostis brevifolia*	1
Poaceae	*Stipagrostis ciliata var. capensis*	1
Poaceae	*Stipagrostis hochstetteriana var. hochstetteriana*	
Poaceae	*Stipagrostis hochstetteriana var. secalina*	
Poaceae	*Stipagrostis namaquensis*	1
Poaceae	*Stipagrostis obtusa*	1
Poaceae	*Stipagrostis uniplumis var. uniplumis*	1

Crassulaceae	*Crassula corallina subsp. macrorrhiza*	1
Crassulaceae	*Crassula cotyledonis*	
Crassulaceae	*Crassula deltoidea*	
Crassulaceae	*Crassula exilis subsp. exilis*	
Crassulaceae	*Crassula exilis subsp. sedifolia*	
Crassulaceae	*Crassula garibina*	
Crassulaceae	*Crassula garibina subsp. garibina*	
Crassulaceae	*Crassula macowaniana*	
Crassulaceae	*Crassula muscosa var. muscosa*	
Crassulaceae	*Crassula sericea var. hottentotta*	
Crassulaceae	*Crassula sericea var. sericea*	
Crassulaceae	*Crassula sericea var. velutina*	
Crassulaceae	*Crassula subaphylla var. subaphylla*	
Crassulaceae	*Crassula tabularis*	
Crassulaceae	*Crassula tenuipedicellata*	
Crassulaceae	*Crassula tomentosa var. glabrifolia*	
Crassulaceae	*Tylecodon reticulatus*	
Crassulaceae	*Tylecodon reticulatus subsp. phyllopodium*	
Crassulaceae	*Tylecodon reticulatus subsp. reticulatus*	
Crassulaceae	*Tylecodon rubrovenosus*	
Crassulaceae	*Tylecodon sulphureus*	
Crassulaceae	*Tylecodon sulphureus var. armianus*	
Crassulaceae	*Tylecodon sulphureus var. sulphureus*	
Cucurbitaceae	*Cucumis africanus*	
Cucurbitaceae	*Cucumis rigidus*	
Cucurbitaceae	*Trochomeria debilis*	
Cyperaceae	*Cyperus marginatus*	
Cyperaceae	*Isolepis hemiuncialis*	
Ebenaceae	*Diospyros acocksii*	
Ebenaceae	*Diospyros ramulosa*	
Ebenaceae	*Euclea pseudebenus*	
Ebenaceae	*Euclea undulata*	
Eriospermaceae	*Eriospermum bakerianum subsp. bakerianum*	
Eriospermaceae	*Eriospermum ernstii*	
Eriospermaceae	*Eriospermum pusillum*	
Euphorbiaceae	*Euphorbia dregeana*	
Euphorbiaceae	*Euphorbia gariepina subsp. balsamea*	
Euphorbiaceae	*Euphorbia gariepina subsp. gariepina*	1
Euphorbiaceae	*Euphorbia gregaria*	
Euphorbiaceae	*Euphorbia gummifera*	
Euphorbiaceae	*Euphorbia inaequilatera var. inaequilatera*	
Euphorbiaceae	*Euphorbia lignosa*	1
Euphorbiaceae	*Euphorbia mauritanica var. corallothamnus*	
Euphorbiaceae	*Euphorbia mauritanica var. mauritanica*	
Euphorbiaceae	*Euphorbia multiceps*	1
Euphorbiaceae	*Euphorbia rudis*	1
Euphorbiaceae	*Euphorbia spinea*	1
Poaceae	*Tragus berteronianus*	
Poaceae	*Tricholaena capensis subsp. arenaria*	
Poaceae	*Tricholaena capensis subsp. capensis*	
Poaceae	*Triraphis ramosissima*	
Polygalaceae	*Polygala leptophylla*	
Polygalaceae	*Polygala leptophylla var. armata*	
Polygalaceae	*Polygala seminuda*	1
Portulacaceae	*Anacampseros baeseckei*	
Portulacaceae	*Anacampseros filamentosa subsp. namaquensis*	
Portulacaceae	*Anacampseros papyracea subsp. namaensis*	
Portulacaceae	*Avonia albissima*	1
Portulacaceae	*Avonia dinteri*	
Portulacaceae	*Avonia herreana*	
Portulacaceae	*Avonia papyracea subsp. namaensis*	
Portulacaceae	*Avonia papyracea subsp. papyracea*	
Portulacaceae	*Avonia quinaria subsp. alstonii*	
Portulacaceae	*Avonia recurvata subsp. minuta*	
Portulacaceae	*Avonia recurvata subsp. recurvata*	
Portulacaceae	*Ceraria fruticulosa*	
Portulacaceae	*Ceraria namaquensis*	
Portulacaceae	*Portulaca kermesina*	
Pottiaceae	*Pseudocrossidium crinitum*	
Pottiaceae	*Syntrichia ammonsiana*	
Pottiaceae	*Tortula atrovirens*	
Pottiaceae	*Trichostomum brachydontium*	
Pteridaceae	*Cheilanthes deltoidea*	
Ptychomitriaceae	*Ptychomitriopsis aloinoides*	
Rubiaceae	*Anthospermum spathulatum subsp. spathulatum*	
Rubiaceae	*Kohautia caespitosa subsp. brachyloba*	
Rubiaceae	*Kohautia cynanchica*	
Rubiaceae	*Nenax cinerea*	
Santalaceae	*Thesium hystricoides*	
Santalaceae	*Thesium lineatum*	1
Sapindaceae	*Pappea capensis*	1
Scrophulariaceae	*Antherothamnus pearsonii*	
Scrophulariaceae	*Anticharis juncea*	
Scrophulariaceae	*Aptosimum junceum*	
Scrophulariaceae	*Aptosimum marlothii*	
Scrophulariaceae	*Aptosimum procumbens*	
Scrophulariaceae	*Aptosimum spinescens*	1
Scrophulariaceae	*Hebenstretia sp.*	
Scrophulariaceae	*Jamesbrittenia aridicola*	
Scrophulariaceae	*Jamesbrittenia glutinosa*	
Scrophulariaceae	*Jamesbrittenia maxii*	
Scrophulariaceae	*Jamesbrittenia ramosissima*	
Scrophulariaceae	*Manulea gariepina*	
Scrophulariaceae	*Manulea nervosa*	

Euphorbiaceae	*Jatropha orangeana*		Scrophulariaceae	*Nemesia maxii*	
Fabaceae	*Acacia erioloba*		Scrophulariaceae	*Peliostomum leucorrhizum*	1
Fabaceae	*Acacia mellifera subsp. detinens*		Scrophulariaceae	*Selago albida*	
Fabaceae	*Adenolobus garipensis*		Scrophulariaceae	*Zaluzianskya affinis*	
Fabaceae	*Crotalaria virgultalis*	1	Scrophulariaceae	*Zaluzianskya diandra*	
Fabaceae	*Indigastrum argyraeum*		Scrophulariaceae	*Zaluzianskya sanorum*	
Fabaceae	*Indigastrum argyroides*		Solanaceae	*Lycium oxycarpum*	
Fabaceae	*Indigofera heterotricha*		Solanaceae	*Lycium eenii*	1
Fabaceae	*Indigofera pechuelii*	1	Solanaceae	*Lycium pumilium*	1
Fabaceae	*Indigofera pungens*	1	Solanaceae	*Nicotiana glauca*	
Fabaceae	*Indigofera sessilifolia*		Solanaceae	*Solanum capense*	1
Fabaceae	*Indigofera sordida*		Solanaceae	*Solanum rigescentoides*	
Fabaceae	*Lebeckia spinescens*	1	Solanaceae	*Solanum tomentosum var. tomentosum*	
Fabaceae	*Leobordea platycarpa*		Urticaceae	*Forsskaolea candida*	
Fabaceae	*Lessertia depressa*		Verbenaceae	*Chascanum garipense*	1
Fabaceae	*Lessertia sp.*		Verbenaceae	*Chascanum pumilum*	1
Fabaceae	*Lotononis fruticoides*		Viscaceae	*Viscum rotundifolium*	
Fabaceae	*Lotononis parviflora*		Zygophyllaceae	*Augea capensis*	1
Fabaceae	*Lotononis rabenaviana*		Zygophyllaceae	*Sisyndite spartea*	1
Fabaceae	*Melolobium candicans*		Zygophyllaceae	*Tribulus cristatus*	
Fabaceae	*Melolobium microphyllum*	1	Zygophyllaceae	*Tribulus pterophorus*	
Fabaceae	*Parkinsonia africana*	1	Zygophyllaceae	*Tribulus terrestris*	
Fabaceae	*Pomaria lactea*		Zygophyllaceae	*Tribulus zeyheri subsp. zeyheri*	
Fabaceae	*Prosopis glandulosa var. glandulosa*	1	Zygophyllaceae	*Zygophyllum dregeanum*	
Fabaceae	*Prosopis sp.*		Zygophyllaceae	*Zygophyllum decumbens*	1
Fabaceae	*Prosopis velutina*		Zygophyllaceae	*Zygophyllum flexuosum*	
Fabaceae	*Requienia sphaerosperma*	1	Zygophyllaceae	*Zygophyllum foetidum*	
Fabaceae	*Rhynchosia totta var. totta*		Zygophyllaceae	*Zygophyllum retrofractum*	1
Fabaceae	*Tephrosia dregeana var. dregeana*		Zygophyllaceae	*Zygophyllum simplex*	
Fabaceae	*Calobota spinescens*		Zygophyllaceae	*Zygophyllum stapffii*	