ENVIRONMENTAL MANAGEMENT PROGRAMME

REVISION 2

for

KARROID PV

on

Remaining Extent of Geel Kop Farm No 456

In terms of the

National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended & Environmental Impact Regulations 2014

Prepared for Applicant: Karroid PV (Pty) Ltd

By: *Cape EAPrac*

Report Reference: KAI/632/21

Department Reference: to be allocated

Case Officer: to be allocated

Date: 18 May 2020

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PURPOSE OF THIS REPORT:

For implementation by EPC & O&M contractor

APPLICANT:

Karroid PV (Pty) Ltd

CAPE EAPRAC REFERENCE NO:

KAI/632/21

DEPARTMENT REFERENCE:

To be allocated

SUBMISSION DATE

18 May 2020

TO BE CITED AS:

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Draft Environmental Management Programme – Revision 1 (KAI/632/21)	20 April 2020
Draft Environmental Management Programme – Revision 2 (KAI/632/21)	18 May 2020

ENVIRONMENTAL MANAGEMENT PROGRAMME

in terms of the

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

Karroid PV

Remaining Extent of Geel Kop Farm No 456

Submitted for:

Departmental Review

Report Issued by:

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ORDER OF REPORT

Environmental Management Programme - Legislated Requirements Checklist

Environmental Management Programme – Main Report

Appendix A: Site Development Plan.

Appendix B: Stormwater, Erosion and Washwater Management Plan

Appendix C: Transport Study and Traffic Management Plan.

ENVIRONMENTAL MANAGEMENT PROGRAMME LEGISLATIVE REQUIREMENTS

This EMP complies with the requirements of Regulation 982 in terms of the 2014 Environmental Regulations (as amended).

Compliance checklists in terms of these three requirements are included in table 2 below.

Appendix 4 of Regulation 982 of the 2014 EIA Regulations contains the required contents of an Environmental Management Programme (EMPr). The checklist below serves as a summary of how these requirements were incorporated into this EMPr.

Table 1: EMPr compliance with Appendix 4 of Regulation 982

Requirement	Description
Details of the EAP who prepared the EMPr; and; The expertise of the EAP to prepare an EMPr, including a curriculum vitae.	This EMPr was prepared by Dale Holder of Cape EAPrac who has more than 13 years' experience as an Environmental Assessment Practitioner. A company profile of Cape EAPrac as well as the CV of the EAP is attached to the BAR
A detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description.	This EMP covers all aspects of the project as currently under assessment. This includes the construction and operation of a photovoltaic (PV) solar facility with a generation capacity of 100Mw, including • Inverter stations; • an on-site substation (including a feed-in transformer to allow the generated power to be connected to Eskom's electricity grid); • A132kV overhead powerline connecting to the project to the Upington MTS substations (assessed via a separate Basic Assessment Report and via a separate EMPr) • auxiliary buildings, including: • administration / office & security (gate house), • control room & workshop, • visitor centre, • ablution / change room and • warehouse / storeroom. • a laydown area of approximately 3-5 ha. • internal electrical reticulation network (underground cabling). • an internal road / track network of approximately 6.5 ha. • An access road of approximately 8m wide within a 15m servitude; • electrified perimeter fencing around the solar facility, including security cameras.
A map at an appropriate scale which superimposes the proposed activity, its associated structures, and	The Site Development Plan attached in Appendix A, includes the sensitive features identified by participating

Requirement	Description
infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers	specialists and indicates how these have been incorporated. The "exclusion areas" identified on this SDP as well as all areas outside of the perimeter fencing are considered as no go areas for construction activities.
A description of the impact management objectives, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all the phases of the development including – (i) Planning and design; (ii) Pre-construction activities; (iii) Construction activities; (iv) Rehabilitation of the environment after construction and where applicable post closure; and (v) Where relevant, operation activities.	Section 3 of this EMPr.
A description and identification of impact management outcomes required for the aspects contemplated above.	Table 5 in section 2 of the EMPR
A description of the proposed impact management actions, identifying the way the impact management objectives and outcomes contemplated above will be achieved and must, where applicable include actions to – (i) Avoid, modify, remedy control or stop any action, activity or process which causes pollution or environmental degradation; (ii) Comply with any prescribed environmental management standards or practises; (iii) Comply with any applicable provisions of the Act regarding closure, where applicable; and (iv) Comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable.	Throughout the report. Summarised in Section 13 of the EMPr.
The method of monitoring the implantation of the impact management actions contemplated above.	Section 8.
The frequency of monitoring the implementation of the impact management actions contemplated above.	Section 8.
An indication of the persons who will be responsible for the implementation of the impact management actions.	Figures 1 & 2 and Section 8
The time periods within which the impact management actions must be implemented.	Throughout the EMPr

Requirement	Description
The mechanism for monitoring compliance with the impact management actions.	Section 8
A program for reporting on compliance, considering the requirements as prescribed in the Regulations.	Section 8
An environmental awareness plan describing the way – (i) The applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) Risks must be dealt with in order to avoid pollution or the degradation of the environment.	Section 4.2 and 4.3
Any specific information that may be required by the competent authority.	Please refer to the table above, where the competent authorities specifically required information is addressed.

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FIGURES

ABBREVIATIONS

AC	Alternating Current
Alt.	Alternative
BGIS	Biodiversity Geographic Information System
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
DWS	Department of Water and Sanitation
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 Liaison Committee
ER	Engineer Representative
ESA	Environmental Site Agent / Ecological Support Area
EMPr	Environmental Management Programme
FPA	Fire Protection Association
GPS	Global Positioning System
ha	Hectare
HIA	Heritage Impact Assessment
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IPP	Independent Power Producer
ISO	International Organisation for Standardisation (ISO 9001)
Kl / Klt	Kilo Litre
Km	Kilometre
Km/h	Kilometres per hour
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
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

1. INTRODUCTION

Cape EAPrac has been appointed by the Applicant, Karroid PV (Pty) Ltd, as the independent **Environmental Assessment Practitioner** (EAP) responsible for compilation of the **Environmental Management Programme** (EMPr) for the Karroid PV renewable energy development on the remainder of farm Geelkop 456.

This EMPr is submitted in compliance with the National Environmental Management Act (NEMA, Act 107 of 1998, as amended) for the proposed development of Karroid PV Development near Upington in the Northern Cape.

The total generation capacity of the solar facility will not exceed **100MW** for input into the national Eskom grid.

The key purpose of this EMPr is to ensure that the remedial and mitigation requirements identified during the Basic Assessment 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 Basic Assessment Report (KAI632/08) which should be referred to where necessary.

1.1. EMPr Approval & Revisions

This EMPr once authorised, becomes a legally binding document and contravention with this document constitutes a contravention with the Environmental Authorisation.

The supplementary plans annexed to this EMP (Stormwater, Erosion and Washwater Management Plan as well as the Transport Study and Traffic Management Plan) must be read in conjunction with this EMPr and maintain the same legal status as the EMPr

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;
- Changes in environmental legislation;
- Results of post-construction monitoring and audit;
- Per instruction from the competent authority; and
- Changes in technology and best practice principles.

The relevant sections of this EMP have been updated to separately reflect the environmental outcomes and environmental actions.

Should amendment of any of the EMPr objectives be required, an application for this must be submitted to the competent authority and approved before such changes are implemented. Changes to the EMPr actions may be affected without the need for an amendment process, subject to approval by the ECO and future amendment as part of the first environmental audit report.

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 internal roads).

For the Construction phase, the EPC Contractor (including any sub-contractors) must ensure that sufficient budget is allocated to the implementation of this EMPr until such time as final rehabilitation is completed.

For the operational phase, the O&M Contractor (including any sub-contractors) must ensure that sufficient budget is allocated to the Operational requirements in this EMPr

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:

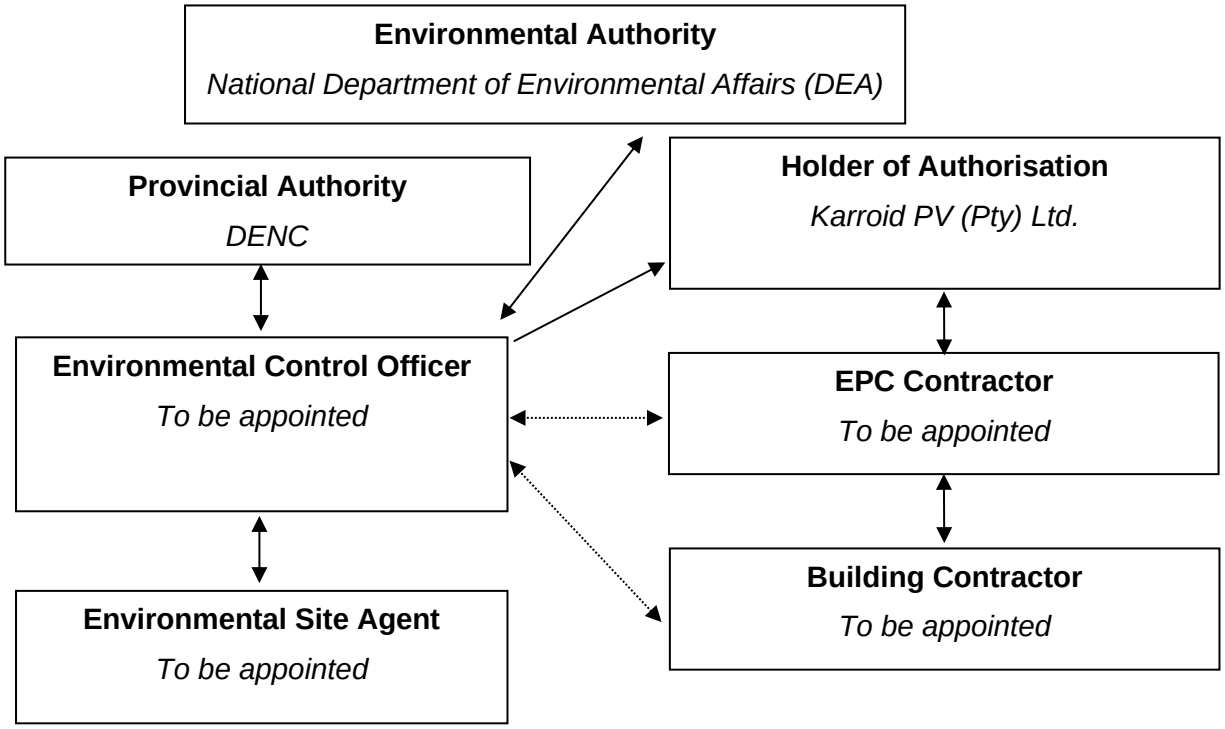

Figure 1: EMPr organisational structure during the construction phase

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

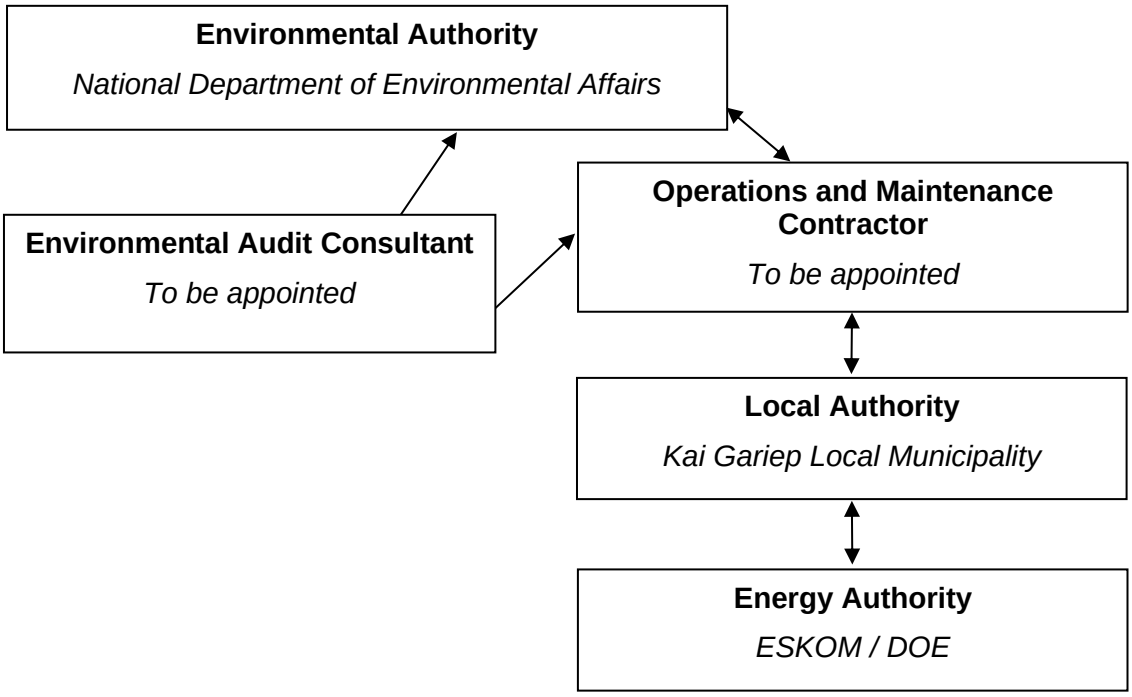

Figure 2: EMPr organisational structure during the operation phase.

This Organisational chart should be updated once the relevant parties are appointed in terms of this EMPr.

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 proposal includes the construction and operation of a photovoltaic (PV) solar facility with a generation capacity of **100Wp** The PV technology will consist of Solar photovoltaic (PV) with either of fixed-tilt-, single-axis tracking- or dual-axis tracking- mounting structures. In terms of the SDP, the following additional infrastructure will be constructed as part of this development:

- Inverter stations;
- an on-site substation (including a feed-in transformer, system metering and facility metering);
- an overhead transmission power line to distribute the generated electricity from the on-site substation to the Upingtom MTS (considered as part of a separate Environmental Process and management outcomes contained in a separate EMPr)
- Integrated Admin/control building, including:
    - Monitoring building
    - administration / office & security (gate house),
    - control room & workshop,
    - visitor centre,
    - ablution / change room and
    - warehouse / storeroom.

- a laydown area (within the project footprint) a temporary laydown area of 2-5ha is provided for. The permanent laydown area may not exceed 1ha and must be within the same area as the temporary laydown.;
- internal electrical reticulation network (underground cabling);
- an internal road / track network
- 10 x 10kLt rainwater tanks; and
- electrified perimeter fencing around the solar facility, including security infrastructure.

This layout was developed to follow a risk adverse approach whereby most of the sensitive areas were eliminated from the layout. This EMP is specific to the Karroid PV development and its associated infrastructure. Please refer to the location plan below and the site development plan attached in appendix A that shows the development area.

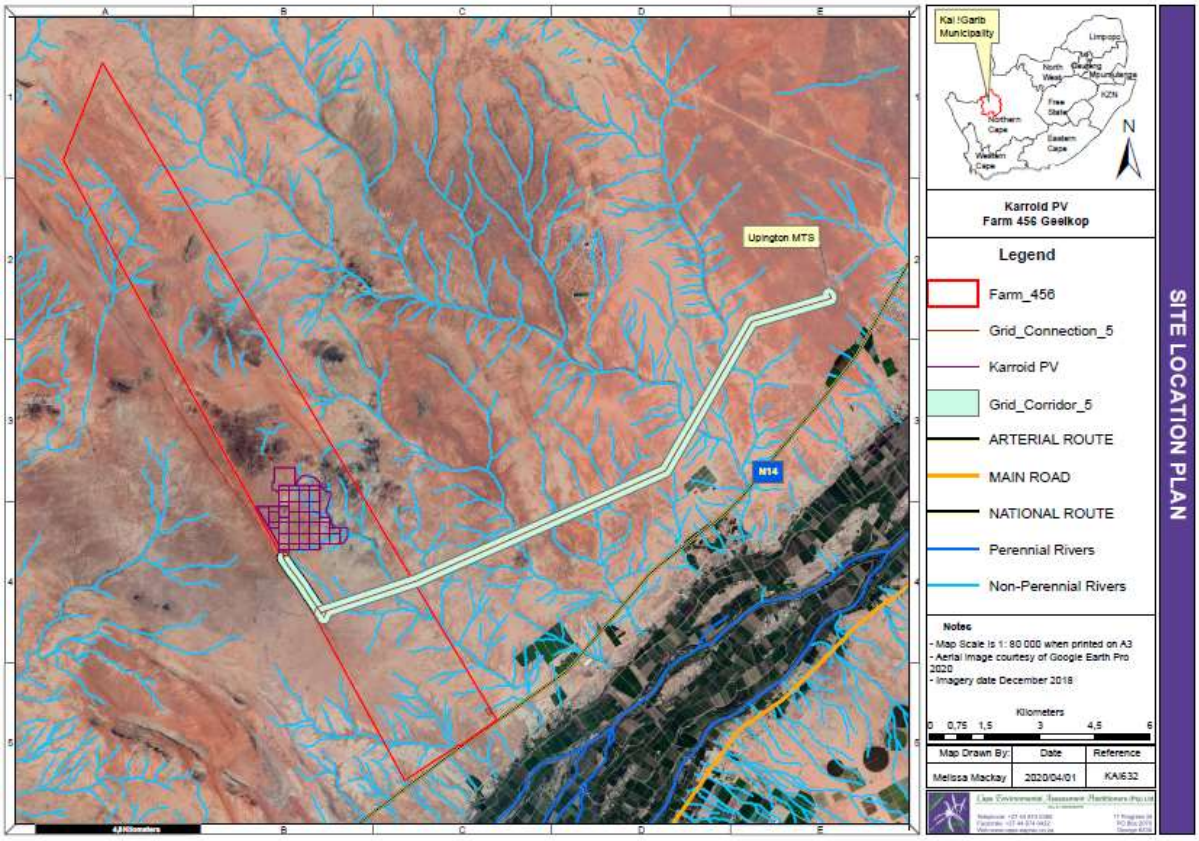

Figure 3: Location of Karroid PV

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.

These four phases can be generally categorised as follows.

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 and laydown area, vegetation clearing for establishment of internal road network)

1.5.2. Construction Phase

The construction phase of the development refers to the earthworks and the actual construction of the civil works (construction of perimeter fencing installation of the PV panel arrays, construction of internal roads, stormwater structures and auxiliary buildings and on site substation), as well as the external infrastructure such as power lines, access roads and gate house. The construction phase will end with the, 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 (Contract Operational Date). 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 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 refer the decommissioning of the panel arrays at the end of their operational lifespan (after the period defined in the Power Purchase Agreement). 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 functional (albeit it less efficient) after the upgrade or decommissioning of the facility could be re-used for other purposes (e.g. at local rural schools and clinics or other primary service providers)

2. ROLES AND RESPONSIBILITIES

Throughout the lifespan of this project, several 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 regarding the implementation of this EMPr.

Responsible Parties	Role and responsibilities
Environmental Authority – National Department of Environmental Affairs.	Role The National Department of Environmental Affairs (DEA) is the **competent / delegated authority** responsible for compliance with the relevant environmental legislation, namely the National Environmental Management Act and other Specific Environmental Management Acts (SEMA's) Responsibilities • 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 – Karroid PV (Pty) Ltd.	Role The holder of the Authorisation is ultimately responsible and legally liable for ensuring compliance with all statutory requirements relating to the Solar facility. Responsibilities • 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 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	Role The ECO fulfils an advisory role to monitor, guide and report compliance with the EMPr. Responsibilities • 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. • 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	Role To assist the ECO with the day to day implementation and monitoring of the environmental management actions that are taking place on site. Responsibilities • 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 – To be appointed	Role The Employer's representative role is likely to be fulfilled by the **project engineer /project engineer** and assumes overall delegated responsibility for compliance with this EMPr, the EA, the conditions of the Planning Approval, Conditions of the WULA and all applicable legislation for the duration of the construction phase. Responsibilities

	• 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 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.
Landowner – Koos Snyman representing the Koos Snyman Family Trust	Role The landowner is responsible for compliance with legislation applicable to the management of the remainder of the property. Responsibilities 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. The holder of the EA must ensure compliance with all relevant legislation including those detailed below and any others that may be relevant to the works to be undertaken.

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 considers 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,**
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**.
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 6**
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 6 & 7** of this EMPr – It has also 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 **Section 7** 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 **Section 1,** 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,** 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 5 & 6** of this EMPr as well as in appendix D-G.
Description of the manner in which **pollution** will be **prevented** and remedied.	This is dealt with throughout the EMPr, but specifically in **Sections 5 & 7**
The EMPR must furthermore, where appropriate;	
Set out **time periods** within which measures must be implemented.	This is dealt with in **throughout** of the EMPr and summarised in section 13.
Contain measures regulating responsibilities for any environmental damage.	This is dealt with is **14** of this EMPr.

EMPr Provision	Report Reference
Develop an **environmental awareness plan** describing the way 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 4.3 & 4.4** of the EMPr.

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n 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)

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The Draft National List of Threatened Ecosystems (Notice 1477 of 2009, Government Gazette No 32689, 6 November 2009) has been gazetted for public comment.

The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the NSBA 2004. In terms of the EIA regulations, a basic assessment report is required for the transformation or removal of indigenous vegetation in a critically endangered or endangered ecosystem regardless of the extent of transformation that will occur. **However, all the vegetation types on the property are classified as Least Threatened.** Please see the **ecological impact assessment** attached in **Annexure E1** in the BAR for further information.

NEMBA also deals with endangered, threatened and otherwise controlled species. The Act provides for listing of species as threatened or protected, under one of the following categories:

- **Critically Endangered**: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered**: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- **Vulnerable**: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- **Protected species**: any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Certain activities, known as Restricted Activities, are regulated by a set of permit regulations published under the Act. These activities may not proceed without environmental authorization.

3.4. Northern Cape Nature Conservation Act (NCNCA) (No. 9 of 2009)

The Northern Cape Nature Conservation 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. In terms of this act the following section may be relevant with regards to any security fencing the solar development may require.

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.

According to the SANBI SIBIS database, 286 indigenous plant species have been recorded from the quarter degree squares 2820 BD, DB and 2821 AC and CA. This includes 7 species of conservation concern as listed in the table below.

An ecological expert will have to be appointed to undertake a detailed site walk through in support of an application for the removal of threatened plants in terms of this legislation. Any conditions of this licence, once issued, must be complied with by the contractor and the holder of the EA.

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".*

Protected species which occur on site are reflected in the table below.

Table 1: Species present on site that are protected in terms of the National Forest Act.

Species	Common Name	SANBI National Red List[1]	Northern Cape Protected[2]	National Forest Act (1998)[3]	Habitat Description
Boscia albitrunca	Shepherd's tree	Least Concern	Yes	Yes	Terrestrial – including seven provinces excluding Western and Eastern Cape
Vachellia erioloba	Camel thorn	Least Concern	Yes	Yes	Widespread in the arid northern

[1] http://redlist.sanbi.org/

[2] Northern Cape Nature Conservation Act (Act No 9 of 2009)

[3] Notice of the list of protected tree species under the National Forests Act 84 of 1998 published in GN 182 in GG 41100 of 8 September 2017

Species	Common Name	SANBI National Red List[1]	Northern Cape Protected[2]	National Forest Act (1998)[3]	Habitat Description
					provinces of South Africa, also Namibia, Botswana, Zimbabwe, southern Angola and south-western Zambia

Please refer to the **Ecological Impact Assessment Report** in **Appendix E**, **Annexure E1** of the BAR for a detailed description of the plant species found to occur in the area.

An ecological expert will have to be appointed to undertake a detailed site walk through in support of an application for the removal of threatened plants in terms of this legislation. Any conditions of this licence, once issued, must be complied with by the contractor and the holder of the EA.

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 as the preferred method to manage plant biomass at the site.

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 conservation of soil, water and vegetation and provides for combating weeds and invader plant species. 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 flood lines of water courses and wetlands.

The abundance of alien plant species on the Karroid PV site is very low, which can be ascribed firstly to the aridity of the site.

In terms of soil and water resources, the seasonal washes and several pans highlighted as sensitive and have been excluded from the development footprint. In order to comply with the requirements of the CARA, the holder of the EA must adopt and implement the Alien Vegetation Management Plan included in this EMPr.

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). South African National Heritage Resources Agency (SAHRA) is the enforcing authority in the Northern Cape, and is registered as a Stakeholder for this environmental process.

In terms of Section 38 of the National Heritage Resources Act, SAHRA will comment on the detailed Heritage Impact Assessment (HIA) where certain categories of development are proposed. Section 38(8) also makes provision for the assessment of heritage impacts as part of an EIA process.

The National Heritage Resources Act requires relevant authorities to be notified regarding this proposed development, as the following activities are relevant:

- *the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;*
- *any development or other activity which will change the character of a site exceeding 5 000 m² in extent;*
- *the re-zoning of a site exceeding 10 000m^2 in extent.*

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.

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).

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.

The EPC contractor will have to ensure compliance with the SAHRA approval, once authorised.

3.9. National Water Act (NWA), NO 36 OF 1998

Water use in South Africa is controlled by the NWA and the enforcing authority is the DWS. The NWA recognises that water is a scarce and unevenly distributed national resource in

South Africa. Its provisions are aimed at achieving sustainable and equitable use of water to the benefit of all users and to ensure protection of the aquatic ecosystems associated with South Africa's water resources. The provisions of the Act are aimed at discouraging pollution and waste of water resources.

In terms of the Act, a land user, occupier or owner of land whereon which an activity that causes, or has the potential to cause pollution of a water resource, has a duty to take measures to prevent pollution from occurring. If these measures are not taken, the responsible authority may do whatever is necessary to prevent the pollution or remedy its effects, and to recover all reasonable costs from the responsible person.

Section 21 of the NWA specifies a number of water uses, including taking water from a water resource, the storing of water, impeding or diverting the flow of water in a watercourse, discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit, disposing of waste in a manner which may detrimentally impact on a water resource, disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process, discharging water from underground for the safety of people, and altering the bed, banks, course or characteristics of a watercourse. These Water uses requires licencing in terms of Section 22 (1) of the Act, unless it is listed in Schedule 1 of the NWA, is an existing lawful use, the water use falls under a General Authorisation issued under Section 39 of the Act, or if the responsible authority waives the need for a licence.

3.10. ASTRONOMY GEOGRAPHIC ADVANTAGE ACT, 2007 (ACT NO 21 OF 2007)

The purpose of the Act is to preserve the geographic advantage areas that attract investment in astronomy. The entire Northern Cape Province, excluding the Tsantsabane Municipality, has been declared an astronomy advantage area. The Northern Cape optical and radio telescope sites were declared core astronomy advantage areas. The Act allowed for the declaration of the Southern Africa Large Telescope (SALT), Meerkat and Square Kilometre Array (SKA) as astronomy and related scientific endeavours that must be protected.

No specific management provisions have been provided by SKA SA for the proposed Karroid PV

3.11. Guidelines & Strategic Documents

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

3.11.1. 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.

3.11.2. 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 importance, as it addresses issues of general waste and wastage minimization during construction activities.

3.11.3. 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.

3.11.4. Other Guidelines considered 3.11.4

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.

Impact management outcome: All onsite staff are aware and understands the individual responsibilities in terms of this EMPr.						
Impact Management Actions.	**Implementation**			**Monitoring**		
	Responsible person.	Method of implementation.	Timeframe for implementation.	Responsible person.	Frequency.	Evidence of compliance.
4.1. Pre-Construction Ecological Requirements • The ecological specialist recommended that the sensitive areas with appropriate buffers at the site should be demarcated by an ecologist as part of the preconstruction activities for the site. • In addition, contracted ecologist should 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 (This has already been undertaken). • 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. • An ecological expert has undertaken a detailed site walk through in support of an application for the removal of threatened plants in terms of this legislation. Any conditions of this licence, once issued, must be complied with by the contractor and the holder of the EA. • An Environmental Control Officer (ECO) should be present for the site preparation and initial clearing activities to ensure the correct demarcation of no-go areas, facilitate environmental induction with construction staff and supervise any flora relocation and faunal rescue activities that may need to take place during the site clearing.	Holder of EA	Physical/ on site	Prior to construction	ECO	Once off	ECO report / physical permit
Impact Management Actions.	**Implementation**			**Monitoring**		
	Responsible person.	**Method of implementation.**	**Timeframe for implementation.**	**Responsible person.**	**Frequency.**	**Evidence of compliance.**
4.2. Pre-Construction Heritage Requirements 4.2 • The protection of any identifies archaeological features on site (i.e. only those requiring in situ protection) and the demarcation thereof must be undertaken as defined by the Archaeology Specialist.	Holder of EA	Physical on site	Prior to construction	ECO	once off / demarcation to be checked monthly	Photographic

4.3. Pre-construction environmental compliance workshop It is a required action 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.	Holder of the EA	Meeting	Prior to construction	ECO	Once off	Signed attendance register

4.4 Environmental Induction Training & Environmental Education - It is a required action that 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 several listed and protected species present at the site and it is confirmed that some of these would be impacted by the development. 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 16 of the EMPr for photographs and description of important plant species). Section 17 provides details of the alien plant species, 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. plants must be carefully removed and transplanted outside the development area as directed by the ecological specialist and/or the ECO). As further plant species of conservation value, as well as archaeological occurrences, are likely to occur in proximity of the major drainage lines and pans 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	ECO	Physical on site	All staff need to undergo such an induction prior to them commencing on staff.	ECO	Continuous	Attendance registers

- 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 proposed actions for demarcation are 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. • All sensitive hydrological features as identified by specialists must be demarcated for exclusion. • The contractor, in conjunction with the ECO, must walk the areas determined and mark the full extent of the area to be disturbed (allowing enough space for the construction activity). • All areas beyond these demarcated areas are considered as “no-go” areas (i.e. the drainage line and pans); and Construction staff must be briefed as part of the environmental induction on the requirements regarding the no-go areas.	EPC Contractor	Physical on site	Prior to physical works on site (installation of perimeter fence is considered to form part of demarcation)	ECO	weekly	Photographic records in ECO report

4.5. Construction Phasing There are several 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.	EPC contractor	Physical / on site	Prior to commencement of drilling, piling and electrical trenching.	ECO / ESA	Weekly	ECO report
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 actions 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 or similar; • 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 enough ablution facilities (chemical toilets and potable water) of which the content must be disposed of regularly and at the suitable facilities.	EPC contractor	Physical on site	Prior to delivery of construction materials to site	ECO / ESA	Weekly	ECO Report

4.7. Water Conservation in Infrastructure The following actions must be considered in the design and construction 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.	EPC Contractor	Design phase	Prior to finalisation of design specifications	Audit consultant	During first independent audit	Audit report

4.8. Environmental Control Officer An Environmental Control Officer (ECO) must be appointed for this project (This appointment must take place during the pre-construction phase before the commencement of any of the authorised activities, including site preparation). The ECO will be responsible for monitoring, reviewing and verifying compliance by the EPC Contractor with the environmental specifications of this EMP and the conditions of the Environmental Authorisation. The appointed ECO must be independent of the EPC contractor and must be suitably qualified and have experience of environmental monitoring and control on similar scale projects. The holder of the EA must provide the name and contact details of the ECO to the Director: Compliance and Monitoring at DEA. 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; • Be fully knowledgeable of all the licences and permits issued to the site. • 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. Reports should be submitted to the National and Provincial environmental authority as well as the holder of the EA and EPC contractor; • Monitor compliance with this EMPr; • Monitor compliance with the Environmental Authorisation; • Monitor implementation of the mitigation and rehabilitation measures and recommendations referred to in the Environmental Authorisation, BAR, 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). • The ECO should be on site for the duration of site establishment and preparation. • ECO site inspections should then 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	EPC Contractor	Design phase	Prior to finalisation of design specifications	Audit consultant	During first independent audit	Audit report

Representative. The Environmental Site Agent as described below should be on site daily and be in communication with the ECO daily. • 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 complaint register in which all complaints and action taken / responses must be recorded. This information must also be included in the ECR; • Keep Record of all activities on site, problems identified, transgressions noted, and a task schedule of tasks undertaken by the ECO; and Engineers Representative on advice 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.						

4.9. Environmental Site Agent (ESA) An environmental site agent should be appointed for the duration of the construction period of the solar project (This ESA must be appointed in the pre-construction phase, prior to the commencement of construction activities). The Terms of Reference for the Environmental Site Agent (ESA) include, but are not limited to the following actions: • To ensure compliance with the Environmental Management Plan and Environmental Authorisation; • The ESA is required to be on site daily, which may be reviewed by the ECO and resident engineer 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; **If 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 if necessary.**	Holder of the EA to appoint	Prior to any physical works on site	Prior to any physical works on site	Audit consultant	During first independent audit	Audit report
4.10. 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 8 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.	Holder of the EA to appoint	Prior to any physical works on site	Prior to any physical works on site	Audit consultant	During first independent audit	Audit report

4.11. Plant Rescue and Protection A Plant Rescue and Protection Plan must be implemented. The Following actions must take place in this regard. • Identification of all listed species which may occur within the site, based on the SANBI SIBIS database as well as the specialist EIA studies for the site and any other relevant literature (This has already taken place by Ecological expert, Mr Simon Todd) • A walk-through of the final development footprint by a suitably qualified botanist/ecologist to locate and identify all listed and protected species which fall within the development footprint. (This has already taken place by Ecological expert, Mr Simon Todd) • A walk-through report following the walk-through which identifies areas where minor deviations to roads and other infrastructure can be made to avoid sensitive areas and important populations of listed species. The report should also contain a full list of localities where listed species occur within the development footprint and the number of affected individuals in each instance, so that this information can be used to comply with the permit conditions required by the authorization as well as provincial requirements. (This has already taken place by Ecological expert, Mr Simon Todd) • Search and rescue operation of all listed species within the development footprint that cannot be avoided. Affected individuals should be translocated to a similar habitat outside of the development footprint and marked for monitoring purposes. Those species suitable for search as rescue have been identified in the walk-through report. It is important to note that a permit is required to translocate or destroy any listed and protected species even if they do not leave the property. Some plants can also be offered to national collections such as the National Botanical Gardens, but no plants should be allowed to go to private collectors unless this is approved by the provincial conservation authorities.	EPC Contractor	Phased / prior to any physical work on a particular section of the site.	Phased / prior to any physical work on a particular section of the site.	ECO/ESA	Continual for duration of construction phase	ECO Report

5. CONSTRUCTION PHASE ENVIRONMENTAL MANAGEMENT

The items contained in this section of the EMPr must be implemented during the construction phase of the development of the Karroid PV Development.

5.1. Water Supply

OUTCOME: To ensure water used during construction is lawfully and sustainably utilised.

The contractor must ensure a supply of water is available on site for sanitation, drinking, dust suppression etc.

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

OUTCOME: To ensure that the handling of topsoil does not result in the pollution or loss of the resource.

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 should not be stripped from the development footprint below the solar panels.

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 actions 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. An 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.
- The topsoil stockpile mustn't be deeper than 1m.
- A minimum buffer area of 20m should be around the topsoil stockpile in which no work may take place.
- The topsoil stockpile must be barricaded to inhibit unwanted vehicle movement around it.

- Topsoil must be moved once when stockpiling and back to disturbed areas during rehabilitation, no double handling.

5.3. Transport & Traffic Management

The Transport Study and Traffic Management plan is attached in **Appendix C** and forms an integral part of this EMPr.

5.4. Concrete Management

OUTCOME: To ensure that the handling of concrete does not result in pollution of soil or water resources.

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 piles/earth screws/rock anchors). However, in instances where rammed piles/earth screws or rock anchors will not practically possible and for other concrete work associated with the substation and inverter stations, the following requirements in terms of concrete management should take place.

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 actions 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.

- If the wash water must be dumped on site, a proper evaporation pit could be built. This would be an excavated hole lined with impermeable plastic with hard barricading and netting to keep birds and animals from using it as a source of water. At the end of the project the material will be carted off-site, the hole will be filled with excavated material and topsoil placed on top.
- If piles start sagging and cement capping must take place, a batching area could be set up. The batching area must have a clear bund wall. Either built or excavated. The bunded area must have one access point. To be used as an entrance and exit. All mixing, loading or cement washing must take place within the bunded area. During rehabilitation the bunded area will be excavated till 200 below natural ground level and all material will be carted off-site. The excavated area will then be backfilled with unused excavated material and topsoil placed over it.

5.5. Cable Trenches

OUTCOME: To ensure that trenching activities are restricted and do not result in loss of topsoil resources.

Electric cables required to connect the inverters to the on-site substation (i.e. AC cables) within the boundaries of the Karroid PV 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. Please refer to the SDP included in **Appendix A** showing all AC cabling running parallel to the internal roads. There will also be limited trenching associated with the DC cabling (although the majority of this will be aboveground – mounted to the panel arrays.)

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 actions must be implemented by the contractor:

- Trenching shall be kept to a minimum through the use of single trenches for multiple service provision (including communication cabling and AC cabling in the same trenches;
- The planning and selection should be done in approximation to the SDP 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).
- Open trenches must be inspected daily for faunal entrapment (small mammals and reptiles). These are to be removed before backfilling of the trenches.

5.6. Management of archaeological resources

OUTCOME: To ensure that works do not result in significant loss of archaeological resources.

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.

5.7. Noise Management

OUTCOME: To ensure nuisance from noise and vibration does not occur.

Although the proposed development is located outside of an urban area, the following noise management actions are applicable to the construction phase of the Karroid PV Development due to its proximity to agricultural activities and potential future tourism activities proposed by the landowner.

- 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).

5.8. Dust Control & Management

OUTCOME: To ensure there is no health risk or loss of amenity due to emission of dust to the environment.

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 following actions are suggested 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 actions 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 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 must be sourced from a licenced resource.
- Dust monitoring must be done 2 months prior to construction to get a baseline and continue during construction.

5.9. Security Fencing

OUTCOME: To ensure that fencing protects project assets while limiting impact on faunal passages.

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 perimeter 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.
- On the top of the fence care must be taken not to have the earth strand too close to an electrified strand. A large bird could accidentally bridge the gap and get electrocuted.
- Only the facility itself should be fenced-off.
- Any security lighting associated with the fencing should be kept to a minimum and be of the low-UV emitting kind that attracts fewer insects.
- The final fencing plan should be submitted to the ECO for comments and approval.

5.10. Blasting

OUTCOME: To ensure any unlikely blasting activities do not disturb sensitive environmental nor social features

Since the PV panel mountings will be drilled / rammed into the earth and will thus not require extensive excavation for foundations, it is therefore highly unlikely that blasting will be required. Should blasting be required for whatever reasons, the following actions 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.

5.11. Ramming Operations

OUTCOME: To ensure that panel mounting operations do not cause pollution or undue mechanical damage to the environment

It is envisioned that ramming will be the preferred method of installing the panel support structures. The following actions must be implemented in this regard. Please refer to the engineering report in Annexure D4 of the Draft EIR 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.
- Ramming vehicles must be parked with a drip tray every evening.
- All routine work on the ramming vehicles will take place on the designated vehicle service bay.

5.12. Stormwater, Wash water and Erosion Management

OUTCOME: To ensure that stormwater and wash water do not cause erosion or pollution of the receiving environment.

The Stormwater, Erosion and Wash water Management Plan (Attached in **Appendix B**) forms an integral part of this EMP and must be adopted and implemented by the holder of the EA. The following key actions are required:

- To limit soil erosion, construction activities (more specifically clearing of land) should be limited to the dry season (May to October) as far as possible.
- Construction activities should be limited to areas outside of the 1:100-year flood line
- Upstream and downstream berms, for each construction site, should be implemented during the pre-construction and construction phases of the project. Upstream diversions will ensure limited surface flows through construction areas. Downstream berms will ensure that sediments eroded from within the construction site will be trapped, therefore reducing the impact to the downstream receiving environment. It is recommended that the berms are constructed out of a non-erodible material, such as sandbags with plastic liners.
- Materials excavated during the construction phase should be deposited in areas outside of drainage lines and stormwater channels. This will ensure minimal contact between concentrated stormwater runoff and the excavated materials.
- Machinery used during the construction process should be regularly (at least daily) checked for oil leaks. During periods where the machinery is not in use, drip trays should be placed under the machinery to contain any spillages.
- Fuels and hydrocarbon stores used during the construction phase should be lined and bunded such that spills from the store areas will not enter the receiving environment.
- Clearing of vegetation for construction purposes must be undertaken in accordance with a method statement. The method statement must include the method of clearing, recovery of and disposal of vegetation.

5.13. Fire Management and Protection

OUTCOME: To reduce the risk of fire to infrastructure and environment.

As mentioned above in Section 3.6 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 can include brush cutting. Utilisation of non-selective herbicides for the management of biomass is prohibited on site.

The following actions 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 few invasive plants identified during the environmental process, these may establish to a degree as a result of site disturbance. This must be done in accordance with the Alien Vegetation Management Plan attached in **Appendix F**;
- 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 firefighting 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.
- During site vegetation clearing, vegetation must not be packed into a couple of large heaps, this could lead to a fire hazard. Vegetation should rather be put into more frequent smaller heaps or broken down by a chipper.

5.14. Sanitation During Construction

OUTCOME: To ensure safe and healthy sanitation for construction staff without increasing pollution risk

Portable chemical ablution facilities must be made available for the use by construction staff for the duration of the construction period. The following actions 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 and away from any washes or drainage lines;
- 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 wastewater 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 builder's break, the toilets should be emptied prior to the break.

Sanitation during operation is discussed above under the design criteria in Section 4.7.

5.15. Fuel Storage

OUTCOME: To ensure lawful fuel storage that does not cause soil and water pollution.

The above ground storage of fuel is subject to authorization in terms of the National Environmental Management Act (NEMA EIA regulations) 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 actions 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 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;
- In the event that the bunded area is a pit that is dug and lined with plastic, adjustments must be made to allow for invertebrates to escape as the plastic doesn't provide any traction and become pitfall traps.
- 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 builder's 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.
- Spill kits must be made available on-site for the clean-up of spills.

5.16. Construction Waste Management

OUTCOME: To ensure the management of waste is both lawful and sustainable.

5.16.1. Litter management

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

5.16.2. 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). A list must be compiled before construction of any existing building rubble on site to avoid disputes. NO construction rubble may be used as fill in landscaping or any other areas on site.

5.16.3. 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).

5.16.4. 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.

Major services and maintenance of construction and delivery vehicles should take place off-site.

Washing of construction and personal vehicles are strictly prohibited on site unless it is done on an impermeable surface that flows into an evaporation pit. The contents of the pit will then be carted off site at the end of the project.

5.17. Theft and Other Crime

OUTCOME: To ensure that activities on site do not increase the criminal activity of the area.

An increase in crime during the construction phase is often a concern. In the case of the Karroid PV Development, 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 consider 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 security guards.

The following actions are relevant in this regard (refer to Section 5.9 above for 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.

5.18. Plant Rescue and Protection.

OUTCOME: To reduce the impact on protected and sensitive botanical features.

A plant rescue and protection plan are included in Appendix D and forms an integral part of this EMPr.

The following environmental management actions applicable to the construction phase have been summarised from this plan.

5.18.1. Identification of species of conservation concern

The ToPS (Threatened and Protected Species) regulations provide for the regulation of activities which may directly or indirectly impact threatened and protected species. Such species are identified under NEMBA as well as by the National Red Data List of Plants. At a provincial level, the Northern Cape Nature Conservation Act (2009) also provides lists of species which are protected within the province. Species listed under the National Red Data List of Plants as well as those protected under the provincial legislation must be specified on permit applications required for site clearing.

A permit application has been made for these species and any requirements of this permit once issued must be complied with.

5.18.2. Mitigation & avoidance options

Where listed plant species fall within the development footprint and avoidance is not possible, then it may be possible to translocate the affected individuals outside of the development footprint. However, not all species are suitable for translocation as only certain types of plants are able to survive the disturbance. Suitable candidates for translocation include most geophytes and succulents. Although there are exceptions, many woody species do not survive translocation well and it is generally not recommended to try and attempt to translocate such species.

5.18.3. Rescue and protection requirements

The following actions are required for the construction phase phases of the development lifecycle.

- ECO to monitor vegetation clearing at the site. Any deviations from the plans that may be required should first be checked for listed species by the ECO and any listed species present which are able to survive translocation should be translocated to a safe site.
- Any listed species observed within the development footprint that were missed during the preconstruction plant sweeps should be translocated to a safe site.

- Many listed species are also sought after for traditional medicine or by collectors and so the ECO should ensure that all staff attend environmental induction training in which the legal and conservation aspects of harvesting plants from the wild are discussed.
- The ECO should monitor construction activities in sensitive habitats such as near rivers and wetlands carefully to ensure that impacts to these areas are minimized.

5.19. Vegetation Clearing

OUTCOME: To ensure that vegetation is minimised and restricted to the development footprint.

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 construction of the Karroid PV. Development 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.

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

- 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;
    - During site vegetation clearing, vegetation must not be packed into a couple of large heaps, this could lead to a fire hazard. Vegetation should rather be put into more frequent smaller heaps or broken down by a chipper.
- 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).

5.20. Animal Rescue & Protection

OUTCOME: To reduce the direct impact on animals affected by the construction activities.

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/experienced person.

All trenches and open excavations should be inspected daily (first thing in the morning) for any trapped fauna (particularly small mammals and reptiles). These should be removed to a

safe location outside of the construction area by the ECO or other suitably qualified / experienced person.

5.21. Re-Vegetation & Habitat Restoration

OUTCOME: To restore habitat disturbed during construction activities.

A re-vegetation and habitat restoration plan are attached in **Appendix E** and is deemed to form an integral part of this EMPr.

Certain of the overarching principles and actions in this section are also contained in other sections of this EMPR. They have been reiterated here to ensure easy referencing.

5.21.1. Topsoil management

Effective topsoil management is a critical element of rehabilitation, particularly in arid and semi-arid areas where soil properties are a fundamental determinant of vegetation composition and abundance. Although some parts of the site consist of exposed bedrock, most parts of the site have at least some topsoil. Where any excavation or topsoil clearing is required, the topsoil should be stockpiled and later used to cover cleared and disturbed areas once construction activity has ceased. The following actions are required for effective topsoil management.

- Topsoil is the top-most layer (0-25cm) of the soil in undisturbed areas. This soil layer is important as it contains nutrients, organic matter, seeds, micro-organisms fungi and soil fauna. All these elements are necessary for soil processes such as nutrient cycling and the growth of new plants. The biologically active upper layer of the soil is fundamental in the maintenance of the entire ecosystem.
- Topsoil should be retained on site in order to be used for site rehabilitation. The correct handling of the topsoil is a key element to rehabilitation success. Firstly, it is important that the correct depth of topsoil is excavated. If the excavation is too deep, the topsoil will be mixed with sterile deeper soil, leading to reduction in nutrient levels and a decline in plant performance on the soil.
- Wherever possible, stripped topsoil should be placed directly onto an area being rehabilitated. This avoids stockpiling and double handling of the soil. Topsoil placed directly onto rehabilitation areas contains viable seed, nutrients and microbes that allow it to revegetate more rapidly than topsoil that has been in stockpile for long periods.
- If direct transfer is not possible, the topsoil should be stored separately from other soil heaps until construction in an area is complete. The soil should not be stored for a long time and should be used as soon as possible. The longer the topsoil is stored, the more seeds, micro-organisms and soil biota are killed.
- Ideally stored topsoil should be used within a month and should not be stored for longer than three months. In addition, topsoil stores should not be too deep, a maximum depth of 1m is recommended to avoid compaction and the development of anaerobic conditions within the soil.
- Topsoil stockpiles should be placed away from any continuous work or movement and should be hard barricaded to avoid unnecessary trampling. A 20m buffer from other work would be ideal.

5.21.2. Mulching

Mulching is the covering of the soil with a layer of organic matter of leaves, twigs bark or wood chips, usually chopped quite finely. The main purpose of mulching is to protect and cover the soil surface as well as serve as a source of seed for revegetation purposes.

- During site clearing the standing woody vegetation should not be cleared and burned, removed or mixed with the soil, but should be cleared separately. The cleared vegetation should be stockpiled and used whole or shredded by hand or machine to protect the soil in disturbed areas and promote the return of indigenous species. Where there is a low shrub or grass layer, this material can be cleared and mixed as part of the topsoil as this will aid revegetation and recovery when it is reapplied.
- Mulch should be harvested from areas that are to be denuded of vegetation during construction activities, provided that they are free of seed-bearing alien invasive plants;
- No harvesting of vegetation may be done outside the area to be disturbed by construction activities;
- Brush-cut mulch should be stored for as short a period as possible, and seed released from stockpiles can also be collected for use in the rehabilitation process.

5.21.3. Seeding

In some areas the natural regeneration of the vegetation may be poor and the application of seed to enhance vegetation recovery may be required. Seed should be collected from plants present at the site and should be used immediately or stored appropriately and used at the start of the following wet season. Seed can be broadcast onto the soil, but should preferably be applied in conjunction with measures to improve seedling survival such as scarification of the soil surface or simultaneous application of mulch.

- Indigenous seeds may be harvested for purposes of re-vegetation in areas that are free of alien or invasive vegetation, either at the site prior to clearance or from suitable neighbouring sites;
- Seed may be harvested by hand and if necessary dried or treated appropriately
- Seed gathered by vacuum harvester, or other approved mass collection method, from suitable shrubs or from the plant litter surrounding the shrubs must be kept apart from individually harvested seed;
- No seed of alien or foreign species should be used or brought onto the site.

5.21.4. Transplants

Also refer to the plant rescue and protection plan in **Appendix D** and the section above for further details on plant rescue.

Where succulent plants are available or other species which may survive translocation are present, individual plants can be dug out from areas about to be cleared and planted into areas which require revegetation. This can be an effective means of establishing indigenous species quickly, this is however unlikely to be a viable option at the current site as there are few suitable species present, but if the conditions are wet then most species have some probability of surviving.

Plants for transplant should only be removed from areas that are going to be cleared.

- Perennial grasses, shrubs, succulents and geophytes are all potentially suitable candidates for transplant.

- Transplants should be placed within a similar environment from where they came in terms of aspect, slope and soil depth.
- Transplants must remain within the site and may not be transported off the site.
- Some species can also grow from cuttings and branches of many succulent species can be rooted in the field.

5.21.5. Use of soil savers

On steep slopes (unlikely on the Karroid PV development site) and areas where seed and organic matter retention is low, it is recommended that soil savers are used to stabilise the soil surface. Soil savers are man-made materials, usually constructed of organic material such as hemp or jute and are usually applied in areas where traditional rehabilitation techniques are not likely to succeed.

- In areas where soil saver is used, it should be pegged down to ensure that is captures soil and organic matter flowing over the surface.
- Soil saver may be seeded directly once applied as the holes in the material catch seeds and provide suitable microsites for germination. Alternatively, fresh mulch containing seed can be applied to the soil saver.

5.21.6. General recommendations

Progressive rehabilitation is an important element of the rehabilitation strategy and should be implemented where feasible.

- Once re-vegetated, areas should be protected to prevent trampling and erosion.
- No construction equipment, vehicles or unauthorised personnel should be allowed onto areas that have been vegetated.
- Where rehabilitation sites are located within actively grazed areas, they should be fenced.
- Fencing should be removed once a sound vegetative cover has been achieved.
- Any runnels, erosion channels or wash ways developing after revegetation should be backfilled and consolidated and the areas restored to a proper stable condition.

5.21.7. Concluding Statement

- The most cost-effective way to reduce the cost and effort for rehabilitation is to reduce and minimize the disturbance footprint. If the panel arrays can be constructed without clearing the site, then the amount of rehabilitation required would be low and any cleared areas would quickly become re-vegetated.
- The solar panels and roads within the development represent hard surfaces that will generate a lot of runoff. As a result, effective runoff management is essential as is an effective vegetation cover to prevent widespread erosion across the site. As most of the site is gently sloping, the risk of erosion is high and retaining vegetation cover between the rows of panels during construction is strongly recommended.

5.22. Alien Plant Management Plan

OUTCOME: To manage alien species in compliance with the AIS regulations.

An Alien Vegetation management plan is attached Appendix F and is deemed to form an integral part of this EMPR.

The following actions are summarised from this plan

5.22.1. Alien Species Presence & Abundance on the Property.

The Karroid PV site has minimal invasive vegetation. The density of alien species within the intact vegetation is generally very low and is restricted to disturbed areas around watering points and kraal sites. Species observed at the site include the following species contained in the table below. Of these several are small prostrate species which are not listed and are not considered a high priority. However the declared invaders and large woody species are most important due to their negative effects and have also been observed to increase rapidly at some of the already completed solar PV projects in the area and are therefore also likely to increase following construction of the current development. Species which are likely to require specific attention include *Prosopis glandulosa*, *Argemone ochroleuca*, *Datura ferox* and *Xanthium spinosum*. *Prosopis gladulosa* is not likely to become an immediate problem, but may gradually invade areas within or near the facility which receive additional runoff. The other species are likely to respond more quickly and may become a problem even during construction if there is sufficient rainfall.

5.22.2. Recommended Management Practice & Clearing Methods

The following general principles and observations which underlie or impact the alien management plan can be made regarding the likely trajectories of vegetation change at PV facilities during and following construction:

- There is likely to be a progression of alien species presence and abundance at the PV sites over time. Initially, alien species are likely to be a significant and persistent problem due to the high levels of disturbance present at the sites following construction. Most alien species are poor competitors and the lack of indigenous vegetation cover will encourage the growth of alien species. Provided that alien species are controlled in a sensitive manner, a cover of perennial grasses is likely to become well established with a couple of years. This should discourage alien species which, with additional control, should become considerably less conspicuous within 5 years of construction. Some more competitive alien species may become established at this time and alien control strategies may need to be adapted over time to address the new problem species.
- Alien species presence will vary from year to year in terms of abundance, density and the identity of species present. This can be ascribed largely to variation in rainfall timing and amount, which will favour a different suite of species each year. Therefore, occasional outbreaks of certain species are not likely to be cause for concern, whereas a persistent high or increasing abundance of a species is indicative of a species where control may be required.
- Management practices will impact indigenous as well as alien species. The dominant management practice at the PV facilities is likely to be mowing to control vegetation height and fire risk within the facility. Regular mowing encourages the growth of low and creeping forms and discourages tall growth forms. This principle is well demonstrated by garden lawns or sports fields where most alien species or weeds in the lawn can be eradicated simply through regular mowing.
- Even without management intervention the vegetation composition of the facilities will change over time. This is due to the shading effect of the panels and the uneven distribution of runoff from the panels. So even where PV sites have not been cleared, it is likely that the vegetation beneath the panels will stabilise at a relatively low level on account of the shading effect, while the runoff at the leading edge of the arrays will

encourage the presence of taller or more dense vegetation, which is problematic as shading of the panels may occur and a high plant biomass poses a fire risk.

Without being too prescriptive as the exact methods and approaches to be used, the following general management actions should be encouraged or strived for:

- Mowing excess vegetation by hand, for example with a weed eater, generates the lowest level of associated disturbance and is identified as the preferred method for vegetation control. However, this is time consuming and more mechanical means such as using a tractor with mower is also considered acceptable.
- There is a target height to which vegetation should be cut. If the vegetation is cut too low, then recovery of the grass layer will be slow, and this may encourage erosion and an increase in alien invasion. On the other hand, if the vegetation is not cut low enough, then recovery will be rapid and frequent follow-up control may be required. It is recommended that the target height for vegetation after mowing should be about 10-15cm.
- The maintenance of firebreaks around the facilities is an important safety control and the roads around the perimeter of the facility should be maintained free of vegetation. This is best achieved by manual clearing. Within the facilities themselves, some vegetation recovery along the internal roads should be considered acceptable.
- Where dense stands of alien species have established that cannot be controlled by manual means, some use of herbicides may be acceptable. However, the associated safety precautions should be taken with regards to the appropriate application methods as well as the use of personal safety equipment (These are outlined in greater detail below). The best-practice clearing method for each species identified should be used. The preferred clearing methods for most alien species can be obtained from the DWAF Working for Water Website. http://www.dwaf.gov.za/wfw/Control/
- The effectiveness of vegetation control varies seasonally, and this is also likely to impact alien species. Control early in the wet season will allow species to re-grow and follow-up control is likely to be required. It is tempting to leave control till late in the wet season to avoid follow-up control. However, this may allow alien species to set seed before control and hence will not contribute towards reducing alien species abundance. Therefore, vegetation control should be aimed at the middle of the wet season, with a follow-up event towards the end of the wet season. There are no exact dates that can be specified here as each season is unique and management must therefore respond according to the state and progression of the vegetation.
- Alien management is an iterative process and it may require repeated control efforts to significantly reduce the abundance of a species. This is often due to the presence of large and persistent seed banks. However, repeated control usually results in rapid decline once seed banks become depleted.
- Some alien species such as Opuntia (Prickly Pear) and trees such as Prosopis (Mesquite) are best individually pulled by hand and in the case of Opuntia removed from the site.
- It is expected that regular vegetation control to reduce plant biomass within the PV field will be conducted and that this will be timed to coincide with the critical growth phases of the most important alien species. This will significantly reduce the cost of alien management as this should contribute towards the control of the dominant alien

species and additional targeted control will be required only for a limited number of species.

5.22.3. General Clearing & Guiding Principles

- Alien control programs are long-term management projects and should include a clearing plan which includes follow up actions for rehabilitation of the cleared area.
- The lighter infested areas should be cleared first to prevent the build-up of seed banks.
- Pre-existing dense mature stands ideally should be left for last, as they probably won't increase in density or pose a greater threat than they are currently.
- Collective management and planning with neighbours may be required in the case of large woody invaders as seeds of aliens are easily dispersed across boundaries by wind or water courses.

All clearing actions should be monitored and documented to keep track of which areas are due for follow-up clearing.

5.22.4. Clearing Methods

- Different species require different clearing methods such as manual, chemical or biological methods or a combination of both.
- However, care should be taken that the clearing methods used do not encourage further invasion. As such, regardless of the methods used, disturbance to the soil should be kept to a minimum.
- Fire is not a natural phenomenon in the area and fire should not be used for alien control or vegetation management at the site.
- The best-practice clearing method for each species identified should be used. The preferred clearing methods for most alien species can be obtained from the DWAF Working for Water Website. http://www.dwaf.gov.za/wfw/Control/

5.22.5. Use of Herbicides for Alien Control

Although it is usually preferable to use manual clearing methods where possible, such methods may create additional disturbance which stimulates alien invasion and may also be ineffective for many woody species which resprout. Where herbicides are to be used, the impact of the operation on the natural environment should be minimised by observing the following:

- Area contamination must be minimised by careful, accurate application with a minimum amount of herbicide to achieve good control.
- All care must be taken to prevent contamination of any water bodies. This includes due care in storage, application, cleaning equipment and disposal of containers, product and spray mixtures.
- Equipment should be washed where there is no danger of contaminating water sources and washings carefully disposed of in a suitable site.
- To avoid damage to indigenous or other desirable vegetation, products should be selected that will have the least effect on non-target vegetation.
- Coarse droplet nozzles should be fitted to avoid drift onto neighbouring vegetation.
- The appropriate health and safety procedures should also be followed regarding the storage, handling and disposal of herbicides.

For all herbicide applications, the following guidelines should be followed:

Working for Water: Policy on the Use of Herbicides for the Control of Alien Vegetation.

Table 4: A dense infestation of Stinkblaar (*Datura ferox*) growing at a South African solar PV plant shortly after construction. A large proportion of this invasion could have been avoided if the vegetation beneath the panels had not been cleared as this vegetation would have utilised the water running off the front of the panels and limited the invasion of the *Datura*.

5.22.6. Construction Phase Activities

The following management actions are aimed at reducing soil disturbance during the construction phase of the development, as well as reducing the likelihood that alien species will be brought onto site or otherwise encouraged.

Table 5: Alien vegetation management requirements during the construction phase.

Action	Frequency
The ECO is to provide permission prior to any vegetation being cleared for development.	Daily
Clearing of vegetation should be undertaken as the work front progresses – mass clearing should not occur unless the cleared areas are to be surfaced or prepared immediately afterwards.	Weekly
Where cleared areas will be exposed for some time, these areas should be protected with packed brush, or appropriately battered with fascine work. Alternatively, jute (Soil Saver) may be pegged over the soil to stabilise it.	Weekly
Cleared areas that have become invaded can be sprayed with appropriate herbicides provided that these are such that break down on contact with the soil. Residual herbicides should not be used.	Weekly
Although organic matter is frequently used to encourage regrowth of vegetation on cleared areas, no foreign material for this purpose should be brought onto site. Brush from cleared areas should be used as much as possible. The use of manure or other soil amendments is likely to encourage invasion.	Weekly
Clearing of vegetation is not allowed within 32m of any wetland, 80m of any wooded area, within 1:100 year flood lines, in conservation servitude areas or on slopes steeper than 1:3,	Weekly

Action	Frequency
unless permission is granted by the ECO for specifically allowed construction activities in these areas.	
Care must be taken to avoid the introduction of alien plant species to the site and surrounding areas. (Particular attention must be paid to imported material such as building sand or dirty earth-moving equipment.) Stockpiles should be checked regularly and any weeds emerging from material stockpiles should be removed.	Weekly
Alien vegetation regrowth on areas disturbed by construction must be controlled throughout the entire site during the construction period.	Monthly
The alien plant removal and control method guidelines should adhere to best practice for the species involved. Such information can be obtained from the DWAF Working for Water website.	Monthly
Clearing activities must be contained within the affected zones and may not spill over into demarcated No Go areas.	Daily
Pesticides may not be used. Herbicides may be used to control listed alien weeds and invaders only.	Monthly
Wetlands and other sensitive areas should remain demarcated with appropriate fencing or hazard tape. These areas are no-go areas (this must be explained to all workers) that must be excluded from all development activities.	Daily

5.22.7. Concluding Statement

- As there are already several alien species present at the site, alien invasion following disturbance at the site is likely to occur rapidly. As a result, alien control should begin during the construction phase to ensure that the density and abundance of alien species remains manageable into the operational phase.
- In the short-term, soil disturbance is likely to be the dominant driver of alien invasion at the site. While, in the long-term the distribution of runoff is likely to be a key driver as those areas which receive water will be wetter and likely to contain a higher alien abundance.
- As disturbance is the major initial driver of alien species invasion, keeping the disturbance footprint to a minimum is a key element in reducing alien abundance. Wherever possible, the indigenous vegetation should be left intact as this will significantly reduce the likelihood of alien invasion.

5.23. Open Space Management

OUTCOME: To manage the undeveloped portions of the footprint to promote ecological diversity.

An open space management plan is attached in appendix G and is deemed to be an integral part of this EMPr.

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, designated no open space areas have been included in the development design. However, the pan avoided by the solar development footprint, could be considered and managed as pockets of 'open space' with the development area.

The management of these no-go / 'open space' areas should essentially include the following three actions:

- As no-go open space areas, access through the drainage line (to the east) and the pan must be controlled (i.e. avoided entirely), in order to maintain the integrity of ecological, agriculture and archaeological resources found there. The no-go area demarcation (e.g. danger tape, signage etc.) implanted during pre-construction, must be maintained throughout the construction and rehabilitation phases.
- During the rehabilitation and operation phases alien plant invasion monitoring of these 'open space areas' must be undertaken on a 6-monthly basis and all alien plants found must be destroyed (ring-barking) and/or removed (cut down and herbicide applied).
- The Low-Level-River-Crossings (LLRC) which allow the crossing of the drainage line by the access road network, must be inspected on a regular (2-monthly) basis to ensure that no erosion is occurring and that there is no obstruction of the natural water flow. Any evidence of erosion found during these inspections must be rectified immediately and the cause of erosion pro-actively sought and remedied to avoid recurrence

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 ENVIONMENTAL MANAGEMENT

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

6.1. PV Panel Maintenance Requirements

OUTCOME: To ensure that PV panel maintenance activities do not directly, nor indirectly result in habitat degradation or pollution of resources.

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. Water for cleaning panels should take place using water from lawful sources on site or from the rainwater collection / storage systems. To further reduce the use of water at the solar facility, the use of alternative panel cleaning methods could be investigated. The use of robotic PV cleaners or high-pressure/low volume water cleaners, as well as compressed air can be considered, should the technology become commercially viable and available during the lifespan of the project.

In compliance with the EA, only biodegradable soap may be used for washing purposes. Care should be taken that the wash-water does not cause any erosion (Please refer to section dealing with wash water management described below).

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 / mowing 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 sandblasting 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. Management of Wash-water

A Stormwater, Erosion and Wash water Management Plan is attached in Appendix B and is deemed to form an integral part of this EMPr

After construction, the washing of the solar panels once every quarter is likely to cause nominal additional run-off. The overall effect on the natural water courses is expected to be very low, due to the high evaporation potential and low rainfall of the area. No chemicals will be used to clean the panels, only water. If required, a biodegradable soap may be used.

6.1.3. 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 **perimeter 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 of 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 twice a year 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. Operation Waste Management

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

6.2.1. 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.

6.2.2. Scrap Metal

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

6.2.3. 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.

The servicing of operation/maintenance vehicles should take place off-site.

6.3. Plant rescue and protection.

OUTCOME: To reduce the impact on the botanical features during operation.

A Plant rescue and protection plan is attached in Appendix D. The following actions terms of this plan must be adopted for the operational phase of the project lifecycle.

- Access to the site should be strictly controlled and all personnel entering or leaving the site should be required to sign and out with the security officers.
- The collecting of plants of their parts should be strictly forbidden and signs stating so should be placed at the entrance gates to the site.

6.4. Alien Vegetation Management

An Alien Vegetation Management Plan is attached in Appendix F of this EMPr

The following management actions are aimed at reducing the abundance of alien species within the site and maintaining non-invaded areas clear of aliens.

Table 6: Alien vegetation management requirements during operation.

Action	Frequency
Surveys for alien species should be conducted regularly. Every 6 months for the first two years after construction and annually thereafter. All aliens identified should be cleared.	Every 6 months for 2 years and annually thereafter
Where areas of natural vegetation have been disturbed by construction activities, revegetation with indigenous, locally occurring species should take place where the natural vegetation is slow to recover or where repeated invasion has taken place following disturbance.	Biannually, but revegetation should take place at the start of the rainy season
Areas of natural vegetation that need to be maintained or managed to reduce plant height or biomass, should be controlled using methods that leave the soil protected, such as using a weed-eater to mow above the soil level.	When necessary
No alien species should be cultivated on-site. If vegetation is required for aesthetic purposes, then non-invasive, water-wise locally occurring species should be used.	When necessary

7. CLOSURE & DECOMMISSIONING PHASE ENVIRONMENAL MANAGEMENT

After the lifespan of the facility (20-25 years), there is a possibility that the entire facility will be decommissioned and closed (although other options for continuation may be investigated)

Appendix 5 of Regulation 982 of the 2014 EIA Regulations contains the required contents of a Closure Plan. The table below shows the minimum requirements for a closure plan. The operating entity for this facility must ensure that the closure plan complies with these requirements as well as any other legislative requirements that may come into effect during the lifecycle of the project.

Table 7: Legislative requirements for a closure plan.

Requirement
(1) A closure plan must include -
(a) Details of - (i) The EAP who prepared the closure plan; and (ii) The expertise of that EAP.
(b) Closure objectives.
(c) Proposed mechanisms for monitoring compliance with and performance assessment against the closure plan and reporting thereon.
(d) Measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity and associated closure to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development including a handover report, where applicable.
(e) Information on any proposed avoidance, management and mitigation measures that will be taken to address the environmental impacts resulting from the undertaking of the closure activity.
(f) A description of the way it intends to – (i) Modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation during closure; (ii) Remedy the cause of pollution or degradation and migration of pollutants during closure.

Requirement	
	(iii) Comply with any prescribed environmental management standards or practises; or (iv) Comply with any applicable provisions of the Act regarding closure.
(g)	Time periods within which the measure contemplated in the closure plan must be implemented.
(h)	The process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of closure.
(i)	Details of all public participation processes conducted in terms of regulation 41 of the Regulation, including – (i) Copies of any representations and comments received from registered interested and affected parties; (ii) A summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; (iii) The minutes of any meetings held by the EAP with interested and affected parties and other role players which record the views of the participants; (iv) Where applicable, an indication of the amendments made to the plan as a result of public participation processes conduction in terms of regulation 41 of these Regulations.
(j)	Where applicable, details of any financial provisions for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts.

Within a period of at least 12 months prior to the planned closure and decommissioning of the site a Closure Plan must be prepared and submitted to the Local Planning Authority (Kai Garib 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 plan must provide detail pertaining to site restoration, soil replacement, landscaping, pro-active conservation, and a timeframe for implementation. Furthermore, Plan must comply with any additional 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 (30-years) to totally decommission the solar facility i.e. make the land available for an alternative land use, a closure plan as detailed above should be developed and should include provision for the following:

- 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 could be donated to local rural schools and clinics upon facility closure and decommissioning;
- The disturbed portions of 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);
- Discontinuation of Lease and Easement Agreements for mainland and assess roads;
- Consider whatever is economically or socially beneficial and risky for the project's Owners and other Stakeholders at this last stage
    - This could include selling equipment on secondary market, recycling of metals and modules as scrap, using some or all of the proceeds to pay the local labour for uninstallation work, etc?.
    - PV leaves no pollution and the equipment other than the modules which should be reused or recycled (There is an existing market for this).

7.2. Scenario 2: Partial Decommissioning / Upgrade of Solar Facility

Due to low variable costs and loans repaid long ago, any owner the facility may be interested in prolonging technical, functional, legal and economic lives of the plans for as long as possible, even beyond Power Purchase Agreement.

- This will require disposal of assets with shorter technical lives are critical (inverters, etc). PV modules, substructures, cables have a lifespan that should be longer than 25 years;
- Under this option, the O&M contractor will have to ensure that the validity period of all licences / permits and agreements is extended where necessary and that any legislation that has subsequently been promulgated is considered.

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 enough output, could be donated to local schools and clinics. Any upgrades to the facility at this stage must comply with relevant legislation and guidelines of the time.

8. MONITORING AND AUDITING

Environmental monitoring and audits are fundamental in ensuring the implementation of the management actions contained within this EMPr, environmentally sustainable development and maintenance of Karroid PV.

To promote transparency and cooperative governance, the results of relevant audits should be submitted to:

- The operators of the facility;
- The local authority (Kai Garib).
- The provincial environmental authority: Department of Environmental Affairs & Nature Conservation (DENC).

- 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.

Appendix 7 of Regulation 982 of the 2014 EIA Regulations contains the required contents of an Environmental Audit Report. The table below shows the legislated requirements of an audit reports, and all relevant environmental audits undertaken as part of this development (during construction and operation) should comply with these requirements.

Table 8: Contents of an audit report

(1) An Environmental audit report prepared in terms of these Regulations must contain:
(a) Details of – (i) The independent person who prepared the environmental audit report; and (ii) The expertise of independent person that compiled the environmental audit report.
(b)Details of – (i) The independent person who prepared the environmental audit report; and (ii) The expertise of independent person that compiled the environmental audit report.
(c) A declaration that the independent auditor is independent in a form as may be specified by the competent authority.
(d) An indication of the scope of, and the purpose for which, the environmental audit report was prepared.
(e) A description of the methodology adopted in preparing the environmental audit report.
(f) An indication of the ability of the EMPr, and where applicable the closure plan to – (i) Sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity on an on-going basis; (ii) Sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the closure of the facility; and (iii) Ensure compliance with the provisions of environmental authorisation, EMPr, and where applicable, the closure plan.
(g) A description of any assumptions made, and any uncertainties or gaps in knowledge.
(h) A description of a consultation process that was undertaken during the course of carrying out the environmental audit report.
(i) A summary and copies of any comments that were received during any consultation process
(j) Any other information requested by the competent authority.

8.1. ECO 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. Recording and Reporting to the DEA.

The following recording and reporting requirements are required:

- The holder of the authorisation must keep all records relating to monitoring and auditing on site and make it available for inspection to any relevant and competent authority in respect of this development.

All documentation e.g. Audit/monitoring/compliance reports and notifications required to be submitted to the department in terms of the EA, must be submitted to the Director: Compliance monitoring.

8.3. Environmental Audit Report

The holder of the EA must submit an environmental audit report to the department within 30 days of completion of the construction phase (i.e. within 30 Days of site handover) and within 30 days of completion of rehabilitation activities.

This environmental audit report must:

- Be compiled an independent environmental auditor;
- Indicate the date of the audit, the name of the auditor and the outcome of the audit;
- Evaluate compliance with the requirements of the approved EMPr and the Environmental Authorisation;
- Include measures to be implemented to attend to any non-compliances or degradation noted;
- Include copies of approvals granted by other authorities relevant to the development for the reporting period;
- Highlight any outstanding environmental issues that must be addressed, along with recommendations for ensuring these issues are appropriately addressed;
- Include a copy of the EA and the approved EMPr;
- Include all documentation such as waste disposal certificates, hazardous waste landfill site licences etc, pertaining to this authorisation; and
- Include evidence of adherence to the conditions of this authorisation and the EMPr where relevant such as training records and attendance registers.

Further to these requirements, this audit report must also comply with the requirements of an audit as highlighted in Annexure 7 of R982 and included in **Error! Reference source not found.** above.

8.4. Plant Rescue monitoring requirements

A plant rescue and protection plan are attached in Appendix D of this EMPR. The following reporting and monitoring requirements are recommended as part of the plant rescue and protection plan:

- Preconstruction walk-through report detailing the location and distribution of all listed and protected species. This should include a walk-through of all infrastructure including all new access roads, PV array areas, underground cables, power line routes, buildings and substations. The report should include recommendations of route adjustments where necessary, as well as provide a full accounting of how many individuals of each listed species will be impacted by the development. (This has already taken place by Ecological expert, Mr Simon Todd)
- Monitoring during construction by the ECO to ensure that listed species and sensitive habitats are avoided. All incidents should be recorded along with the remedial measures implemented.

- Post construction monitoring of plants translocated during search and rescue to evaluate the success of the intervention. Monitoring for a year post-transplant should be enough to gauge success.

8.5. Habitat Restoration Monitoring requirements

A habitat restoration plan is attached in **Appendix E** of the EMPr.

As rehabilitation success, particularly in arid areas is unpredictable, monitoring and follow-up actions are important to achieve the desired cover and soil protection.

- Re-vegetated areas should be monitored every 4 months for the first 12 months following construction.
- Re-vegetated areas showing inadequate surface coverage (less than 20% within 12 months after re-vegetation) should be prepared and re-vegetated;
- Any areas showing erosion, should be re-contoured and seeded with indigenous grasses or other locally occurring species which grow quickly.

8.6. Alien Vegetation Monitoring During the Construction Phase

An alien vegetation management plan is attached in Appendix F.

The following monitoring actions should be implemented during the construction phase of the development.

Table 9: Alien vegetation monitoring requirements during the construction phase.

Monitoring Action	Indictor	Timeframe
Document alien species present at the site	List of alien species	Preconstruction
Document alien plant distribution	Alien plant distribution map within priority areas	3 Monthly
Document & record alien control measures implemented	Record of clearing activities	3 Monthly
Review & evaluation of control success rate	Decline in documented alien abundance over time	Biannually

8.7. Alien Vegetation Monitoring During the Operational Phase

An alien vegetation management plan is attached in Appendix F.

The following monitoring and evaluation actions should take place during the operational phase of the development.

Table 10: Alien vegetation monitoring requirements during the operational phase

Monitoring Action	Indictor	Timeframe
Document alien species distribution and abundance over time at the site	Alien plant distribution map	Biannually
Document alien plant control measures implemented & success rate achieved	Records of control measures and their success rate. A decline in alien distribution and cover over time at the site	Biannually

Document rehabilitation measures implemented, and success achieved in problem areas	Decline in vulnerable bare areas over time	Biannually

9. MANAGEMENT ACTIONS FROM SPECIALISTS

Please refer to the table below, which summarises the mitigation measures recommended by both the Specialists and Cape EAPrac. This table summarises the mitigations, and details whether they should be included as conditions of approval, or whether they have been included as actions in the EMPr. The table furthermore reflects to which stage of the development the proposed mitigation measures are applicable. In instances where suggested mitigations have already been incorporated into the design phase, they have been reflected as such.

Table 11**:** Recommended mitigation measures required for the construction, operation and decommissioning of the Karroid PV development.

Mitigation	**Condition of Approval**	**Included in EMPr**	**Construction Phase**	**Operational Phase**	**Decomissioning Phase**
Terrestrial Ecology					
Restrict impact to development footprint only and limit disturbance spreading into surrounding areas.	✓	✓	✓	✓	✓
As far as possible, locate infrastructure within areas that have been previously disturbed or in areas with lower sensitivity scores.		✓	✓		
Avoid sensitive features and habitats when locating infrastructure		✓	✓		
Cross streams and other linear features at right angles, where possible, and also near their end-points or where there are natural breaks in the feature		✓	✓		
Construct adequate structures at points where roads cross watercourses, either proper stabilized dips in the road or culverts that do not limit the width of natural channels or the natural hydrological function.		✓	✓		
No mass clearing of vegetation for the PV arrays should be allowed. Vegetation to be brush cut and only in exceptional circumstances completely cleared.	✓	✓	✓		
Compile a Rehabilitation Plan		✓	✓	✓	✓
Compile an Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas.		✓	✓	✓	✓
Where possible, access roads should be located along existing farm, access and district roads		✓	✓		
Access to sensitive areas outside of development footprint should not be permitted during construction.		✓	✓		
Undertake monitoring to evaluate whether further measures would be required to manage impacts.		✓	✓	✓	
A number of protected species were found on site. The following mitigation measures would help to avoid and limit impacts: It is a legal requirement to obtain permits for specimens that will be lost.	✓	✓	✓		
A detailed pre-construction walk-through survey will be required during a favourable season to locate any additional individuals of protected plants. This	✓	✓	✓		

Mitigation	Condition of Approval	Included in EMPr	Construction Phase	Operational Phase	Decomissioning Phase
survey must cover the footprint of all approved infrastructure, including internal access roads.					
If possible, plants should be conserved in situ, along with an appropriate buffer zone around them		✓	✓		
Plants lost to the development can be rescued and planted in appropriate places in rehabilitation areas. This will reduce the irreplaceable loss of resources as well as the cumulative effect		✓	✓		
A Plant Rescue Plan must be compiled to be approved by the appropriate authorities.		✓	✓		
Restrict impact to development footprint only and limit disturbance spreading into surrounding areas. Limit clearing of natural habitat designated as sensitive, especially rocky outcrops, cliffs and riparian habitats.	✓		✓		
No speeding on access roads – install speed control measures, such as speed humps, if necessary		✓	✓		
No hunting of protected species.		✓	✓		
Personnel to be educated about protection status of species, including distinguishing features to be able to identify protected species.		✓	✓		
Report any sitings to conservation authorities		✓	✓	✓	
Undertake dust fall-out monitoring and manage, where necessary	✓	✓	✓		
Compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control. This should include any areas within proximity to the project that may be affected by the project, or that could have an influence on invasion by alien invasive plants into the property		✓	✓	✓	
Undertake regular monitoring to detect alien invasions early so that they can be controlled.		✓	✓	✓	
Avoid development of designated sensitive habitats		✓	✓		
Appropriate lighting should be installed to minimize impacts on nocturnal animals.		✓	✓	✓	
Construction activities should not be undertaken at night.		✓	✓		
Compile and implement a stormwater management plan, which highlights control priorities and areas and provides a programme for long-term control		✓	✓		
Undertake regular monitoring to detect erosion features early so that they can be controlled		✓	✓	✓	
Avoid building on or near steep or unstable slopes. Construct proper culverts, bridges and/or crossings at drainage-line crossings, and other attenuation devices to limit overland flow		✓	✓		
No additional clearing of vegetation should take place without a proper assessment of the environmental impacts and authorization from relevant authorities		✓		✓	
If any additional infrastructure needs to be constructed, for example overhead powerlines, communication cables, etc., then these must be located next to existing infrastructure, and clustered to avoid dispersed impacts.		✓		✓	
No driving of vehicles off-road		✓		✓	
Implement Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas.		✓		✓	
Access to sensitive areas outside of development footprint should not be permitted during operation.		✓		✓	

Mitigation	Condition of Approval	Included in EMPr	Construction Phase	Operational Phase	Decomissioning Phase
Surface runoff and erosion must be properly controlled and any issues addressed as quickly as possible.					
No illegal collecting of any individuals, particularly the Armadillo Girdled Lizard		✓	✓	✓	
No hunting of protected species or hunting of any other species without a valid permit.		✓	✓	✓	
Personnel to be educated about protection status of species, including distinguishing features to be able to identify protected species		✓	✓	✓	
Avifaunal					
Activity should as far as possible be restricted to the footprint of the infrastructure.		✓	✓		✓
Measures to control noise and dust should be applied according to current best practice in the industry.		✓	✓		✓
Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical.		✓	✓		✓
Access to the rest of the property must be restricted. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint is concerned.		✓	✓		
A single perimeter fence should be used .		✓		✓	
With regards to the infrastructure within the substation yard and inverter station, the hardware is too complex to warrant any mitigation for electrocution at this stage. It is rather recommended that if any impacts are recorded once operational, site specific mitigation be applied reactively.		✓		✓	
Palaeontology					
Implementation of a chance find procedure		✓	✓		
Visual					
Investigate the possibility of undertaking screening		✓	✓		
Plan to maintain the height of structures as low as possible;		✓	✓		
Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development		✓	✓		
Reinstate any areas of vegetation that have been disturbed during construction		✓	✓		
Remove all temporary works		✓		✓	
Monitor rehabilitated areas post-construction and implement remedial actions;		✓		✓	
Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.		✓		✓	
Remove infrastructure not required for the post-decommissioning use of the site		✓			✓
All alien plant re-growth must be monitored and should these alien plants reoccur these plants should be re-eradicated. The scale of the development does however not warrant the use of a Landscape Architect and / or Landscape Contractor.		✓	✓		
It is further recommended that a comprehensive rehabilitation / monitoring plan be implemented from the project onset to ensure a net benefit to the environment within all areas that will remain undisturbed.		✓	✓	✓	
Vegetation clearing should occur in a phased manner in accordance with the construction programme to minimise erosion and/or run-off		✓	✓		
Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment. Suitable dust and		✓	✓		

Mitigation	Condition of Approval	Included in EMPr	Construction Phase	Operational Phase	Decomissioning Phase
erosion control mitigation measures should be included in the EMP to mitigate these impacts.					
Any stormwater within the development area must be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments and reduce flow velocities (e.g. water used when washing the PV Panels).		✓	✓	✓	
Suitable stormwater management features with erosion control measures (gabions) should also be installed in areas where concentrated flows are anticipated		✓	✓		
Strict use and management of all hazardous materials used on site.		✓	✓		
Strict management of potential sources of pollution (e.g. litter, hydrocarbons from vehicles & machinery, cement during construction, etc.) within demarcated / bunded areas		✓	✓		
Containment of all contaminated water by means of careful run-off management on site.		✓	✓		
Appropriate ablution facilities should be provided for construction workers during construction and on-site staff during the operation of the facility. These must be situated outside of any delineated water courses or the buffers shown		✓	✓		
Strict control of the behaviour of construction workers.		✓	✓		
Appropriate waste management		✓	✓		
Working protocols incorporating pollution control measures (including approved method statements by the contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced.		✓	✓		
Agriculture					
Installation of proper Erosion control, and drainage on the access road.		✓	✓		
Dust control on the access road during construction.		✓	✓		
The general objective is to position the PV facilities on the lowest potential soil and not in places that may have impact on agricultural activities, drainage lines and places with a sensitive nature. Existing road alignments are followed and roads upgraded for use during the live span of facility. With the appropriate planning, the same live style can be achieved during the lease period of the facility from the land so occupied by the facility.		✓	✓		
Refuelling normally takes place in the workshop of the control building. A designated area for refuelling must be constructed with an impervious floor and low wall that will keep the spillage inside. Any spillage must be cleaned with absorbent material as soon as possible and disposed into clearly marked containers. Where spillage takes place, contaminated soil must be excavated and replaced with unpolluted soil. The contaminated soil should be collected by a licenced landfill contractor.		✓	✓		
Ensure that most infrastructure features are erected on transformed or non-arable land. Implement stormwater management as an integral part of planning and as a guideline for the positioning of structures. Use existing roads and conservation structures to the maximum in the planning and operation phases. Rehabilitate disturbed areas as soon as possible after construction.		✓	✓		
Erosion and sediment control with proper water run-off control planning.		✓	✓		
Appropriate handling and storage of chemicals and hazardous substances and waste should be done.		✓	✓		

Mitigation	Condition of Approval	Included in EMPr	Construction Phase	Operational Phase	Decomissioning Phase
When spillage accidently takes place, it should be removed and replaced with unpolluted soil. The clean soil can be sourced from excavations nearby. The polluted soil must be piled at a temporary storage facility with a firm waterproof base and is protected from inflow of storm water. It must have an effective drainage system to a waterproof spillage collection area. Contaminated soil must be disposed of at a hazardous waste storage facility.		✓	✓		
Clear trees and bushes selectively, leaving grass un-disturbed. Use mechanised machinery when installing posts to eliminate need for foundations. Construct on alternate strips to combat possible erosion.		✓	✓		
Establish structures on the contour. Use grass strips to regulate flow speed		✓	✓		
Social					
Where reasonable and practical, the proponent should appoint local contractors and implement a 'locals first' policy, especially for semi and low-skilled job categories. However, due to the low skills levels in the area, the majority of skilled posts are likely to be filled by people from outside the area.		✓	✓		
Before the construction phase commences the proponent should meet with representatives from the KGLM to establish the existence of a skills database for the area. If such as database exists it should be made available to the contractors appointed for the construction phase.		✓	✓		
Where feasible, efforts should be made to employ local contactors that are compliant with Broad Based Black Economic Empowerment (BBBEE) criteria;		✓	✓		
The local authorities, community representatives, and organisations on the interested and affected party database should be informed of the final decision regarding the project and the potential job opportunities for locals and the employment procedures that the proponent intends following for the construction phase of the project.		✓	✓		
Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase		✓	✓		
The recruitment selection process should seek to promote gender equality and the employment of women wherever possible.		✓	✓		
The KGLM, in conjunction with the local business sector and representatives from the local hospitality industry, should identify strategies aimed at maximising the potential benefits associated with the project.		✓	✓		
Where possible, the proponent should make it a requirement for contractors to implement a 'locals first' policy for construction jobs, specifically for semi and low-skilled job categories;		✓	✓		
The proponent should consider the option of establishing a Monitoring Forum (MF) in order to monitor the construction phase and the implementation of the recommended mitigation measures. The MF should be established before the construction phase commences, and should include key stakeholders, including representatives from local communities, local KGLM Councillor for Ward 8, farmers and the contractor(s). The MF should also be briefed on the potential risks to the local community associated with construction workers;		✓	✓	✓✓	
The proponent and the contractor(s) should, in consultation with representatives from the MF, develop a code of conduct for the construction phase. The code should identify which types of behaviour and activities are not acceptable. Construction workers in breach of the code should be dismissed. All dismissals must comply with the South African labour legislation;		✓	✓	✓	
The proponent and the contractor should implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase;		✓	✓		

Mitigation	Condition of Approval	Included in EMPr	Construction Phase	Operational Phase	Decomissioning Phase
The construction area should be fenced off before construction commences and no workers should be permitted to leave the fenced off area;		✓	✓		
The contractor should provide transport for workers to and from the site on a daily basis. This will enable the contactor to effectively manage and monitor the movement of construction workers on and off the site.		✓	✓		
Where necessary, the contractors should make the necessary arrangements to enable low and semi-skilled workers from outside the area to return home over weekends and/ or on a regular basis. This would reduce the risk posed to local family structures and social networks;		✓	✓		
The contractor must ensure that all construction workers from outside the area are transported back to their place of residence within 2 days for their contract coming to an end;		✓	✓		
It is recommended that no construction workers, with the exception of security personnel, should be permitted to stay over-night on the site.		✓	✓		
The proponent should implement a policy that no employment will be available at the gate.		✓	✓		
The construction area should be fenced off prior to the commencement of the construction phase. The movement of construction workers on the site should be confined to the fenced off area;		✓	✓		
The proponent must enter into an agreement with the local farmers in the area whereby damages to farm property etc. during the construction phase will be compensated for. The agreement should be signed before the construction phase commences;		✓	✓		
Traffic and activities should be strictly contained within designated areas		✓	✓		
Strict traffic speed limits must be enforced on the farm		✓	✓		
All farm gates must be closed after passing through		✓	✓		
Contractors appointed by the proponent should provide daily transport for low and semi-skilled workers to and from the site. This would reduce the potential risk of trespassing on the remainder of the farm and adjacent properties		✓	✓		
The proponent should hold contractors liable for compensating farmers and communities in full for any stock losses and/or damage to farm infrastructure that can be linked to construction workers. This should be contained in the Code of Conduct to be signed between the proponent, the contractors and neighbouring landowners. The agreement should also cover loses and costs associated with fires caused by construction workers or construction related activities (see below)		✓	✓		
The Environmental Management Plan (EMP) must outline procedures for managing and storing waste on site, specifically plastic waste that poses a threat to livestock if ingested		✓	✓		
Contractors appointed by the proponent must ensure that all workers are informed at the outset of the construction phase of the conditions contained on the Code of Conduct, specifically consequences of stock theft and trespassing on adjacent farms.		✓	✓		
Contractors appointed by the proponent must ensure that construction workers who are found guilty of stealing livestock and/or damaging farm infrastructure are dismissed and charged. This should be contained in the Code of Conduct. All dismissals must be in accordance with South African labour legislation		✓	✓		
The option of establishing a fire-break around the perimeter of the site prior to the commencement of the construction phase should be investigated;		✓	✓		
Contractor should ensure that open fires on the site for cooking or heating are not allowed except in designated areas;		✓	✓		

Mitigation	Condition of Approval	Included in EMPr	Construction Phase	Operational Phase	Decomissioning Phase
Smoking on site should be confined to designated areas;		✓	✓		
Contractor should provide adequate fire-fighting equipment on-site, including a fire fighting vehicle;		✓	✓		
Contractor to provide fire-fighting training to selected construction staff		✓	✓		
The movement of heavy vehicles associated with the construction phase should be timed to avoid times of the week, such as weekends, when the volume of traffic travelling along the N14 may be higher;		✓	✓		
The section of access road from the N14 that passes adjacent to the vineyards should be surfaced		✓	✓		
Dust suppression measures must be implemented on un-surfaced roads, such as wetting on a regular basis and ensuring that vehicles used to transport sand and building materials are fitted with tarpaulins or covers.		✓	✓		
All vehicles must be road-worthy and drivers must be qualified and made aware of the potential road safety issues and need for strict speed limits		✓	✓		
An Environmental Control Officer (ECO) should be appointed to monitor the establishment phase of the construction phase;		✓	✓		
All areas disturbed by construction related activities, such as access roads on the site, construction platforms, workshop area etc., should be rehabilitated at the end of the construction phase		✓	✓		
The implementation of a rehabilitation programme should be included in the terms of reference for the contractor/s appointed		✓	✓		
The implementation of the Rehabilitation Programme should be monitored by the ECO		✓	✓		
Implement a skills development and training programme aimed at maximising the number of employment opportunities for local community members; Maximise opportunities for local content, procurement and community shareholding		✓	✓		
The KGLM should liaise with the proponents of other renewable energy projects in the area to investigate how best the Community Trusts can be established and managed so as to promote and support local, socio-economic development in the region as a whole.		✓	✓		
The KGLM should be consulted as to the structure and identification of potential trustees to sit on the Trust. The key departments in the KGLM that should be consulted include the Municipal Managers Office, IDP Manager and LED Manager		✓	✓		
Clear criteria for identifying and funding community projects and initiatives in the area should be identified. The criteria should be aimed at maximising the benefits for the community as a whole and not individuals within the community;		✓	✓		
Strict financial management controls, including annual audits, should be instituted to manage the funds generated for the Community Trust from the SEF plant.		✓	✓		
The proponent should ensure that retrenchment packages are provided for all staff retrenched when the plant is decommissioned.		✓	✓		
All structures and infrastructure associated with the proposed facility should be dismantled and transported off-site on decommissioning		✓	✓		
Revenue generated from the sale of scrap metal during decommissioning should be allocated to funding closure and rehabilitation of disturbed areas.		✓	✓		
The Northern Cape Provincial Government, in consultation with the ZFMDM, KGLM and the proponents involved in the development of renewable energy projects in the GKLM, should consider establishing a Development Forum to co-ordinate and manage the development and operation of renewable energy		✓	✓		

Mitigation	Condition of Approval	Included in EMPr	Construction Phase	Operational Phase	Decomissioning Phase
projects in the area with the specific aim of mitigating potential negative impacts and enhancing opportunities. This would include identifying key needs, including capacity of existing services, accommodation and housing and the implementation of an accredited training and skills development programmes aimed at maximising the opportunities for local workers to be employed during the construction and operational phases of the various proposed projects. These issues should be addressed in the Integrated Development Planning process undertaken by the KGLM and ZFMDM.					
Traffic					
Stagger component delivery to site .		✓	✓		✓
Reduce the construction period		✓	✓		✓
The use of mobile batch plants and quarries in close proximity to the site		✓	✓		✓
Staff and general trips should occur outside of peak traffic periods.		✓	✓		✓
Regular maintenance of gravel roads by the Contractor during the construction phase and by Client/Facility Manager during operation phase		✓	✓		✓
Dust Suppression of gravel roads during the construction phase, as required.		✓	✓		✓
Regular maintenance of gravel roads by the Contractor during the construction phase and by Client/Facility Manager during operation phase		✓	✓		✓

10. 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.

10.1. 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.

11. 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).*

12. 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 Karroid PV 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.

12.1. 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;

12.2. 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 Karroid PV.

12.3. Contractor's Pre-Construction Obligations

Contractors may not commence any construction on Karroid PV:

- 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 (this has already been done);
- 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, within the development footprint has been carried out in compliance with the plant rescue and protection plan in appendix D 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 Garib Municipality); and
- All contract staff has attended the required environmental induction training and on-going environmental education sessions, as necessary.

12.4. 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.

13. SITE DEVELOPMENT PLAN

The Site Development Plan (SDP) is attached in Appendix A of this EMPr. Approval of this EMPr infers approval of the SDP. The holder of the EA and the contractor must ensure that all works are undertaken in approximation to the SDP. Should there be any dispute on any aspect of the works in relation to the SDP, the ECO must make ruling, which should be referred to the CA if necessary.

The table below shows the key components as defined in the SDP and the EMPr applicability of each of these components.

Table 11: EMP Sections applicable to SDP Components

SDP Component	EMPr Applicability
Construction Road	Sections 4, 5, 6,7 & 8
Perimeter Road	Sections 4, 5, 6,7 & 8
Internal Roads	Sections 4, 5, 6,7 & 8
Access Road	Sections 4, 5, 6,7 & 8
Perimeter Fencing	Sections 5
PV Panels	Sections 4, 5, 6,7 & 8
Inverter Stations	Sections 4, 5, 6,7 & 8
AC Cabling	Sections 4 & 5,
Sub-Station	Sections 4, 5, 6,7 & 8
Monitoring Building	Sections 4 & 5
Laydown Area	Section 5
Evacuation Line	Dealt with in terms of a separate EMPr

14. IMPLEMENTATION

The following table is provided to assist the developer, design team, engineer and contractor with the effective implementation of this EMPr. The table 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. Pan 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 siting / walk down		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

Item		Management Action	Timing	Responsible Party	Monitoring
					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 cable trenches		Implementation of recommendations of Erosion Management Plan defined in EMPr.	During detailed design and throughout the construction phase.	Contractor	Engineer, ESA and ECO.
Protection of Archaeological Resources		Avoidance of drainage line and pans within and 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

Item		Management Action	Timing	Responsible Party	Monitoring
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. Do not strip topsoil from entire development footprint	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 specialists.	Design phase and throughout the construction phase	Design Team, Engineer and Contractors	ECO & ER.
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.

Item		Management Action	Timing	Responsible Party	Monitoring
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 & Kai Garib 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.

15. 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.

15.1. 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 always have the right to stop work and/or certain activities on site in the case of non-compliance or failure to implement remediation measures.

15.2. Offences and Penalties

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

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.

16. REFERENCES

DEA (2010). *National Climate Change Response Green Paper 2010.*

DEA (January 2008). *National Response to South Africa's Electricity Shortage.* Interventions to address electricity shortages.

DEA&DP (2003). Waste Minimisation *Guideline for Environmental Impact Assessment reviews.* NEMA EIA Regulations Guideline & Information Series, Department Environmental Affairs & Development Planning.

DEA&DP (2005). *Guideline for the review of specialist input in the EIA process*. NEMA EIA Regulations Guideline & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2005). *Guideline for involving biodiversity specialists in the EIA process*. NEMA EIA Regulations Guideline & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2005). *Guideline for environmental management plans*. NEMA EIA Regulations Guideline & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2005). *Provincial urban edge guideline*. Department Environmental Affairs & Development Planning.

DEA&DP (2006). *Guideline on the Interpretation of the Listed Activities.* NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2007). *Guide on Alternatives,* NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2007). *Guideline on Appeals,* NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2007). *Guideline on Exemption Applications.* NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2007). *Guideline on Public Participation*. NEMA EIA Regulations Guidelines & Information Document Series, Department of Environmental Affairs & Development Planning.

DEA&DP (2009). *Guideline on Need & Desirability,* NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2009). *Guideline on Alternatives*, NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2009). *Guideline on Transitional Arrangements,* NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2009). *Guideline on Exemption Applications*. NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2009). *Guideline on Appeals*. NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP (2009). *Guideline on Public Participation*. NEMA EIA Regulations Guideline and Information Document Series, Department Environmental Affairs & Development Planning.

DEA&DP. (May 2006). *Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape*: Specialist Study: Executive Summary - CNdV Africa prepared for Provincial Government of the Western Cape.

Department of Mineral & Energy (1998). *White Paper on Energy Policy of the Republic of South Africa***.**

Department of Mineral & Energy (2003). *The White Paper on Renewable Energy***.**

DEAT (2002). Integrated Environmental Management Information Series 3: *Stakeholder Engagement*. Department of Environmental Affairs and Tourism, Pretoria.

DEAT (2004). *Criteria for determining alternatives in EIAs*, Integrated Environmental Management, Information Series 11, Department of Environmental Affairs & Tourism, Pretoria.

DEAT (2004). *Environmental Management Plans*, Integrated Environmental management, Information Series 12, Department Environmental Affairs & Tourism.

DEAT (2005). *Assessment of Impacts and Alternatives*, Integrated Environmental Management Guideline Series, Department of Environmental Affairs & Tourism, Pretoria.

DEAT (2005). Guideline 4: *Public Participation*, in terms of the EIA Regulations 2005, Integrated Environmental Management Guideline Series, Department of Environmental Affairs and Tourism, Pretoria.

DEAT (2006). *EIA Regulations* in terms of the National Environmental Management Act (Act No 107 of 1998) (Government Notice No R 385, R 386 and R 387 in Government Gazette No 28753 of 21 April 2006).

DWA (2001). *Generic public participation guideline*. Department of Water Affairs and Forestry.

Hsai-Yang, F (Ed)(2006). *Environmental Geotechnology Dictionary* (online version). University of North Caroline, Charlotte, USA.

Integrated Resource Plan for Electricity (Oct. 2010)**.** Revision 2, Version8.

International Finance Corporation – World Bank Group. (April 2007). *Environmental, Health and Safety Guidelines for Electric Power Transmission and Distribution.*

International Finance Corporation – World Bank Group. (April 2007). *Environmental, Health and Safety Guidelines for Wind Energy.*

International Finance Corporation – World Bank Group. (April 2007). *General Environmental, Health and Safety Guidelines.*

Keatimilwe K & Ashton PJ 2005. *Guideline for the review of specialist input in EIA processes.* Department Environmental Affairs & Development Planning.

Lochner P (2005). *Guideline for Environmental Management Plans*. Department Environmental Affairs & Development Planning.

Lower Orange River Transfrontier Conservation Area Planning: Background Information Document (August 2007). Retrieved on 29 March 2012 from:

www.dwaf.gov.za/Documents/Other/RMP/LOR/LORRMPBIDAug07.pdf

Lubbe, C. (2019). Agricultural Potential Study for Bloemsmond 5, Lubbe, Swellendam.

Mucina, L. & Rutherford, M.C. (eds) 2006. *The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19.* South African National Biodiversity Institute, Pretoria.

Münster, F. (2005). *Guidelines for Determining the Scope of Specialist Involvement in EIA Processes: Edition 1.* CSIR Report No ENV-S-C 2005 053 A. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs and Development Planning, Cape Town.

Oberholzer B (2005). *Guideline for involving visual & aesthetic specialists*. Department Environmental Affairs & Development Planning.

National Energy Regulator of South Africa (NERSA)(Feb.2010). *Rules on selection criteria for renewable energy projects under the REFIT Programme.*

National Protected Area Expansion Strategy for S.A. 2008: Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. Government of South Africa, Pretoria, 2010. ISBN 978-1-919976-55-6.

Northern Cape Business online. Retrieved from: http://www.northerncapebusiness.co.za on 27 March 2012.

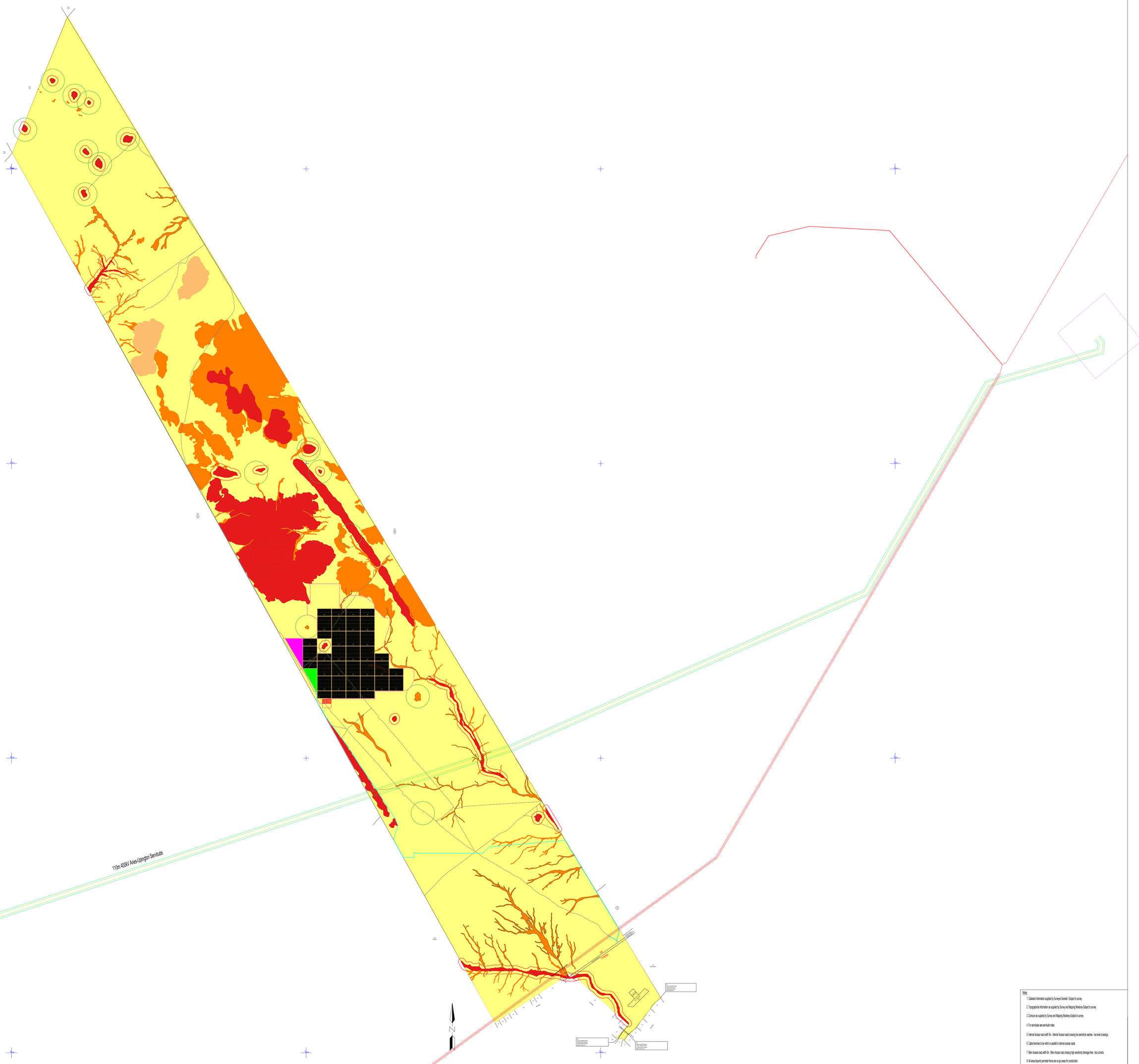
Northern Cape Business online. *Solar Power.* Retrieved from: http://www.northerncapebusiness.co.za/special features/941417.htm on 27 March 2012.

Saayman, I. (2005). *Guideline for Involving Hydrogeologists in EIA Processes: Edition 1.* CSIR Report No ENV-S-C 2005 053 D. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs and Development Planning, Cape Town.

SANBI Biodiversity GIS (2007). South African National Biodiversity Institute, Cape Town, South Africa.

Winter S & Beaumann N (2005). *Guideline for involving heritage specialists in EIA processes.* Department Environmental Affairs & Development Planning.

Appendix A: Site Development Plan.



Notes:

1. Cadastral information supplied by Surveyor-General - Subject to survey.
2. Topographical information as supplied by Survey and Mapping Woodley-Subject to survey.
3. Contours as supplied by Survey and Mapping Woodley-Subject to survey.
4. For servitudes see servitude notes.
5. Internal Access road width 5m. Internal Access roads crossing low sensitivity washes - low level crossings.
6. Cable trenches to be within or parallel to internal access roads.
7. Main Access road width 8m. Main Access road crossing high sensitivity drainage lines - box culverts.
8. All areas beyond perimeter fence are no-go areas for construction.
9. Permanent laydown area will not exceed 1ha and will be contained within the footprint of the temporary laydown area.
10. Project to connect to the Upington MTS via the Geel Kop collector switching station (assessed as part of a separate environmental (Basic Assessment) process).

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Datasil: System:	UTM34
Hoogte Datasil: Height System:	MSL (GOOGLE EARTH)
Skaal: Scale:	1 : 25 000
Datum: Date:	21 April 2020
Landmeter: Land Surveyor:	L A van Dyk
Projek Titel: Project Title:	REMAINDER OF THE FARM GEEL KOP No. 456 ADMIN DISTRICT : GORDONIA
Titel: Title:	KARROID PV SITE DEVELOPMENT PLAN
Tekening Nommer: Drawing Nummer:	V20127-KAR-100
Geteken deur: Drawn by:	Hens. DPE Rev: Rev No: 00
Vel: Sheet:	1 van of 2

GENERAL NOTES:

1. Cadastral information supplied by Surveyor–General – Subject to survey.
2. Topographical information as supplied by Survey and Mapping Mowbray–Subject to survey.
3. Contours as supplied by Survey and Mapping Mowbray–Subject to survey.
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10. Project to connect to the Upington MTS via the Geel Kop collector switching station (assessed as part of a separate environmental (Basic Assessment) process).

LEGEND: EXISTING INFRASTRUCTURE

- R — Reservoir
- WP — Windpump
- Internal access roads
- McTaggerts–Oasis 132kV powerline
- McTaggerts–Oasis 132kV 31m servitude

PROPOSED INFRASTRUCTURE

- Internal Access roads
- Access roads
- Laydown
- O&M Complex and Auxiliary Buildings
- Substation
- Perimeter Fence
- Inverter / MV Transformer Station
- Guard House & Security
- PV Table
- 110m 400kV Aries–Upington servitude

ENVIRONMENTAL SENSITIVITIES

- Pan
- 200m Avifauna Buffer around Pans
- Ecology Medium – Low Sensitivity
- Ecology Medium Sensitivity
- Ecology Medium – High Sensitivity
- Ecology High Sensitivity
- Aquatic Moderate – High Sensitivity
- Aquatic High Sensitivity
- Aquatic High Sensitivity 48m No–Go Buffer

CLIENT:
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PROJECT TITLE:
KARROID PV

DRAWING TITLE:
SITE DEVELOPMENT PLAN

LOCATION:
FARM GEEL KOP NO 456 RE

DATE:	SCALE:	PAPER SIZE:
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D PEINKE	D PEINKE	P SMITH

DRAWING NO.: V20127–KAR–100 SHEET 2 OF 2
REV. NO.: 00

APPROVAL:
SIGNATURE: NAME: PR. REG.: DATE:
THE ORIGINAL IS HELD AT THE HEAD OFFICE

Appendix B: Stormwater, Erosion and Washwater Management Plan

Stormwater, Wastewater and Erosion Management Plan for Karroid

Report Prepared for

Karroid (Pty) Ltd

Report Number 558582/Karroid

Report Prepared by

srk consulting

April 2020

Stormwater, Wastewater and Erosion Management Plan for Karroid

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SRK Project Number 558582/Karroid

April 2020

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Authors:

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Executive Summary

Karroid (Pty) Ltd. is proposing the development of a commercial solar Photo-Voltaic (PV) facility and associated infrastructure on a development area located approximately 20km south-west of Upington, within the Kai !Garib Local Municipality and the ZF Mgcawu District Municipality in the Northern Cape Province. The site borders the Dawid Kruiper Local Municipality.

This report documents the Stormwater, Wastewater and Erosion Management Plan (referred to as the SWMP) required for the proposed development. The SWMP aims to facilitate the protection of surface water resources and covers the total project development area.

Based on the potential impacts, as well as legal requirements and best practice guidelines, specific objectives were developed for stormwater and erosion management. A plan was then developed to address each objective to protect surface water resources.

The report concluded that stormwater impacts can be managed at the development area in a practical way that will protect water bodies and minimise erosion. It is recommended that the SWMP be further developed during detailed designs stage. The plan will be incorporated into an environmental specification for use during construction and be implemented during operation of the facility

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Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd. (SRK) by Karroid (Pty) Ltd (the Client). The opinions in this Report are provided in response to a specific request from the Client to do so.

SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them.

Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

1 Introduction

SRK Consulting (South Africa) (Pty) Ltd. (SRK) was approached by Karroid (Pty) Ltd (the Client) to develop a Stormwater, Wastewater and Erosion Management Plan (referred to as the SWMP) for the proposed new development of a commercial solar Photo-Voltaic (PV) facility and associated infrastructure to be implemented for Karroid, in the Northern Cape of South Africa about 23 km South-West of Upington.

2 Objectives and Scope of the Report

2.1 Objectives

The objective of this report is to prepare a SWMP that protects the surface water resources, manages erosion risks and complies with the regulations and guidelines for the construction and operation phases of the Karroid facility.

2.2 Scope

This report covers the following scope:

- Delineation of the catchments draining to the development area;
- Determination of the type of catchment (clean or dirty area). This is required as the clean water needs to be diverted away from any dirty water areas and dirty water needs to be collected and reused. The clean water is also diverted away from Karroid to minimise the potential erosion that could occur along the pillars of the solar farm;
- Calculations of peak stormwater discharges from each catchment and sizing of required infrastructure associated with each catchment; and
- Presenting recommendations regarding the considerations that need to be considered during design, construction and operation phases of the proposed project.

The SWMP is a conceptual study at this stage, a detailed survey and SWMP study will need to be undertaken during the design of the required infrastructure.

The layout of the development area is shown in Figure 2-1.

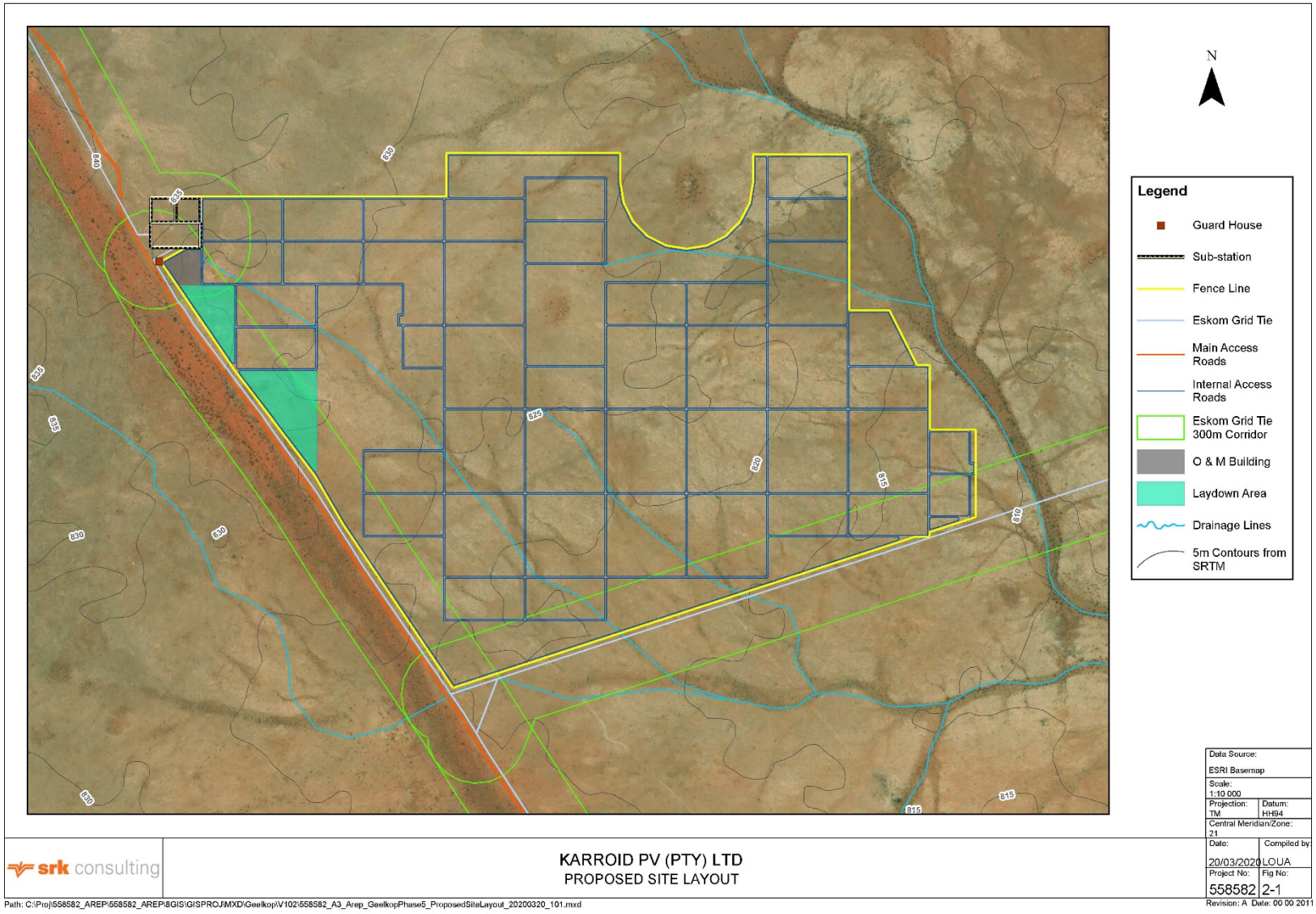


Figure 2-1: Karroid Conceptual Site Layout

3 Supporting Information

This section summarises all the information and assumptions upon which the SWMP is based. This is done to highlight how the plan was developed: by matching regulations and guidelines to the specific needs of the project in the local natural conditions on site, and hence the information is key to understanding the plan. The relevant information can be divided into:

- Project information;
- Guidelines and regulations; and
- Natural characteristics on site.

3.1 Project information

The site information was provided by the client, and information for the area in general was obtained from the Background Information Document (supplied by the Client), and Draft Basic Assessment Report (Cape EAPrac, 2019). Further site information was provided by the Client in the form of electronic maps, photographs and GIS information.

The proposed infrastructure and the associated potential pollutants are as follows:

- Fixed-tilt or tracking solar PV panels with a maximum height of 3.5 m;
- An O&M building, inclusive of laydown area, toilet facilities connected to a conservancy tank for wastewater collection and a chemical storage area;
- An electrical substation including transformers containing oil;
- On-site inverters and inverter transformers (containing oil) located between the panels to step up the power;
- Cabling between the project's components, to be laid underground where practical;
- Fencing around the development area;
- An access road to the development area;
- Internal access roads:
    - Existing roads will be used as access roads where possible; and
    - Existing roads will be extended to create access to the Karroid facility where possible.
- During construction, a temporary laydown area and a workshop will be added.

Fuel and acids (generally considered high risk contaminants to stormwater) have been ruled out as potential threats as neither will be stored or used on site. General waste will only be stored temporarily and taken off site regularly for disposal to landfill.

3.2 Legislation and guidelines

SWMPs are generally required as part of the Environmental Management Programme (EMPr) and for Water Use License Applications. The general principal that was used in the design is:

- Divert clean water away from the Karroid to minimise the potential for erosion of any of the infrastructure;
- Contain any dirty water emanating from the site (silt laden material) and discharge the settled water from the site; and

- Isolate the dirty water areas (hydrocarbons).

Municipal regulations, which usually determine specific standards for each municipality, but still adhere to the overall principles of the regulations and guidelines above, will be consulted during detailed design.

3.3 Natural conditions

3.3.1 Climate

The development area lies in an arid to semi-arid climatic region with average rainfall below 200 mm per year. The average evaporation rate in the area is 2 281 mm. In summer months temperatures can be in excess of 42°C and in winter months dip to below 4°C.

3.3.2 Design rainfall

The rainfall analysis was based on the “Design Rainfall Estimation in South Africa” (DRE) program developed by JC Smithers and RE Schulze (Smithers & Schulze, 2002). The program implemented procedures from the Water Research Commission (WRC) project entitled “Rainfall Statistics for Design Flood Estimation in South Africa” (WRC Project K5/1060).

The rainfall data was obtained from 6 closest rainfall stations (Smithers and Schulze - Design Rainfall in South Africa). The rainfall stations for the catchment area were selected based on criteria such as altitude relative to the area of interest, the record history of the weather stations and proximity to the study area.

The catchment has a mean annual precipitation of 152 mm. The rainfall station closest to the development area is Geelkop (0283098W), which is approximately 12 km from the site catchments.

Table 3-1: Design Rainfall (mm) Data Interpolated from the Six Closest Stations

Mean Annual Rainfall	**152 mm**		**Latitude**	**-28.587237**		**degrees**	
Altitude	**775 mamsl**		**Longitude**	**21.040049**		**degrees**	
Storm Duration	**Return Period (Years)**						
	2	**5**	**10**	**20**	**50**	**100**	**200**
5 minutes	5.9	9.3	11.8	14.4	18.1	21.1	24.4
15 minutes	11.1	17.3	22.0	26.8	33.7	39.3	45.4
1 hour	16.5	25.9	32.9	40.1	50.3	58.8	67.9
1.5 hours	18.6	29.2	37.0	45.1	56.6	66.1	76.4
2 hours	20.2	31.7	40.2	49.0	61.6	71.9	83.0
8 hours	26.2	41.2	52.1	63.3	79.9	93.3	107.7
24 hours	32.2	50.6	64.1	78.2	98.2	114.6	132.4
5 day	36.8	57.8	73.2	89.3	112.2	131.0	151.3

3.4 Potential Stormwater, Wastewater and Erosion Impacts

An overall analysis of the available data and the development plans reveal the following potential impacts:

- The facility presents a very low risk to adversely impacting surface water resources because:

- Except for the necessary bush clearing and trampling to construct the Karroid, the development will leave the natural vegetation (including all dale riparian vegetation), soil conditions and topography largely undisturbed;
- The development area and roads have been well placed, as they lie mostly outside of the natural water ways and most river crossings are over very small drainage lines or rivers, characterised with small catchments and low flows;
- Sewage and landfill waste will be disposed offsite;
- Rainfall in the area is low and few steep slopes exist to generate high flow velocities.

- Some potential impacts do exist, including:
  - Possible contamination of stormwater by:
    - Sediment that is collected in the runoff due to disturbance of the ground;
    - Oil leaks from the transformers;
    - Oil and lubricant in wash down water from the workshop; and
    - Overflow of wastewater from the conservancy tanks.
  - Potential for erosion:
    - Where any stormwater drains discharge into rivers or onto the natural land surface; and
    - At river / road crossing.
  - Potential exists to impede and disrupt flow if infrastructure is placed within water courses;
  - Potential exists to damage infrastructure and exacerbate erosion if infrastructure is placed within areas that are inundated in floods.

4 Project Specific Objectives

The project specific objectives were developed based on the laws and guidelines mentioned in Section 3.2 and are as follows:

- Keep clean water clean by constructing diversions or bunds. This prevents any clean runoff from entering any potentially dirty areas and minimises the potential for erosion along the disturbed areas. The bunds or diversions should be designed for a 1:50-year flood event;
- Collect and treat discharge water or runoff from any dirty areas. Dirty water should not spill into clean water systems more than once in a 50-year return period;
- Bund any areas housing hazardous substances or pollutants, including any oils;
- Do not impede surface or subsurface water flows more than what is required to implement the required clean – dirty water separation:
  - Minimise disturbed areas such that surface and subsurface movement of water along the drainage lines is not reduced; and
  - Ensure any engineered clean stormwater drainage directs water to the naturally receiving drainage line.
- Erosion control:

  - Prevent erosion in general, and minimize the potential for erosion in large storm events of 1:50-year flood events or greater; and
  - Dissipate stormwater energy at all drainage outlets to velocities that are unlikely to cause erosion in storm events less than 1:50-year flood events (i.e. <1 m/s).

- Monitoring and management:
  - Inspect and monitor performance and integrity of all SWMP infrastructure on an annual basis;
  - Include an erosion monitoring plan that ensures that the onset of erosion is detected and rehabilitated within 6 months, and any acute erosion due to large storm events is detected within 2 weeks; and
  - Include a monitoring system for spills and leaks such that they are detected and remediated, as soon as practically possible.

- General:
  - Ensure no infrastructure, except road crossings and solar panel supports (solar panel mounting structures could possibly clip the edges of low sensitivity drainage lines) are built within the water courses;
  - Conduct a pre-development and post development survey to ensure that the pre-development natural ground level is maintained or rehabilitated, if required;
  - No cement stabilisation of piles shall be used within the low sensitivity drainage features. Foundation could rather utilise longer piles in these areas to achieve adequate structural stability;
  - Do not build infrastructure, in particular infrastructure containing potential pollutants, within 300 m of natural drainage lines; and
  - Review and improve the stormwater management plan regularly.

5 Hydrology Study

The first step in the SWMP development is an analysis of the development area and the proposed facility. The analysis found that the proposed facility is likely to have an intrinsically low impact on the surface water resources due to:

- The vegetation, soil and topography will remain mostly undisturbed;
- The development footprint and roads are well placed, as they lie mostly outside of the natural watercourses and most river crossings will have low flows;
- Water use on site, with the potential to generate runoff, such as solar panel washing, is negligible in volume compared to stormflows;
- Sewage and landfill waste will be taken offsite for disposal; and
- Rainfall in the area is low and few steep gradients exist.

Despite the low impact on surface water resources, some potential impacts are possible including:

- Dirty areas will exist, which could contribute to contamination including:
  - Transformers, which could leak oil;

  - The workshop, which may store oils or lubricants that could contaminate wash down water; and
  - The sewage conservancy tank, which could leak or overflow.
- Erosion, where stormwater drains discharge to the natural environment or around stockpiles – estimated stormflows indicate that erosion could be significant in such localised areas without proper detailed design to mitigate for higher flow velocities;
- Potential road crossings, which could exacerbate erosion without proper design, were identified –these crossed relatively small drainage lines but will need to be confirmed during a detail design, based on a detailed land survey of the project area; and
- Disruption of natural flow, and possibly erosion, where solar panels are located within watercourses and flood prone areas.

5.1 Delineation of clean and dirty areas

The development area is divided into clean and dirty areas as follows:

- Dirty areas:
  - The workshop where oils and lubricants may be stored and used. The workshop will only be temporary (during the construction phase). A chemical storage area will be constructed for the operational phase of the project, which will include proper containment and bunding for all chemicals stored on site;
  - The medium-voltage transformers (at the inverter stations) placed around the development area, as these will contain oil;
  - Transformers at the substation, as these will contain oil;
  - The conservancy tanks, as this will contain sewage; and,
  - Vehicle wash bay that has a hardstanding surface on which vehicles are washed, containing the dirty water and draining to a sump.
- Clean areas are deemed to be all areas outside of those stated above as dirty areas.

5.2 Identification of road crossings

Potential road crossings were identified for all the roads that will be upgraded or built as part of the project, considering that the road / river crossings are conceptual at this stage, and their locations are approximate. Any internal road crossings will be minor and conceptual designs provided in this report can be used as a basis for such crossings.

The crossings are shown in Figure 5-1.

It is extremely unlikely that minor modifications in road position will change the assessments and conclusions in this report. Also note that most of the road crossings are over minor natural drainage lines near the source of their flow.

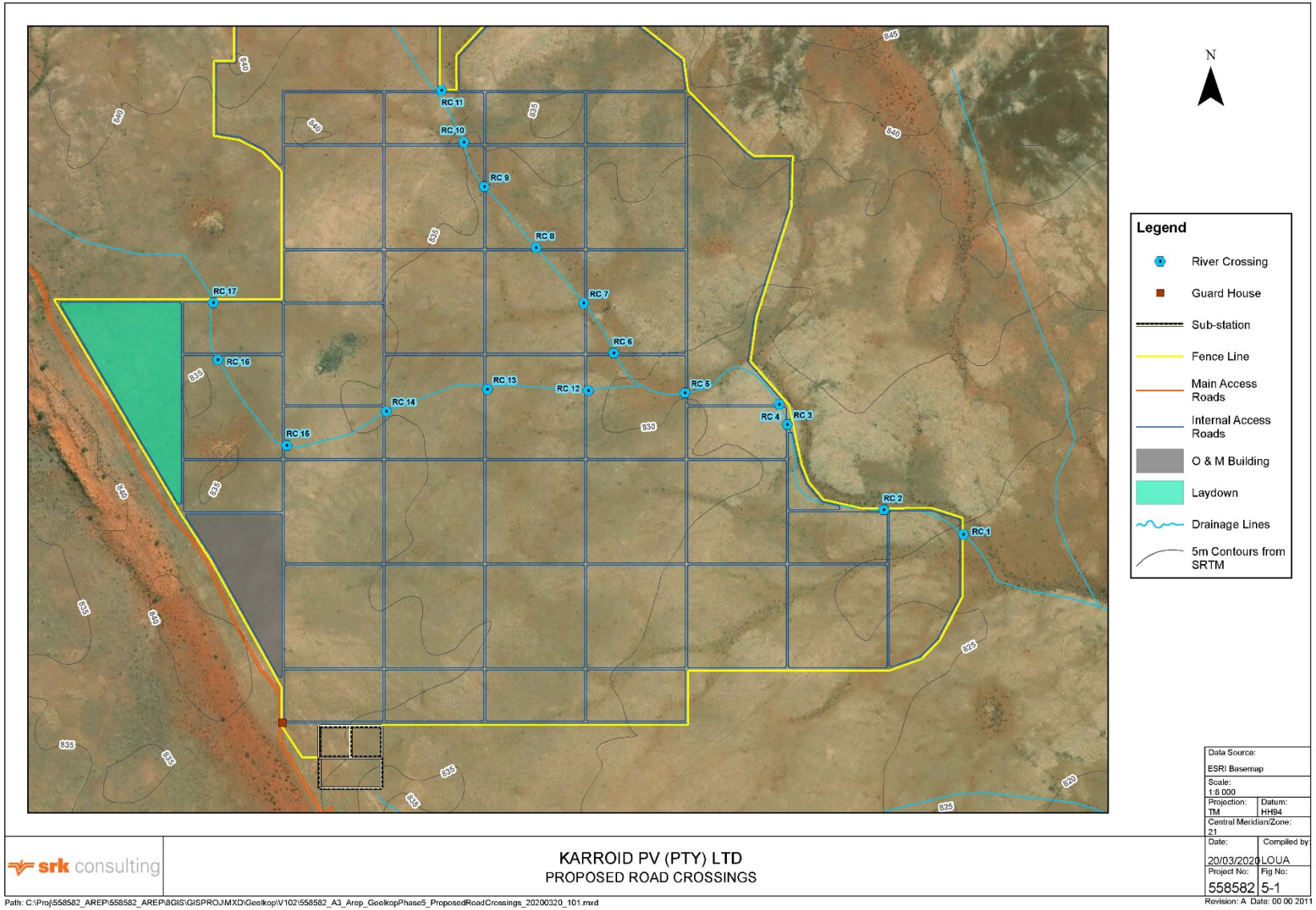


Figure 5-1: Conceptual Road Crossings

5.3 Delineation of catchments

In order to delineate the catchments, a Digital Terrain Model (DTM) had to be created in order to use GIS techniques to determine these delineations and characterisation of the various catchments. No detailed survey information was available at the time of the study, so Shuttle Radar Terrain Model (SRTM) data was used to develop the DTM.

The following catchments were delineated:

- Catchments of the watercourses where they cross any of the proposed development area;
- The receiving catchments close to where the catchment discharges.

The catchments are as shown in Figure 5-2 below.

5.4 Catchment Parameters

The slope of a catchment is a very important characteristic in the determination of flood peaks. Steep slopes cause water to run faster and to shorten the critical duration of flood inducing storms, thus leading to the use of higher rainfall intensities in the runoff formulae. On steep slopes the vegetation is generally less dense, soil layers are shallower, and there are fewer depressions, all of which cause water to run off more rapidly. The result is that infiltration is reduced, and flood peaks are consequently even higher.

Also required is the land use and associated Manning's N-value for the various land uses. These contribute to the estimation of volume of water stored, infiltrated and ultimately resulting in runoff for each catchment.

The average slope and other critical parameters for the catchments under consideration are presented in Table 5-2.

Table 5-1: Conceptual Catchment Characteristics

Catchment Name	Longest Watercourse Length (m)	Cumulative Area (m2)	Cumulative Area (km2)	Width (m)	% Catchment Slope	% impervious	Impervious Area Manning n-value	Pervious Area Manning n-value
Catchment_1	17730	34297011	34.297	785	2.6	5.0	0.013	0.03
Catchment_3	1526	779161	0.779	563	1.5	5.0	0.013	0.03
Catchment_4	16265	32522336	32.522	1627	1.8	5.0	0.013	0.03
Catchment_7	14703	29518253	29.518	2198	1.6	5.0	0.013	0.03
Catchment_8	1535	818631	0.819	570	1.9	5.0	0.013	0.03
Catchment_10	1455	1200171	1.200	1011	1.2	5.0	0.013	0.03
Catchment_11	4760	7643965	7.644	1063	1.3	5.0	0.013	0.03
Catchment_12	13081	25327503	25.328	458	1.9	5.0	0.013	0.03
Catchment_13	3001	3394394	3.394	1222	0.9	5.0	0.013	0.03
Catchment_14	3360	5201229	5.201	453	1.1	5.0	0.013	0.03
Catchment_15	12642	14261333	14.261	897	1.3	5.0	0.013	0.03
Catchment_16	2824	1625567	1.626	623	1.2	5.0	0.013	0.03
Catchment_17	1807	991128	0.991	606	1.1	5.0	0.013	0.03
Catchment_18	10789	11701650	11.702	498	1.4	5.0	0.013	0.03
Catchment_19	9760	10347602	10.348	1107	1.1	5.0	0.013	0.03
Catchment_20	8335	7507246	7.507	787	2.8	5.0	0.013	0.03
Catchment_21	1636	1485230	1.485	1045	2.5	5.0	0.013	0.03
External Catchments								
S6	1207	981279	0.981	997	2.2	5.0	0.013	0.03
S7	3991	3316952	3.317	1296	1.4	5.0	0.013	0.03
S8	1900	837287	0.837	500	1.7	5.0	0.013	0.03

5.5 Storm peaks

The hydrological and hydraulic parameters of all the catchments contributing towards the study area were calculated and the overland peak flow rates were determined along the study area. The magnitude of the flood peak depends on the catchment characteristics and the rainfall intensity. PCSWMM was used as a flood analysis modelling tool to determine peak discharges at each sub-catchment.

PCSWMM is a dynamic rainfall-runoff simulation model, based on the SCS-SA method, used for single event or long-term simulation of runoff quantity. The model was set up for the site and used to calculate the 1:2 year, 1:5 year, 1:10 year, 1:20 year, 1:50 year, 1:100 year and the 1:200 year recurrence interval flood peaks based on the design rainfall depths calculated in Section 3.3.2 above.

Manning's 'n' coefficient used in the model for the impervious and pervious areas were 0.013 and 0.035 respectively. The Manning's n for the pervious areas is based on the arid grassland, shrubs with freely drained soils type vegetation found within the project drainage areas. Imperviousness within the catchments is very low (3 -5%) due to the fact that the catchments are highly undeveloped, soils are drained, and high percolation rates are expected.

The available land cover was obtained from the topographical information, satellite images available on Google Earth, site visit feedback from the client, as well as the relevant literature for the SCS method.

The SCS-SA hydrological modelling uses deterministic modelling techniques to aid in the estimation of peak flow rates. The model parameters include:

- Catchment slope, size and shape for each of the catchments. The catchments extended up to the origin of the drainage paths;
- Land-use information regarding current and potential future development conditions;
- Soil condition and Antecedent Moisture Conditions (AMC);
- Drainage size; and
- Storm rainfall estimated from the available daily rainfall records.

Storm peaks were calculated for the catchments shown in Figure 5-2 using the PCSWMM model and peak flows generated within each sub-catchment are considered conceptual due to lack of detailed contour data (topographical survey data).

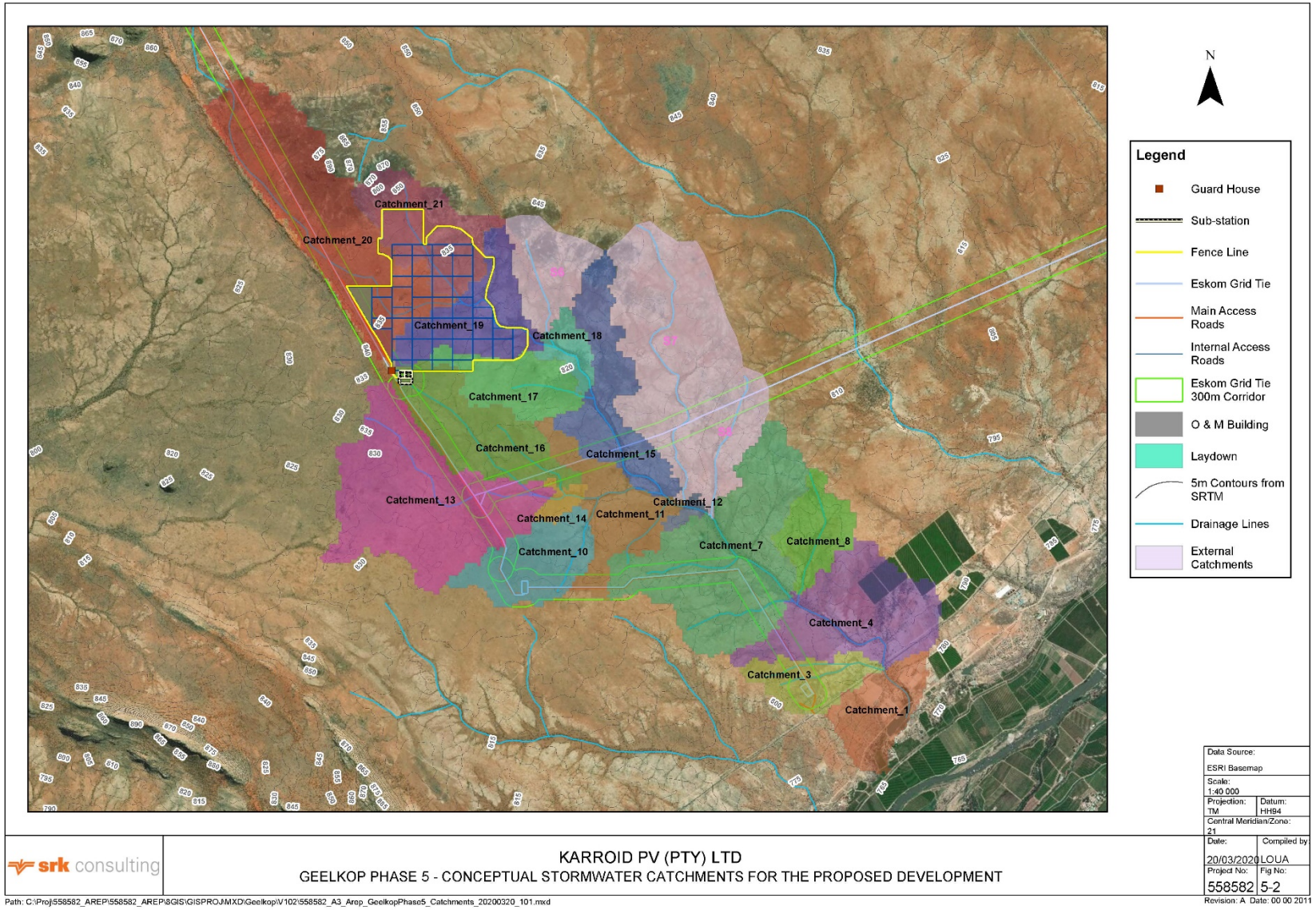
The conceptual peaks are given in Table 5-3. The peaks are both pre-development and post-development scenarios, because the vegetation, topography and soil conditions will largely be the same, except where the main buildings (O&M building, stores, etc.) are placed, and this accounts for a negligible proportion of the development area from a surface area viewpoint.

Note that the wash water was not considered in the storm peaks, because solar panel washing is unlikely to be done in the rainy season, which will be negligible in comparison to storm volumes.

Table 5-2: Peak Flows for Conceptual Catchments

Catchment Name	2yr Peak	5yr Peak	10yr Peak	20yr Peak	50yr Peak	100yr Peak	200yr Peak
Catchment 1	10.0	15.6	21.0	27.3	34.5	41.9	47.7
Catchment 3	0.6	0.9	1.1	1.4	1.7	2.0	2.4
Catchment 4	9.8	15.3	20.4	26.6	33.4	41.2	46.3
Catchment 7	9.4	14.6	19.4	25.1	31.4	39.5	49.2
Catchment 8	0.6	0.9	1.2	1.4	1.8	2.2	2.5
Catchment 10	0.9	1.4	1.7	2.1	2.6	3.2	3.7
Catchment 11	3.8	5.8	7.6	9.8	12.5	18.7	24.6
Catchment 12	8.6	13.3	17.4	22.3	28.3	37.8	53.3
Catchment 13	2.1	3.1	4.0	5.0	6.3	7.8	9.2
Catchment 14	3.1	4.7	6.0	7.6	9.4	11.8	13.8
Catchment 15	4.7	7.1	9.2	11.6	14.5	18.4	21.9
Catchment 16	1.1	1.6	2.1	2.6	3.2	3.9	4.6
Catchment 17	0.7	1.1	1.4	1.7	2.1	2.5	3.0
Catchment 18	4.2	6.3	8.2	10.3	12.9	16.3	19.4
Catchment 19	3.8	5.7	7.4	9.3	11.6	14.6	17.3
Catchment 20	2.3	3.6	4.7	6.1	7.8	10.1	12.2
Catchment 21	1.2	1.7	2.2	2.6	3.2	4.0	4.6
External Catchments							
S6	0.8	1.2	1.5	1.8	2.2	2.7	3.1
S7	0.4	0.6	0.8	1.0	1.2	1.5	1.8
S8	0.6	0.9	1.2	1.4	1.8	2.2	2.5

The implications of the storm peaks calculated, and their impact on the SWMP, are discussed in Section 6.


N
Legend
Guard House
Sub-station
Fence Line
Eskom Grid Tie
Main Access Roads
Internal Access Roads
Eskom Grid Tie 300m Corridor
O & M Building
Laydown
5m Contours from SRTM
Drainage Lines
External Catchments
Catchment_21
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Catchment_4
Catchment_3
Catchment_1
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Scale: 1:40 000
Projection: TM
Datum: HH84
Central Meridian/Zone: 21
Date: 20/03/2020
Compiled by: LOUA
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Figure 5-2: Conceptual Stormwater Catchments for the Proposed Development

6 Conceptual Design and Review

This section provides detail on why management approaches were selected, any alternatives that should be considered, and further steps required to confirm or improve the conceptual plan.

6.1 Waste and wastewater management

Waste will be disposed of at a registered landfill site and domestic wastewater at a licensed wastewater treatment plant (i.e. waste will be treated off site), hence, the SWMP only focuses on temporary storage on site.

Domestic waste should be stored out of the rain and wind, collected (and disposed of) regularly as is currently proposed for the development.

The conceptual design of the wastewater (sewage) conservancy tank was not within the scope of this report, however, the current conceptual plan was evaluated in terms of the risks that this may pose to stormwater. Management of the tank is the main risk, because the system could fail if the tank is not emptied regularly resulting in overflows. Consequently, a float switch controlled alert system is recommended.

Oil and lubricants in the workshop, and oil from the transformers must be bunded (See Section 6.5 for bunding requirements) as per legal requirements and hence, this was recommended without any alternatives.

6.2 Channels, diversions and dissipaters

It is recommended that channels be placed on the upgradient side of any roads to control erosion, as well as around any of the dirty areas to divert clean water around these areas. In most cases, diversions can be used to direct clean water around dirty areas.

Solar panel areas are not considered dirty, and upstream catchment areas are small and thus stormwater does not generally need to be diverted around these solar panel areas.

Using the conceptual infrastructure layout plans and regional contours (obtained from the STRM programme), high-level conceptual designs were developed (i.e. typical drain and dissipater types). These were based on the following preliminary conclusions:

- Peak flows for the stormwater catchments are low;
- Most of the area is under 2% grade, and it is potentially possible to design earth or gravel drains rather than concrete drains, because low erosion potential exists at these low flow gradients; and
- Even though engineering designs might achieve low velocity flows in the drains, dissipaters are recommended at any outlets to control the transition of water from concentrated channel flow to overland dispersed flow or in-river flow – in addition, it is possible that outlets (e.g. adjacent to road/river crossings) could be locally steep.

Typical generic conceptual designs, based on the above discussions, were compiled as shown in Figure 7-1.

6.3 Road crossings

Using the conceptual infrastructure layout plans and regional contours, high-level conceptual designs were developed. These were based on the following preliminary conclusions:

- Most crossings are small and on areas with low gradients, and thus the roads are well-placed to generally avoid erosion at crossings; and
- Drifts would be the best crossing design from a practical, economic and environmental point of view for the road crossings;

Typical conceptual designs, based on the above discussions, were compiled for information purposes and are shown in Figure 7-1.

6.4 Erosion and sediment transport

The main erosion risks are drain outlets (Section 6.1), road crossings (Section 6.3) and stockpiles.

Permanent stockpiles should be avoided. However, material excavated during construction of the panels might be significant (cumulative volume). In that case, a suitable area should be selected for the stockpile such that it is unlikely to erode and result in sediment transport. Silt traps and diversion drains should also be designed for the stockpile. Where possible, the stockpiled material should be used in the construction of diversions and bunds.

6.5 Bunding

Requirements for bunding of potential contaminants are specified in detail in the National Norms and Standards for the Storage of Waste (Notice 926 of 29 November 2013, Department of Environmental Affairs, National Environmental Management: Waste Act 2008, Act No.29 of 2008). The specification, which will apply to the development area, reads as follows: *"bunds having a capacity which can contain at least 110% of the maximum contents of the waste storage facility. Where more than one container or tank is stored, the bund must be capable of storing at least 110% of the largest tank or 25% of the total storage capacity, whichever is greater (in the case of drums the tray or bund size must be at least 25% of total storage capacity)."*

Bunded areas should be sealed to ensure spilled contaminants cannot leak out of the bunded areas.

6.6 Monitoring and management

Monitoring and management are key to the success of a SWMP. The following are therefore included as a key aspect of SWMP:

- Frequent inspections until the success of the design and any unexpected problems are resolved / confirmed;
- Review of the plan after a few years to improve, where possible, its practicality, cost-effectiveness or efficacy;
- Alerts that do not rely on a fulltime environmental manager on site (which may not be feasible) including:
    - Automatic alert systems for the wastewater conservancy tank (e.g. a float driven switch alert system);
    - Brief, annual refresher training that should not take more than half an hour for each staff member; and
    - Well placed signs that remind staff members of reporting of incident / issues, as soon as possible and reduce the likelihood that forgetfulness or confusion will prevent reporting.

7 Stormwater, Wastewater and Erosion Management Plan

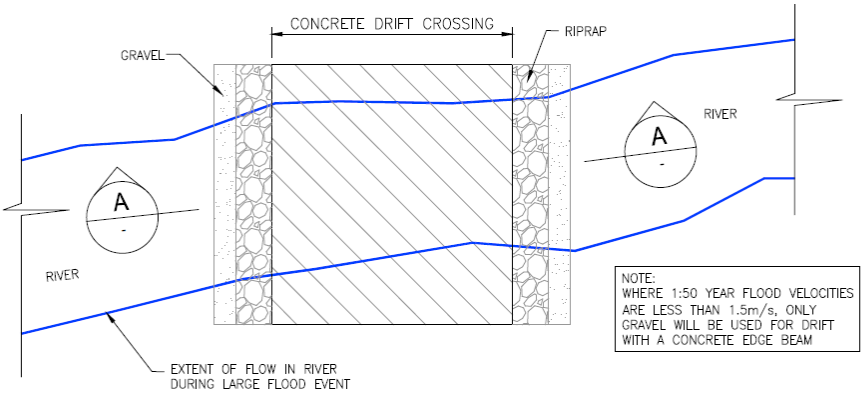
The SWMP, including wastewater management, is summarised in Table 7-1 and Figure 7-1 with supporting information and discussions of alternatives, where relevant, is provided in Section 3 and Section 3.4.

Table 7-1: Construction and Operations / Maintenance SWMP

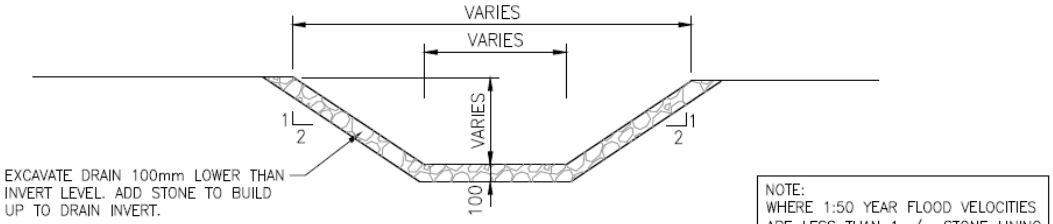
General principle	Specific outcomes	When	Ref No.	Focus area	Action	By whom
Separate clean - and dirty water to ensure clean water remains uncontaminated	Temporary containments and diversion (designed for a 1 in 5-year event)	During contractors site establishment	1	• Stockpiles; • Laydown areas; • Workshops; and • Any other area likely to generate sediment during a storm event or contain contaminants that can be disbursed.	Clean water diversions or bunds: Construct stormwater drains or bunds to divert clean runoff around dirty areas. The diversion should be sized for 1 in 5-year event. Typical design will be an excavated earth channel or berms.	Construction contractor's onsite environmental officer/representative
	Permanent containments and diversions (designed for a 1 in 50-year event)	Constructed prior to operation	2	• The workshop and chemical stores; • Transformers, inverters and substations; and • Wastewater conservancy tank.	Clean water diversions or bunds: Construct stormwater drains or bunds to divert clean runoff around the workshop, chemical stores, transformers, inverters, substations and wastewater conservancy tank. The diversion should be designed for a 1 in 50-year event.	Included in detailed designs of design engineer and carried out by contractor appointed for construction
Collect and, where required, treat dirty water or runoff from any dirty areas.	Dirty water should not have the potential to spill into clean water systems more than once every fifty years (where influenced by stormwater)	Before stockpiles are deposited	3	Stockpiles	Construct silt fences or berms: to prevent the sediment transport into rivers.	Included in detailed designs of design engineer and carried out by contractor appointed for construction
		Throughout construction	4	Waste	Dispose of landfill, oils and other contaminants offsite	
		During site establishment	5	Sewage	Supply chemical toilets	
		Constructed prior to operation	6	Workshop	Workshop collection drain with oil and grease trap: Construct a small concrete drain collecting all water, potentially containing oils and lubricants, from workshop floor and directing it through an oil and grease trap before discharge (or removing to offsite facility). Floor to be sloped such that all water will collect in drains.	
		Inspected every 3 months for first 2 years and then revise	7	Workshop	Clean the oil and grease trap: The oil and grease traps are to be inspected and, when necessary, cleaned and waste taken to a registered offsite facility	Workshop manager and assurance by environmental manager
		As required when the tank is full	8	Transformers	Dispose of transformer oil offsite: Dispose of any spent oil, removed from transformers during maintenance, to a registered offsite facility	
		As required when the tank is full	9	The sewage conservancy tank	Transport sewage to municipal works: Regularly collect sewage in the conservancy tank and disposed of at a licensed municipal sewage treatment plant.	
	Bund any hazardous substance or pollutant storage areas (including any oils), as per regulations	Throughout construction	10	General	Construct temporary bunds for any chemicals such as oils or fuel stored on sited during construction. Bunds must contain at least 100% of the volume of the container. If all containers are stored together the bund must store at least 110% of the largest container or 25% of the total storage capacity, whichever is greater. Suitability of the material of bund must be investigated whenever a new substance is added to the bund	Included in detailed designs of design engineer and carried out by contractor appointed for construction
		Constructed prior to operation	11	Transformers	Transformer bunds: All transformers will be bunded with bund capacity of at least 110% of the maximum volume of oil in the transformer. Transformers and bund will be protected from rainfall by small covers or roof or housed in containers, as applicable.	
			12	The sewage conservancy tank	Sewage conservancy bund: The sewage conservancy tank will be a closed tank with an automatic alert system.	
		During operation: as and when containers are purchased	13	Workshop	Small trays for workshop chemicals: Bund any containers with oils and lubricants by placing them in plastic trays that is at least 100% of the volume of the container. If all containers are stored together the bund needs to store at least 110% of the largest container or 25% of the total storage capacity, whichever is greater. Suitability of the bund must be investigated whenever a new substance is added to the bund.	Workshop manager and assurance by environmental manager
Do not impede surface and subsurface flow along drainage lines	Minimise dirty areas such that surface and subsurface movement of water along the drainage lines is not impeded	Constructed prior to operation	14	The workshop, transformers, wastewater conservancy tank	Diversion channels placed to minimised dirty areas: Place diversion channels directly upstream of dirty areas such that dirty area catchments are minimised in footprint	Included in detailed designs of design engineer and carried out by contractor appointed for construction
		Throughout construction	15	• Laydown areas; and • Stockpiles	Minimise laydown areas and stockpiles.	
	Ensure any engineered clean stormwater drainage directs water to the closest naturally receiving drainage line		16	All drains	Ensure that any temporary stormwater drains or diversion berms direct water towards the drainage line to which it would naturally flow	
		Constructed prior to operation	17	Along roads, the workshop, transformers, wastewater conservancy tank	Drains to follow natural topography: Ensure outlets drain towards the natural drainage line that would originally have received flow from that area	

General principle	Specific outcomes	When	Ref No.	Focus area	Action	By whom
Control, monitor and manage erosion	Prevent erosion in general	Constructed prior to operation	18	All areas	Maintain natural topography: Do not disturb the natural topography or vegetation between the solar panel installations	Included in detailed designs of design engineer and carried out by contractor appointed for construction
		During operation	19		No stockpiles if possible: Do not stockpile (during operation). If spoil from pilings is likely to be significant, a dedicated stockpile location must be identified, and stormwater protection measures designed when detailed layouts are available.	Assurance by environmental manager
	Minimize erosion in large storm event of 1 in 50- years or greater	Constructed prior to operation	20	All drains	Engineer low velocity drains: Drains sloped and sized such that velocities do no exceed 1 m/s	Included in detailed designs of design engineer and carried out by contractor appointed for construction
			21	Road crossings	Engineered drifts: Line all major drifts on road crossings with concrete to protect from traffic damage and high flow velocities (For smaller drifts gravel might suffice). Place a section of riprap (larger rocks) underlain by gravel and with gravel on either side to facilitate a smooth flow transition. Detailed modelling and design of road crossings such that erosion is controlled to be a feature of the detailed design.	
	Dissipate stormwater at all drainage outlets to velocities unlikely to cause erosion in natural soils for a 1 in 50-year storm event		22	All drains	Dissipaters: At drain outlets widen the channel and use riprap (can be sourced from spoil during construction) or reno mattresses to dissipate stormwater flows	
			23	Road crossings	Dissipation at road crossings: Detailed modelling and design of road crossings including riprap (can potentially be sourced from spoil during construction) or reno-mattresses.	
	Prevent erosion in general	Throughout construction	24	All	Maintain natural topography and vegetation: Do not disturb the natural topography or vegetation where possible	Construction contractors onsite environmental officer/representative
	Minimize erosion in large storm event of 1 in 5-years or greater		25	All drains	Engineer low velocity temporary drains: Drains sloped and sized such that velocities do no exceed 1 m/s in a 1 in 5-year event	
		Early in construction	26	Road crossings	Engineered temporary drifts: Build roads and road crossings before other infrastructure.	
	Ensure that any chronic erosion is detected and rehabilitated within 6 months	Every 3 months for the first 2 years and annually thereafter	27	• PV cell blocks; • Drains; • Outlet of all Drains; and • All-natural drainage lines that cross the access road.	Inspect and remediate noticeable erosion: Inspect all focus areas for erosion. If erosion is found, remediate and redesign the drainage in the area. If erosion is found in a natural drainage line, conduct an assessment and determine the cause. Develop a plan to prevent future erosion.	Environmental manager or hydrologist/engineer/environmental scientist appointed by the environmental manager
	Ensure that any acute erosion due to large storm events is detected within 2 weeks.	Install prior to operation	28	Main office	Install a rain gauge that can measure greater than 115 mm (100-year, 24-hour event)	Included in detailed designs of design engineer and carried out by contractor appointed for construction
		After a rain event of greater than 65 mm in one day (a 10 year - 24-hour rain event) or when staff notice flood damage.	29	All-natural drainage lines that run through the site	Inspect and remediate acute erosion: Inspect all focus areas for erosion. If erosion is found remediate and redesign the drainage in the area. If erosion is found in a natural drainage line conduct and assessment and determine the cause and develop a plan to prevent future erosion.	Environmental manager or hydrologist/engineer/environmental scientist appointed by the environmental manager
		Design and development prior to operation	30	All	Set up rain data system: Build or buy a basic rain program, preferably electronic, that allows site staff to enter rain data from the rain gauge. Ideally the system should alert the environmental manager and site manager when a rainfall event in excess of 65 mm per day is entered.	
		Daily	31	Main office	Record rain data: Read and record rain gauge daily;	Onsite staff member tasked by the Environmental manager
		Update annually in case of staff change	32		Signs at main office to aid problem reporting: Ensure that a sign providing the following is posed in the reception area, the control room, on each transformer and in the workshop: The name, telephone number and email address of the environmental manager. The sign should state: “If you notice any leaks or spills or erosion anywhere on the property please phone or email the environmental manager on …….”	Environmental manager
	Training	Annually	33	All	Training: Provide a short briefing to all construction staff on the dynamics of erosion and leaks that covers at least: • How to identify erosion; • How to identify a leak, including car leaks;	Environmental manager or hydrologist/engineer/environmental scientist appointed by the environmental manager

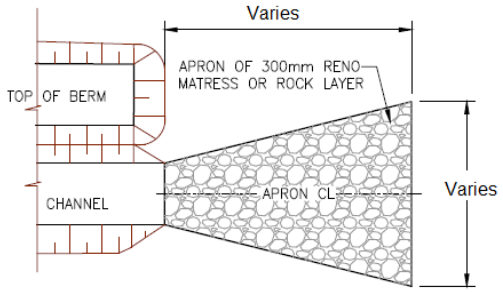
General principle	Specific outcomes	When	Ref No.	Focus area	Action	By whom
					• Where to find contact details of the environmental officer/representative in case of leaks or erosion.	
	Ensure that any erosion is detected and rehabilitated	After rain events	34		Inspect the site for erosion after rain events. If erosion is found, remediate and redesign the drainage in the area. If erosion is found in a natural drainage line, conduct an assessment to determine the cause and develop a plan to prevent future erosion.	Contractors environmental officer/representative
		During site establishment	35		Install a rain gauge that can measure greater than 115 mm (100-year, 24-hour event). This rain gauge will also be used during operation.	
Monitor and manage stormwater system	Include a monitoring system for spills and leaks such that they are detected as soon as possible.	Once every 2 weeks	36	All	Leak inspection: regularly check for leaks and for any breaches or evidence of spills or any other problems not in adherence to this SWMP. All cars should also be checked for oil leaks and any leaks found should be stopped immediately, the cause of the leak identified, the problem remediated such that no further leaks occur, and any contaminated soil or water assessed and remediated.	Contractors environmental officer/representative
	Include a monitoring system for spills and leaks such that they are detected as soon as possible.	Every 3 months for the first 2 years and annually thereafter	37		Leak inspection: regularly check for leaks and for any breaches or evidence of spills or any other problems that would indicate that it is not in adherence to this plan. All cars should also be checked for oil leaks during the inspection. Any leaks found should be stopped immediately, the cause of the leak sought, the problem remediated such that no further leaks occur, and any contaminated soil or water assessed and remediated.	Environmental manager or hydrologist/engineer/environmental scientist appointed by the environmental manager
		Continuous	38		Data capture, training and signs: see 32, 33, 34, 35, 36, & 37	Environmental manager and staff in general
		Construct prior to operation	39	The sewage conservancy tank	Sewage conservancy tank alert system: Install a float switch-controlled alarm that will alert the control room when the conservancy tank has less than 2 weeks of capacity remaining.	Included in detailed designs of design engineer and carried out by contractor appointed for construction
			40	Transformers	Signs at transformers: Post a sign on transformers stating “If you notice any leaks or spills or erosion anywhere on the property please phone reception on ……and report it”	
General	Do not build infrastructure within near to watercourses	Detailed design	41	All	Ensure no infrastructure except roads, solar panels and solar panel supports are built within 300 m of a water course. In particular, ensure no dirty areas, that may contain pollutants, are within 300 m of the water course	Design engineer or engineer appointed by the design engineer
	Do not build infrastructure containing potential pollutants in any of the natural drainage lines.		42		Ensure that final infrastructure plans do not propose any potentially polluting infrastructure, such as transformers, workshops or conservancy tanks in the natural drainage lines (currently none are proposed)	
	Review and improve stormwater management plan regularly.	Once every 5 years	43		Review and improve the stormwater plan	Environmental manager or engineer appointed by the environmental manager
	Review and inspect	Once every 2 months depending on the construction schedule	44		Inspect the site to ensure adherence to the stormwater management plan	Clients environmental representative or engineer
	Do not place stockpiles or other potentially polluting construction items within 300 m of the watercourse	Detailed design and throughout construction	45		Do not place laydown areas, stockpiles within 300 m of the watercourse	Design engineer or engineer appointed by the design engineer
	General	Detailed design	46		Develop a specific environmental specification for any construction including, but not limited to, the actions in this stormwater management plan and its principles	Clients environmental representative or specialist



TYPICAL PLAN OF
DRIFT CROSSING



TYPICAL CROSS SECTION THROUGH
THROUGH DIVERSION CHANNEL



TYPICAL PLAN OF
DISSIPATER AT END OF CHANNEL

srk consulting	TYPICAL CONCEPTUAL DESIGNS OF STORMWATER INFRASTRUCTURE (TO BE CONFIRMED IN DETAILED DESIGN)	Project No. 558582

Figure 7-1: Typical Conceptual Designs of Stormwater Infrastructure

8 Conclusions and Recommendations

In conclusion:

- The proposed facility will have an intrinsically low impact on surface water resources;
- The potential stormwater impacts that do exist can be managed in a practical and cost-effective way; and
- The plan is conceptual, because no detailed contour data is available and only conceptual infrastructure layouts were made available at the time of the study.

It is recommended that the SWMP be developed further during the detailed design by:

- Conducting a detailed topographic survey;
- Delineating floodlines for major rivers and assessing any safety requirements due to flooding;
- Developing a stormwater layout and conceptual designs based on the above information and infrastructure layout plan;
- Sizing the culverts or drifts associated with the proposed road crossings such, that it can handle at least the 1:2-year flood event, or a minimum of 600mm diameter or height (for maintenance purposes);
- Developing conceptual designs into detailed designs with sufficient detail to support construction; and
- The plan should be incorporated into an environmental specification for use during construction and incorporated into the operational environmental management of the site.

Prepared by	**Reviewed by**
SRK Consulting - Certified Electronic Signature srk consulting 558582/43926/Report 9200-6830-2910-THJE-07/04/2020 This signature has been printed digitally. The Author has given permission for its use for this document. The details are stored in the SRK Signature Database	SRK Consulting - Certified Electronic Signature srk consulting 558582/Bushmanland/43926/Report 1511-3971-9931-SHEP-07/04/2020 This signature has been printed digitally. The Author has given permission for its use for this document. The details are stored in the SRK Signature Database
Jeandre Thompson, *Pr. Eng*	Peter Shepherd, *Pr. Sci. Nat*
Principal Engineer	Principal Hydrologist, Partner

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

10 References

Cape EAPrac. (2019). *Basic Assessment Report.* Cape Town: Cape EAPrac.

Department of Water Affairs and Forestry. (4 June 1999). *GN R 704 Regulations in terms of section 26 of the National Water Act on the Use of Water for Mining and Related Activities aimed at the Protection of Water Resources.* Pretoria: Government Gazette .

Department Water Affairs and Forestry. (2006). *G1 Best Practice Guideline for Storm Water Management, Best Practice Guidelines for Water Resource Protection in the South African Mining Industry. .* Pretoria: Department of Water Affairs and Forestry (Now DWS).

Smithers, J. C., & Schulze, R. W. (2002). *Design rainfall and flood estimation in South Africa.* Pietermaritzburg: University of Natal.

Appendix C: Transport Study and Traffic Management Plan.

PROPOSED KARROID PV DEVELOPMENT: SOLAR ENERGY PV FACILITY AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE PROVINCE

TRANSPORT STUDY

MARCH 2020
Final Issue

Prepared by:

JG AFRIKA (PTY) LTD

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	Rev 14

TITLE:
PROPOSED KARROID PV DEVELOPMENT: SOLAR ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE PROVINCE

JGA REF. NO.	DATE:	REPORT STATUS
5314	30/03/2020	Final Issue

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AUTHOR

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CLIENT CONTACT PERSON

Peter Smith

SYNOPSIS

Preparation of a Transport Study for the proposed Karroid PV Solar Energy Facility in the Northern Cape Province, pertaining to all relevant traffic and transportation engineering aspects.

KEY WORDS:

Solar Energy Facility, Transport Study

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO 9001: 2015 which has been independently certified by DEKRA Certification.

Verification	Capacity	Name	Signature	Date
By Author	Senior Technologist	Adrian Johnson		30/03/2020
Checked by:	Associate	Iris Wink		30/03/2020
Authorised by:	Director	Harold Tiganis		30/03/2020

Filename:	X\5314_JG_Transport Study_Karroid PV

Report template version: 2017-10-30

SPECIALIST EXPERTISE

IRIS SIGRID WINK

Profession	Civil Engineer (Traffic & Transportation)
Position in Firm	Associate
Area of Specialisation	Manager: Traffic & Transportation Engineering
Qualifications	PrEng, MSc Eng (Civil & Transportation)
Years of Experience	17 Years
Years with Firm	7 Years

SUMMARY OF EXPERIENCE

Iris is a Professional Engineer registered with ECSA (20110156). She joined JG Afrika (Pty) Ltd. in 2012. Iris obtained a Master of Science degree in Civil Engineering in Germany and has more than 15 years of experience in a wide field of traffic and transport engineering projects. Iris left Germany in 2003 and has worked as a traffic and transport engineer in South Africa and Germany. She has technical and professional skills in traffic impact studies, public transport planning, non- motorised transport planning and design, design and development of transport systems, project planning and implementation for residential, commercial and industrial projects and providing conceptual designs for the abovementioned. She has also been involved with transport assessments for renewable energy projects and road safety audits.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

PrEng -Registered with the Engineering Council of South Africa No. 20110156
-Registered Mentor with ECSA for the Cape Town Office of JG Afrika
MSAICE -Member of the South African Institution of Civil Engineers
ITSSA -Member of ITS SA (Intelligent Transport Systems South Africa)
SAWEA -Member of the South African Wind Energy Association
SARF -South African Road Federation: Committee Member of Council
SARF WR - SARF Western Region Committee Member
SARF RSC - Road Safety Committee Member
IRF **- Global Road Safety Audit Team Leader with the International Road Federation (IRF)**

EDUCATION

1996 - Matric – Matric (Abitur) – Carl Friedrich Gauss Schule, Hemmingen, Germany
1998 - Diploma as Draughtsperson – Lower Saxonian State Office for Road and Bridge Engineering
2003 - MSc Eng (Civil and Transportation) – Leibniz Technical University of Hanover, Germany

SPECIFIC EXPERIENCE

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd)
2016 – Date
Position – Associate

- **Rondekop Windfarm** – Transport study for the proposed Kudusberg Windfarm near Sutherland, Northern Cape – Client: G7 Renewable Energies

- **Kudusberg Windfarm** – Transport study for the proposed Kudusberg Windfarm near Sutherland, Northern Cape – Client: G7 Renewable Energies
- **Multiple Traffic Impact and Route Assessment** for the proposed Solar PV Facilities in the Northern Cape – Client: Private Developer
- **Kuruman Windfarm –** Transport study for the proposed Kuruman Windfarm in Kuruman, Northern Cape – Client: Mulilo Renewable Project Developments
- **Coega West Windfarm** – Transportation and Traffic Management Plan for the proposed Coega Windfarm in Coega, Port Elizabeth – Client: Electrawinds Coega
- **Traffic and Parking Audits** for the Suburb of Groenvallei in Cape Town – Client: City of Cape Town Department of Property Management.
- **Road Safety Audit** for the Upgrade of N1 Section 4 Monument River – Client: Aurecon on behalf of SANRAL
- **Sonop Windfarm** – Traffic Impact Assessment for the proposed Sonop Windfarm, Coega, Port Elizabeth – Client: Founders Engineering
- **Universal Windfarm** - Traffic Impact Assessment for the proposed Universal Windfarm, Coega, Port Elizabeth – Client: Founders Engineering
- **Road Safety Audit** for the Upgrade of N2 Section 8 Knysna to Wittedrift – Client: SMEC on behalf of SANRAL
- **Road Safety Audit** for the Upgrade of N1 Section 16 Zandkraal to Winburg South – Client: SMEC on behalf of SANRAL
- **Traffic and Road Safety Studies** for the Improvement of N7 Section 2 and Section 3 (Rooidraai and Piekenierskloof Pass) – Client: SANRAL
- **Road Safety Appraisal**s for Northern Region of Cape Town – Client: Aurecon on behalf of City of Cape Town (TCT)
- **Traffic Engineering Services** for the Enkanini Informal Settlement, Kayamandi - Client: Stellenbosch Municipality
- **Lead Traffic Engineer** for the Upgrade of a 150km Section of the National Route N2 from Kangela to Pongola in KwaZulu-Natal, Client: SANRAL
- **Traffic Engineering Services** for the Kosovo Informal Settlement (which is part of the Southern Corridor Upgrade Programme), Client: Western Cape Government
- **Traffic and Road Safety Studies** for the proposed Kosovo Informal Housing Development (part of the Southern Corridor Upgrade Program), Client: Western Cape Government.
- **Road Safety Audit Stage 3** – Upgrade of the R573 Section 2 between Mpumalanga/Gauteng and Mpumalanga/Limpopo, Client: AECOM on behalf of SANRAL
- **Road Safety Audit Stage 1 and 3** – Upgrade of the N2 Section 5 between Lizmore and Heidelberg, Client: Aurecon on behalf of SANRAL
- **Traffic Safety Studies** for Roads Upgrades in Cofimvaba, Eastern Cape – Client: Cofimvaba Municipality
- **Road Safety Audit Stage 1 and 3** – Improvement of Intersections between Olifantshoek and Kathu, Northern Cape, Client: Nadeson/Gibb on behalf of SANRAL
- **Road Safety Audit Stage 3** – Upgrade of the Beacon Way Intersection on the N2 at Plettenberg Bay, Client: AECOM on behalf of SANRAL

- **Traffic Impact Assessment** for a proposed Primary School at Die Bos in Strand, Somerset West, Client: Edifice Consulting Engineers
- **Road Safety Audit** Stage 1 and 3 – Improvement of R75 between Port Elizabeth and Uitenhage, Eastern Cape, Client: SMEC on behalf of SANRAL

SPECIALIST DECLARATION

I, **IRIS WINK**, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant;
- Regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- All the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: _____

Name of Specialist: IRIS WINK

Date: 30/03/2020

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Yes. See attached CV
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Yes. See attached declaration
c) an indication of the scope of, and the purpose for which, the report was prepared;	Yes. See section 1.1
(cA) an indication of the quality and age of base data used for the specialist report;	n/a
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Yes. See section 6.1
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	n/a
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Yes. See section 1.3
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Yes. Chapters 3 and 6
g) an identification of any areas to be avoided, including buffers;	Yes. Chapter 3
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	n/a
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Yes. Section 1.4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Yes. Chapters 3, 6, 8 and 9
k) any mitigation measures for inclusion in the EMPr;	Yes. Chapter 10
l) any conditions for inclusion in the environmental authorisation;	n/a
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	n/a
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Yes. Chapter 6
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
q) any other information requested by the competent authority.	n/a
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	n/a

TABLE OF CONTENTS

TABLES

FIGURES

ANNEXURES

PROPOSED KARROID PV DEVELOPMENT: SOLAR ENERGY PV FACILITY AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE PROVINCE

1 INTRODUCTION AND METHODOLOGY

1.1 Scope and Objectives

Karroid PV (Pty) Ltd is proposing the development of a commercial solar photovoltaic (PV) facility and associated infrastructure on a site located approximately 30km south-west of Upington within the Kai !Garib Local Municipality and the ZF Mgcawu District Municipality in the Northern Cape Province.

The power generated from the project will be sold to Eskom and will feed into the national electricity grid. Ultimately, the project is intended to be a part of the renewable energy projects portfolio for South Africa, as contemplated in the Integrated Resource Plan.

A separate basic assessment process will be undertaken for the grid connection infrastructure to connect the Karroid PV solar PV facility to the Upington Main Transmission Substation.

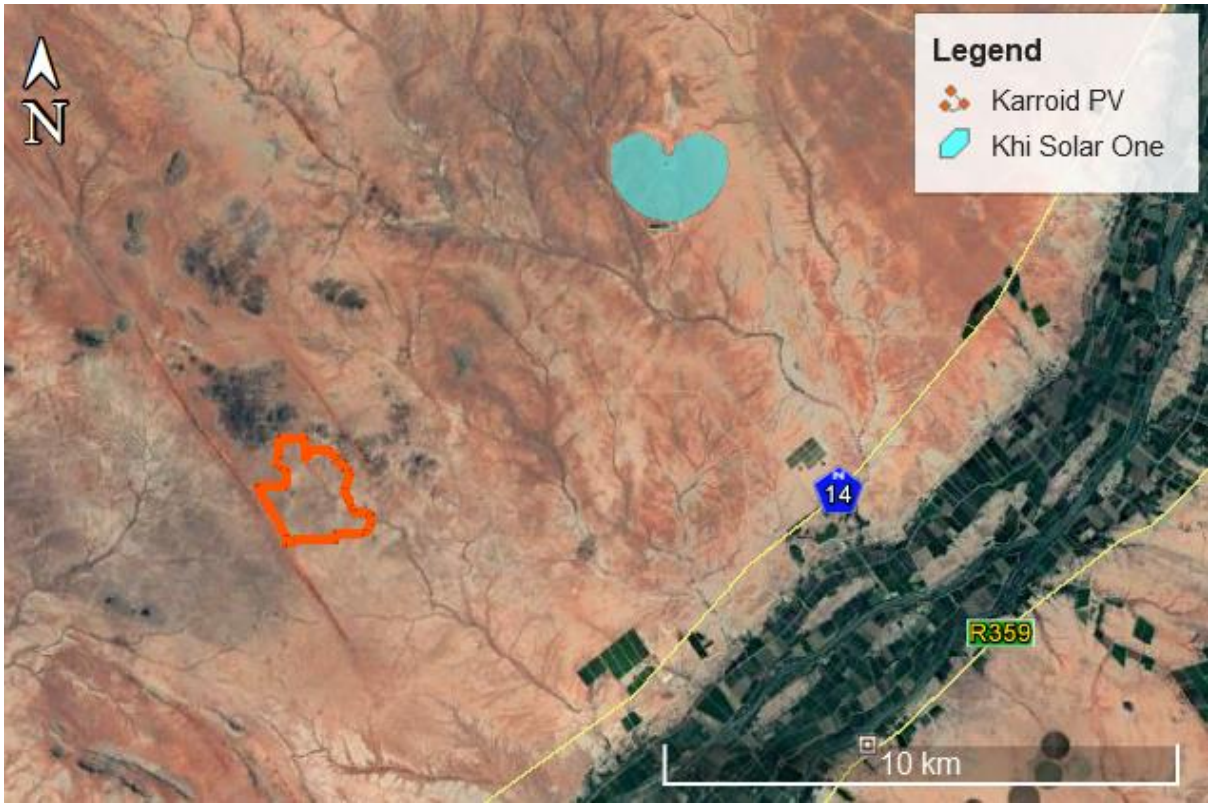

Figure 1-1: Karroid PV Development site

As part of the environmental impact processes, the services of a Transportation Specialist are required to conduct a Transport Study. The main objective of this report is to undertake the Transport Study for the proposed Karroid PV Development site.

The following two main transportation activities will be investigated:

- Abnormal load vehicles transporting components to the site.
- The transportation of construction materials, equipment and people to and from the site/facility.

The transport study will aim to provide the following objectives:

- Assess activities related to traffic movement for the construction and operation (maintenance) phases of the facility.
- Recommend a preliminary route for the transportation of the components to the proposed site.
- Recommend a preliminary transportation route for the transportation of materials, equipment and people to site.
- Recommend alternative or secondary routes where possible.

1.2 Terms of Reference

The Terms of Reference for this Transport Study include the following:

General:

- A description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project;
- A description and evaluation of environmental issues and potential impacts (including direct, indirect, cumulative impacts and residual risks) that have been identified; and
    - Direct, indirect, cumulative impacts and residual risks of the identified issues must be evaluated within the EIA Report in terms of the following criteria:
    - The nature, which shall include a description of what causes the effect, what will be affected and how it will be affected;
    - A statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts;
    - A comparative evaluation of the identified feasible alternatives, and nomination of a preferred alternative;
    - Any aspects conditional to the findings of the assessment which are to be included as conditions of the Environmental Authorisation;
    - This must also include any gaps in knowledge at this point of the study. Consideration of areas that would constitute “acceptable and defendable loss” should be included in this discussion;
    - A reasoned opinion as to whether the proposed project should be authorized;
    - Summary of the positive and negative impacts and risks of the proposed project and identified alternatives; and
    - Mitigation measures and management recommendations to be included in the Environmental Management Programme to be submitted with the FEIR.

Specific:

- Extent of the transport study and study area;
- The proposed development;
- Trip generation for the facility during construction and operation;
- Traffic impact on external road network;
- Accessibility and turning requirements;
- National and local haulage routes;

- Assessment of internal roads and site access;
- Assessment of freight requirements and permitting needed for abnormal loads; and
- Traffic accommodation during construction.

1.3 Approach and Methodology

The report deals with the traffic impact on the surrounding road network in the vicinity of the site:

- during the construction of the access roads;
- construction of the facility; and
- operation and maintenance during the operational phase.

This transport study was informed by the following:

Project Assessment

- Overview of project background information including location maps, component specs and any possible resulting abnormal loads to be transported; and
- Research of all available documentation and information relevant to the proposed facility.

The transport study considered and assessed the following:

Traffic and Haul Route Assessment

- Estimation of trip generation;
- Discussion on potential traffic impacts;
- Assessment of possible haul routes; and
- Construction and operational (maintenance) vehicle trips.

Site layout, Access Points and Internal Roads Assessment per Site

- Description of the surrounding road network;
- Description of site layout;
- Assessment of the proposed access points; and
- Assessment of the proposed internal roads on site.

The findings of the transport assessment are detailed in this report prepared as part of the environmental impact assessment process for the proposed Karroid PV Development.

1.4 Assumptions and Limitations

The following assumptions and limitations apply:

- This study is based on the project information provided by Karroid PV (Pty) Ltd;
- According to the Eskom Specifications for Power Transformers (Eskom Power Series, Volume 5: Theory, Design, Maintenance and Life Management of Power Transformers), the following dimensional limitations need to be kept when transporting the transformer – total maximum height 5 000mm, total maximum width 4 300 mm and total maximum length 10 500 mm;
- Maximum vertical height clearances along the haulage route is 5.2 m for abnormal loads;
- Imported elements will be transported from the most feasible port of entry, which is deemed to be the Port of Saldanha in the Western Cape;

- If any elements are manufactured within South Africa, these will be transported from their respective manufacturing centers, which would be either in the greater Johannesburg, Pinetown/Durban or Cape Town for the transformer, inverter and the support structures.
- All haulage trips will occur on either surfaced national and provincial roads or existing gravel roads; and
- Material for the construction of internal access roads will be sourced locally as far as possible.

1.5 Source of Information

Information used in a transport study includes:

- Project Information provided by Karroid PV (Pty) Ltd;
- Google Earth.kmz provided by Karroid PV (Pty) Ltd;
- Google Earth Satellite Imagery;
- Information gathered during the site visit; and
- Project research of all available information.

2 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE TRANSPORT STUDY

2.1 Port of Entry

The two possible ports of entry to receive the imported parts are Saldanha and Port Elizabeth. The distance from Port Elizabeth to the site via road is approximately 930km ,and from Saldanha to the site approximately 780km via the N7 and R27 (shown in purple in the following Figure 2-1) and approximately 870km via the N7 and N14 (shown in green in Figure 2-1). Based on minimal travel distance, the preferred port of entry is Saldanha.

The Port of Saldanha is the largest and deepest natural port in the Southern Hemisphere able to accommodate vessels with a draft of up to 21.5m. The port covers a land and sea surface area of just over 19,300 hectares within a circumference of 91km with maximum water depths of 23.7m. Unique to the port is a purpose-built rail link directly connected to a jetty bulk loading facility for the shipment of iron ore. The Port is operated by Transnet National Ports Authority.

Figure 2-1: Haulage Routes (Port of Entry - Saldanha)

2.2 Transportation requirements

It is anticipated that the following vehicles will access the site during construction:

- Conventional trucks within the freight limitations to transport building material to the site;
- 40ft container trucks transporting solar panels, frames and the inverter, which are within freight limitations;
- Flatbed trucks transporting the solar panels and frames, which are within the freight limitations;
- Light Differential Vehicle (LDV) type vehicles transporting workers from surrounding areas to site;
- Drilling machines and other required construction machinery being transported by conventional trucks or via self-drive to site; and
- The transformers will be transported as abnormal loads.

2.3 Abnormal Load Considerations

It is expected that the transformers will be transported with an abnormal load vehicle. Abnormal permits are required for vehicles exceeding the following permissible maximum dimensions on road freight transport in terms of the Road Safety Act (Act No. 93 of 1996) and the National Road Traffic Regulations, 2000:

- Length: 22 m for an interlink, 18.5 m for truck and trailer and 13.5 m for a single unit truck
- Width: 2.6 m
- Height: 4.3 m measured from the ground. Possible height of load – 2.7 m.
- Weight: Gross vehicle mass of 56 t resulting in a payload of approximately 30t
- Axle unit limitations: 18 t for dual and 24 t for triple-axle units
- Axle load limitation: 7.7 t on the front axle and 9 t on the single or rear axles

Any dimension / mass outside the above will be classified as an Abnormal Load and will necessitate an application to the Department of Transport and Public Works for a permit that will give authorisation for the conveyance of said load. A permit is required for each Province that the haulage route traverses.

2.4 Further Guideline Documentation

The Technical Recommendations for Highways (TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outlines the rules and conditions that apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed. Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges and culverts.

The general conditions, limitations and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power / mass ratio, mass distribution and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the Road Traffic Act and the relevant regulations.

2.5 Permitting – General Rules

The limits recommended in TRH 11 are intended to serve as a guide to the Permit Issuing Authorities. It must be noted that each Administration has the right to refuse a permit application or to modify the conditions under which a permit is granted. It is understood that:

a) A permit is issued at the sole discretion of the Issuing Authority. The permit may be refused because of the condition of the road, the culverts and bridges, the nature of other traffic on the road, abnormally heavy traffic during certain periods or for any other reason.
b) A permit can be withdrawn if the vehicle upon inspection is found in any way not fit to be operated.
c) During certain periods, such as school holidays or long weekends an embargo may be placed on the issuing or permits. Embargo lists are compiled annually and are obtainable from the Issuing Authorities.

2.6 Load Limitations

The maximum load that a road vehicle or combination of vehicles will be allowed to carry legally under permit on a public road is limited by:

- the capacity of the vehicles as rated by the manufacturer;
- the load which may be carried by the tyres;
- the damaging effect on pavements;
- the structural capacity on bridges and culverts;
- the power of the prime mover(s);
- the load imposed by the driving axles; and
- the load imposed by the steering axles.

2.7 Dimensional Limitations

A load of abnormal dimensions may cause an obstruction and danger to other traffic. For this reason, all loads must, as far as possible, conform to the legal dimensions. Permits will only be considered for indivisible loads, i.e. loads that cannot, without disproportionate effort, expense or risk of damage, be divided into two or more loads for the purpose of transport on public roads. For each of the characteristics below there is a legally permissible limit and what is allowed under permit:

- Width;
- Height;
- Length;
- Front Overhang;
- Rear Overhang;
- Front Load Projection;
- Rear Load Projection;
- Wheelbase;
- Turning Radius; and
- Stability of Loaded Vehicles.

2.8 Transporting Other Plant, Material and Equipment

In addition to transporting the specialised equipment, the normal Civil Engineering construction materials, plant and equipment will need to be transported to the site (e.g. sand, stone, cement, gravel, water, compaction equipment, concrete mixers, etc.). Other components, such as electrical cables, pylons and substation transformers, will also be transported to site during construction. The transport of these items will generally be conducted with normal heavy loads vehicles, except for the transformers which require an abnormal load vehicle.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Description of the site

A preferred project site with an extent of 255 ha has been identified by Karroid PV (Pty) Ltd as a technically suitable site for the development of a solar PV facility with a contracted capacity of up to 100MW. The entire project site is located within Focus Area 7 of the Renewable Energy Development Zones (REDZ), which is known as the Upington REDZ. Due to the location of the project site within a REDZ, a Basic Assessment (BA) process will be undertaken in accordance with GN113 and GN114 as formally gazetted on 16 February 2018. The project site is located on the following farm portion:

- Remaining Extent of Geel Kop Farm No 456.

The Khi Solar One concentrated solar power plant is located north-east of the proposed site.

Figure 3-1: Aerial View of Proposed Karroid PV Development

The PV energy facility is to consist of solar photovoltaic (PV) technology, fixed-tilt-, single-axis tracking- or dual-axis tracking- mounting structures, with a net generating capacity of 100MW as well as associated infrastructure, which will include:

- On-site switching-station / substation;
- Auxiliary buildings (gatehouse and security, control centre, office, warehouse, canteen & visitors centre, staff lockers etc.);
- Inverter-stations, transformers and internal electrical reticulation (underground cabling);
- Access and internal road network;
- Laydown area;

- Karroid PV will connect from the onsite sub-station to the Upington MTS (400/132 kV), via the 132kV Geelkop Collector Substation;
- Rainwater tanks; and
- Perimeter fencing and security infrastructure.

3.2 National Route to Site for Imported Components

It is assumed that the Solar PV panels will be imported and transported to the site. There are two viable options for the port of entry for imported components - the Port of Saldanha in the Western Cape and the Port of Ngqura in Port Elizabeth. The Port of Saldanha is located approximately 870km away from the site via the N7 and N14 whilst the Port of Ngqura is located approximately 930km travel distance from the proposed site. The Port of Saldanha is the preferred port of entry due to the shorter travelling distance, however, the Port of Ngqura can be used as an alternative should the Port of Saldanha not be available.

The preferred route from the preferred point of entry is shown in green in the Figure below. An alternative route, shown in purple, deviates from the preferred route at Vanrhynsdorp. The preferred route is approximately 870km in length and will start at the Port of Saldanha, heading east to Moorreesburg via the R45 and passing Piketberg, Vanrhynsdorp via the N7, heading east at Springbok onto the N14 and passing Keimoes via the N14 en route to the site.

An alternative route from the Port of Ngqura, shown in blue in the Figure below, is approximately 930km in length and follows the N10 in a northwest direction en route towards Upington. The route passes Upington onto the N14 and heads west along the N14 to the proposed site.

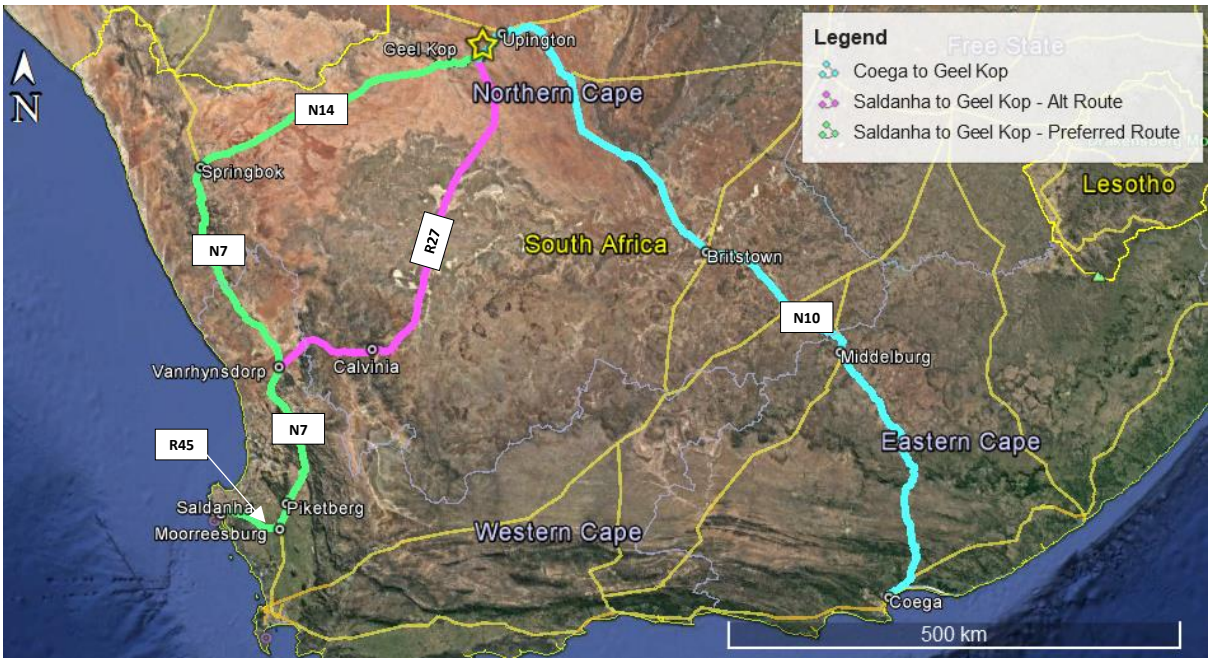

Figure 3-2: Haulage Routes

With the above route options there are several passes, bridges and other road structures, which the haulage vehicles will pass over. However, none of the imported goods will require abnormal loads and there are no limitations for normal heavy vehicles using these routes.

3.3 Route for Components manufactured within South Africa

It is anticipated that elements manufactured within South Africa will be transported to the site from the Cape Town, Johannesburg and/or Pinetown/Durban areas.

The transformer will be transported with an abnormal load vehicle and therefore it needs to be verified that the route from the manufacturer to the site does not have any load limitations for abnormal vehicles. At this stage, only a high-level assessment can be undertaken as no information of the exact location of the manufacturer is known and all road structures (such as bridges and culverts) need to be confirmed for their load bearing by SANRAL or the respective Roads Authority.

It is critical to ensure that the abnormal load vehicle will be able to move safely and without obstruction along the preferred route. The preferred route should be surveyed prior to construction to identify any problem areas, e.g. intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification. After the road modifications have been implemented, it is recommended to undertake a "dry-run" with the largest abnormal load vehicle, prior to the transportation of any components, to ensure that the delivery will occur without disruptions.

3.3.1 Route from Johannesburg Area to Site – Normal Loads

With the haulage distance being the minimal haulage distance to site, it is assumed that the inverter and support structure will be manufactured in the Johannesburg area and transported to site via road. The general route distance is around 820km and no road limitations are expected on this route for normal loads vehicles as it will mainly follow national and provincial roads. The haulage route is shown in the Figure 3-3 below.

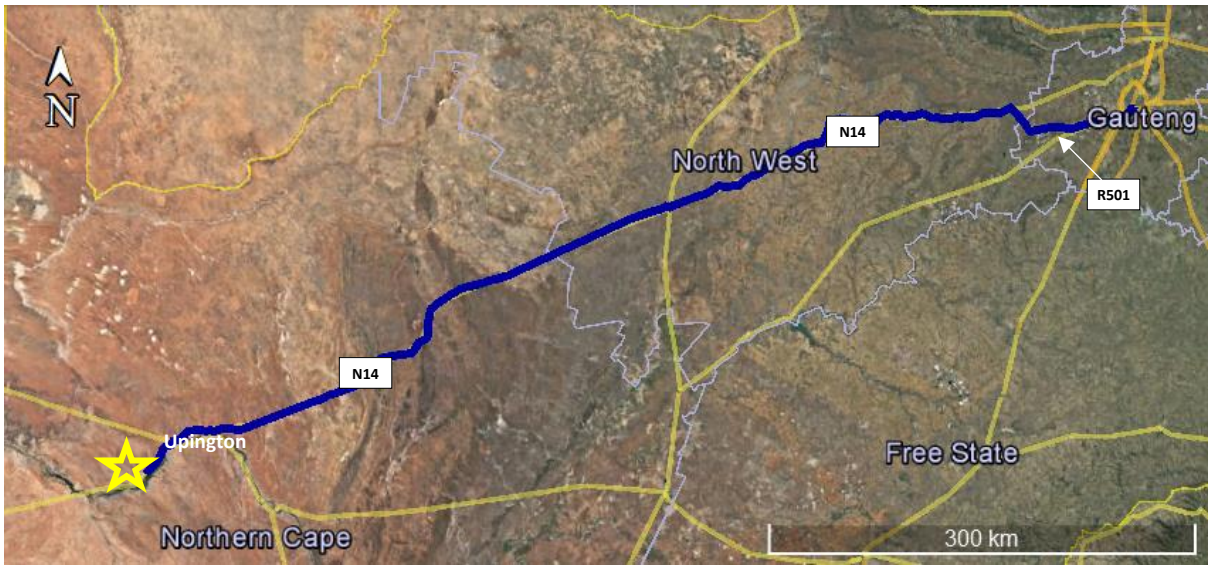

Figure 3-3: Haulage Route from Johannesburg Area to Site for Normal Loads

3.3.2 Route from Pinetown / Durban to Site - Normal load

As a manufacturing centre, Pinetown/Durban can manufacture the inverter and support structures which will then be transported to site via road transportation.

The inverter and support structures elements are typically transported as normal loads and no road limitations are envisaged along the route for normal load freight, shown in the Figure below. Haulage

vehicles will mainly travel on national and provincial roads and the total distance is approximately 1 200km.This distance is however approximately 380km longer than the Johannesburg haulage route.

Figure 3-4: Haulage Route from Pinetown Area to Site

3.3.3 Route from Cape Town Area to Site – Normal Load

The inverter and support structures can also alternatively be manufactured in Cape Town and transported to site. The recommended haulage route for this option will follow National Road N7 from Cape Town to Moorreesburg. From Moorreesburg it will follow the same route proposed for the imported components, shown in Figure 3-2. The general route distance is around 870km and no road limitations are expected on this route for normal loads vehicles as it will mainly follow national and provincial roads. The route is, however, approximately 50km longer than the Johannesburg haulage route.

3.3.4 Route from Johannesburg Area to Site – Abnormal Load

It is understood that the transformer will be manufactured locally in South Africa and be transported from the Johannesburg area to site. As the transformer will be transported with an abnormal load vehicle, the route planning needs a more detailed investigation of the feasible routes taking into account any limitations due to existing road structures. Furthermore, a load of abnormal dimensions may cause an obstruction and danger to other traffic and therefore the transformer needs to be transported as far as possible on roads that are wide enough for general traffic to pass. It is expected that the transformer can be transported to site via the same route used for normal loads.

There are several bridges and culverts along this route, which need to be confirmed for load bearing and height clearances. There will be several turns along the way and a couple of small towns to pass through, such as Delareyville and Vryburg. According to the desktop study, all turning movements along the route are manageable for the abnormal vehicle.

However, there are a number of alternative routes which can be investigated if the above route or sections of the route should not be feasible.

3.4 Proposed main access road to the Proposed Development

The main access road to the proposed development will be the N14, shown in the Figure below. The N14 road is also earmarked as the main access road to proposed renewable energy facilities on neighbouring farms.

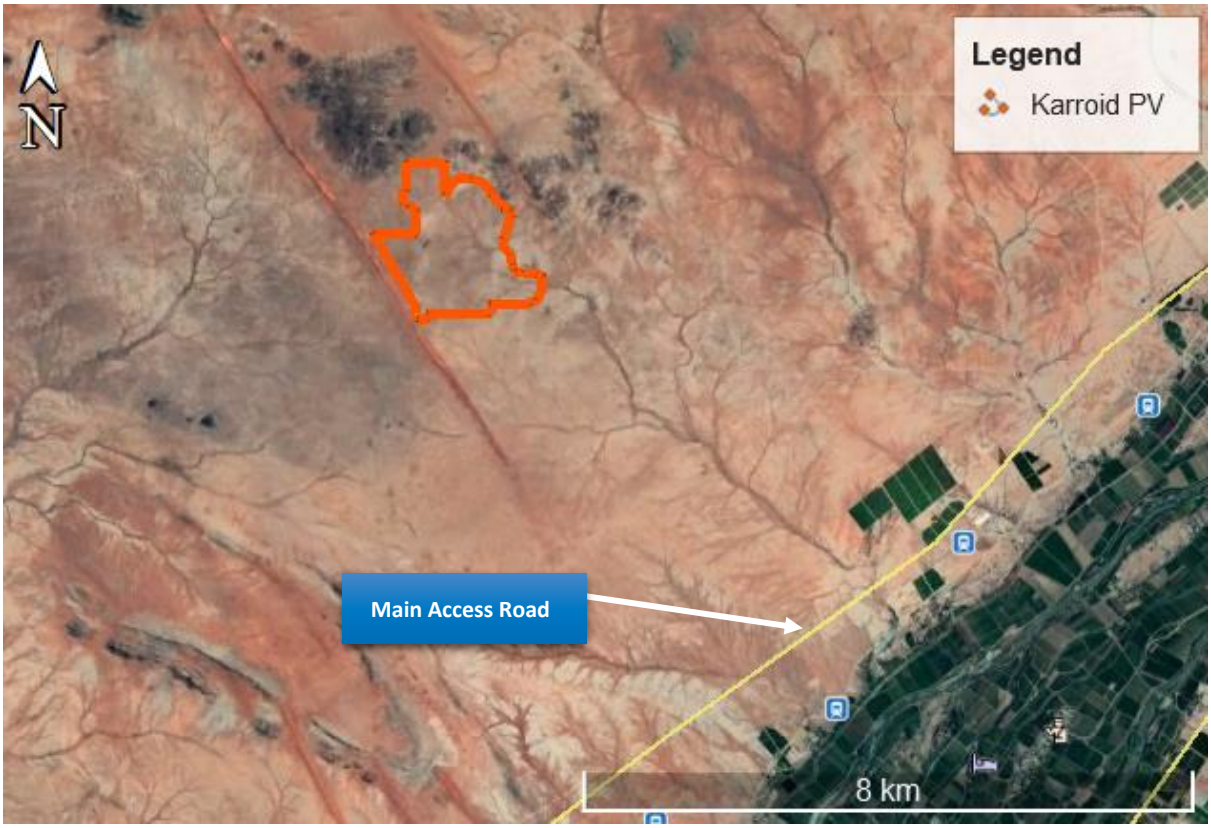

Figure 3-5: Main Access Road to the Development

3.4.1 Proposed Access Route

Four access points were investigated, show in the Figure below. All the potential access points are located off the N14 and will allow practically direct access to the Karroid PV site.

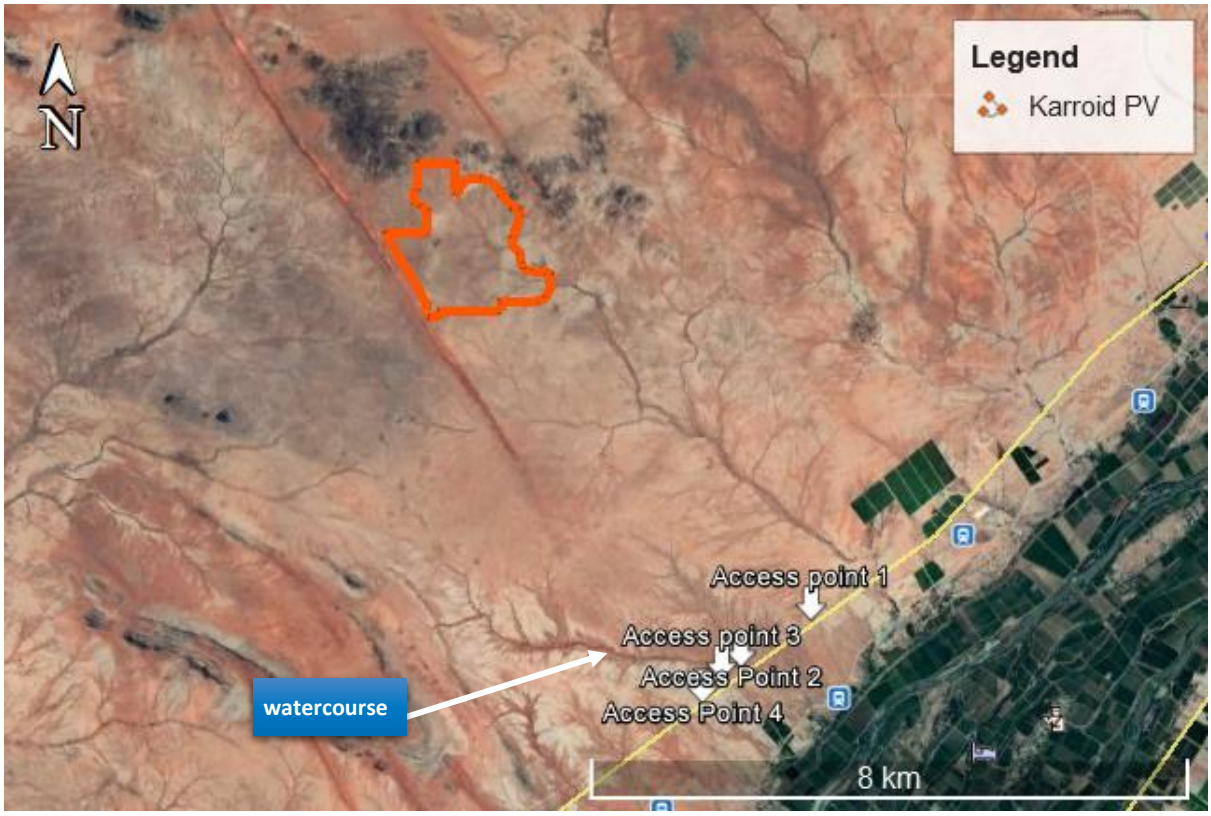

Figure 3-6: Potential Access Points

The N14 is a single carriageway with one lane per direction running in an east-west direction. Sight distances at the intersections/access points are deemed acceptable.

Figure 3-7: N14

Access point 1 is an existing farm access. It is proposed that the Karroid PV site be accessed via an 8.1km new road, shown in the **Figure 3-9** below. The alignment of the new road follows existing gravel tracks as far as possible.

Figure 3-8: Access point 1 - Existing

Figure 3-9: Access point 1 and new access road

Access points 2 to 4, although also in close proximity to the site boundary, would require the construction of a bridge structure over the existing watercourse.

Figure 3-10: Access Point 2 - Existing

Figure 3-11: Access Point 3 - Existing

Figure 3-12: Access Point 4 - Existing

Access point 1 **is deemed the preferred access route** as it allows direct access to the proposed site and does not require additional structures.

The access point proposed for Karroid PV will need to be upgraded to cater for the construction vehicles navigating the road to the laydown areas on site. Generally, the road width at the access point needs to be a minimum of 6m and the access roads on site a minimum of 5m. The radius at the access point from the N14 needs to be large enough to allow for all construction vehicles to turn safely. It is recommended that the access point shall be surfaced and the internal access roads on site can remain gravel.

The exact location and design of the internal access road to the Karroid PV Development needs to be established at detailed design stage. Existing structures and services such as drainage structures and pipelines will need to be evaluated if impacting on the access road.

It is recommended that the site access be controlled via a boom and gatehouse. Security staff is to be stationed on site at the access booms during construction and an electronic number plate reader id to be implemented once the solar farm is in operation. It is recommended to allow for at least 25m stacking distance at the boom access to the site.

It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will hence need to be maintained during the additional loading of the construction phase and then reinstated after construction is completed. The gravel roads will require grading with a grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage.

3.5 Main Route for the Transportation of Materials, Plant and People to the proposed site

The nearest towns in relation to the proposed site are Upington, Keimos and Kakamas. It is envisaged that most of the materials, plant and labour will be sourced from these towns.

Concrete batch plants and quarries in the vicinity could be contracted to supply materials and concrete during the construction phase, which would reduce the impact on traffic on the surrounding road network. Alternatively, mobile concrete batch plants and temporary construction material stockpile yards could be commissioned on vacant land near the proposed site. Delivery of materials to the mobile batch plant and the stockpile yard could be staggered to minimise traffic disruptions.

It is envisaged that most materials, water, plant, services and people will be procured within a 60 km radius from the proposed site; however, this would be informed by the REIPPPP requirements.

4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Key legal requirements pertaining to the transport requirements for the proposed development are:

- Abnormal load permits, (Section 81 of the National Road Traffic Act)
- Port permit (Guidelines for Agreements, Licenses and Permits in terms of the National Ports Act No. 12 of 2005), and
- Authorisation from Road Authorities to modify the road reserve to accommodate turning movements of abnormal loads at intersections.

5 IDENTIFICATION OF KEY ISSUES

5.1 Identification of Potential Impacts

The potential transport related impacts are described below.

5.1.1 Construction Phase

Potential impact

- Construction related traffic
- The construction traffic would also lead to noise and dust pollution.
- This phase also includes the construction of roads, excavations, trenching for electrical cables and other ancillary construction works that will temporarily generate the most traffic.

5.1.2 Operational Phase

During operation, it is expected that staff and security will periodically visit the facility. Approximately 30 full-time employees will be stationed on site. The traffic generated during this phase will be minimal and will not have an impact on the surrounding road network.

5.1.3 Decommissioning Phase

This phase will result in the same impact as the Construction Phase as similar trips are expected.

5.1.4 Cumulative Impacts

- Traffic congestion/delays on the surrounding road network.
- Noise and dust pollution

6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

6.1 Potential Impact (Construction Phase)

Nature of the impact

- Potential traffic congestion and delays on the surrounding road network and associated noise and dust pollution.

Significance of impact without mitigation measures

- Traffic generated by the construction of the facility will have a significant impact on the surrounding road network. The exact number of trips generated during construction will be determined by the haulage company transporting the components to site, the staff requirements and where equipment is sourced from.

From experience on other projects of similar nature, the number of heavy vehicles per 7MW installation is estimated to range between 200 and 300 trips depending on the site conditions and requirements. For the 100MW, the total trips can therefore be estimated to be between 2 858 and 4 286 heavy vehicle trips, which will generally be made over a 12-month construction period. Choosing the worst-case scenario of 4 286 heavy vehicles over a 12-month period travelling on an average of 22 working days per month, the resulting daily number of vehicle trips is approximately 17. Considering that the number of vehicle trips during peak hour traffic in a rural environment can roughly be estimated at around 20-40% of the average daily traffic, the resulting vehicle trips for the construction phase are approximately 4-7 trips. The impact on general traffic on the N14 is therefore deemed nominal.

If the PV panels are to be imported instead of manufactured within South Africa, the respective shipping company will be able to indicate how the panels can be packed (for example using 2MW packages and 40ft containers). These can then be stored at the port and repacked onto flatbed trucks.

During operation, approximately 30 full-time employees will be stationed on site and hence vehicle trips generated will be low and will have a negligible impact on the external road network.

The developer may investigate the use of borehole water for the cleaning of the PV panels. Should rainwater or borehole water not be available or suitable, the following assumptions have been made to estimate the resulting trips generated from transporting water to the site:

- 5 000 litre water bowsers to be used for transporting the water
- Approximately 5 litres of water needed per panel
- A range of between 350,000 – 400,000 Solar panels are expected for the site
- Assuming the worst-case scenario of 400,000 Solar panels, the total number of trips is therefore approximately 400 water bowsers can be expected.
- Panels will be cleaned up to four times a year.

It is expected that these trips will not have a significant impact on external traffic. However, to limit the impact, it is recommended to schedule these trips outside of peak traffic periods. Additionally, the provision of rainwater tanks at the site is expected to decrease the number of trips.

The significance of the transport impact without mitigation measures during the construction phase can be rated as medium. However, considering that this is temporary and short term in nature, the impact can be mitigated to an acceptable level.

Proposed mitigation measures

- The delivery of components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
- Dust suppression of gravel roads during the construction phase, as required.
- Regular maintenance of gravel roads by the Contractor during the construction phase and by the Owner/Facility Manager during the operation phase.
- The use of mobile batch plants and quarries near the site would decrease the traffic impact on the surrounding road network.
- Staff and general trips should occur outside of peak traffic periods as far as possible.
- If required, low hanging overhead lines (lower than 5.1m) e.g. Eskom and Telkom lines, along the proposed routes will have to be moved to accommodate the abnormal load vehicles.
- The preferred route should be surveyed to identify problem areas (e.g. intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification). After the road modifications have been implemented, it is recommended to undertake a “dry-run” with the largest abnormal load vehicle, prior to the transportation of any components, to ensure that delivery will occur without disruptions. This process is to be undertaken by the haulage company transporting the components and the contractor, who will modify the road and intersections to accommodate abnormal vehicles. It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will need to be maintained during the additional loading of the construction phase and reinstated after construction is completed.
- Design and maintenance of internal roads. The internal gravel roads will require grading with a grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage. This process is to be undertaken by a civil engineering consultant or a geometric design professional.

Significance of impact with mitigation measures

The proposed mitigation measures for the construction traffic will result in a minor reduction of the impact on the surrounding road network, but the impact on the local traffic will remain moderate as the existing traffic volumes are deemed to be low. The dust suppression, however, will result in significantly reducing the impact.

7 NO-GO ALTERNATIVE

The no-go alternative implies that the proposed Karroid PV Development does not proceed. This would mean that there will be no negative environmental impacts and no traffic impact on the surrounding network. However, this would also mean that there would be no socio-economic benefits to the surrounding communities, and it will not assist government in meeting the targets for renewable energy. **Hence, the no-go alternative is not a preferred alternative.**

8 IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in the tables below. The assessment methodology is attached as **Annexure A**.

Table 8-1: Impact Rating - Construction Phase – Traffic Congestion

IMPACT TABLE – CONSTRUCTION PHASE		
Environmental Parameter	*Traffic Congestion*	
Issue/Impact/Environmental Effect/Nature	*Transport of equipment, material and staff to site will lead to congestion.*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*No loss*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	Local (2)	Local (1)
Probability	Highly probable (4)	Improbable (2)
Duration	Very Short (1)	Very Short (1)
Magnitude	Moderate (6)	Low (4)
Significance rating	Medium (36)	Low (12)
Mitigation measures	• *Stagger component delivery to site* • *Reduce the construction period* • *The use of mobile batch plants and quarries in close proximity to the site* • *Staff and general trips should occur outside of peak traffic periods.* • *Regular maintenance of gravel roads by the Contractor during the construction phase and by Client/Facility Manager during operation phase.*	
Residual Risks:	• *None, Traffic will return to normal levels after construction is completed.*	

Table 8-2: Impact Rating - Construction Phase – Dust Pollution

IMPACT TABLE – CONSTRUCTION PHASE		
Environmental Parameter	*Air quality will be affected by dust pollution*	
Issue/Impact/Environmental Effect/Nature	*Traffic on roads will generate dust.*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*No loss*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	Local (2)	Local (1)
Probability	Highly probable (4)	Improbable (2)
Duration	Very Short (1)	Very Short (1)
Magnitude	Moderate (5)	Minor (2)
Significance rating	Medium (32)	Low (8)
Mitigation measures	• *Dust Suppression of gravel roads during the construction phase, as required.* • *Regular maintenance of gravel roads by the Contractor during the construction phase and by Client/Facility Manager during operation phase.*	
Residual Risks:	• *Dust pollution during the construction phase cannot be completely mitigated but mitigation measures will significantly reduce the impact. Dust pollution is limited to the construction period.*	

Table 8-3: Impact Rating - Construction Phase – Noise Pollution

IMPACT TABLE – CONSTRUCTION PHASE		
Environmental Parameter	*Noise pollution due to increased traffic.*	
Issue/Impact/Environmental Effect/Nature	*Traffic on roads will generate noise.*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*No loss*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	Local (2)	Local (1)
Probability	Highly probable (4)	Improbable (2)
Duration	Very Short (1)	Very Short (1)
Magnitude	Moderate (5)	Minor (2)
Significance rating	Medium (32)	Low (8)
Mitigation measures	• *Stagger component delivery to site* • *Reduce the construction period as far as possible* • *The use of mobile batch plants and quarries in close proximity to the site* • *Staff and general trips should occur outside of peak traffic periods*	
Residual Risks:	• *Noise pollution during the construction phase cannot be completely mitigated but mitigation measures will significantly reduce the impact. Noise pollution is limited to the construction period.*	

Table 8-4: Impact Rating - Operation Phase

IMPACT TABLE – OPERATION PHASE
The traffic generated during this phase will be negligible and will not have any impact on the surrounding road network.

Table 8-5: Impact Rating - Decommissioning Phase

IMPACT TABLE – OPERATION PHASE
This phase will have the same impact as the Construction Phase i.e. traffic congestion, air pollution and noise pollution, as similar trips/movements are expected.

9 CUMULATIVE IMPACTS

To assess the cumulative impact, it was assumed that all renewable energy projects within 50km currently proposed and authorized, would be constructed at the same time. This is the precautionary approach as in reality these projects would be subject to a highly competitive bidding process. Only a handful of projects would be selected to enter into a power purchase agreement with Eskom, and construction is likely to be staggered depending on project-specific issues.

The construction and decommissioning phases are the only significant traffic generators for renewable energy projects. The duration of these phases is short term (i.e. the impact of the generated traffic on the surrounding road network is temporary and renewable energy facilities, when operational, do not add any significant traffic to the road network). Even if all renewable energy projects within the area are constructed at the same time, the roads authority will consider all applications for abnormal loads and work with all project companies to ensure that loads on the public roads are staggered and staged to ensure that the impact will be acceptable.

The assessments of cumulative impacts are collated in the table below.

Table 9-1: Cumulative Impact

Nature: *Traffic generated by the proposed development and the associated noise and dust pollution.*		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Low (2)	Moderate (3)
Duration	Very Short (1)	Short (2)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Definite (5)
Significance	**Medium (36)**	**Medium (55)**
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Confidence in findings: High.		
Mitigation: • *Stagger component delivery to site* • *Dust suppression* • *Reduce the construction period* • *The use of mobile batch plants and quarries in close proximity to the site* • *Staff and general trips should occur outside of peak traffic periods*		

10 ENVIRONMENTAL MANAGEMENT PROGRAM INPUTS

It is recommended that dust suppression and maintenance of gravel roads form part of the EMPr. This would be required during the Construction phase where an increase in vehicle trips can be expected. No traffic related mitigation measures are envisaged during the Operation phase due to the negligible traffic volume generated during this phase.

Table 10-1: EMPr Input – Construction Phase

Impact	**Mitigation/Management Objectives**	**Mitigation/Management Actions**	**Monitoring**		
			Methodology	***Frequency***	***Responsibility***
A. CONSTRUCTION PHASE					
A.1. TRAFFIC IMPACTS					
Dust and noise pollution Transportation of material, components, equipment and staff to site	Minimize impacts on road network.	▪ Stagger component delivery to site ▪ The use of mobile batch plants and quarries near the site would decrease the impact on the surrounding road network ▪ Dust suppression ▪ Reduce the construction period as far as possible ▪ Maintenance of gravel roads	▪ Regular monitoring of road surface quality. ▪ Apply for required permits prior to commencement of construction	▪ Before construction commences and regularly during construction phase.	▪ Holder of the EA

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		▪ Apply for abnormal load permits prior to commencement of delivery via abnormal loads ▪ Assess the preferred route and undertake a 'dry run' to test ▪ Staff and general trips should occur outside of peak traffic periods as far as possible. ▪ Any low hanging overhead lines (lower than 5.1m) e.g. Eskom and Telkom lines, along the proposed routes will have to be moved to accommodate the abnormal load vehicles, if required			

11 CONCLUSION AND RECOMMENDATIONS

As it had not been decided at the time of undertaking the transport study which manufacturers will be contracted for the solar PV components, all possible haulage routes were included into this study.

The potential transport related impacts for the construction and operation phases for the proposed Karroid PV Development were assessed.

- The construction phase traffic, although significant, will be temporary and impacts are considered to have a **low significance**.
- During operation, it is expected that staff and security will periodically visit the facility. Approximately 30 full-time employees will be stationed on site. The traffic generated during this phase will be minimal and will not have an impact on the surrounding road network.

The potential mitigation measures mentioned in the construction phase are:

- Dust suppression
- Component delivery to/ removal from the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
- The use of mobile batch plants and quarries near the site would decrease the impact on the surrounding road network.
- Staff and general trips should occur outside of peak traffic periods.
- A “dry run” of the preferred route.
- Design and maintenance of internal roads.
- If required, any low hanging overhead lines (lower than 5.1m) e.g. Eskom and Telkom lines, along the proposed routes will have to be moved to accommodate the abnormal load vehicles.

The construction and decommissioning phases of a development are the only significant traffic generators and therefore noise and dust pollution will be higher during these phases. The duration of the phases is short term, i.e. the impact of the traffic on the surrounding road network is temporary and solar energy facilities, when operational, do not add any significant traffic to the road network.

Access point 1 deemed the preferred access route as it allows direct access to the proposed site and does not require additional structures to be constructed.

The development is supported from a transport perspective provided that the recommendations and mitigations contained in this report are adhered to.

The impacts associated with Karroid PV Development are acceptable with the implementation of the recommended mitigation measures and can therefore be authorised.

12 REFERENCES

- Google Earth Pro
- SANS 10280/NRS 041-1:2008 - Overhead Power Lines for Conditions Prevailing in South Africa
- Road Safety Act (Act No. 93 of 1996)
- The Technical Recommendations for Highways (TRH 11): “Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads

Annexure A - ASSESSMENT METHODOLOGY

ASSESSMENT METHODOLOGY

Impacts were assessed in term of the following Assessment Criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.

- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):

- The **duration**, wherein it will be indicated whether:
    - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
    - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
    - medium-term (5–15 years) – assigned a score of 3;
    - long term (> 15 years) - assigned a score of 4; or
    - permanent - assigned a score of 5;

- The **consequences (magnitude)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).

- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high. The **significance** is calculated by combining the criteria in the following formula:

$$S=(E+D+M)*P$$

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

- the status, which will be described as either positive, negative or neutral.

- the degree to which the impact can be reversed.

- the degree to which the impact may cause irreplaceable loss of resources.

- the degree to which the impact can be mitigated.