ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE CONSTRUCTION, OPERATION AND DECOMMISSIONING OF A PHOTOVOLTAIC POWER GENERATION FACILITY, DE AAR

PREPARED FOR:

Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd

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ENVIRONMENTAL MANAGEMENT PROGRAMME

DJ ENVIRONMENTAL CONSULTANTS REPORT #10134

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TABLE OF CONTENTS

List of Appendices

GLOSSARY

Agricultural zoning*: Means the property is zoned for agricultural use irrespective of whether it has actually been used for farming practices*

Applicant*: A person who has submitted or intends to submit an application*

Biodiversity*: The variety of organisms considered at all levels, from genetic variants belonging to the same species through species, genera, families to higher taxonomic echelons. Also includes the variety of natural communities and ecosystems*

Carbon Footprint: *a measure of the amount of carbon dioxide produced by a person, organization, or location at a given time, measured in units of carbon dioxide.*

Ecological Footprint: *A measure of human demand on the Earth's ecosystems i.e. the amount of biologically productive land and sea area needed to regenerate the resources a human population consumes and to absorb and render harmless the corresponding waste.*

Endemic*: Restricted to a given region; usually used to denote a species, genus or family which is confined to a specific area.*

Environment*: The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects*

Environmental Consultant*: Means the independent consultant who has expertise in the area of environmental concern being dealt with in the specific application and who must on behalf of the applicant, comply with the requirements of the EIA regulations (GN No R1183 of 5 September 1997, as amended) and who must have no financial or other interest in the undertaking of the proposed activity, except with regard to the compliance with these regulations*

Environmental Impact Assessment*: A study of the environmental consequences of a proposed course of action.*

Ephemeral*: An organism that has a short life cycle*

Evaluation: *The process that "uses the information from monitoring to analyse the process, programmes and projects to determine if there are opportunities for changes to the strategy, programmes and projects. Evaluation, like monitoring, should promote learning. In the implementation stage of a LED strategy, evaluation is used to determine if the actions are meeting the strategic objectives, efficiently, effectively and/or at all."*

Footprint*: Means the total surface area of the proposed project/development*

Geo-hydrology*: The study of groundwater*

***Heritage Resources**: Historically important features such as graves, trees and the fossil beds and culturally significant symbols, spaces and landscapes, archaeological, palaeontological and cultural materials*

***Hydrology:** The study of rivers, lakes and wetlands*

***Listed Activity**: Means any activity as identified by the Minister of Environmental Affairs and Tourism has in terms of sections 24 and 24D of the National Environmental Management Act (Act No. 107of 1998), as amended, listed under GNR 386 and 387*

***Projects:** A set of ideas, aims or activities that serve to implement specific program components. They must be prioritised and all costs must be established. They are time bound and measurable.*

***Public Participation Process**: A process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to, specific matters*

***Red Data Species**: Species of plants and animals that because of their rarity and/or level of endemism are listed in a Red Data Book which provides an indication of their threat of extinction and recommendations for their protection*

***Scoping Report**: A written report describing the issues identified to date for inclusion in an EIA*

***Scoping**: A procedure to consult with Interested and Affected Parties to determine issues and concerns and for determining the extent of and approach to an EIA, used to the focus the EIA*

***Stakeholders:** Interested, affected and influential individuals, organisations, governments or agencies with stakes in, or influence on, the planning outcome.*

***Visual Absorption Capacity**: The potential for the area to conceal an object or proposed development*

***Visual Impact Assessment**: A study of the visual consequences of a proposed development or course of action.*

ABBREVIATIONS

EMP	**:**	Environmental Management Programme
CLO	**:**	Community Liaison Officer
DJEC	**:**	DJ Environmental Consultants
ECO	**:**	Environmental Control Officer
RE	:	Resident Engineer
DEA	:	Department of Environmental Affairs

ENVIRONMENTAL MANAGEMENT PROGRAMME FOR A PROPOSED 10 MW PHOTOVOLTAIC POWER GENERATION FACILITY, DE AAR

1 INTRODUCTION

1.1 Background

General

DJ Environmental Consultants (DJEC) have been appointed by Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd to ensure compliance with the National Environmental Management Act (107 0f 1998), as amended, Impact Regulations and Procedures as outlined by the Department of Environmental Affairs (DEA).

Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd has identified PV power generation potential in the mountain ranges of the Northern Cape, within the Emthanjeni Local Municipality, northwest of the town of De Aar. The proposed site that has been evaluated consists of a single property on which a total of 10MW of electricity will be generated. In addition to the power plant, associated infrastructure such as a road, electricity distribution lines, a control room and temporary waste storage facilities may be required. The relevant property has been rezoned as Special Zone (Renewable Energy Generation) and development will consist of a 344m X 500m array of photovoltaic (PV) panels located in the Southern part of the 1,102.49 hectare farm.

The listed activities that triggered the Scoping and EIA process as required by the NEMA according to GN 386 and GN 387 included:

Listed activities triggered by development

Government Notice R386 Activity No(s):	Activity Description
12	The transformation or removal of indigenous vegetation of 3ha or more or of any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act No 10 of 2004). (A precautionary approach has been adopted , the verification of this listed activity is not yet confirmed)
15	The construction of a road that is wider than 4m or that has a reserve wider than 6m, excluding roads that fall within the ambit of another listed activity or which are access roads of less than 30m long.

16(b)	The transformation of undeveloped, vacant or derelict land to residential mixed, retail, commercial, industrial or institutional use where such development does not constitute infill and where the total area to be transformed is bigger than 1ha.
Government Notice R387 Activity No(s):	**Activity Description**
1(a)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the generation of electricity where (i) the electricity output is 20 megawatts or more; or (ii) The elements of the facility cover a combined area in excess of 1 ha.
1 (l):	The construction of facilities or infrastructure, including associated structures or infrastructure for the transmission and distribution of above ground electricity with a capacity of 120kv or more.
2	Any development activity, including associated structures and infrastructure, where the total area of the developed area is, or is intended to be, 20 hectares or more.

The proposed development is also in compliance with the recently approved government regulations, Government Notice No. R.543 of 2 August 2010, under the National Environmental Management Amendment Act, 2008 (Act No. 62 of 2008) (NEMAA).

The listed activities that triggered the Scoping and EIA process under the NEMA are listed in Listing Notices 1 and 3 published in Government Notices No. R.544 and R.546 respectively. The NEMAA listed activities triggered by the proposed development are shown in the table below.

Activities triggered by the proposed development under NEMA

Government Notice R.544 (Listing Notice 1) Activity No(s):	**Activity Description**
1	The construction of facilities or infrastructure for the generation of electricity where: (ii) the output is 10 megawatts or less but the total extent of the facility covers an area in excess of 1 hectare.
10	The construction of facilities or infrastructure for the transmission and distribution of electricity – (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts;
23	The transformation of undeveloped, vacant or derelict land to – (ii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total

	area to be transformed is bigger than 1 hectare but less than 20 hectares;
Government Notice R.546 (Listing Notice 3) Activity No(s):	**Activity Description**
14	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetation cover constitutes indigenous vegetation (a) **In eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape provinces**: i. All areas outside urban areas.

The Environmental Management Programme is drafted as part of the Scoping and EIA process as undertaken for the De Aar Solar Generation Facility. This document should therefore be read in conjunction with the final EIA Report (December 2010) as submitted and approved by the Department of Environmental Affairs in order to contextualise the EMP.

1.2 Project description

1.2.1 Physical development

Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd has identified PV power generation potential in the arid Karoo and mountain ranges of the most Southerly part of the Northern Cape Province, within the Emthanjeni Local Municipality. The town of De Aar lies on the N10, linking Port Elizabeth on the south coast of the Eastern Cape, crossing the N1, with Upington in the North. The town is also linked North-South by the R48 which goes North and East to Phillips Town and South via the R348 to Richmond on the N1. The proposed site that has been evaluated and consists of a single property, farm no. 145/2 (Northwest site). Development on the preferred site will consist of a 344m x 500m array located in the Southern part of the 1,102.49 hectare farm.

The solar PV plant components are shown in the Photo 1 below:

Photo 1: Illustration of photovoltaic panels

Provided by Yingli Solar. Source Arcus Gibb In Viridian Consulting (pty) Ltd (2010).Basic assessment Report. Installation and operation of photovoltaic power generation facility, De Aar, Northern Cape

The Photovoltaic (PV) components will be delivered to the site in standard shipping containers by trucks. To provide access to the site, existing gravel roads will be upgraded and will have a minimum width of 4 metres. New gravel roads will be constructed at the PV sites.

Erection of Photovoltaic Panels:

Due to the characteristics of the solar resource profile of the specific site, PV panels need to be placed exactly at the right location and orientation, in order to utilize the energy potential of the solar resource that is available. The Panels will be placed on the steel mountings at an angle by hand.

Foundation and materials:

Foundations will need to be excavated for the PV panels and for this; a 10 ton excavator will be used. The foundations will be 1m deep, 1m wide and 6m long per panel array (see Photo 2 below). 30MPa concrete and reinforcing steel will also be used in the foundation.

Photo 2 *Illustration* ***of foundations to be used per panel area with steel mounting brackets erected on them.***

The steel mounting brackets hold the PV panels above ground and at an angle.

Construction equipment and timing:

The only heavy duty construction equipment that will be present on site is a 10 ton excavator (see illustration in Photo 3). The area required for construction will be 1.7 hectares per MW of installed PV panels, giving a total of approximately 17ha for the 10MW facility. All excavated material will be for road works and no material will be stored on site.

Photo 3: ***Illustration of a Kato 10ton excavator***

Source: Google images

Construction Camp

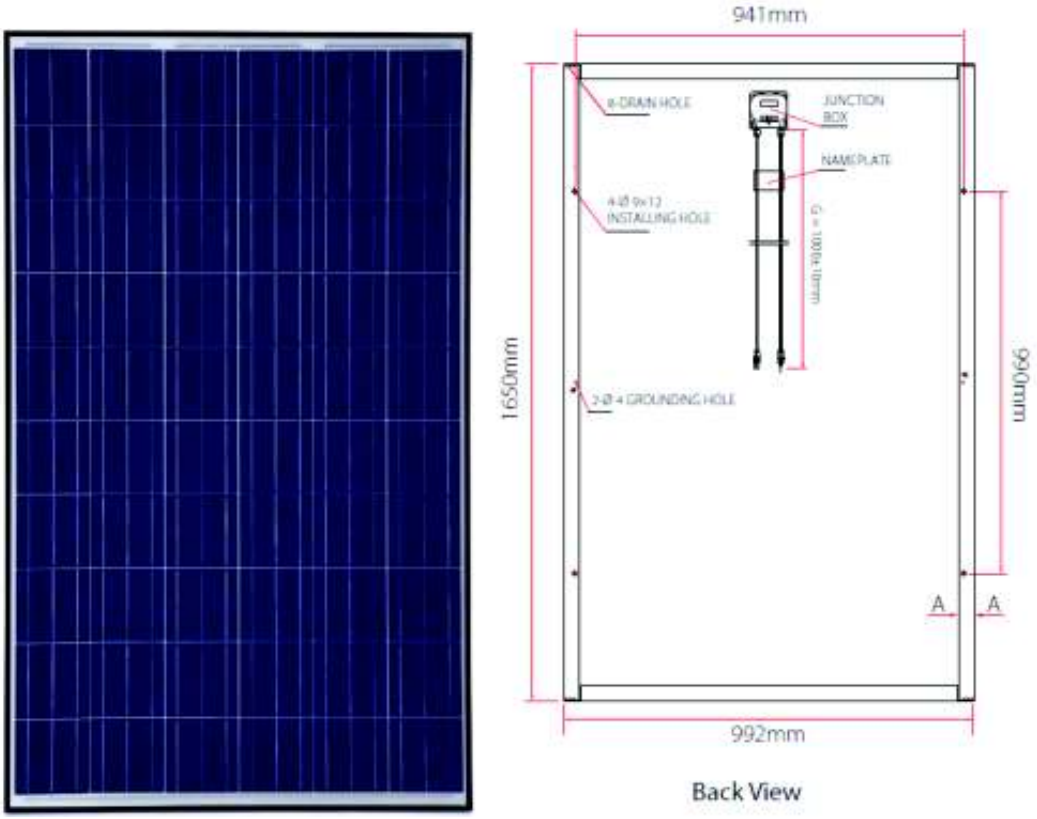
A construction camp will be established on site. The construction camp will take up an area of 2000 square meters and will mostly be used as a storage area for the PV panels and machinery which will be used during the construction phase of the project. The construction

period is expected to last twelve months, of which one month will consist of laying the foundation, and the remainder of the time will be spent connecting the PV panels to the steel mounting brackets and completing the connection to the electrical grid.

PV Panel Main dimensions:

The PV panels to be used will be TSM-PC05.08 230Wp Trina Solar panels, with dimensions of 1650mm by 990mm. A picture showing the type of panels to be used is shown in Photo 4 below.

Photo 4: ***Illustration of the individual PV Panels to be used***



The PV panels are expected to generate power according to the basics of solar electric operational concept. Under this concept, electricity can be produced from sunlight through a process called photovoltaic (PV). "Photo" refers to light and "voltaic" to voltage. The term describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun. Solar cells are made of semi-conducting material, most commonly silicon, coated with special additives. When light strikes the cell, electrons are knocked loose from the silicon atoms and flow in a built-in circuit, producing electricity. If a load is connected under these conditions, an electrical current will result, which is capable of doing work. The current produced is proportional to the amount of light absorbed by the device. In a solar cell, the photovoltaic effect is manifested as the generation of voltage at its terminals while being struck by the suns rays.

A thin silicon cell, four inches across, can approximately produce more than one watt of direct current (DC) electrical power in full sun. Individual solar cells can be connected in series and parallel to obtain desired voltages and currents. These groups of cells are packaged into standard modules that protect the cells from the environment while providing useful voltages and currents. PV modules are extremely reliable since they are solid state and there are no moving parts.

Silicon PV cells manufactured today can provide thirty or more years of useful service life. Some manufacturers provide warranties of up to 25 years on their PV product (at 80 percent of original power rating). For example, a 100 Wp PV module in full direct sunlight (1,000 W/m2) operating at 25°C will generate 100 Watts per hour (referred to as a Watt-hour–[Wh] at rated conditions. Modules can be connected together in series and/or parallel in an array to provide required voltages and currents for a particular application.

1.2.2 Proposed service infrastructure

The proposed development will require the construction of a gravel access road 1300m long and with a minimum width of 4m, a control building and also a 2m high perimeter fencing to be erected at a distance of 6m from the installation. However, the PV facility will operate automatically only requiring inspections at fixed intervals by a single technical engineer. Remote monitoring will therefore be used to monitor the PV facility.

The De Aar substation has two different voltage levels namely 132 kV and 22 kV. De Aar 132 kV substation is connected to Hydra 132 kV via a single line. There is one 22/132 kV transformer installed at De Aar rated at 20 MV·A. The De Aar PV power plant will be directly connected to the De Aar substation via a 22 kV line onto the De Aar substation 22 kV busbar.

The scope of work required to enable this connection will involve the following:

- construction of 1 x 2.5 km, 22 kV line from De Aar PV power plant to De Aar substation;
- installation of 1 x 22 kV line bat and the De Aar PV power plant substation.

The scope of work at the Eskom De Aar Substation will involve:

- extension of the 22kV busbar;
- installation of 1 x 22 kV bus section bay;
- installation of 1 x 22 kV line bay.

Control Centre

A single story building will be built and will be used as the control centre. The control building will house the onsite monitoring equipment, maintenance and control offices. It is expected

that the structure will be a single storey building which will take up an area of 6 x 10m on the ground. The control building will be housed next to the PV panels.

Connection Centre

A single story building will be built and will be used as the connection centre. The connetion centre will house the main switch gear, auxiliary supply and metering equipment. It is expected that the structure will be a single storey building which will take up an area of 5.5 x 2.5m on the ground. The control building will be housed next to the PV panels.

1.2.3 Transport of the PV components

De Aar is well placed to be served by road and rail transport from Port Elizabeth, Cape Town and Saldanha Bay. Materials to be imported will be shipped to the Cape Town Harbour and then transported by road over a distance of ±820km to the site.

A **Traffic Impact Statement Study** has been commissioned and the following is recommended:

i) Temporary high visibility advanced warning signs Types W107 and W108 (Intersection Ahead) are erected on the R48 in both directions approaching the position of the access to the facility during construction and that permanent high visibility advance warning signs Types W107 and W108 (Intersection Ahead) are erected on the R48 once construction is completed and the facility is fully operational.

ii) The Northern Cape Department of Transport, Roads and Public Works be requested to repair the potholes for the section between the N10 and the access to the site prior to construction commencing.

iii) During construction and as part of the contract, the contractor is to be required to monitor the condition of the R48 and repair the road where it becomes damaged due to construction traffic.

iv) Whilst theoretically there is no potential for reflections from the panels and infrastructure to affect passing motorists on the R48, the reflections from the arrays are to be monitored from the first installation to confirm this.

No other remedial or mitigation measures will be required to accommodate the additional traffic generated by the proposed photovoltaic power generation facility.

Figure 1.1 shows the AM Peak Hour, PM Peak Hour and Daily Traffic Generated by the Proposed Mulilo Power Generation Facility. Find attached under Appendix 7 the Traffic Impact Statement as prepared by Aurecon (Pty) Ltd.

Figure 1.1: ***AM Peak Hour, PM Peak Hour and Daily Traffic***

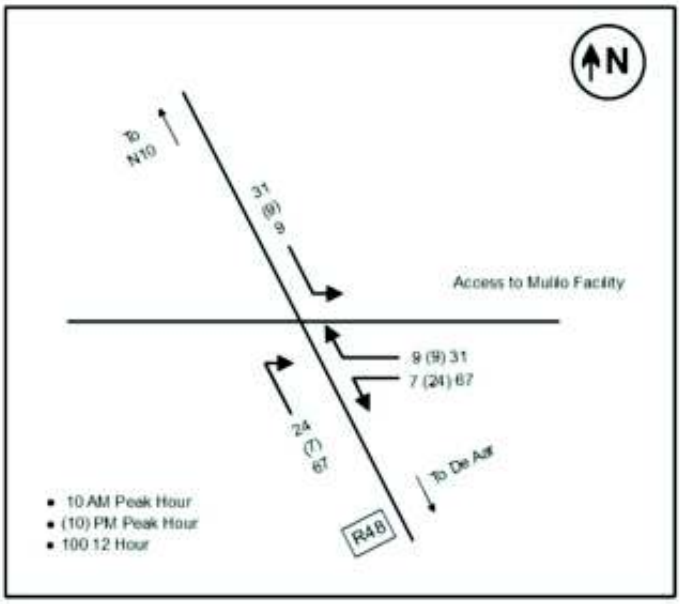


Figure 1.2 shows the location of De Aar in relation to Cape Town Harbour.

Figure 1.2: ***Port Entrance on West Coast of South Africa***

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Figure 1.3: Proposed Position of10MW Facility

1.3 The Environmental Management Programme

The Environmental Management Programme ("EMP") is as a tool which can be used to minimise or prevent the impacts of the proposed development on the immediate and surrounding environment, during construction, operation and decommissioning and to enhance the positive benefits of the project. Potential impacts may include such aspects as noise, dust, pollution, litter, impacts on flora and fauna, traffic, safety, soil stabilisation and re-vegetation.

A number of specific management recommendations have been made in this document; however these should be used as a guide only. It should be noted that other types of impacts are possible and that these should be identified during the activities at the site. The EMP is a dynamic document that is updated with the availability of additional information. Additional mitigatory measures and procedures may be required, and these should be included on an ad hoc basis to improve the overall document.

It is recommended that a copy of the environmental authorisation from the Department of Environmental Affairs, and the EMP be included in the contract document during tender negotiations for the project. The contents of this documentation should be made known to all parties involved at the site and a copy of the EMP should be available on site at all times.

The broad objectives of the EMP are to ensure that:

- all environmental safeguards are carried out correctly
- site activities are well-managed
- adverse impacts on the environment are minimised
- the biodiversity of the site is conserved or enhanced
- all relevant legislation is complied with, and
- the project is monitored for possible environmental impacts.

Site description

The vast and arid Northern Cape is by far the largest province taking up nearly a third of South Africa's land area. The main geographic features defining the locality, in which this development site is situated, are the wide, almost flat to undulating open spaces, big skies and sparse settlements.

Emerging from the plain are conical and ridge shaped hills and larger flatter plateauxwhich are intrusions of dolerite rock, and form the only vertical relief. The hills are about100m above the plain, and the plateaux are about 250m above the plain.

There are two perennial rivers locally, the Elandsfontein running south to north, and passing De Aar to the west, and the Brak which runs from the east to the west and passes De Aar to the north. The Brak lies on the north boundary of the north west option. Both sites are crossed by seasonal water flows; in the south east site the flows are captured in depressions, in the north west site, the flow is into the Brak

Figure 1.3: Locality Map

2. COMMUNICATION PROCEDURES

2.1 ENVIRONMENTAL CONTROL OFFICER

An Environmental Control Officer (ECO) will be appointed and remunerated by the Employer prior to commencement of operations to ensure that the EMP is being adhered to. Should modifications to this document be required these should be agreed to by all parties concerned, namely the engineer, the contractor and the ECO.

2.2 DUTIES OF THE ECO

Duties of the ECO are listed in Appendix 2. The engineer must be recognised as the senior authority on site and all communications and instructions between the ECO and the contractor should occur via the engineer.

2.3 PROBLEMATIC ISSUES

Should problematic issues arise, the ECO has the authority to call a special meeting with the Engineer, and if necessary work can be stopped if no agreement is reached to resolve the matter.

2.4 ENVIRONMENTAL REGISTER

An environmental register (can be recorded in the site instruction book) should be kept on site in which incidents related to actual impacts are recorded. This may include information related to such aspects as mismanaged, rescue programme for extant vegetation on the site, dust generation and complaints from adjacent neighbours. It should also contain information relating to actions taken. Any party on site may complete the register, however, it is envisaged that the engineer, the contractor and the ECO will be the main contributors, and who will also be the main parties involved in mitigatory actions.

2.5 METHOD STATEMENTS

These will be required for activities which may result in significant impacts/nuisance effects. One of the underlying principles of a method statement is to ensure sustainable natural resource management. The Contractor shall provide Method Statements for approval by the ECO and the Engineer prior to work commencing on aspects of the project deemed or identified to be of greater risk to the environment and/or which may not be covered in sufficient detail in the EMP, when called upon to do so by the Engineer or ECO.

Method statements are written submissions by the Contractor in response to requirements of this EMP or to a request by the ECO. This is submitted to the ECO and Engineer and, where practical and deemed necessary, should be endorsed as being acceptable by the environmental representative of the Relevant Authority.

Method statements must be submitted at least five (5) days prior to the date on which approval is required (start of the activity). Failure to submit a method statement may result in suspension of the activity concerned until such time as 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.

The method statements shall cover relevant details with regard to:

- Construction procedures and location of the construction site.
- Start date and duration of the procedure.
- Materials, equipment and labour to be used.
- How materials, equipment and labour would be moved to and from the site as well as on site during construction.
- Storage, removal and subsequent handling of all materials, excess materials and waste materials of the procedure.
- Sustainable management and use of natural resources.
- Emergency procedures in case of any reasonably potential accident / incident which could occur during the procedure.
- Compliance / non-compliance with the EMP specification and motivation if non-compliant.

Method statements required:

Based on the specifications in this EMP, the following method statements are required as a minimum:

- Site clearing
- Site layout and establishment

- Hazardous substances
- Cement and concrete batching
- Traffic accommodation
- Erosion remediation and stabilisation
- Fire control and emergency procedures
- Vegetation rehabilitation plan
- Sustainable management and the use of natural resources

2.6 ENVIRONMENTAL EDUCATION PROGRAMME

The Contractor shall ensure that adequate environmental awareness training of senior site personnel takes place and that all construction workers receive an induction course on the importance and implications of the EMP.

As a minimum, training should include:

- Explanation of the importance of complying with the EMP.
- Discussion of the potential environmental impacts of construction activities.
- The benefits of improved personal performance.
- Employees' roles and responsibilities, including emergency preparedness.
- Explanation of the mitigation measures that must be implemented when carrying out their activities.
- Explanation of the specifics of this EMP and its specifications (no-go areas, etc.)
- Explanation of the management structure of individuals responsible for matters pertaining to the EMP.

Contractor general site staff members are to attend an initial presentation of approximately one hour. Approximately half an hour a month thereafter for the duration of the contract shall be allowed for employees to attend any follow-up lectures, should such follow-up lectures be deemed necessary by the ECO. In addition, all new staff and sub-contractor's employees that spend more than one day a week or four days in a month on site are to attend the environmental education program within 1 (one) week of commencement of work. The Contractor shall supply the ECO with a monthly report indicating the number of employees that will be present on site during the following month and any changes in this number that may occur during the month.

No more than 20 people shall attend each course and the cost, venue and logistics for this / these course(s) shall be the Contractor's responsibility. This is also to allow for the cost of environmental signage the ECO may require to be erected in the main contractor's construction camp and any handouts given to site staff during initial environmental awareness training presentations. The ECO shall keep a register of all personnel attending the Environmental Education Program.

The contractor shall keep records of all environmental training sessions, including names, dates and the information presented.

2.7 LEGISLATIVE FRAMEWORK

Obligations imposed by the EMP are legally binding in terms of conditions of local authority approvals for this development and in terms of amendments to the Particular Conditions of Contract that pertain to this project.

The requirements of this EMP do not release the Developer from the requirements of any legislation that may be applicable to the project. Further to this, Appendix 2 contains a list with links of some but not necessarily all South African policy, Legislation and Guidelines applicable to the project, of which the Developer and design team should take cognisance.

2.8 OCCUPATIONAL HEALTH AND SAFETY REQUIREMENTS

The Occupational Health and Safety Act (Act 85 of 1993) and in particular the requirements of the Construction Regulations must be complied with.

2.9 DISPUTE RESOLUTION

Any disputes or disagreements between the Contractor and the Engineer or Principal Agent for building works shall be resolved as per the relevant dispute resolution Sections contained within the General Conditions of Contract (civil works) and Joint Building Contract Committee (building works) contract documentation respectively.

Where any disputes or disagreements arise between the Engineer or Principal Agent and the ECO, specifically with regard to environmental management on Site and which cannot be resolved, then the matter will be referred to the environmental management department of the local municipal authority for clarification and their decision will be binding on all parties.

2.10 CONTRACTUAL CONFLICTS

In the event of any conflict occurring between the provisions of the EMP and the project specifications contained within other project documentation, the terms herein shall be secondary.

2.11 COMMUNITY RELATIONS

The Developer shall be responsible for responding to third party or public queries and/or complaints relating to operations. In addition, the Developer shall be responsible for dissemination of information to the community and the media (press releases, notice boards, etc).

The Contractor shall notify the ECO and the Engineer of any complaints lodged. The Contractor shall be responsible for maintaining a Complaints Register to record complaints received and action taken. This register will be made available to the Developer, ECO, the Engineer and the relevant authority.

2.12 SOCIAL RESPONSIBILITIES

The Developer and Contractors shall encourage and implement wherever possible the procurement of locally based labour, skills and materials.

3. ENVIRONMENTAL SENSITIVITY AND MITIGATORY MEASURES

A variety of potential impacts are associated with the construction activities for this project.

Table 1: The construction activities and their potential impacts

Activities	Potential Impacts	EMP Approach
The use of heavy machinery and equipments	• Generate high noise levels and create dust problems and nuisance; • cause erosion due the damage creating to natural terraces • compact soil and changing surface water flows • contaminate water and soil as a result of oils spills and machinery fluids	Refer to Section 5.2 and Section 9

	dumping • damage wild life habitats	
Materials extraction	• cause erosion	Refer to Section 6
Hazardous substances	• damage valuable ecosystems and habitats	Refer to Section 6
Clearing and levelling	• destroy ecosystems and habitats • Produce areas of bare soil which cause erosion.	Refer to Section 5.4, 5.8 and 5.12
Excavation	• Cause erosion when excavated soil is piled inappropriately.	Refer to Section 5.8
Filling	• Destroy valuable ecosystems • May cause risk of landslide in future	Refer to Section 5.4, 5.12 and 5.13
Cut and fill	• cause soil erosion • alter hydrology and degrade water quality • damage ecosystems and habitats	Refer to Section
Disturbance of drainage	• Altered drainage regimes potentially influencing groundwater and the recharge volume	Refer to Section 5.16 and section 8

Specific management recommendations

The following recommendations have been made by the specialists involved.

Table 2: Mitigatory measures to be implemented as proposed by the various specialist consultants

IMPACT	MITIGATION
Archaeology	• Although the AIA (Archaeology Impact Assessment) calls for mitigation in the form of recording and collecting of artefacts, the author explicitly states that the artefacts have shifted considerably both vertically and horizontally and that there is no potential for *in situ* material or deposit and no possiblity of dating the site. The archaeologist concludes that the site is of low significance and of no research potential.

	• SAHRA considers mitigation unnecessary and thus will not be required pre construction. Please refer to Appendix 10 for SAHRA Final Comment.
Botany	• Habitat destruction must be kept to absolute minimum by keeping the lay-down areas as small as possible, reducing the number and size/length or roads and reducing the final extent of the developed area. • No excavations may be left open for more than 1 week, and they should preferably be closed up within 1 day, using the carefully stockpiled soil that came out of the trench. • No dumping or temporary storage of any materials may take place outside designated and demarcated laydown areas. • Alien vegetation management must be undertaken in the 2.5km long powerline servitude and along the edges of all on-site infrastructures on an annual basis. • An alien removal program must be implemented to remove alien vegetation from within the no-go area and should run concurrently with construction activities. Cleared alien vegetation must not be dumped on adjacent intact vegetation during clearing but should be temporarily stored in a demarcated area. • Removal of alien invasive species or other vegetation must be in accordance with the Conservation of Agricultural Resources Act (Act No.43 of 1983). • A habitat rehabilitation plan must be developed for the site. • Vegetation clearing must be kept to a minimum. Mitigation measures to reduce risk of erosion and the invasion of alien species to be applied. • Applicant to inform the provincial department and/or the DEA should the removal of protected species, medicinal plants and “data deficient” plant species be required. • No disturbance may occur within 30m of any wetland features, pans, drainage lines and dams without obtaining a WULA from the DWA.
Avian	i. Bird monitoring to be undertaken 6 months prior to commencement of construction activities by a qualified avifaunal specialist. ii. Analyse pre-construction monitoring data and integrate findings into EMP. iii. Minimizing the inclusive construction footprint of the development and abbreviating construction time. iv. Minimising the length of any new power lines installed, ensuring that

	all new lines are marked with bird flight diverters (Jenkins et al. 2010) along their entire length, and that all new power line infrastructure is adequately insulated and bird friendly in configuration (Lehman et al. 2007). v. Ensure construction EMP is applied.
Visual	i) There will be a visual impact of increased traffic movements for the duration of the construction period. Mitigation of these issues can be offered by keeping the contract time to the minimum, and by ensuring that road junctions have good sightlines, traffic control measures when needed, and signage. Good traffic management and keeping local people informed. ii) Upgrading of road junctions and rehabilitate after works. iii) Return ground to original state. iv) Built forms should not be greater in height than overall installation; use of local materials to blend in. v) Careful consideration to be given to the visual implications of any construction camp. North West Option: the camp will be at its most unobtrusive on the west side of the site where there will be screening from the higher ground. <u>Dust generation, movement of machinery and vehicles</u>: Access roads to be kept clean and storage of materials to be screened. Storage of builders' rubble to be controlled. <u>Fires and litter</u>: All site operatives to receive training in awareness of these issues. In addition, no fires to be allowed, littering to be regarded as a serious offence and no contaminants to be allowed to enter the environment by any means. <u>New roads into the site</u> Roadways should be low key in appearance; gravel is the most appropriate surface material. <u>Solar plant</u> The visual impact of the facility must be mitigated by planting a vegetation screen in close proximity to the receptor similar in form and density to the natural vegetation of the receiving environment.

	Light Pollution Night lighting of the construction site must be minimised with requirements of safety and efficiency.
Palaeontology	i. Should substantial fossil remains be exposed during construction, the ECO should alert SAHRA so that appropriate action (*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist.
Traffic	i) Existing road infrastructure must be used as far a possible for providing access to the proposed site. Where no road infrastructure exists, new roads should be placed within existing disturbed areas and environmental conditions must be taken into account to ensure that minimum damage is caused to natural habitats. ii) Temporary high visibility advanced warning signs Types W107 and W108 (Intersection Ahead) to be erected on the R48 in both directions approaching the position of the access to the facility during construction and that permanent high visibility advance warning signs Types W107 and W108 (Intersection Ahead) to be erected on the R48 once construction is completed and the facility is fully operational. iii) The Northern Cape Department of Transport, Roads and Public Works be requested to repair the potholes for the section between the N10 and the access to the site prior to construction commencing. iv) During construction and as part of the contract, the contractor is to be required to monitor the condition of the R48 and repair the road where it becomes damaged due to construction traffic. v) Whilst theoretically there is no potential for reflections from the panels and infrastructure to affect passing motorists on the R48, the reflections from the arrays are to be monitored from the first installation to confirm this. vi) Signs must be placed along construction roads to identify speed limits, travel restrictions and other standard traffic control information. To minimise impacts on local commuters, consideration should be given to limiting construction vehicles travelling on public roadways during morning and late afternoon commute time. See Appendix 7 for the detailed **Traffic Impact Statement**
Stormwater	Solar facility – internal drainage i) Cross drainage in the form of v-drains should be provided to intercept

	overland flow and to direct this to the spines. The cross drainage will also assist with erosion control. These v-drains can take the form of road side drains and must be lower than the surrounding area to intercept flows. The channels can be compacted earth channels but will require maintenance on a regular basis and after each rainfall event due to possible scouring. ii) The construction of a concrete lined system (more expensive) is advised for use. The channels must be at least 300 mm deep, v-shaped, with a left side slope of 1:1 and right side slope of 1:3 when looking in the downstream direction. iii) It is recommended that the surfaces around plinths be compacted well graded gravel with a 38mm gravel capping layer. Erosion protection in the form of packed stones with average diameters of 200 mm is required at the drain outfalls from the solar facility for a distance of no less than 12 m. Alternatively two gabion mattresses, 6.0 m long x 2 m wide x 0.3 m thick can be installed at the outfalls <u>Solar facility – external drainage</u> i) Bypass channels and earth berms must be provided along the outside boundaries (western, eastern, and southern sides) to intercept and direct overland flow away from the site as well as decrease soil erosion. These berms must be at least 0.6 m in height to prevent possible overtopping. The berms could be planted with indigenous grasses to further resist erosion. ii) It should be noted that while a single (maximum) height is detailed above, the height of the berms could be made to vary (commencing lower increasing to the maximum height) in the direction of flow. Refer to the **Stormwater Management Plan** (Appendix 9) for the specifications of the berms. Provision will have to be made for access roads across crossing the berms. <u>Erosion Abatement for Construction Period</u> To minimize the potential for impairment of the quality of receiving waters during construction the following measures should be taken, both as erosion prevention and control measure: i) Straw barriers should be installed in drainage paths to intercept suspended solids carried by overland flow. These are erosion barriers placed at intervals of 25-50 m apart in the drainage paths which will intercept suspended solids from entering the natural drainage paths. ii) Packed stone (also known as rip-rap) must be placed as liners for channel spines. These comprise packed stones with an average

	diameter of 100 mm, packed in the channels as lining material to control flow velocities and hence erosion. iii) Earth cut-off berms at boundaries of the facility. These will assist in directing flow away from the site and reduce the possibility of flooding from runoff origination from outside the site. iv) Provide erosion protection at channel outfalls and positions of high flow concentration. These comprise packed stones with an average diameter of 200 mm, packed in the drainage path to control flow velocities and hence erosion.

4. PRE CONSTRUCTION

4.1 Site boundaries - the site boundaries within which the contractor may operate should be agreed to prior to the start of the site operations. The contractor should fence or demarcate these at the very start of the project. Specific areas should be set aside within this area for various types of activity ranging from materials storage to chemical toilet facilities. Access to risk areas such as the hazardous substances store (oils, fuels etc.) should be restricted.

4.2 No-go areas - any particularly sensitive areas should be demarcated as “no-go” or restricted access areas. These areas should be delineated on plan and on the site with pegs or fencing and which are out of bounds to unauthorised persons. Authorisation must be obtained prior to entry.

4.3 Site Layout - The location of the contractor’s camp, toilet facilities and storage areas should be agreed to prior to the commencement of work at the site and should be agreed in conjunction with the ECO, Engineer and Contractor. These should all be kept in good condition throughout the project to prevent environmental degradation.

4.4 Site Clearance

(a) Vegetation clearance

Plant material removed from the site, including the existing covering of grasses, conservation worthy vegetation and alien invasive vegetation, is not to be dumped anywhere other than an approved waste disposal site.

Plant material removed from the site is not to be burnt on site unless a burning permit has been obtained from the Department of Environment.

(b) Topsoil

Topsoil / top material that is stripped from the site during the earthworks operation shall be retained for future rehabilitation/landscaping use, where feasible. Top material should exclude litter, building rubble, alien plant material or any other waste. Topsoil shall be stored in areas demarcated by the ECO and Engineer and in piles not higher than 2 m.

The stockpiles shall not be compacted or disturbed, and shall be domed at the top to promote runoff. Should significant erosion (e.g. through rain or wind) of the stockpiled material occur, the stockpiles should be covered with shade cloth or Geotech fabrics or similarly suitable material to prevent such erosion.

4.5 Drinking Water - The Contractor shall ensure that drinking water is available for all staff on site. If no potable water source is available on site then the Contractor shall import drinking water to the site.

4.6 Eating Areas - If employees are to eat elsewhere on site other than in the campsite, the Contractor shall designate restricted places for eating within the specified working areas, in consultation with the ECO. The Contractor shall provide adequate refuse bins with lids in all these places.

4.7 Working Hours – The hours of operation shall be restricted to those stipulated by the Employer and/or the local authority.

5. CONSTRUCTION PHASE

5.1 ECO Visits - the ECO should visit the site twice weekly for the duration of the construction period. On the performance of the contractor, the frequency of the site visits may be altered. If required, the ECO may introduce some form of penalty system should compliance with the EMP prove problematic.

5.2 Appropriate Machinery - The contractor shall at all times carefully consider what machinery is appropriate to the task while minimising the extent of environmental damage. Areas where machinery and vehicles are stored and used must be bunded to prevent pollutants such as fuel and oil from spilling onto the soil.

5.3 Soil erosion and sedimentation control - The Contractor shall, as an ongoing exercise, implement erosion and sedimentation control measures to the satisfaction of the ECO and Engineer. During construction, the Contractor shall protect all areas susceptible to erosion by installing necessary temporary and permanent drainage works

as soon as possible and by taking any other measures necessary to prevent stormwater from concentrating in streams and scouring slopes, banks, etc.

Refer to the **Stormwater Management Plan** under Appendix 9.

Any runnels or erosion channels developed during the construction or maintenance period shall be backfilled and compacted and the areas restored to a proper condition. Stabilisation of cleared areas to prevent and control erosion and/or sedimentation shall be actively managed. The method of stabilisation shall be determined in consultation with the ECO.

Consideration and provision shall be made for the following methods (or combination thereof): brushcut packing or chip cover, straw stabilising, watering, planting/sodding, soil binders and anti-erosion compounds, mechanical cover or packing structures (including the use of geofabric, log/pole fencing, etc.).

Traffic and movement over stabilised areas shall be restricted and controlled, and damage to stabilised areas shall be repaired and maintained to the satisfaction of the ECO. In areas where construction activities have been completed and where no further disturbance would take place, rehabilitation and revegetation should commence as soon as possible.

5.5 **Fires** – no fires will be allowed outside the construction area and adequate fire fighting equipment according to the fire hazard must be available on site in good working order. Any welding and cutting activities will only be permitted inside the working areas.

5.6 **Fire fighting Equipment** - In order to define what fire fighting equipment is necessary at the site, it is recommended that the local fire department be contacted for advice in this area.

5.7 **Safety and First Aid –** all people working on site are responsible for their own safety and those of others on site. Contractors and Engineers shall comply with the relevant regulations including the Occupational Health and Safety Act (Act 85 of 1993). A comprehensive first aid kit and suitably trained personnel should be available on site at all times.

5.9 **Traffic disruption** – traffic and personnel using the road that provides access to the site shall not be disrupted and standard traffic management procedures will be implemented in these areas where necessary to maintain access at all times. In this regard it shall be

noted that the adjacent erven remains occupied by others and vehicular access to these areas shall be maintained at all times.

5.10 Fauna – Catching of wild animals (including reptiles, amphibians, birds and invertebrates, etc.) by any means, including setting of snares, poisoning, shooting and trapping is illegal. All incidents of harm to any animal must be reported to the ECO. The contractor is to report any problem animals (e.g. a snake that will not move off site on its own) to the ECO who will organise for their relocation.

5.11 Archaeology and Palaeontology –Should anything of an archaeological nature be found on site by the Contractor (or any other party), e.g. stone hand tools, remnants of old structures not previously visible, old ceramic shards etc, work is to be stopped in the area immediately, and the ECO / Engineer notified. Failure to notify the ECO of a find will result in a penalty. This aspect must be carefully explained to workers during the Environmental Education Programme undertaken by the ECO. The ECO will advise on demarcation of this area, and notify a relevant specialist to view material and ascertain whether further study of the area is required. Should a specialist confirm a genuine artefact or fossil and recommend further study of the area, work in the applicable area is to cease until further notice. Should any human remains be disturbed, exposed or uncovered during earthworks, these should immediately be reported to the ECO and a professional archaeologist.

5.12 Excavation and Trenching - During excavation and trenching activities, care is to be taken to ensure that the stockpiling of top material is kept separate from sub-soils. Top material saved is to be replaced as top material and is to serve as the final layer when back-filling. The Contractor shall reinstate all working areas to the satisfaction of the Engineer. Areas opened for trenching should be restricted to the minimum required to be worked in and closed up in a working day or as dictated by technical requirements such as length of pipe or cable. Trenches are to be closed as soon as possible after services have been laid in them, to prevent them from posing safety hazards to people, traffic and animals and to prevent rainwater erosion. Trenches shall be refilled to the same level as (or slightly higher to allow for settlement) the surrounding land surface to minimise erosion. No excavations may be left open for more than 1 week. Excess soil shall be stockpiled in an appropriate manner. In the event of material removed during trenching being excessive after backfilling or being unsuitable as overburden, the excess material must be removed from the construction site to a site agreed upon by the Engineer. Dewatering systems shall make use of filtered extraction points to prevent silt uptake and extracted water shall be released in such a manner as to avoid erosion on the site and prevent siltation or pollution of any stormwater system.

5.13 Protection of Natural Vegetation - The Contractor shall be responsible for informing all employees about the need to prevent any harmful effects on natural vegetation on or around the construction site as a result of their activities. Clearing of natural vegetation shall be kept to a minimum. The removal, damage and disturbance of natural vegetation without the written approval of the ECO are prohibited.

Before vegetation clearing takes place in any construction area, search and rescue and seed collection shall be undertaken.

The use of herbicides is prohibited unless approved by the ECO.

5.14 Protection of fauna – The Contractor shall ensure that no hunting, trapping, shooting, poisoning or otherwise disturbance of any fauna takes place. The feeding of any wild animals is prohibited. The use of pesticides is prohibited unless approved by the ECO. No domestic pets or livestock are permitted on site.

5.15 Air Emissions – Construction materials and stockpiled soils must be covered if they are a source of dust. Dust abatement techniques must be used before and during surface clearing, excavation or blasting activities.

6. MATERIALS MANAGEMENT

6.1 All potentially hazardous substances should be stored in a defined area (hazardous substances store), which is covered, has secondary containment and has restricted access. This area should be constructed in such a manner that any spillages can be contained within this area and to prevent entry into the underlying subsoil and groundwater. Fuel kept on site shall be contained in suitable tanks that shall be constructed within the required concrete/brick bunds.

Depending on the types of materials stored on site, suitable product recovery materials should be readily available. The location of the hazardous substances store should be agreed between the ECO, Engineer and Contractor prior to site establishment.

6.2 The contractor shall keep Material Safety Data Sheets on site for all potentially hazardous materials used. Suitably trained personnel shall be available on the site during working hours so that in the event of human exposure to any hazardous materials that the correct first aid actions are taken.

6.3 All material used by the contractor during the construction phase shall be managed in such a way that it does not cause pollution, or that minimises pollution. All building

materials should be stored away and the areas bunded appropriately such that there will be no runoff from these areas. All building materials must be removed after construction.

6.4 Concrete works – cement powder has a high alkalinity which can contaminate and dramatically affect soil, groundwater and surface water. The following recommendations are made:

- Mixing areas to be defined on site and carefully located.
- Cement contaminated water should be fed to a container, neutralised and suitably disposed of (to sewer if acceptable to the Municipality) or sent to a suitable landfill site. In the latter case, chain of custody documentation should be provided to ensure a suitable end recipient. The latter should be kept with the environmental register.
- If possible, the use of ready mix concrete should be considered.
- Cement bags should be suitably stored and the used bags disposed of via the solid waste stream.
- Excess or spilled concrete should be disposed of to a suitable landfill site, with chain of custody documentation provided.
- Cement is to be stored in a secure weatherproof location to avoid contamination of the environment.
- Suitable screening and containment shall be in place to prevent windblown contamination associated with bulk cement silos, loading and batching.

6.5 No materials containing invasive plant seeds, litter or contaminants may be imported to site. The Engineer shall be informed of the sites of origin of imported gravel, sand, stone etc. and shall have the authority to reject imported material if deemed necessary.

6.6 All imported materials (e.g. sand) must be stockpiled within the Contractor's camp or agreed demarcated area. Stockpile areas must be approved by the Engineer before any stockpiling commences. Material stockpiles must be protected against wind and water erosion (for prevention of dust, clogging of the stormwater system and other problems).

7. WASTE HANDLING: SOLID WASTE

7.1 Waste should be categorised by the contractor and disposed of in a suitable manner into different waste streams (including general and hazardous waste). Wherever possible recycling should be carried out. No dumping within the surrounding area is to be permitted. Where potentially hazardous substances are being disposed of, a chain of

custody document should be kept with the environmental register as proof of final disposal. General waste is to be collected either by the Municipality or via a waste disposal contractor. The frequency of collections will be such that waste containment receptacles do not overflow. Refer to the **Waste Management Plan** under Appendix 8.

7.2 The contractor should provide an adequate number of waste receptacles for general waste at points around the construction site, and a single collection point for hazardous waste. The contractor will be responsible for emptying these at regular intervals and for ensuring that the site is kept clean from litter. Particular care shall be taken with the disposal of materials that could be wind-borne or waterborne to ensure that the release of these materials is minimised (the latter is considered advisable for hazardous waste). The use of netting covers or sealed containers may be considered. Areas should be demarcated for specific activities including food consumption, with suitable waste receptacles provided.

7.3 Composting toilet facilities will be supplied and managed by the contractor, these are to be located in a specific area agreed to by the ECO prior to placement and to be used by all personnel. A minimum of one toilet per 15 persons.

8. WASTE HANDLING: WASTE WATER

8.1 No construction fluids should be allowed to enter any watercourses or onto any adjacent land.

8.2 No wastewater shall be disposed of into the soil. This does not include clean groundwater from rainwater.

9. MACHINERY MANAGEMENT

9.1 All vehicles, equipment, fuel and petroleum services and tanks must be maintained in good condition that prevents leakage and possible contamination of soil or groundwater.

Construction machinery should be located away from sensitive areas when parked for extended periods of time. A dedicated parking area should be defined with drip trays beneath any leaking equipment. Fuel/lubricant absorbing media (peat/moss type products) within these drip trays should be used to hold the spilled liquids. These materials should be replaced regularly to prevent over-saturation and potential spillage of free product. This material should be disposed of as hazardous waste and be collected

by an approved contractor/delivered to a suitable waste site. Chain of custody documentation should be provided as proof of final end recipient.

9.2 Machinery should not be located beneath the foliage of any trees.

All spills are to be recorded in the Environmental Register, including any clean-up actions taken to remediate the spillage. Such actions are to be agreed with the ECO prior to taking place.

10. NOISE

10.1 Noise generation is likely to be one of the most significant impacts at the site during the construction phase. Every attempt should be made to reduce noise levels considering the construction site.

10.2 The contractor should use modern equipment, which produces the least noise. Any unavoidably noisy equipment should be identified and located in an area where it has least impact. The use of noise shielding screens should be considered and the operation of such machinery restricted to when it is actually required.

10.3 No noise generating work can be conducted after 8 p.m. and before 7 a.m. on any workday or during any Sunday, without the prior approval of the engineer. Due to contractual commitments, it is possible the contractor may need to work longer periods than those stipulated to avoid being penalised for time delays. Any such issues will be discussed and agreed upon by the engineer, contractor and ECO.

10.4 The applicant must ensure that the construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA wear ear protection equipment.

10.5 The applicant must ensure that the National Noise Control Regulations and SANS10103:2008 are adhered to and reasonable measures to limit noise from the work site are implemented.

10.6 The applicant must ensure that all equipment and machinery are well maintained and equipped with silencers.

11. SEARCH AND RESCUE

Search and rescue of all rare or localised plant species within construction areas shall be undertaken before any site clearing takes place. Search and rescue shall include the

collection of plants, cuttings and, where applicable, seed. Search and rescue of seed and cuttings for propagation purposes may be undertaken within “no go” areas under the supervision of the ECO.

Rescued plant material shall either be planted nearby within suitable habitats in areas that will not be disturbed in the foreseeable future or held at a suitable nursery deemed suitable for later use in re-vegetation to the satisfaction of a landscape architect/horticulturist.

12. PENALTIES AND BONUSES

Where the Contractor inflicts damage upon the environment or fails to comply with any of the environmental specifications contained within this EMP, he/she shall be liable to pay a penalty for breach of the conditions of the environmental specifications which form part of the works contract. The Contractor is deemed NOT to have complied with this Specification if: within the boundaries of the site, site extensions and haul / access roads there is evidence of contravention of the Specification;

- environmental damage ensues due to negligence;
- the Contractor fails to comply with corrective or other instructions issued by the Resident Engineer/ECO within a specific time;
- the Contractor fails to respond adequately to complaints from the ECO or public.

Penalties shall be issued per incident and per individual for the Contractor’s responsibility at the discretion of the Engineer in consultation with the ECO. The amount of the penalty shall be determined by the Engineer, in consultation with the ECO. The Engineer shall inform the Contractor of the contravention and the amount of the penalty, and will deduct the amount from monies due under the Contract. Payment of any penalties in terms of the contract shall not absolve the offender from being liable from prosecution in terms of any law.

The following penalties (not an exclusive list) shall be issued in addition to any remedial costs incurred as a result of non-compliance with the environmental specifications and shall be imposed by the Engineer on the Contractor for contraventions of the environmental specifications by individuals or operators employed by the Contractor and/or his sub-contractors. Where there are ranges, the amount shall depend on the severity and extent of the damage done to the environment:

a)	An individual entering a “no-go” area by foot	R 100

	(without Engineer's /ECO's permission)	
b)	An individual failing to adhere to speed limit on site	R 100
c)	An individual driving a vehicle in a "no-go" area	R 500 – R 2000
d)	An individual driving any earthmoving plant in a "no–go" area	R 500 – R 5000
e)	A plant operator ignoring a verbal warning to have an oil leak from his machinery repaired	R 200
f)	An individual littering on site	R 50
g)	An individual not making use of the ablution facilities	R 50
h)	An individual making an illegal fire on site	R 200 – R 10 000
i)	An individual causing unnecessary damage to fauna on site	R 100 – R 2000
j)	An individual / team wasting water	R 100 – R 2000
k)	An individual not reporting a suspected archaeological find to the ECO	R 200 – R 2000
l)	An individual / team contaminating the site or stormwater system with paint/hazardous substances	R 200 – R 2000

For each subsequent similar offence committed by the same team or individual, the penalty shall be doubled in value to a maximum value of R10 000.

The following penalties are suggested for transgressions where damage has been done to the environment:

a)	Erosion	A penalty equivalent in value to the cost of rehabilitation plus 20%

b)	Oil spills	A penalty equivalent in value to the cost of clean up operation plus 20%
c)	Damage to sensitive environments	A penalty equivalent in value to the cost of restoration plus 20%
d)	Damage to archaeological finds	A penalty to a maximum of R100 000 shall be paid for any damage to any archaeological sites / finds

All monies collected through penalties shall be held by the proponent and be accounted for. A summary page is to be included with the monthly payment certificates as a record of penalties issued to date. A portion of these funds may be used for token monetary bonuses to individual site staff members that have shown exceptional diligence in applying good environmental practice on the site. The remaining funds shall be allocated for the purposes of contributing to environmental education efforts in the local community e.g. posters, excursions or trees for the local school or environmental resource material for the local public library. A committee consisting of the Developer, ECO, Engineer and possibly the local authority, will make a final decision regarding the precise allocation of all penalty funds.

13. MEASUREMENT AND PAYMENT

All aspects covered in this document shall be deemed to be included as a sum in the Preliminaries tendered by the Contractor in the Schedule of Quantities.

14. OPERATIONAL PHASE

An ECO or Environmental Manager should be appointed during the operational phase of the development. The role of the ECO during this phase is to address the ongoing operation of the plant and to ensure that the issues that have been identified are addressed on a continued basis and in a manner that limits any environmental impact.

The ECO/Environmental Manager will conduct quarterly monitoring for two years post construction and then bi-annually during the Operational Phase to ensure compliance. Records of monitoring to be kept.

During the operational phase it is imperative to operate the solar plant in such a way that ensures that the operational activities are properly managed and operational activities are

undertaken without significant disruption to other land uses in the area, in particular with regard to botanical, traffic and road use, visual and heritage resources of the site.

In order to meet this objective, the mitigatory measures below have been identified:

Table 3: Operational phase mitigatory measures:

IMPACT	MITIGATION
Botany	• No dumping or temporary storage of any materials may take place outside designated and demarcated laydown areas. • Alien vegetation management must be undertaken in the 2.5km long powerline servitude and along the edges of all on-site infrastructures on an annual basis.
Avian	• Minimizing noise and disturbance associated with maintenance activities at the plant • Refine post-construction monitoring protocol in terms of results of pre-construction • Commence with post-construction monitoring by qualified avifaunal specialist. • Periodically collate and analyse post construction monitoring data (3-monthly). • Review report on post construction monitoring and integrate findings into operational EMP and broader mitigation scheme
Visual	• Good management practices to be ensured. • Carry out repairs promptly and keeping area tidy. • Return ground to original state. • Rehabilitation to be done promptly • Lighting should be designed to minimise light pollution
Traffic	No other remedial or mitigation measures other than those proposed for the construction phase will be required to accommodate the additional traffic generated by the proposed photovoltaic power generation facility. Whilst theoretically there is no potential for reflections from the panels and infrastructure to affect passing motorists on the R48, the reflections from the arrays are to be monitored from the first installation to confirm this.
Heritage, Archaeology and	• No above ground heritage resources exists on the site. • No significant impact on the cultural landscape will be made.

Palaeontology	• No significant heritage (built environment) constraints affecting the site. • SAHRA still handles all heritage as well as archaeological matters in the Northern Cape Province. Should anything of heritage concern be identified it needs to be brought under the attention of the Cape Town office as well as Ngwao Boswa Kapa Bokone.

15. POST CONSTRUCTION

15.1 Final site cleaning - the contractor shall clear and clean the site and ensure that everything not forming part of the permanent works is removed from site before issuing the completion certificate or as otherwise agreed.

16. DE-COMMISSIONING

See Appendix 3 the plan for the dismantling of the plant and rehabilitation of the area.

17. GENERAL

The Community Liaison Officer ("CLO") is responsible for:

- Liaison with the local police force to co-ordinate security measures.
- Continue public liaison to ensure Interested and Affected Parties are kept up to date on the project.

APPENDIX 1

RESPONSIBILITIES AND AUTHORITY

A) EMP ADMINISTRATION

Copies of this EMP shall be kept at the site office and will be distributed to all senior contract personnel. All senior personnel shall be required to familiarise themselves with the contents of this document.

B) ROLES AND RESPONSIBILITIES

The implementation of this EMP requires the involvement of several stakeholders, each fulfilling a different but vital role to ensure sound environmental management during the construction phase.

THE DEVELOPER [Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd]

The Developer refers to the Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd who is ultimately responsible for compliance with all conditions of approval of the development or any aspect thereof by any authority.

With respect to the construction phase of the Development, the Developer is to:

- ensure that all relevant approvals and permits have been obtained prior to the start of construction activities on site;
- ensure, via DJ Environmental Consultants, that the EMP has been approved by the Department of Environmental Affairs (DEA) prior to the start of construction activities on site;
- appoint an independent suitably qualified or experienced Environmental Control Officer (ECO) prior to the start of construction activities on site, and for the duration of the construction phase;
- Provide all principal contractors working on the project with a copy of this EMP as part of tender contract documentation to allow the contractors to cost for its requirements within their respective construction contracts.

2. THE ENGINEER

For the purposes of this document “The Engineer” refers to the engineer for the development, or any other person (such as the architect/project manager/principal agent) authorised by the Developer, to be undertaken.

The responsibilities of the Engineer are to:

- ensure that the requirements as set out in this EMP and by the relevant Authorities are adhered to and implemented;

- assist the ECO in ensuring that the conditions of the EMP are being adhered to and promptly issuing instructions requested by the ECO, to the Contractor. All site instructions pertaining to environmental matters issued by the Engineer are to be copied to the ECO;
- assist the ECO in making decisions and finding solutions to environmental problems that may arise during the construction phase;
- reviewing and approving construction method statements with input from the ECO;
- ordering the removal of person(s) and/or equipment not complying with the specifications or issuing a stop works order (as required by the ECO or otherwise);
- issuing of penalties for transgressions of environmental site specifications;
- providing input into the ECO's ongoing internal review of the EMP.

3. THE CONTRACTOR

For the purposes of this document "The Contractor" refers to any directly appointed (by the Developer) company or individual undertaking the implementation of the works.

The Contractor is to:

- ensure implementation of all applicable Environmental Management Specifications, including all additional requirements related with approved method statements, during all works on site, failing which penalties, as outlined in the environmental management specifications may be imposed by the ECO;
- ensure that all of its sub-contractors, employees, suppliers, agents or servants etc. are fully aware of the environmental management requirements detailed in the Environmental Management Specifications;
- liaise closely with the Engineer and the ECO and ensure that the works on site are conducted in an environmentally sensitive manner;
- inform the Engineer as well as the ECO should environmental issues on site go wrong, e.g. dumping, pollution, littering;
- carry out instructions issued by the Engineer, on request of the ECO, required to fulfil his/her compliance with the EMP.

4. ENVIRONMENTAL CONTROL OFFICER'S DUTIES

The ECO's duties, *inter alia*, must be to ensure compliance with the EMP through monitoring and proactive and open communication channels with the project/site management and, when necessary, enforce the environmental requirements

The ECO's responsibilities should include the following:

- monitoring and verifying that the EMP is adhered to at all times and taking action if the specifications are not followed;
- to environmentally educate and raise the awareness of the Contractor and his staff as to the sensitivity of the Site and to facilitate the spread of the correct attitude during works on Site;
- ensure that educational information is displayed in strategic positions;
- take immediate action on Site where clearly defined and agreed no go areas are violated, or in danger of being violated, and to inform the Engineer/ Developer of the occurrence and action taken;
- monitoring and verifying that environmental impacts are kept to a minimum;
- reviewing and approving construction method statements together with the Engineer/Developer;
- assisting the Contractor in finding environmentally responsible solutions to problems;
- keeping records of all activities/ incidents on Site in a Site Diary concerning the environment;
- inspecting the Site and surrounding areas regularly (minimum weekly) with regard to compliance with the EMP;
- Keeping a register of complaints and report these first to the Engineer/Developer for action / follow-up;
- requesting the removal of person(s) and/or equipment not complying with the specifications (done via the Engineer/Developer);
- recommending the issuing of penalties for transgressions of environmental site specifications to the Engineer/Developer;
- completing start-up, monthly and site closure checklists;
- keeping a photographic record of progress on Site from an environmental perspective;
- Undertaking a continual internal review of the EMP and making recommendations to the Engineer/Developer.

The ECO has the authority to recommend to the Engineer/Principal Agent that works be stopped, if in his/her opinion serious harm to, or impact on, the environment is imminent, is likely to occur or has occurred and such actual or potential harm or impact is in contravention

of this EMP, and which is, or may be, caused by construction, or related works. All stop works orders to the Contractor are, as normal, to be issued through the Engineer or Principal Agent. However, should the PA not be readily available in an emergency case or be in dispute with the ECO regarding work stoppage, then the ECO shall, in these exceptional circumstances, have the authority to recommend to the Department of Environmental Affairs and Development Planning that works be stopped.

Upon failure by the Contractor or Contractor's employee to show adequate consideration to the environmental aspects of this contract, the ECO may recommend to the Engineer and the project management team to have the Contractor's representative or any employee(s) removed from the site or have work suspended until the matter is remedied. No extension of time will be considered in the case of such suspensions and all costs will be borne by the Contractor.

The ECO will be responsible for the compilation of a final closure checklist for the project, completed when all works related to the project have been completed and the site has been cleared of all construction related debris, materials or equipment not forming part of the permanent works. This checklist will audit the Contractor's compliance with the EMP throughout the duration of the construction phase and this checklist, together with a final written report will be submitted to the Department of Environmental Affairs and Development Planning in order to achieve "environmental closure" of the site.

Signed

Dudley Janeke – Principal Environmental Scientist
(DJ Environmental Consultants)

Quinton Terhoven – Senior Environmental Scientist
(DJ Environmental Consultant)

APPENDIX 2

LEGISLATIVE REQUIREMENTS

- Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965) (http://www.capetown.gov.za/en/CityHealth/Documents/Legislation/Act%20-%20Atmospheric%20Pollution%20Prevention%20Act%20-%2045%20of%201965.pdf)

- Environmental Conservation Act, 1989 (Act No. 73 of 1996) (http://www.chr.up.ac.za/chr_old/indigenous/documents/South%20Africa/Legislation/Environment%20Conservation%20Act.pdf)

- National Environmental Management Act, 1998 (Act No. 107 of 1998) (http://www.saia.org.za/documents/NATIONAL%20ENVIRONMENTAL%20MANAGEMENT%20ACT.pdf)

- World Heritage Convention Act, 1999 (Act No. 49 of 1999) (http://www.info.gov.za/view/DownloadFileAction?id=70616)

- National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (http://www.info.gov.za/view/DownloadFileAction?id=68034)

- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (http://www.info.gov.za/gazette/acts/2004/a10-04.pdf)

- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (http://www.info.gov.za/view/DownloadFileAction?id=67978)

- National Environmental Management: Waste Act (Act No. 59 of 2008) (http://www.info.gov.za/view/DownloadFileAction?id=97351)

- National Water Act (36 of 1998) (http://www.info.gov.za/view/DownloadFileAction?id=70693)

- Occupational Health and Safety Act, 1993 (Act No.85 of 1993) http://info.gov.za/acts/1993/a85-93.pdf

- National Forest Act, 1998 (Act No. 84 of 1998) http://www.waternet.co.za/policy/le

- Should fill material be required for any purposes, the use of borrow pits must comply with the provisions of the Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) administered by the Department of Mineral Resources. http://www.info.gov.za/view/DownloadFileAction?id=68062

- Conservation of Agricultural Resources Act (Act No.43 of 1983) http://www.nda.agric.za/docs/act43/eng.htm

APPENDIX 3

DE-COMMISIONING PHASE:

PLAN FOR DISMANTLING OF PLANT AND REHABILITATION OF SITE

PLAN FOR THE DISMANTLING OF THE PLANT AND RESTORING THE AREA TO ITS ORIGINAL CONDITION

1. PURPOSE

The purpose of this document is to describe the technical conditions and necessary stages of dismantling the projected plant after its useful life, as well as the tasks required to restore the terrain to its original condition.

2. DETAILS OF THE PLOT

Plot not determined.

3. TASKS AT THE DISMANTLING STAGE

3.1 Disconnection from the electricity network

Once the plant has finished operations and before proceeding with the dismantling of the facilities, the plant will be disconnected from the electricity network in the following stages.

- Disconnection of the medium-voltage overhead network: Disconnection of the plant from the existing medium-voltage network will be carried out, therefore isolating it. This task will be undertaken at the distribution centre, as well as the overhead line junction. Since the line belongs to the distribution company, operations will be performed during a scheduled stoppage for maintenance work on the line.

  Tasks:

  1) Isolation of the plant through the opening of lines in the distribution centre.
  2) Removal of overhead medium-voltage conductors corresponding to the junction.
  3) Replacement of modified supports (double circuit) with the original ones (single circuit) if the company deems it necessary.

  Conductors, remaining supports and other surplus materials will be stored for delivery to an authorised recycling company.

- Disconnection of the medium-voltage underground network: Disconnection of the interconnection ring will be performed at transformer and distribution centre level.

- Disconnection of the low voltage network. Tasks:

1) Disconnection of inverters by means of switches.
2) Disconnection of module branches by means of disconnect switches.
3) Disconnection of cabling connecting modules in series.
4) Dismantling of protective tubing and cabling.

Conductors and other surplus material will be stored in containers for delivery to an authorised recycling company.

3.2 Disassembly of modules

Once the disconnection of the modules has been carried out, they will then be removed from support structures.

The dismantled modules will be stored for later delivery to an authorised company.

3.3 Dismantling of structures

After the modules have been disassembled, the structures will be dismantled.

The dismantled elements will be stored for later delivery to an authorised company.

3.4 Removal of micropile foundations

This will be carried out either manually or mechanically. After removal, they will be transported to a landfill site.

3.5 Opening of trenches and removal of the underground electrical network.

Dismantled elements will be stored for later delivery to an authorised company.

3.6 Transformer and distribution centres

Since these centres are monobloc and are installed on site with all machinery pre-installed at the factory, the supplier or authorised company will be called in for their removal as they were installed, i.e. as a single block.

3.7 Inverter buildings

After disconnecting the machinery and removing the inverters, panels and other equipment, the buildings will be demolished and the rubble transported to a landfill site.

Equipment will be stored for later delivery to an authorised company.

4. PLAN FOR RETURNING THE LAND TO AGRICULTURAL USE

Objectives

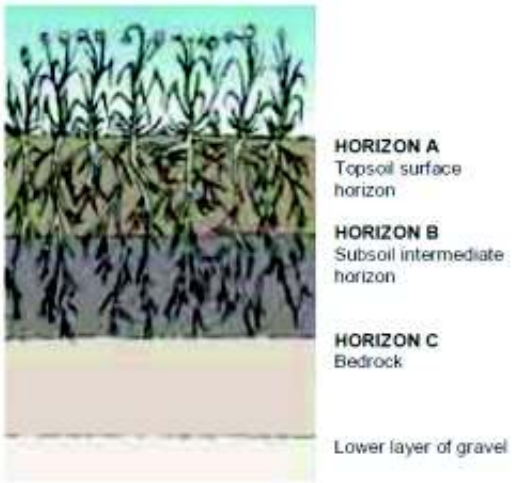
In agriculture, the availability of soil with a suitable structure and composition is fundamental for profitable exploitation. When a non-agricultural activity has been carried out on land over a period of time, it is necessary to find out what affect this has had on the properties of the subsoil and, therefore, anticipate what corrective measures are necessary to return it as near as possible to its original state.

For this reason, the aim of this plan is to restore the land to its original substratum characteristics (or as near as possible) for subsequent use as farmland.

Generally, fertile agricultural land should have the structure shown in the picture.

This case consists of restoring the first two horizons, A and B, as depths greater than one metre will not be reached.

In herbaceous agriculture, where the roots of plant species do not penetrate deeply, treatment is usually only carried out on these more superficial layers.



4.1 SUBSOILING AND RESTORING TOPSOIL

This will be carried out in all parts of the affected project area and will essentially consist of two stages:

- Subsoiling of the disturbed mineral layer (horizon B): This involves drilling or removing material from this soil layer to a depth of 50 to 100 cm in order to air it and enable the agricultural plant species situated above to take root.

- Extending the topsoil (horizon A): This involves distributing soil that is rich in mineral nutrients and with good texture and structure over the mineral layer. For agricultural soils, this layer should not exceed 40 cm in depth.

A. Subsoiling of the disturbed covering or mineral layer (horizon B):

This involves decompacting the soil by fragmenting the layer to reduce density, therefore promoting root development, improve permeability to water and air and increase its ability to retain water.

The subsoiler is the machine that performs this work. Its function is to break up the layers of soil affected by the previous activity and remove obstacles in the soil such as impermeable layers, stones, stumps or roots from previous cultivation, etc.

In this case, one or two passes with the subsoiler or mole plough will be performed. These tools are

mounted onto a tractor and are used either to break up the ground (subsoiler) or to produce small tunnel-shaped holes (mole plough).

Typically, a mole subsoiler has a single arm that moves the soil to make simple linear drainage channels. The standard subsoiler has several arms and carries out two tasks at the same time: facilitating the drainage of the lower layers and cracking the subsoil to encourage the growth of plant roots.

Before starting this work, existing topsoil should be removed, and depending on its quality, stored for use in the next phase.

Subsoiler with four arms

Mole plough mounted on a tractor

B. Reconstitution of topsoil (horizon A):

To restore agricultural land, a layer of topsoil with characteristics that are well suited to the planned crops will be applied in two stages:

- After the construction phase of the plant: The topsoil that was removed and stored during the earth-moving phase will be re-spread over the land in areas designated by the project.

- After the dismantling of the structures: The condition of the still usable topsoil will be examined and soil from outside will be brought in and added where necessary.

The topsoil will be around 30 cm in depth and spread evenly over the agricultural land. The material will be deposited and flattened to avoid irregularities but not compacted, i.e. too much pressure will not be applied.

If workers need to operate on the affected mineral layer (horizon B), the work will be carried out either on foot with machines that apply little pressure to the soil or from marked paths (the existing paths and access routes of the solar plant can be used), which will de decompacted and covered with topsoil as soon as the work has been completed.

Before carrying out any spreading of topsoil, the workers will need to remove manually the larger stones that remain scattered over the surface area after subsoiling to ensure an even distribution of topsoil.

Slow absorption and low solubility organic fertilizers can also be added to the soil, if a severe lack of nutrients is noticed in the soil.

4.2 CORRECTIONS OR SOIL SCIENCE IMPROVEMENTS

The previous measures might not be sufficient for the soil to attain the physical and chemical properties required for plant development. In such a case, it would be necessary to undertake soil improvement work so that it can support such plant species.

Firstly, an analysis of the soil's mineral nutrients needs to be carried out to establish if the proportions of sodium, potassium, calcium and magnesium are adequate for the plant species to be cultivated. This would include a pH measurement to calculate the soil's acidity or alkalinity and, if necessary, the taking of corrective measures.

If a pH acid correction is necessary, quicklime (CaO), calcium carbonate (Ca CO3), dolomite (calcium-magnesium carbonate) or ash can be added as well as building rubble or materials, provided that these materials are available and not excessively expensive.

These liming materials should be spread at a depth of 15 cm prior to applying the topsoil.

Lime not only serves to adjust pH but also increases nutrient availability and the effectiveness of fertilizers, promotes decomposition of organic matter and increases the amount of calcium and nitrogen in the soil.

Alternatively, if the soil is too basic or alkaline, additional manure or natural soil should be added to neutralise it, more or less depending on the quality of the subsoil.

4.3 FERTILIZERS-HUMIC CORRECTIONS

If the result of the analysis of subsoil nutrients indicates that the soil is in poor condition, additional fertilizer would be applied.

The composition of this fertilizer is often organic matter from different origins. It may come from farms (manure) or from waste decomposition (compost).

This correction improves drainage and aeration of the soil, increases water retention capacity, provides a long-term nutrient reserve, increases stability, reduces surface runoff and promotes germination.

To complement humic correction, chemical fertilization is carried out, which is no more than the addition of nutrients (mainly nitrogen and phosphorus), which can be a decisive factor in whether the soil can be cultivated.

This operation must be performed at the beginning of planting. At first, easily absorbed nitrates (NO3-) are added, followed by urea (CO (NH2) 2), which is absorbed more slowly.

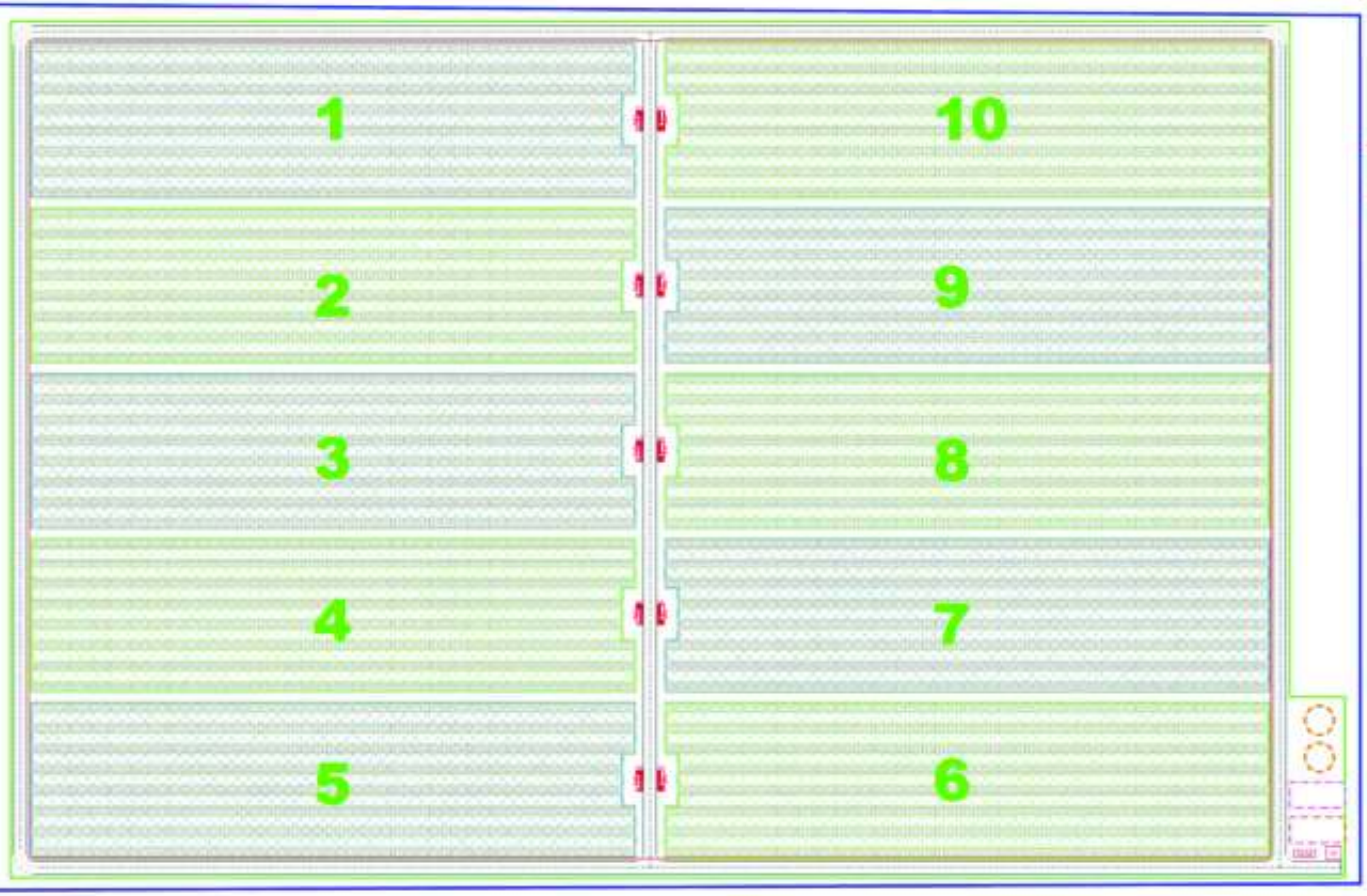
These nitrogen compounds must be added more often than other fertilizers, at least during the first months after planting, since the soil is poor quality and nitrogen is essential for plant development.

As a supplement to chemical fertilizers, the initial planting of grasses and legume plants can be considered, as they are able to collect atmospheric nitrogen and fix it to their roots, thus saving on fertilizers.

APPENDIX 4

SITE LAYOUT PLAN

MULTICRISTALINE GENERAL LAYOUT FIXED OPTION	
PEAK POWER	10,3224 MWp
NOMINAL POWER	10,00 MWn
TECHNOLOGY	MULTICRISTALINE SOLAR MODULE
MODULE	TRINA SOLAR
MODULE DIMENSIONS	1650 x 992 mm
TILT	20°
AZIMUTH	0°
STRUCTURE	1x4 FIXED
PLANT AREA	17,00 ha
INVERTERS	20 X GREEN POWER PV 500
MODULE POWER	230 WP



LEGEND

NORTH

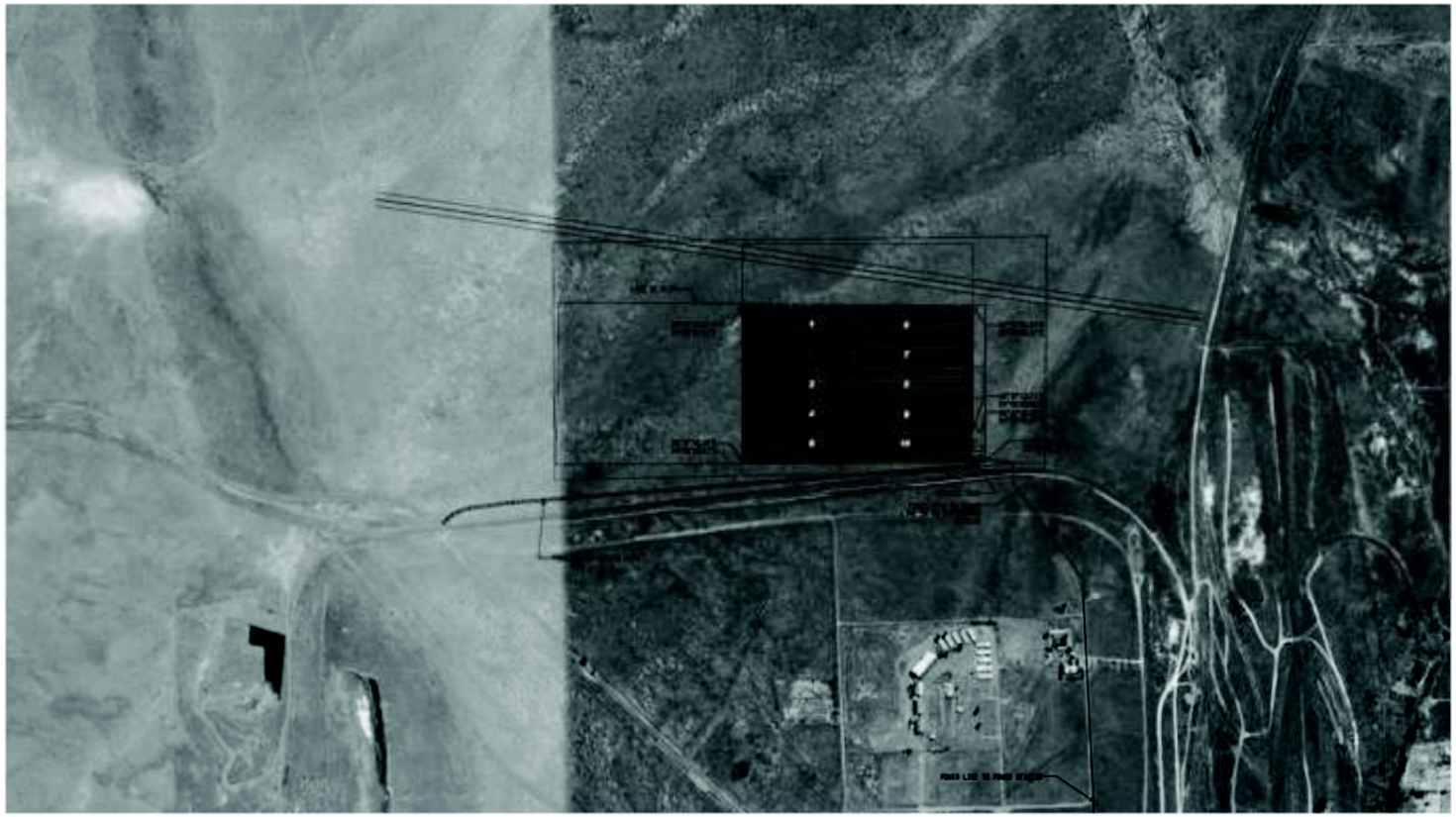
Gestamp Solar

MULILO

PROPOSED PHOTOVOLTAIC SOLAR POWER PLANT DE AAR PHASE I - 10MW

DE AAR - SOUTH AFRICA

GENERAL LAYOUT



SITE PLAN
SCALE 1 : 5000

NOTE / NOTA :

THE COPYRIGHT ON THIS DRAWING, THE DESIGN AND DETAILS SHOWN THEREON, IS RESERVED BY THE ARCHITECTS.

ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

THIS DRAWING MUST NOT BE SCALED, ONLY FIGURED DIMENSIONS MAY BE USED.

DIE KOPIEREG OP HIERDIE TEKENING, DIE ONTWERP EN BESONDERHEDE DAARIN BEVAT, WORD DEUR DIE ARGITEKTE GEHANDHAAF.

ALLE MATE EN VLAKTES MOET DEUR DIE KONTRAKTEUR OP DIE BOUTERREIN GEVERIFIEER WORD VOORDAT ENIGE WERK GEDOEN WORD.

MOENIE AFMETINGS AAN VAN HIERDIE TEKENING SKEMAL WORD NIE. GEBRUIK SLEGS GEGEWE AFMETINGS.

Gestamp Solar

GDY ARCHITECTS
GOLDBLATT DU PLESSIS

KIMBERLEY

BESTAMP
PROPOSED 10MW SOLAR
PV POWER PLANT ON
FARM 2/145
PAARDE VALLEY
DE AAR

DESCRIPTION: SITE PLAN

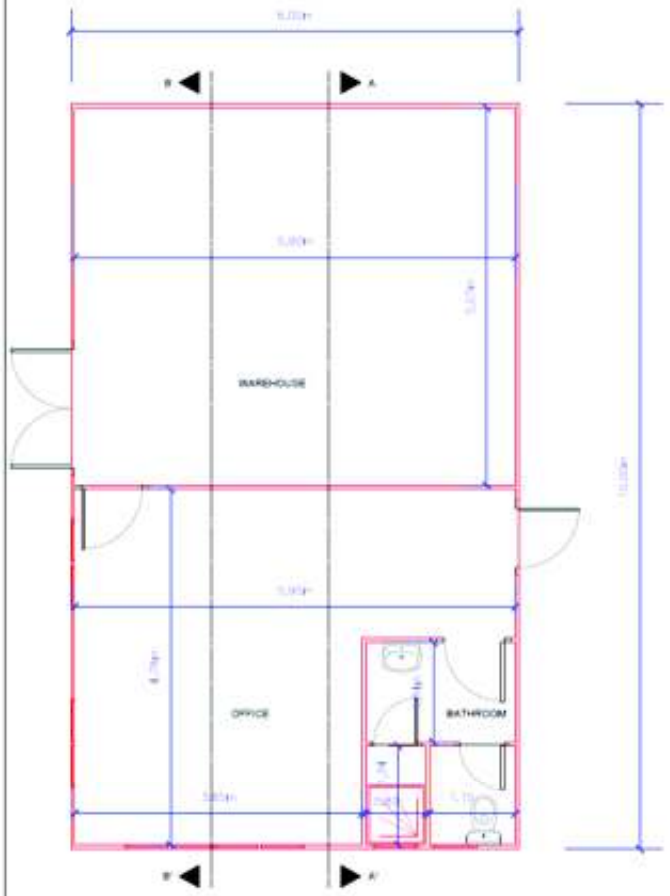
DESIGN	DRAWN	DATE	DATE
	K. LOURENS	APRIL 2012	
MANAGER	CHECKED	RETURNED	ISSUED
	E.Y. BAILEY		

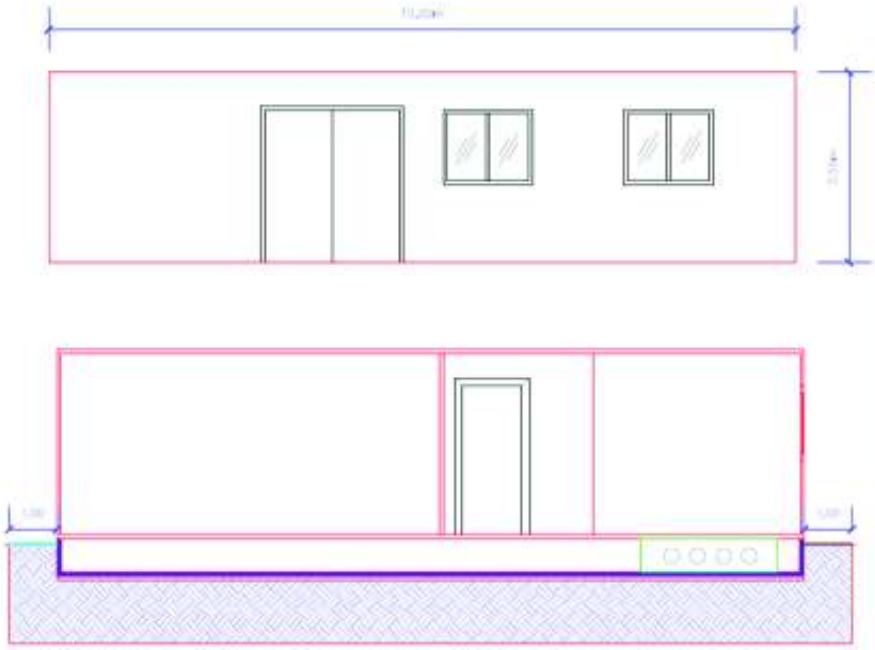
SHEET SIZE: A1
SCALE: 1 : 5000

DRAWING NUMBER: 2012/20/00

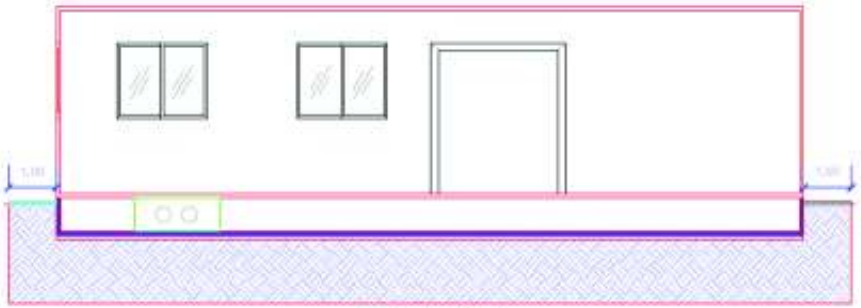
APPENDIX 5

BUILDING DETAILS





A-A' SECTION



B-B' SECTION

NOTES:

GPS	LB / DZG	LFC	
ABR 2012	S/E		

Gestamp Solar

C/ Tilos 15, 7ª planta
28045 Madrid

Tel.: +34 91 177 00 10
Fax: +34 91 177 00 25

MULILO

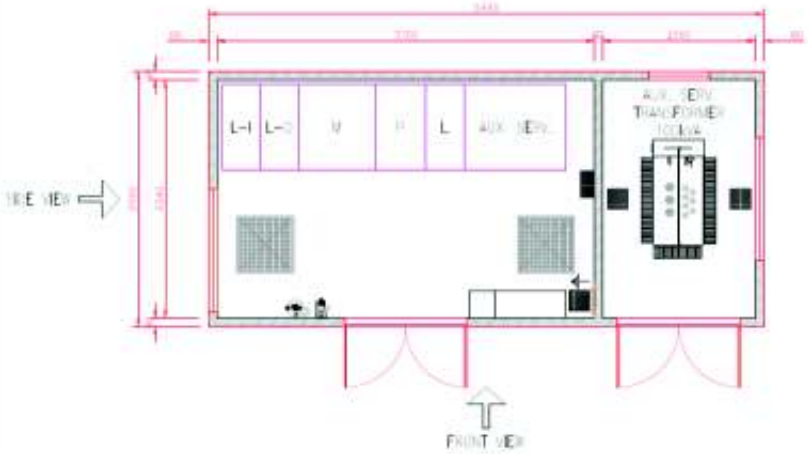
PROJECT: PROPOSED PHOTOVOLTAIC SOLAR POWER PLANT DE AAR PHASE I - 10MW

DE AAR (SOUTH AFRICA)

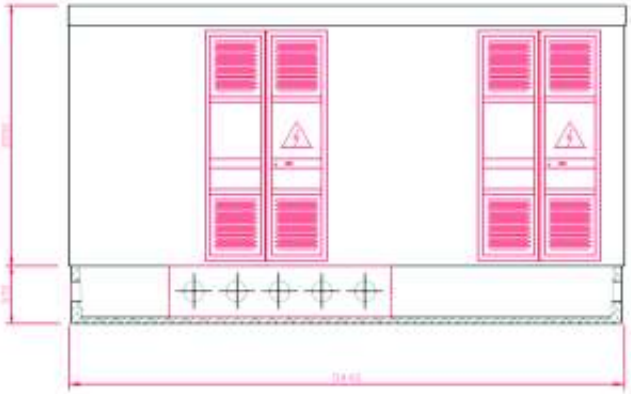
TITLE: CONTROL CENTER

DT_SF0004	A3	ED-CCO	22	02

FLOOR

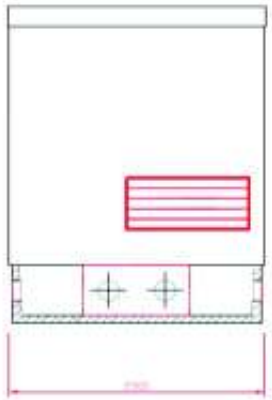


FRONT VIEW



SECTION

SIDE VIEW



NOTES

DESIGNED	CHECKED	APPROVED	
GPS	LB / DZG	LFC	

ABR 2012	S/E

Gestamp Solar

Ombú St 3, 2nd floor
28045 Madrid

Tel.: +34 91 177 00 10
Fax: +34 91 177 00 25

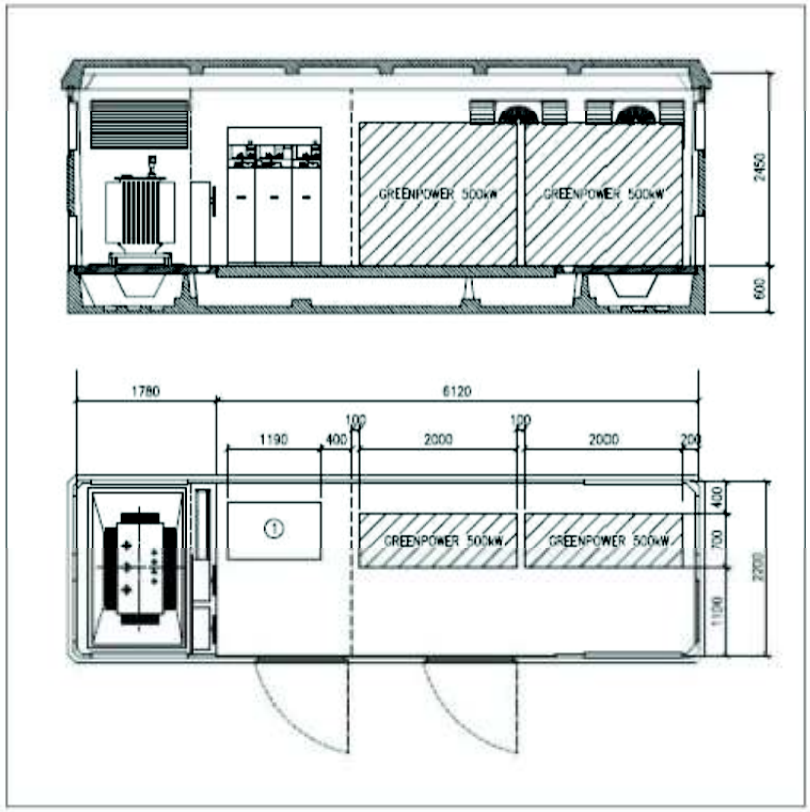
CLIENT: MULILO

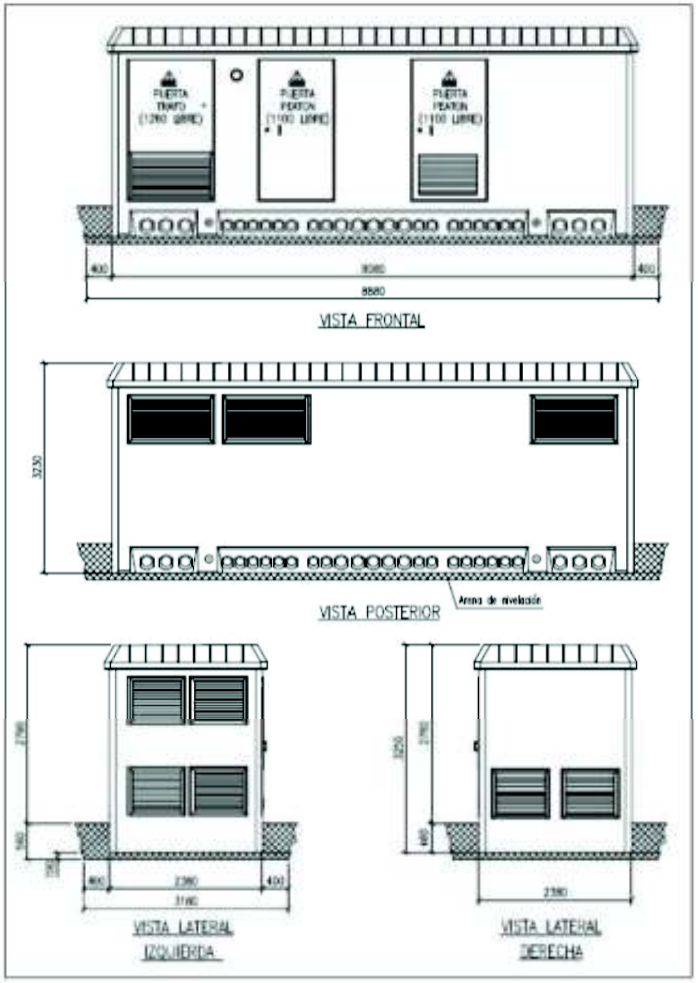
PROJECT: PROPOSED PHOTOVOLTAIC SOLAR POWER PLANT DE AAR PHASE I - 10MW

LOCATION: DE AAR - SOUTH AFRICA

TITLE: CONNECTION CENTER

DRAWING NO.	SIZE	SCALE	SHEET	REV.
DT_SFD004	A3	ED-CEN	21	A





NOTES:

REV.	DATE	DESCRIPTION
REVISIONS		

DESIGNED	CHECKED	APPROVED	ISSUED
GPS	LB / DZG	LFC	

DATE	STAGE
ABR 2012	S/E

Gestamp Solar

C/ Titán 15, 7ª planta
28045 Madrid
Tel.: +34 91 177 00 10
Fax: +34 91 177 00 25

DESIGNED: MULILO

PROJECT: PROPOSED PHOTOVOLTAIC SOLAR POWER PLANT DE AAR PHASE I - 10MW

LOCATION: DE AAR (SOUTH AFRICA)

TITLE: INVERTER + TRANFORMER CENTER

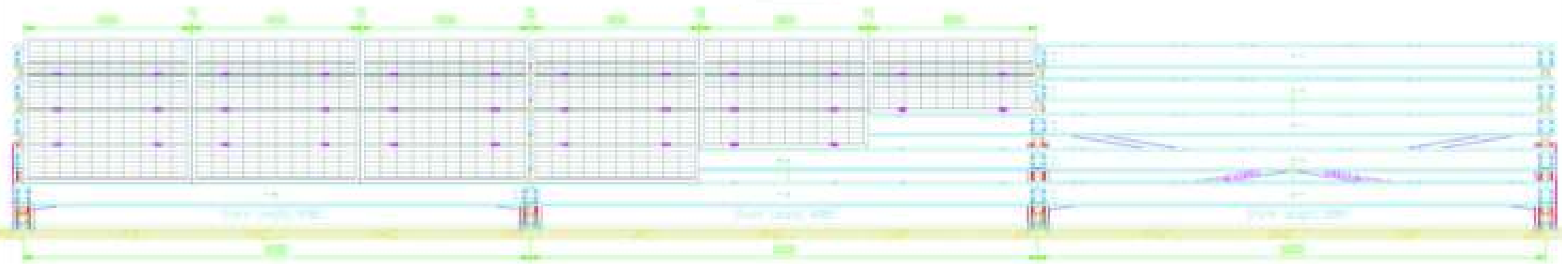
DRAWING NO.	SIZE	SCALE	SHEET	REV.
OT_SF0004	A3	ED-INV+CTR	20	02

APPENDIX 6

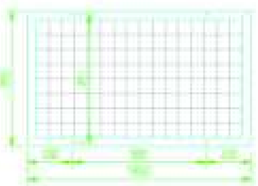
FENCE AND SOLAR DETAIL

NOTES

FRONT VIEW



PHOTOVOLTAIC PANEL



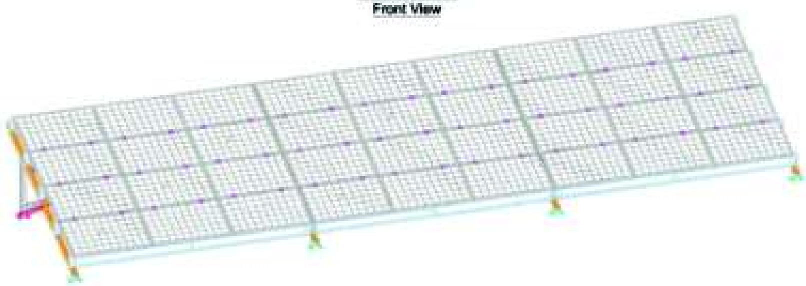
Note:

- All structure components and joints are hot dip galvanized according to the norm UNE-EN ISO 1461.

- The set screw for the structure is hot dip galvanized.
- 8.8 Quality of the screws.

- The set screw for the photovoltaic panels will be stainless steel.
- A2-70 Quality of the screws.

PERSPECTIVE
Front View



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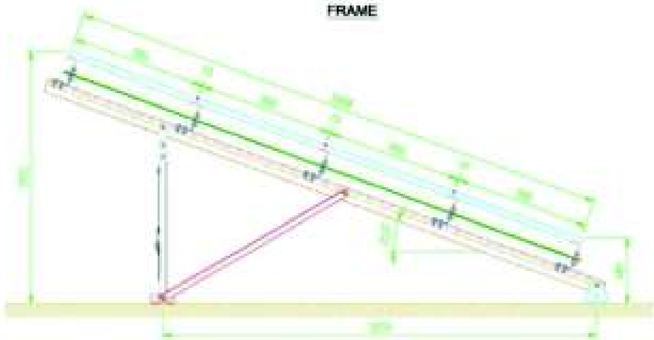


PERSPECTIVE
Back View

GPS	LB / DZG	LPC	
ABR 2012	S/E		

Gestamp Solar

C/ Titán 15, 7ª planta
28045 Madrid
Tel.: +34 91 177 00 10
Fax: +34 91 177 00 25

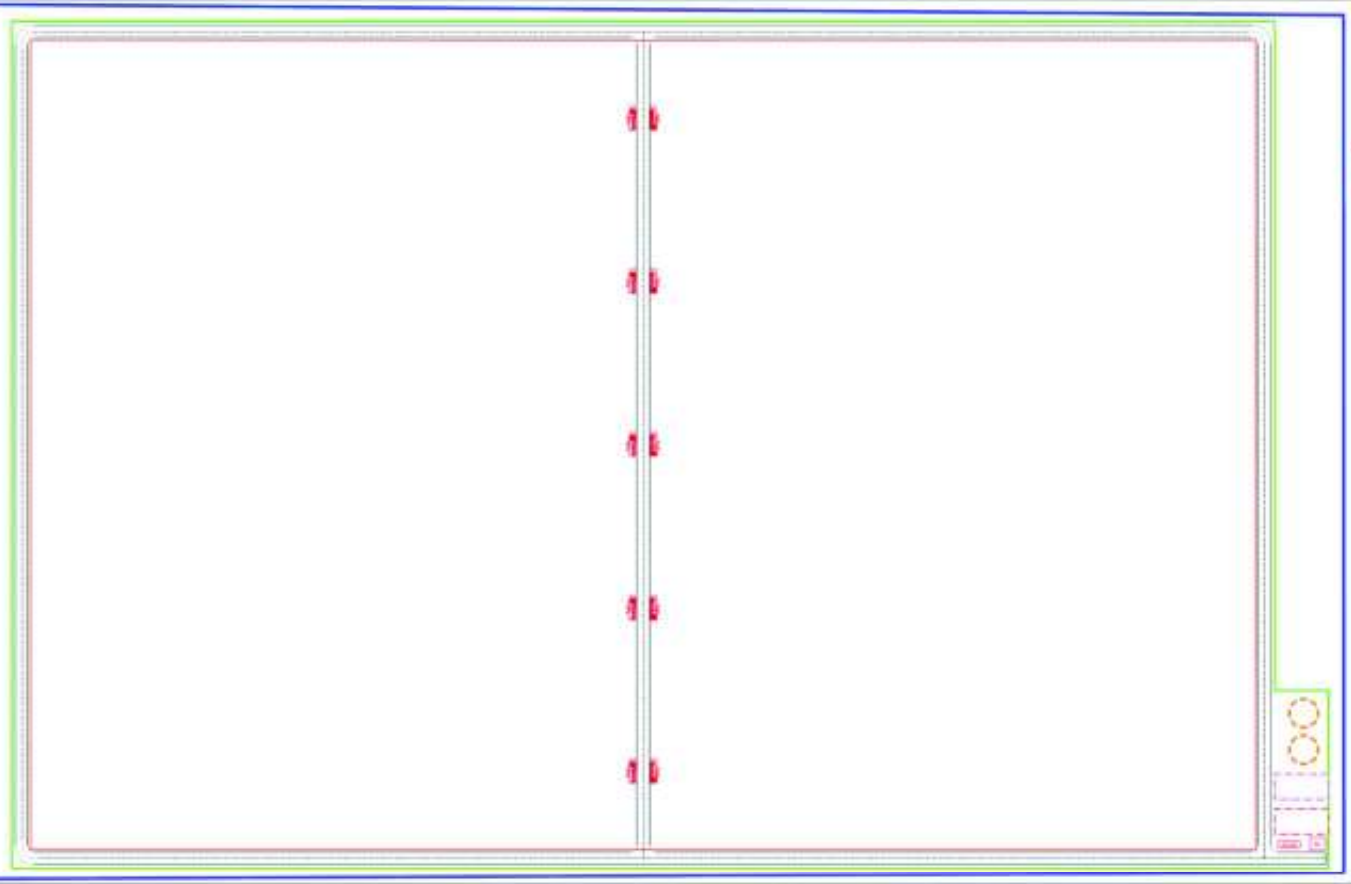
MULILO

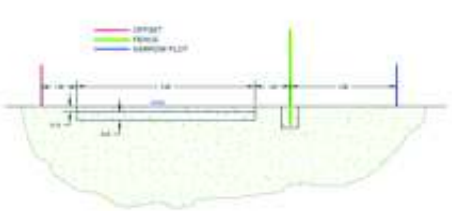
PROPOSED PHOTOVOLTAIC SOLAR POWER PLANT DE AAR PHASE I - 10MW

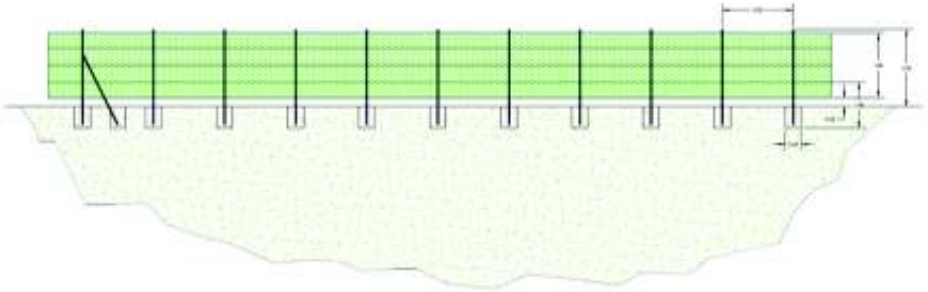
DE AAR - SOUTH AFRICA

STRUCTURE

DT_SF0004	A3	DT-EST	23	02







NOTES

LEGEND

NORTH

W E

S

Gestamp Solar

PROPOSED PHOTOVOLTAIC SOLAR POWER PLANT DE AAR PHASE I - 50MW

DE AAR - SOUTH AFRICA

FENCE

APPENDIX 7

TRAFFIC IMPACT STATEMENT

TRAFFIC IMPACT STATEMENT FOR THE PROPOSED MULILO RENEWABLE ENERGY SOLAR PV DE AAR (PTY) LTD PHOTOVOLTAIC POWER GENERATION FACILITY

LOCATED NORTH OF DE AAR, NORTHERN CAPE

Project No. : 108421

aurecon
Leading. Vibrant. Global.

APRIL 2012

PREPARED BY:
AURECON (PTY) LTD
P O Box 932
PINETOWN
3600

CONTACT PERSON:
Mr Mike van Tonder
Tel no: +27 (031) 714 2511

PREPARED FOR:
Mulilo Renewable Energy Solar PV De Aar (PTY) LTD
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Cape Town International Airport
7425

CONTACT PERSON:
Mr Warren Morse
Tel no: +27 (021) 934 5278

Project Title				Project Number
Mulilo Renewable Energy Solar PV De Aar (PTY) LTD – Proposed Mulilo Photovoltaic Power Generation Facility North of De Aar				108421
Document Title		Traffic Statement for the Proposed Mulilo Renewable Energy Photovoltaic Power Generation Facility North of De Aar		
File Reference		108421_DeAar		
Version	Date (dd/mm/yy)	Filename	MuliloPhotovoltaicTrafficStatement_DeAar	
1	23/04/12	Description	Traffic Statement for the Proposed Mulilo Renewable Energy Photovoltaic Power Generation Facility North of De Aar – Final Draft	
			Prepared by	Reviewed by	Approved
		Name	J Janki	D Kellock	M van Tonder
		Signature			
Version	Date (dd/mm/yy)	Filename			
		Description			
			Prepared by	Reviewed by	Approved
		Name			
		Signature			
Version	Date (dd/mm/yy)	Filename			
		Description			
			Prepared by	Reviewed by	Approved
		Name			
		Signature			

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

LOS	Level of Service
TIA	Traffic Impact Assessment
Veh/h	Vehicles per Hour

1. INTRODUCTION

Mulilo Renewable Energy Solar PV De Aar (PTY) LTD (hereafter referred to as Mulilo) is the primary project developer of a photovoltaic power generation facility. Mulilo appointed DJ Environmental consultants to carry out an Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act (NEMA), (Act No. 107 of 1998) as amended in 2010, for the construction and operation of the photovoltaic power generation facility and associated infrastructure. Mulilo then appointed Aurecon South Africa Pty (Ltd) to undertake a specialist traffic impact statement for the proposed facility.

This Traffic Impact Statement addresses the following traffic and transportation related implications of the proposed photovoltaic power generation facility:

- Existing traffic volumes on the N10 & R48 passing the site
- Acceptability from a traffic safety point of view of the location of the entrance/s to the proposed facility
- Safety of drivers from possible visual distraction from the photovoltaic panels, given the surrounding context
- Risk posed by construction and operational vehicles
- Limitations of this Traffic Impact Statement
- Based on existing volumes of traffic, recommendations for mitigation measures for traffic impacts, including:
    - Mitigation of visual distraction
    - Avoidance of accidents
    - Other recommendations

2. LOCATION OF THE PROPOSED VOLTAIC POWER GENERATION FACILITY

The proposed photovoltaic power generation facility is planned to be located on the Farm Number 145/2 situated in Paarde Valley, approximately 4km northwest of the town of De Aar in the Northern Cape. The farm is located immediately adjacent to and north of the R48 and to the east of the N10/R48 intersection as shown Figure 1 below.

aurecon	LOCALITY PLAN MULILO RENEWABLE ENERGY PHOTO VOLTAIC POWER GENERATION FACILITY DE AAR	PROJECT 108421 FIGURE FIG 1
April 2012	AURECON (PTY) LTD	NOT TO SCALE

3. EXISTING ROAD NETWORK AND TRAFFIC CONDITIONS

3.1 DESCRIPTION OF THE POTENTIAL TRAFFIC ROUTING

During construction the materials and equipment will be routed to the site as follows:

Cape Town Harbour, onto the N1 freeway, then turning onto the N10 and into De Aar. This routing is shown on local and regional aerials in Annexure C

Mulilo has confirmed that there will be no abnormal loads and that all loads will conform to normal load height and weight restrictions. As such no abnormal load permits and no detailed assessment of this route will be required.

Some traffic may be routed from and to De Aar during construction and during operations.

As such only a localised traffic impact assessment will be undertaken for this EIA process and this report will be forwarded to the relevant road authorities for comment and / or approval.

3.2 REGIONAL ROUTE 48 (R48) & PROPOSED SITE ACCESS INTERSECTION

Regional Route 48 (R48), a provincial regional route, extends from National Road 10 (N10) through the northern suburbs of De Aar and then continues onto the north. A site visit was undertaken on 18 April 2012 and the following observations along the R48 were recorded during this site visit:

- Horizontal and vertical alignment of R48: Relatively straight with a few horizontal curves in the vicinity of where the access intersection is planned. A flat crest vertical curve is located just to the west of the access position. To the east the road is flat.
- Road level: The natural ground slopes from west to east and the R48 is constructed above natural ground level (approximately 1m) on both sides.
- Road width: 6.0m made up of two, 3.0m lanes, one in each direction.
- Drainage: Culverts located along drainage lines beneath the road at various locations with natural drainage along both road edges.
- Condition of the road surface: Asphalt surface in good to fair condition. Evidence of minor and major rehabilitation works. Pot holes throughout route.
- Services:
    - Electrical power line ± 4m from edge of road on the north and south sides at the proposed access point.
    - R48 crosses a rail line at a level crossing in an east-west direction to the south of the proposed access point
    - Culvert beneath the R48 to the west of the rail line

- Lighting and street lighting: None.
- Street furniture:
    - Guard rails
    - Road signs
- Public transport activity and facilities: None.
- Pedestrian activity and footpaths formal and informal: Very low activity using existing farm access roads and then R48.
- Speed limit: 80km/h
- Vegetation: Low level sparse brush, no trees
- Evidence of animal activity: None.
- Existing access: To the east and west at km92,227 adjacent to rail line. Proposed access is to the north of the rail line heading east.
- Sight distances from existing access point: Restricted to approximately 400m by a horizontal curve to and from the west. No restrictions to and from the east.
- Adjacent accesses: None.
- Possible alternative accesses: Just north of the R48 Voortrekker Street intersection, then crossing the rail line to the site boundary.

The incident record at the De Aar Police Station could not be accessed, however a discussion with the local farmers revealed that there have been no fatal incidents along the R48 in the vicinity of the proposed access point, to their knowledge, and the last serious accident occurred more than five years ago to the west of the access. This accident however didn't involve the two vehicles.

3.3 NATIONAL ROUTE 10 (N10) & ROUTE 48 (R48) INTERSECTION

National Road 10 (N10), a national route, extends in a northwest - southeast direction as it passes the R48 intersection. A site visit was undertaken on 18 April 2012 and the following observations were recorded along the N10 and R48 during this site visit:

- Horizontal and vertical alignment of:
    - N10: Passes through a bend at the intersection and then straight to the east and west of the intersection. Flat vertical alignment on both sides of the intersection.
    - R48: Straight and thereafter a gentle horizontal curve and before straightening up again to the west of the intersection. Flat vertical alignment west of the intersection.
- Road level: Natural ground is flat along both roads and both roads have been constructed above natural ground level (approximately 1.5m) on both sides.
- Road width:
    - R48: 6.0m wide made up of 3.0m lanes, no shoulders.
    - N10: 12.0m wide made up of 3.5m lanes and 2.5m shoulders on either side.

- Drainage: Culverts located along drainage lines beneath the roads at various locations with natural drainage along both road edges.
- Condition of the road surface:
    - R48: Asphalt surface in good to fair condition. Evidence of minor and major rehabilitation works. Pot holes throughout route.
    - N10: Asphalt surface in excellent condition as road has recently been resurfaced and remarked.
- Services:
    - Electrical power line ± 8m from edge of road on north and south of N10 at the intersection.
- Lighting and street lighting: None.
- Street furniture:
    - Road signs, delineators, warning & information signs.
- Public transport activity and facilities: None.
- Pedestrian activity and footpaths formal and informal: Locals cycling in the afternoon from R48 turning left heading up the N10 possibly heading to the next exit off the N10 and back into De Aar.
- Speed limit:
    - R48: 80km/h
    - N10: 120km/h
- Vegetation: Low level sparse brush, no trees
- Evidence of animal activity: None.

The incident record at the De Aar Police Station could not be accessed, however a discussion with the local farmers indicated no fatal or serious accidents in the last five years at this intersection.

3.4 EXISTING TRAFFIC CONDITIONS

Sample peak period traffic counts were conducted during the site visit on the 18 April 2012 at the intersection of the R48 and existing site access, as well as at the intersection of the N10 and R48.

The data showed that both of these roads carry very low volumes of traffic during both the AM and PM peak hour periods. A total of 42 veh/h two-way during the AM peak period and 51 veh/h during the PM peak period were recorded on the R48 just west of the access intersection. A total of 30 veh/h two-way during the AM peak period and 44 veh/h two-way during the PM peak period were recorded on the N10 just west of the N10/R48 intersection.

The SIDRA intersection traffic analysis software was used to assess the existing perfomance of the roads and intersections. The package shows results in terms of Level of Service (LOS) which ranges from LOS A (free-flow conditions and no delay or congestion) to LOS F (breakdown conditions with congestion and very high delays)

based on traffic volumes, intersection geometry and other factors. As expected levels of service were very good due to the low volumes of traffic that were recorded.

Both the N10 and the R48 currently operate at a LOS A with close to zero saturation levels, indicating large spare capacity. Both of the intersections analysed also operate at very good LOS ranging between LOS A & LOS B. Saturation levels at the intersections are also close to zero indicating large spare capacity.

The detailed output of the SIDRA analyses which also shows the peak hour traffic flows are contained in Appendix A.

4. THE PROPOSED MULILO RENEWABLE ENERGY PHOTOVOLTAIC POWER GENERATION FACILITY

4.1 DESCRIPTION OF THE PROJECT

The proposed Mulilo Photovoltaic Project is expected to have a power generating capacity of 10 MW. A photovoltaic project usually comprises the following components:

- PV panel array
- Wiring to central inverters
- Connection to grid
- Balance of plant and ancillary facilities.

PV Array

The facility is proposed to have an array of photovoltaic panels covering just less than 17 hectares. The 10MW facility will be made up of a 500m x 320m array of photovoltaic panels laid in rows. Within the site there will be 160 tables, with each table consisting of 2 blocks arranged in 80 rows. The final number of panels per site will be dependent on the final configuration of the array and the power rating of the panels. The distance between rows will be around 8.0 metres, in order to ensure that the panels do not cast shadows on each other. The panel mounting method will determine the height of the panels above ground, but it is expected that the height of the panels will be just less than 2.5 metres. The size of each panel will be about 1.7 x 1.0m. The PV panels will be mounted on steel structures which are fixed into the ground through concrete strip foundation.

The PV sites will be connected to ten central inverters with a rated power of 2 x PV 500kW. The inverters will be housed in small structures situated close to the panels and will then be connected to a central connection centre which will be the point of connection to the national electricity grid. The central inverters will convert direct current (DC) to alternating current (AC) at the required frequency to feed into the Eskom grid. Each inverter will have an output voltage of about 240Vac.

Fixed tilt panels are proposed to be used for the development rather than tracking panels. The panels will face north and will be tilted at 20 degrees which is the optimum angle for collection of sunlight at the project site. The panels will have low-reflective surfaces to enhance the absorption of sunlight.

Connection to the Grid

The grid connection requires transformation of the voltage from the 240Vac inverter output. The inverter output will be stepped up to 22kV via transformers housed in the inverter houses. Underground cables will be routed to a central AC bus bar in connection centre located within the confines of the PV plant.

Transmission cables to the grid from the plant will be via overhead or lines. A mini substation will route electricity to the grid.

The site is within a short distance of the Eskom substation which is linked to the National Grid (see Figure 1 above).

Centralised Control Facility and Security

A building anticipated to be under 60m² in area will be constructed to accommodate control facilities for the PV plant. Monitoring and security equipment for the PV plant will also be housed in this facility.

In order to ensure the security of the facility, the entire plant will be surrounded by perimeter fencing which will be supplied with sensors and alarms to detect any irregular activity. Amongst the technologies available, optic fibre may be used, in which case trenching of the cables will be required. In order to maximise security and to assist with the detection of any breaches, CCTV cameras and flood lights will also be installed.

The preliminary Site Layout Plan is contained in Annexure D to this report.

4.2 HOURS OF OPERATION

The facility will be operational 24 hours a day, however, for the purpose of estimating traffic impact it is anticipated that during both construction and operations, the facility will only generate traffic during the 12 daylight hours.

The traffic analysis will therefore include the AM peak hour, the PM peak hour and the 12 hour daylight period.

4.3 ACCESS TO THE PROPOSED FACILITY

The proposed access to the facility will be constructed north of the railway line off the R48 as shown in Figure 1 above. This access road will be built during the construction of the power generation facility and be used for all construction and operational activity of the plant. The majority of the facility is planned to be located at the eastern end of the site, north of the R48. The majority of the traffic generated by the proposed power

generation facility is expected to enter and leave the site via the proposed single access point.

5. TRAFFIC GENERATION AND DISTRIBUTION OF THE PROPOSED MULILO PHOTO VOLTAIC POWER GENERATION FACILITY

5.1 TRAFFIC GENERATION

Table 1 below presents the activities that are expected to generate traffic during construction phase of the facility:

Table 1: Activities that are Expected to Generate Traffic During Construction of the Mulilo Facility

Activity	One-Way Trip / Month	One-Way Trip / Week	Average One-Way Trip / Day	Maximum Possible Two-Way Trips / Hour	
				AM Peak Hour	PM Peak Hour
Delivery of Panels	56	15	3	2	2
Delivery of Foundation Slabs	220	52	10	4	4
Delivery of Inverters			10*	4	4
Delivery of Transformers			8*	4	4
Delivery of Inverter Houses	20	5	1	2	2
Delivery of Mounting Systems	16	4	1	2	2
Delivery of Cables			4*	2	2
General Delivery of Construction Materials	22	5	1	2	2
TOTALS	334	81	38	22	22

* One off deliveries

The one-way daily trips have been converted to two-way hourly trips; arrive laden and leave empty within the hour is equivalent to two trips. Also for maximum potential impact on any given average weekday, it has been assumed that deliveries, even once off deliveries, will occur during an AM and PM peak period. This is a very conservative

approach as it is unlikely that all deliveries including once off deliveries will occur during the same hour. Table 2 below presents the activities that are expected to generate traffic during the operational phase of the facility:

Table 2: Activities that are expected to Generate Traffic During Operations of the Mulilo Facility

Activity	One-Way Trip / Month	One-Way Trip / Week	Average One-Way Trip / Day	Maximum Possible Two-Way Trips / Hour	
				AM Peak Hour	PM Peak Hour
Delivery of Potable Water	22	1	1	2	2
Bus Transporting Staff	22	5	1*	1	1
Sanitation Waste Disposal	4	1	1	2	2
General Service Deliveries	80	20	4	2	2
Private Vehicles	400	70	15	15	15
TOTALS	**528**	**97**	**21**	**22**	**22**

* It is assumed that the bus transporting staff stays on the premises.

5.2 TRIP DISTRIBUTION

With the exception of the foundation slabs and the general construction materials, all equipment, which will be imported from abroad, is expected to be delivered along the N1 and N10 to the site, from Cape Town. These vehicles will then return empty to the south.

The foundation slabs and general construction material during construction as well as all operational traffic are expected to come from and return to the east (De Aar) along the R48.

5.3 PEAK HOUR TRAFFIC GENERATION

The highest AM and PM peak hour traffic generation will occur during construction and when the first phases of the facility are operational. There will thus be a combination of both construction and operational traffic using the access at the same time which is considered to be the maximum impact scenario.

Using the above traffic generation and distribution assumptions, the peak hour and daily traffic generated by the proposed Mulilo power generation facility for the construction and operations combined has been calculated and assigned onto the R48 and N10 via the access point off the R48. These combined peak hour and daily traffic flows are shown in Figure 2 below:

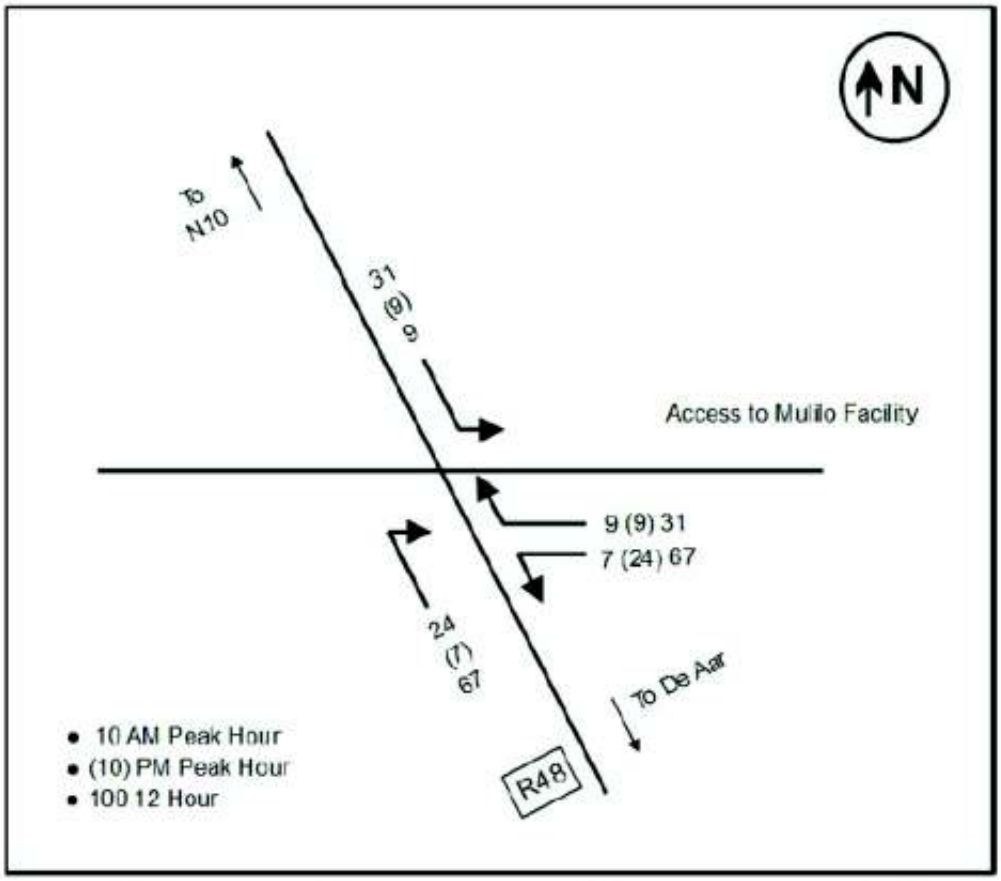

Figure 2: AM Peak Hour, PM Peak Hour and Daily Traffic Generated by the Proposed Mulilo Power Generation Facility

The above peak hour and daily traffic generation figures are considered to be very low.

The generated traffic was added to the existing traffic and analysed using the SIDRA analysis package. The results of this analysis showed that the LOS at the R48 and site access intersection will reduce slightly from a LOS B to a LOS C during the AM and PM peak periods.

The LOS at the N10 and R48 intersection will remain unchanged at a LOS B. Both the N10 and R48 two-way traffic will operate unchanged at a LOS A. The existing plus facility generated traffic and the detailed analysis results are contained in Annexure A.

6. TRAFFIC IMPACT STATEMENT

6.1 TRAFFIC IMPLICATIONS OF THE PROPOSED DEVELOPMENT

The existing plus Mulilo development generated traffic flows on the surrounding road network are still very low. The N10 and R48 will still operate at a very good Level of Service A, even with this additional traffic. The new, left- and right-turning traffic from

the R48 into the proposed formal access to the facility is not considered to be high during both construction and operation, and no exclusive right-turn lanes or left-turn deceleration lanes will be required to accommodate the facility generated traffic. The access approach from the site to the R48 only needs to be single lane which will be able to accommodate both the left-turning and right-turning traffic from the site.

6.2 LOCATION OF ACCESS

From a geometric and road safety perspective, the location of the existing and proposed access to the facility on the R48 is considered to be acceptable although there are numerous potential alternative locations should this existing access not be acceptable to Mulilo, the landowner or the Emthanjeni Local Municipality for any reason.

6.3 ROAD SAFETY

Road safety conditions along the N10 and the R48 in the vicinity of the site are considered to be good with an unconfirmed low accident rate. The speed limit on the R48 passing the site is 80 km/h and the shoulder and stopping sight distance conditions to and from both directions at the location of the proposed access are considered to be acceptable for this speed limit.

There is no evidence of public transport activity nor wild or domestic animal activity within the road reserve in the vicinity of the site. Minimal pedestrian activity was observed, however due to the low volume of traffic, no remedial measures need to be taken.

As the volume of traffic that enters and leaves this existing access point is expected to increase noticeably, particularly when there will be both construction and operational activities occurring at the same time, advanced warning of this side road activity will be required.

6.4 ABNORMAL LOADS

Mulilo has confirmed that the construction of the facility will not generate any abnormal loads. All loads will conform to the height and weight restrictions of normal loads and will thus be able to travel along the local, provincial and national road network. As such specific evaluation of the roads that will form the route for the equipment and materials for eth construction and operation of the facility will not be required.

6.5 CONDITION OF ROAD SURFACES

The roads condition assessment showed that only the R48 had sections that were in fair condition with potholes along its entire length in the vicinity of the site. The road therefore currently requires to be repaired and this is the responsibility of the Northern Cape Department of Transport, Roads and Public Works (NC DoTRPW). Construction of the photovoltaic renewable energy facility is likely to accelerate the deterioration of this road and it is therefore recommended that the NC DoTRPW be requested to repair

the potholes for the section between the N10 and the access to the site prior to construction commencing. During construction and as part of the contract, it will be the responsibility of the contractor to monitor the condition of the R48 and repair the road where it becomes damaged due to construction traffic.

All other roads are in good and excellent condition and are unlikely to be adversely impacted by the construction or operation of the proposed photovoltaic facility.

6.6 RAIL CROSSING

The analysis showed that the increase in the volume of traffic expected to cross the rail level crossing located just to the east of the proposed access intersection will be low and will be predominantly light vehicles as construction traffic is expected to come from the N10.

6.7 DRIVER DISTRACTION

Probably one of the biggest potential impacts of this photovoltaic power generation facility is driver distraction, firstly from the novelty impact of the facility as there are not many such facilities currently in South Africa and secondly from potential glare and / or reflection off the panels which may distract drivers as they are travelling past the facility at 80km/h. The photovoltaic facility will be located on the eastern boundary of the site approximately 850m to the east of the R48, which will significantly reduce the distraction the panels will have on drivers. The panels will be located to the east of the R48 and will be north facing away from the R48 and therefore it will not be possible for the panels to reflect onto the R48. The panels will be mounted as shown on Figure 3 below and described as follows:

- At a 20° angle facing north.
- Approaching traffic on the R48 from the west will therefore have a side view of the panels, and traffic approaching from the south east will see the back of the panels.
- The panels themselves will be dark-blue with a non-reflective (matt) finish.
- The steel support structures will also be given a non-reflective (matt) finish.

On the basis of the above, it will not be possible for any reflection from the panels to occur onto the R48 from the south east or west.

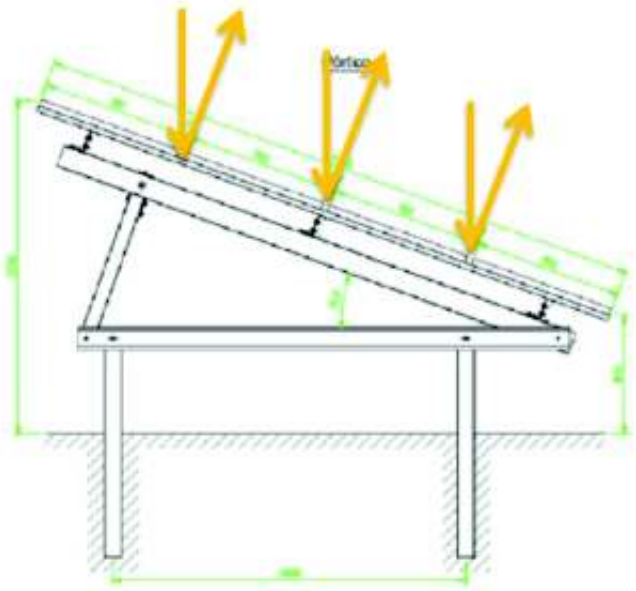

Figure 3: Photovoltaic Panel Mounting and Reflection

6.8 LIAISON WITH ROAD AUTHORITIES

This report has been submitted to SANRAL, the Northern Cape Department of Transport, Roads and Public Works and the Emthanjeni Municipality for comment and / or approval as necessary. Copies of these correspondences are contained in Annexure C.

7. RECOMMENDATIONS

Based on the above analysis the following is recommended:

- Temporary high visibility advanced warning signs Types W107 and W108 (Intersection Ahead) are erected on the R48 in both directions approaching the position of the access to the facility during construction and that permanent high visibility advance warning signs Types W107 and W108 (Intersection Ahead) are erected on the R48 once construction is completed and the facility is fully operational.
- The NC DoTRPW be requested to repair the potholes for the section between the N10 and the access to the site prior to construction commencing.
- During construction and as part of the contract, the contractor is to be required to monitor the condition of the R48 and repair the road where it becomes damaged due to construction traffic.
- Whilst theoretically there is no potential for reflections from the panels and infrastructure to affect passing motorists on the R48, the reflections from the arrays are to be monitored from the first installation to confirm this.

No other remedial or mitigation measures will be required to accommodate the additional traffic generated by the proposed Mulilo Renewable Energy photovoltaic power generation facility.

This Traffic Impact Statement has been prepared in accordance with the published guidelines for Traffic Impact Assessments and has no limitations as far as a specialist study for this project is concerned.

ANNEXURE A

SIDRA INTERSECTION OUTPUT DATA – EXISTING TRAFFIC

MOVEMENT SUMMARY

Site: N10 AM Peak

N10 West of Site Access

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: N10 East											
22	T	21	0.0	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
Approach		21	0.0	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
North West: N10 West											
28	T	25	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
Approach		25	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
All Vehicles		46	0.0	0.013	0.0	NA	0.0	0.0	0.00	0.00	120.0

LOS (Aver. Int. Delay): **NA**. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 24 April 2012 14:26:58
SIDRA INTERSECTION 5.0.5.1510
Project: C:\Users\Justin Jank\Documents\Projects\108421 - Mulilo Solar Farms\De Aar\De Aar Traffic Data.sip
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: N10 PM Peak

N10 West of Site Access

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: N10 East											
22	T	19	0.0	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
Approach		19	0.0	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
North West: N10 West											
28	T	13	0.0	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
Approach		13	0.0	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
All Vehicles		32	0.0	0.010	0.0	NA	0.0	0.0	0.00	0.00	120.0

LOS (Aver. Int. Delay): **NA**. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: R48 AM Peak

R48 West of Site Access

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: R48 East											
22	T	26	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		26	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
North West: R48 West											
28	T	27	0.0	0.014	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		27	0.0	0.014	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
All Vehicles		54	0.0	0.014	0.0	NA	0.0	0.0	0.00	0.00	100.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: R48/N10 AM Peak

Intersection of N10/R48
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: N10 East											
5	T	4	0.0	0.003	10.1	LOS B	0.0	0.1	0.02	0.47	81.7
6	R	1	0.0	0.003	9.3	LOS A	0.0	0.1	0.02	1.69	47.9
Approach		5	0.0	0.003	9.9	LOS B	0.0	0.1	0.02	0.72	71.6
North East: RoadName											
24	L	1	0.0	0.002	11.6	LOS B	0.0	0.1	0.02	0.97	45.6
26	R	1	0.0	0.002	10.2	LOS B	0.0	0.1	0.02	0.99	46.7
Approach		2	0.0	0.002	10.9	LOS B	0.0	0.1	0.02	0.98	46.2
West: N10 West											
10	L	1	0.0	0.001	8.3	LOS A	0.0	0.0	0.00	1.00	48.8
11	T	1	0.0	0.001	10.1	LOS B	0.0	0.0	0.00	0.43	82.3
Approach		2	0.0	0.001	9.2	LOS B	0.0	0.0	0.00	0.72	61.4
All Vehicles		9	0.0	0.003	10.0	NA	0.0	0.1	0.02	0.77	61.7

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

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SIDRA INTERSECTION 5.0.5.1510
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: R48/N10 PM Peak

Intersection of N10/R48
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: N10 East											
5	T	3	0.0	0.002	10.1	LOS B	0.0	0.1	0.04	0.45	81.1
6	R	1	0.0	0.002	9.3	LOS A	0.0	0.1	0.04	1.52	47.9
Approach		4	0.0	0.002	9.9	LOS B	0.0	0.1	0.04	0.72	69.2
North East: RoadName											
24	L	1	0.0	0.002	11.5	LOS B	0.0	0.1	0.04	0.96	45.6
26	R	1	0.0	0.002	10.3	LOS B	0.0	0.1	0.04	0.97	46.7
Approach		2	0.0	0.002	10.9	LOS B	0.0	0.1	0.04	0.96	46.2
West: N10 West											
10	L	1	0.0	0.003	8.3	LOS A	0.0	0.0	0.00	1.47	48.8
11	T	4	0.0	0.003	10.1	LOS B	0.0	0.0	0.00	0.48	82.3
Approach		5	0.0	0.003	9.7	LOS B	0.0	0.0	0.00	0.68	72.5
All Vehicles		12	0.0	0.003	10.0	NA	0.0	0.1	0.02	0.75	64.6

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 24 April 2012 12:06:57
SIDRA INTERSECTION 5.0.5.1510
Project: C:\Users\Justin Jank\Documents\Projects\10842 1 - Mulilo Solar Farms\De Aar\De Aar Traffic Data.sip
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: R48 PM Peak

R48 West of Site Access

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: R48 East											
22	T	26	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		26	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
North West: R48 West											
28	T	18	0.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		18	0.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
All Vehicles		44	0.0	0.013	0.0	NA	0.0	0.0	0.00	0.00	100.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: R48/Site Access AM Peak

Intersection of R48/Existing Gravel Site Access
Stop (All-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: R48 East - De Aar											
21	L	1	0.0	0.015	12.5	LOS B	0.0	0.1	0.00	1.07	46.3
22	T	26	0.0	0.015	12.1	LOS B	0.0	0.1	0.00	1.00	46.7
23	R	1	0.0	0.015	12.9	LOS B	0.0	0.1	0.00	1.08	46.0
Approach		28	0.0	0.015	12.1	LOS B	0.0	0.1	0.00	1.00	46.7
East: Existing Farm Access											
4	L	1	0.0	0.003	15.5	LOS C	0.0	0.1	0.54	1.14	43.1
5	T	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.14	44.1
6	R	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.13	44.1
Approach		3	0.0	0.003	14.6	LOS C	0.0	0.1	0.54	1.14	43.8
North West: R48 West											
27	L	1	0.0	0.015	12.5	LOS B	0.0	0.1	0.00	1.07	46.3
28	T	27	0.0	0.015	12.1	LOS B	0.0	0.1	0.00	1.00	46.7
29	R	1	0.0	0.015	12.9	LOS B	0.0	0.1	0.00	1.09	46.0
Approach		29	0.0	0.015	12.1	LOS B	0.0	0.1	0.00	1.00	46.7
West: Existing Farm Access											
10	L	1	0.0	0.003	15.5	LOS C	0.0	0.1	0.54	1.14	43.1
11	T	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.14	44.1
12	R	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.13	44.1
Approach		3	0.0	0.003	14.6	LOS C	0.0	0.1	0.54	1.14	43.8
All Vehicles		64	0.0	0.015	12.4	LOS B	0.0	0.1	0.05	1.01	46.4

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 24 April 2012 11:51:27
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: R48/Site Access PM Peak

Intersection of R48/Existing Gravel Site Access
Stop (All-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: R48 East - De Aar											
21	L	1	0.0	0.015	12.5	LOS B	0.0	0.1	0.00	1.07	46.3
22	T	27	0.0	0.015	12.1	LOS B	0.0	0.1	0.00	1.00	46.7
23	R	1	0.0	0.015	12.9	LOS B	0.0	0.1	0.00	1.09	46.0
Approach		29	0.0	0.015	12.1	LOS B	0.0	0.1	0.00	1.00	46.7
East: Existing Farm Access											
4	L	1	0.0	0.003	15.5	LOS C	0.0	0.1	0.54	1.14	43.1
5	T	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.14	44.1
6	R	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.13	44.1
Approach		3	0.0	0.003	14.6	LOS C	0.0	0.1	0.54	1.14	43.8
North West: R48 West											
27	L	1	0.0	0.015	12.5	LOS B	0.0	0.1	0.00	1.07	46.3
28	T	26	0.0	0.015	12.1	LOS B	0.0	0.1	0.00	1.00	46.7
29	R	1	0.0	0.015	12.9	LOS B	0.0	0.1	0.00	1.08	46.0
Approach		28	0.0	0.015	12.1	LOS B	0.0	0.1	0.00	1.00	46.7
West: Existing Farm Access											
10	L	1	0.0	0.003	15.5	LOS C	0.0	0.1	0.54	1.14	43.1
11	T	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.14	44.1
12	R	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.13	44.1
Approach		3	0.0	0.003	14.6	LOS C	0.0	0.1	0.54	1.14	43.8
All Vehicles		64	0.0	0.015	12.4	LOS B	0.0	0.1	0.05	1.01	46.4

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 24 April 2012 12:03:02
SIDRA INTERSECTION 5.0.5.1510
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SIDRA INTERSECTION

SIDRA INTERSECTION OUTPUT DATA – EXISTING PLUS GENERATED TRAFFIC

MOVEMENT SUMMARY

Site: R48/Site Access Existing Plus Generated PM Peak

Intersection of R48/Existing Gravel Site Access
Stop (All-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: R48 East - De Aar											
21	L	1	0.0	0.018	12.5	LOS B	0.0	0.2	0.00	1.06	46.3
22	T	27	0.0	0.019	12.1	LOS B	0.0	0.2	0.00	0.98	46.7
23	R	7	0.0	0.019	12.9	LOS B	0.0	0.2	0.00	1.07	46.0
Approach		36	0.0	0.019	12.3	LOS B	0.0	0.2	0.00	1.00	46.6
East: Existing Farm Access											
4	L	25	0.0	0.034	15.1	LOS C	0.1	0.6	0.47	1.14	43.3
5	T	1	0.0	0.034	13.7	LOS B	0.1	0.6	0.47	1.14	44.3
6	R	9	0.0	0.034	13.7	LOS B	0.1	0.6	0.47	1.13	44.3
Approach		35	0.0	0.034	14.7	LOS C	0.1	0.6	0.47	1.14	43.6
North West: R48 West											
27	L	9	0.0	0.019	12.5	LOS B	0.0	0.2	0.00	1.06	46.3
28	T	26	0.0	0.019	12.1	LOS B	0.0	0.2	0.00	0.98	46.7
29	R	1	0.0	0.019	12.9	LOS B	0.0	0.2	0.00	1.07	46.0
Approach		37	0.0	0.019	12.2	LOS B	0.0	0.2	0.00	1.00	46.6
West: Existing Farm Access											
10	L	1	0.0	0.004	15.7	LOS C	0.0	0.1	0.56	1.14	43.0
11	T	1	0.0	0.004	14.3	LOS B	0.0	0.1	0.56	1.14	44.0
12	R	1	0.0	0.004	14.3	LOS B	0.0	0.1	0.56	1.13	44.0
Approach		3	0.0	0.004	14.7	LOS C	0.0	0.1	0.56	1.14	43.7
All Vehicles		112	0.0	0.034	13.1	LOS B	0.1	0.6	0.17	1.05	45.5

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 25 April 2012 11:13:48
SIDRA INTERSECTION 5.0.5.1510
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: R48/Site Access Existing Plus Generated AM Peak

Intersection of R48/Existing Gravel Site Access
Stop (All-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: R48 East - De Aar											
21	L	1	0.0	0.028	12.6	LOS B	0.0	0.3	0.00	1.04	46.3
22	T	26	0.0	0.028	12.1	LOS B	0.0	0.3	0.00	0.97	46.7
23	R	25	0.0	0.028	12.9	LOS B	0.0	0.3	0.00	1.05	46.0
Approach		53	0.0	0.028	12.5	LOS B	0.0	0.3	0.00	1.01	46.4
East: Existing Farm Access											
4	L	1	0.0	0.003	15.5	LOS C	0.0	0.1	0.54	1.14	43.1
5	T	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.14	44.1
6	R	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.13	44.1
Approach		3	0.0	0.003	14.6	LOS C	0.0	0.1	0.54	1.14	43.6
North West: R48 West											
27	L	9	0.0	0.020	12.5	LOS B	0.0	0.2	0.00	1.06	46.3
28	T	27	0.0	0.020	12.1	LOS B	0.0	0.2	0.00	0.98	46.7
29	R	1	0.0	0.020	12.9	LOS B	0.0	0.2	0.00	1.07	46.0
Approach		38	0.0	0.020	12.2	LOS B	0.0	0.2	0.00	1.00	46.6
West: Existing Farm Access											
10	L	1	0.0	0.003	15.5	LOS C	0.0	0.1	0.54	1.14	43.1
11	T	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.14	44.1
12	R	1	0.0	0.003	14.2	LOS B	0.0	0.1	0.54	1.13	44.1
Approach		3	0.0	0.003	14.6	LOS C	0.0	0.1	0.54	1.14	43.6
All Vehicles		97	0.0	0.028	12.5	LOS B	0.0	0.3	0.04	1.01	46.3

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 25 April 2012 11:13:48
SIDRA INTERSECTION 5.0.5.1510
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Two-Way R48 Existing Plus Generated AM Peak

R48 West of Site Access

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: R48 East											
22	T	26	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		26	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
North West: R48 West											
28	T	37	0.0	0.015	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		37	0.0	0.015	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
All Vehicles		63	0.0	0.015	0.0	NA	0.0	0.0	0.00	0.00	91.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 25 April 2012 11:13:48
SIDRA INTERSECTION 5.0.5.1510
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Two-Way R48 Existing Plus Generated PM Peak

R48 West of Site Access

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: R48 East											
22	T	26	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		26	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
North West: R48 West											
28	T	27	0.0	0.014	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
Approach		27	0.0	0.014	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
All Vehicles		54	0.0	0.014	0.0	NA	0.0	0.0	0.00	0.00	89.5

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 25 April 2012 11:13:48
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Two-Way N10 Existing Plus Generated AM Peak

N10 West of Site Access

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: N10 East											
22	T	31	0.0	0.016	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
Approach		31	0.0	0.016	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
North West: N10 West											
28	T	25	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
Approach		25	0.0	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
All Vehicles		56	0.0	0.016	0.0	NA	0.0	0.0	0.00	0.00	120.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 25 April 2012 11:13:49
SIDRA INTERSECTION 5.0.5.1510
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Two-Way N10 Existing Plus Generated PM Peak

N10 West of Site Access

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South East: N10 East											
22	T	28	0.0	0.015	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
Approach		28	0.0	0.015	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
North West: N10 West											
28	T	13	0.0	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
Approach		13	0.0	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	120.0
All Vehicles		41	0.0	0.015	0.0	NA	0.0	0.0	0.00	0.00	120.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: R48/N10 Existing Plus Generated PM Peak

Intersection of N10/R48
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: N10 East											
5	T	3	0.0	0.008	10.1	LOS B	0.0	0.3	0.03	0.38	80.7
6	R	9	0.0	0.008	9.3	LOS A	0.0	0.3	0.03	0.87	47.7
Approach		13	0.0	0.008	9.5	LOS B	0.0	0.3	0.03	0.75	53.2
North East: RoadName											
24	L	1	0.0	0.002	11.7	LOS B	0.0	0.1	0.04	0.96	45.6
26	R	1	0.0	0.002	10.3	LOS B	0.0	0.1	0.04	0.97	46.7
Approach		2	0.0	0.002	11.0	LOS B	0.0	0.1	0.04	0.97	46.2
West: N10 West											
10	L	1	0.0	0.003	8.3	LOS A	0.0	0.0	0.00	1.47	48.8
11	T	4	0.0	0.003	10.1	LOS B	0.0	0.0	0.00	0.48	82.3
Approach		5	0.0	0.003	9.7	LOS B	0.0	0.0	0.00	0.68	72.5
All Vehicles		20	0.0	0.008	9.7	NA	0.0	0.3	0.03	0.75	56.2

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 25 April 2012 11:13:48
SIDRA INTERSECTION 5.0.5.1510
Project: C:\Users\Justin Jank\Documents\Projects\108421 - Mulilo Solar Farms\De Aar\De Aar Traffic Data.sip
8000990, AURECON SOUTH AFRICA (PTY) LTD, LIMITED

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www.sidrasolutions.com

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: R48/N10 Existing Plus Generated AM Peak

Intersection of N10/R48
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: N10 East											
5	T	4	0.0	0.009	10.1	LOS B	0.0	0.3	0.02	0.39	81.4
6	R	9	0.0	0.009	9.3	LOS A	0.0	0.3	0.02	0.92	47.8
Approach		14	0.0	0.009	9.5	LOS B	0.0	0.3	0.02	0.76	54.6
North East: RoadName											
24	L	1	0.0	0.002	11.6	LOS B	0.0	0.1	0.02	0.98	45.6
26	R	1	0.0	0.002	10.3	LOS B	0.0	0.1	0.02	0.99	46.7
Approach		2	0.0	0.002	11.0	LOS B	0.0	0.1	0.02	0.98	46.1
West: N10 West											
10	L	1	0.0	0.001	8.3	LOS A	0.0	0.0	0.00	1.00	48.8
11	T	1	0.0	0.001	10.1	LOS B	0.0	0.0	0.00	0.43	82.3
Approach		2	0.0	0.001	9.2	LOS B	0.0	0.0	0.00	0.72	61.4
All Vehicles		18	0.0	0.009	9.6	NA	0.0	0.3	0.02	0.78	54.3

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (HCM).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: 25 April 2012 11:13:48
SIDRA INTERSECTION 5.0.5.1510
Project: C:\Users\Justin Jank\Documents\Projects\108421 - Mulilo Solar Farms\De Aar\De Aar Traffic Data.sip
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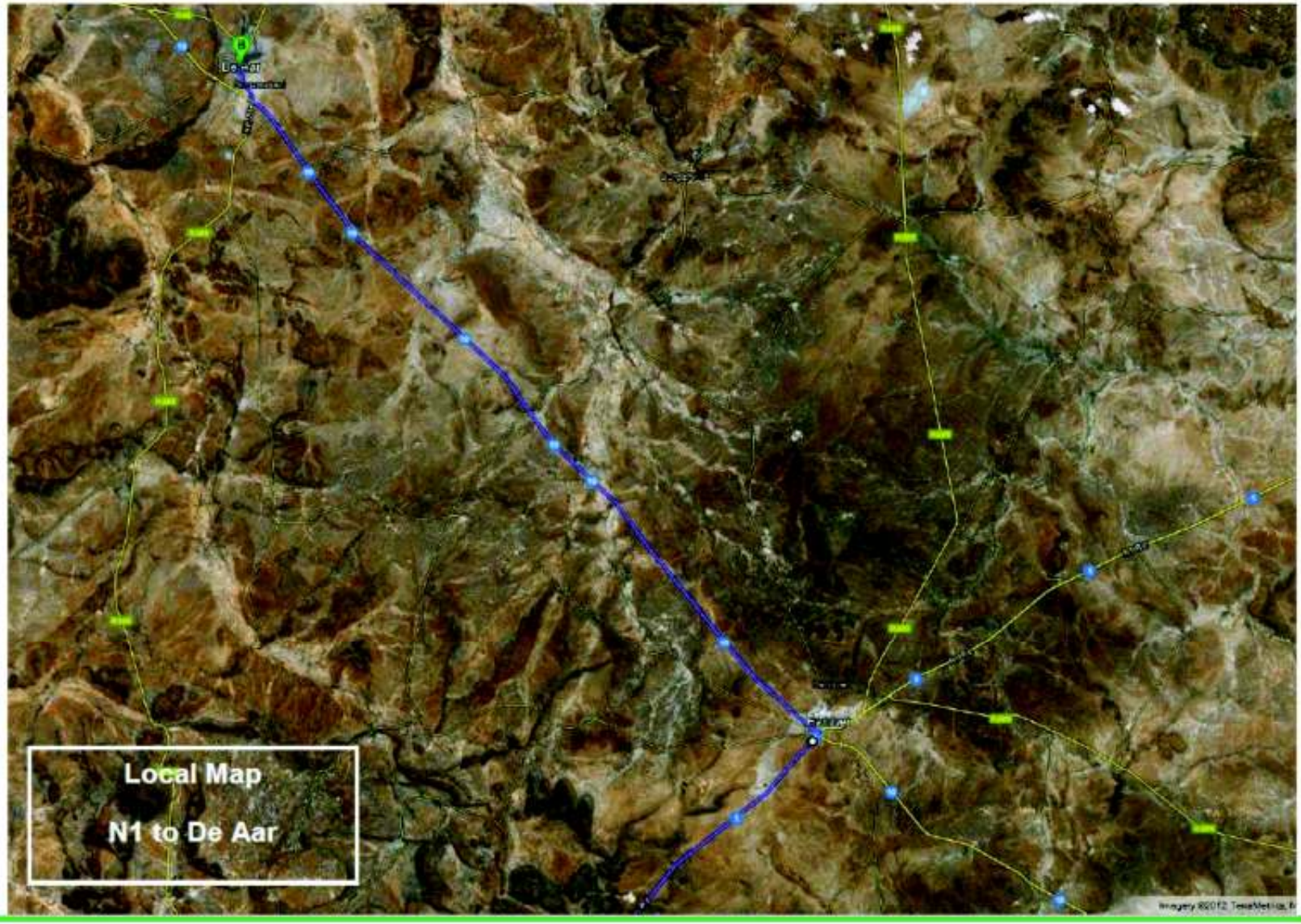
SIDRA INTERSECTION

ANNEXURE B

LOCAL AND REGIONAL AERIAL MAPS (SOURCE: GOOGLE MAPS)


Regional Map
Cape Town Harbour
to De Aar
Cape Town


Local Map
Cape Town Harbor to
N1 toward De Aar
Maitland
Pinelands


Local Map
N1 to De Aar

ANNEXURE C

APPLICATION LETTERS TO AUTHORITIES

eThekwini

South Africa

aurecon

Our reference: 108421
Your reference:

26 April 2012

Emthanjeni Local Municipality
45 Voortrekker Street
De Aar
7000

Email : w.lubbe@emthanjeni.co.za

Attention: Willie Lubbe

Dear Mr Willie

SPECIALIST TRAFFIC AND TRANSPORTATION STUDY FOR A PROPOSED PHOTOVOLTAIC RENEWABLE ENERGY FACILITY ON THE R48 AT DE AAR

Mulilo Renewable Energy Solar PV De Aar (PTY) LTD proposes to develop a photovoltaic power generation facility on the R48 near De Aar. Mulilo has appointed Aurecon South Africa (Pty) Ltd to undertake a specialist traffic and transportation study of this proposed facility as part of the Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act (NEMA), (Act No. 107 of 1998) as amended in 2010, for the construction and operation of the facility and associated infrastructure.

During construction, the equipment and materials for the facility will be routed from Cape Town harbour via the N1 and N10 to the site and will not use the local De Aar road network. Light vehicle construction traffic and light vehicle traffic during operations are, however, expected to use the local De Aar road network the additional traffic volumes are so low that impact of this additional traffic will be negligible.

Notwithstanding this, please find attached a copy of the Specialist Traffic and Transportation Report for this proposed photovoltaic power generation facility near De Aar for your records.

It would be appreciated if you could review the report and comment / approve the report accordingly.

Leading. Vibrant. Global.

Do not hesitate to contact us should you require any further information or should you wish to clarify any aspects of this report.

Yours faithfully
AURECON SOUTH AFRICA (PTY) LTD

M A van Tonder PrEng

eThekwini
3rd Floor Park Row Building
School Road
Pinetown 3600

PO Box 932
Pinetown 3600
South Africa

T +27 31 714 2500
F +27 31 702 0287
E ethekwini@aurecongroup.com
W aurecongroup.com

aurecon

Our reference: 108421
Your reference:

26 April 2012

Northern Cape Department of Transport,
Roads and Public Works
Private Bag X1368
Southey Chambers
Southey Street
Kimberly
8300

Email : klawrence@ncpg.gov.za (Secretary: Kaylene Lawrence)

Attention: Ruth Palm

Dear Ms Ruth

SPECIALIST TRAFFIC AND TRANSPORTATION STUDY FOR A PROPOSED PHOTOVOLTAIC RENEWABLE ENERGY FACILITY ON THE R48 AT DE AAR

Mulilo Renewable Energy Solar PV De Aar (PTY) LTD proposes to develop a photovoltaic power generation facility on the R48 near De Aar. Mulilo has appointed Aurecon South Africa (Pty) Ltd to undertake a specialist traffic and transportation study of this proposed facility as part of the Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act (NEMA), (Act No. 107 of 1998) as amended in 2010, for the construction and operation of the facility and associated infrastructure.

On behalf of Mulilo Renewable Energy Solar PV De Aar (PTY) LTD we hereby wish to apply for formal access to the site off the R48. The existing farm access will be replaced by the formal access to the facility. In this regard, please find attached a copy of the Specialist Traffic and Transportation Report for this proposed photovoltaic power generation facility near De Aar for your records. The report has been undertaken in accordance with SA published guidelines for Traffic Impact Assessments.

It would be appreciated if you could review the report and comment on / approve the proposed access accordingly.

Aurecon South Africa (Pty) Ltd Reg No 1977/003711/07
Board of Directors
[illegible]

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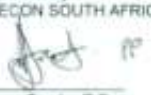
Do not hesitate to contact us should you require any further information or should you wish to clarify any aspects of this report.

Yours faithfully
AURECON SOUTH AFRICA (PTY) LTD



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F +27 31 702 0282
E ethekwini@aurecongroup.com
W aurecongroup.com

PO Box 952
Pinetown 3600
South Africa

aurecon

Our reference: 108421
Your reference:

26 April 2012

SANRAL
Western Region
Private Bag X19
Bellville
7535

Email : Runkelc@nra.co.za

Attention: Ms Colene Runkel

Dear Ms Runkel

SPECIALIST TRAFFIC AND TRANSPORTATION STUDY FOR A PROPOSED PHOTOVOLTAIC RENEWABLE ENERGY FACILITY ON THE R48 AT DE AAR

Mulilo Renewable Energy Solar PV De Aar (PTY) LTD proposes to develop a photovoltaic power generation facility on the R48 near De Aar. Mulilo has appointed Aurecon South Africa (Pty) Ltd to undertake a specialist traffic and transportation study of this proposed facility as part of the Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act (NEMA), (Act No. 107 of 1998) as amended in 2010, for the construction and operation of the facility and associated infrastructure.

During construction, the equipment and materials for the facility will be routed from Cape Town harbour via the N1 and N10 to the site in De Aar. The intersection of the N10 and the R48 is thus likely to experience an increase in traffic flows and this has been assessed in the study.

In this regard, please find attached a copy of the Specialist Traffic and Transportation Report for this proposed photovoltaic power generation facility near De Aar for your records.

It would be appreciated if you could review the report and comment / approve the report accordingly.

Aurecon South Africa (Pty) Ltd Reg No 1977/003711/07
Board of Directors
[illegible]

Leading. Vibrant. Global.

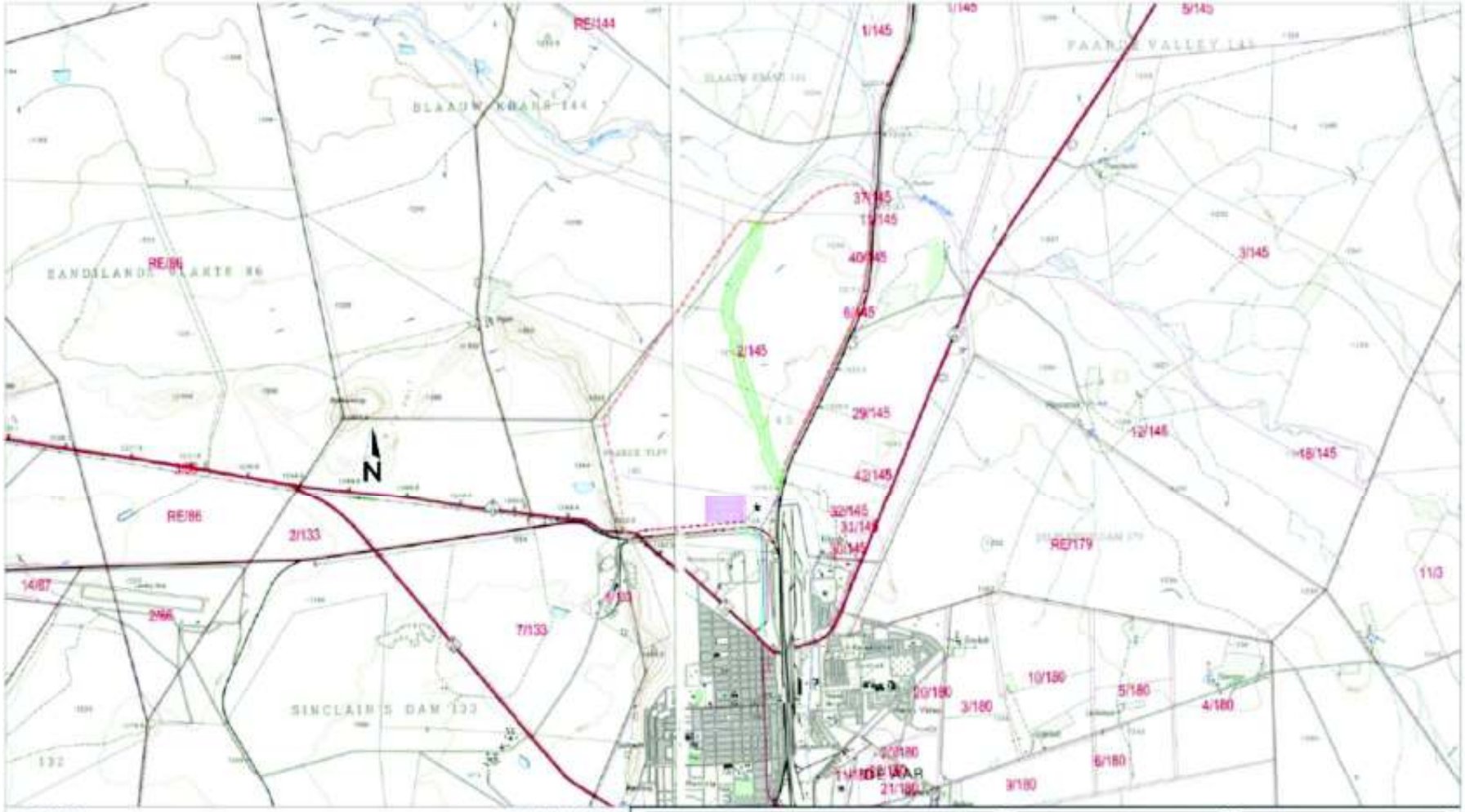
Do not hesitate to contact us should you require any further information or should you wish to clarify any aspects of this report.

Yours faithfully
AURECON SOUTH AFRICA (PTY) LTD

M A van Tonder PrEng

ANNEXURE D

PRELIMINARY SITE LAYOUT PLAN OF THE PROPOSED MULILO PHOTOVOLTAIC POWER GENERATION FACILITY


RE/144
BLAAUW KRANS 144
RE/86
SANDILANDS PLAATS 86
RE/86
2/133
7/133
SINCLAIR'S DAM 133
14/87
2/66
132
1/145
37/145
40/145
6/145
2/145
29/145
42/145
32/145
31/145
3/145
12/146
18/145
RE/179
11/3
10/180
5/180
4/180
3/180
6/180
9/180
20/180
21/180
N
LEGEND
PV DIMENSIONS
PROJECT
PHOTOVOLTAIC POWER GENERATION FACILITY
MULILO RENEWABLE ENERGY SOLAR PV DE AAR (PTY) LTD
SITE
PROPOSED POSITION FOR A 10MW FACILITY
SITE 1
Drawn By
Designed By
Reviewed By
Approved By
Scale
1 : 50 000
Date
SEPT 2011
Project No.
DA PV1
Dwg No.
DAPV 1
Rev.
0
MULILO
RENEWABLE ENERGY

APPENDIX 8

WASTE MANAGEMENT PLAN

CONSTRUCTION WASTE MANAGMENT PLAN FOR THE PHOTOVOLTAIC GENERATION FACILITY, DE AAR

PREPARED FOR:
Mulilo Renewable Energy De Aar PV (Pty) Ltd

MAY 2012

REFERENCE NUMBER: E12/12/20/1673

DJ ENVIRONMENTAL CONSULTANTS REPORT 10134

AECI BUSINESS PARK, BUILDING NO 2,OFFICE 10-16,DE BEER RD EXTENSION, SOMERSET WEST 7130
POSTNET SUITE 66, PRIVATE BAG X15 SOMERSET WEST, 7130, TEL +27 21 8510900 FAX +27 21 8510933

EXPERTISE OF ENVIRONMENTAL ASSESSMENTS PRACTITIONERS

NAME	Quinton Terhoven
RESPONSIBILITY ON PROJECT	Project Management
QUALIFICATION	BSc (1989–1993; UWC) BSc-Hons (1994–1994, UWC) HDE (P/G) (1995-1995, UWC) MSc (1996-2002, UWC) EIA and Strategic Environmental Assessment (Short course)
PROFESSIONAL ASSOCIATION	Pr.Sci.Nat 400334/11 International Association for Impact Assessments
EXPERIENCE IN YEARS	6
EXPERIENCE	Quinton has served as an Environmental Control Officer on residential and cemetery developments, worked in the public facilitation field on various developments and been involved in Environmental Impact Assessments for inter alia various developments in South Africa as well as in the Seychelles.

NAME	Dudley Janeke
RESPONSIBILITY ON PROJECT	Project Management and review
QUALIFICATION	BSc (Ed) (198–1992; UWC) BSc-Hons-Botany (1995–1997, UWC) 1997 University of Cape Town - Integrated Environmental Management (Short course)
PROFESSIONAL ASSOCIATION	International Association for Impact Assessments
EXPERIENCE IN YEARS	16
EXPERIENCE	Dudley Janeke has been involved in the Integrated Environmental Management field since 1995 and has been a principal of three environmental practices since 1997. His areas of expertise include environmental impact assessments, environmental site management and public participation programmes both locally, national and internationally.

TABLE OF CONTENTS

Figures:

Attachments:

1. PROJECT INFORMATION

Name of Project	Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd
Location	The site is located within an existing farming area which is zoned for Agricultural purposes. The proposed site is also located in the central part of South Africa where there is very good solar radiation due to the low incidence of cloud cover, and moderate altitude of over 1000m above sea level. The site was selected based on solar radiation data from two sources-NASA global data, and South African Weather Services long term data.
Starting date	October 2012
Short Description	Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd has identified PV power generation potential in the mountain ranges of the Northern Cape, within the Emthanjeni Local Municipality, northwest of the town of De Aar. The proposed site that has been evaluated consists of a single property on which a total of 10MW of electricity will be generated. In addition to the power plant, associated infrastructure such as a road, electricity distribution lines, a control room and temporary waste storage facilities will be required.
Main Contractor	To be appointed
Responsibility for waste	Mulilo Renewable Energy De Aar PV (Pty) Ltd

2. LEGISTLATIVE FRAMEWORK

The South African Constitution (Act 108 of 1996) is the supreme law of the land. All laws, including environmental waste management planning must comply with the supreme law. The Constitution states that the people of South Africa have the right to an environment that is not detrimental to human health, and imposes a duty on the state to promulgate legislation and to implement policies to ensure that this right is upheld. All departments of state or administration in the national, provincial or local levels of government have similar obligations. The principles of co-governance are also set out in the Constitution including their roles and responsibilities. According to the Constitution, responsibility for waste management functions is to be devolved to the lowest possible level of government. Local government therefore is assigned the responsibility for refuse removal, refuse dumps and solid waste disposal. Provincial government has the exclusive responsibility to ensure that local government carries out these functions effectively.

In addition to the Constitution, a number of government policies and statutes are relevant to waste management at the local government level, which includes the following:

- National Environmental Management Act 107 of 1998
- Environment Conservation Act 73 of 1989
- Municipal Demarcation Act 27 of 1998
- Municipal Structures Act 117 of 1998
- Municipal Systems Act 32 of 2000
- The Development Facilitation Act 67 of 1995
- The Physical Planning Act 125 of 1991
- Atmospheric Pollution Prevention Act 45 of 1965
- National Water Act 36 of 1998
- Health Act 63 of 1977
- White Paper on Environmental Management Notice 749 of 1998
- White Paper on Integrated Pollution and Waste Management for South Africa, Notice 227 of 2000

- Minimum Requirements for Waste Disposal by Landfill, 2nd edition, 1998
- Minimum Requirements for the Handling and Disposal of Hazardous Waste, 2nd Edition, 1998
- Minimum Requirements for Monitoring at Waste Management Facilities, 2nd edition, 1998
- National Waste Management Strategy and Action Plans.
- Relevant Provincial Legislation
- Local government By-Laws on waste management.

3. DESCRIPTION

• This project shall generate the least amount of waste possible by properly planning material procurement (ordering, transportation and delivery), ensuring proper material handling and storage to reduce the avoidable generation of wastage (i.e. broken and damaged materials) and reusing potential waste materials on site wherever possible. Of the inevitable waste that is generated, as many of the waste materials as economically feasible shall be recovered and sorted for donation, reuse elsewhere or stored separately for recycling.

• Appendix A below identifies all the waste materials that will be generated on this project. It gives a breakdown of the waste materials by type and quantity. It also describes the end of-life option selected for each material and the associated handling procedures.

• Waste avoidance is given first priority, followed by waste minimisation (see figure 1). These shall be discussed at the beginning of every safety meeting (or technical meeting). As each new subcontractor comes on site the ECO, construction manager or resident engineer will present him/her with a copy of the waste management plan and provide a tour of the waste management areas on site, including the recycling area if applicable. The subcontractor will be expected to ensure that all of his/her crewmembers comply with the waste management

plan. All waste containers will be clearly labelled (i.e. unwanted waste, and specific reusable and recyclable waste).

• The construction site shall be clearly signposted with information relating to waste management including directions to waste containers and the recycling centre, waste collection intervals, waste management targets and progress on site, acceptable and unacceptable site waste practice and outstanding performers among others.

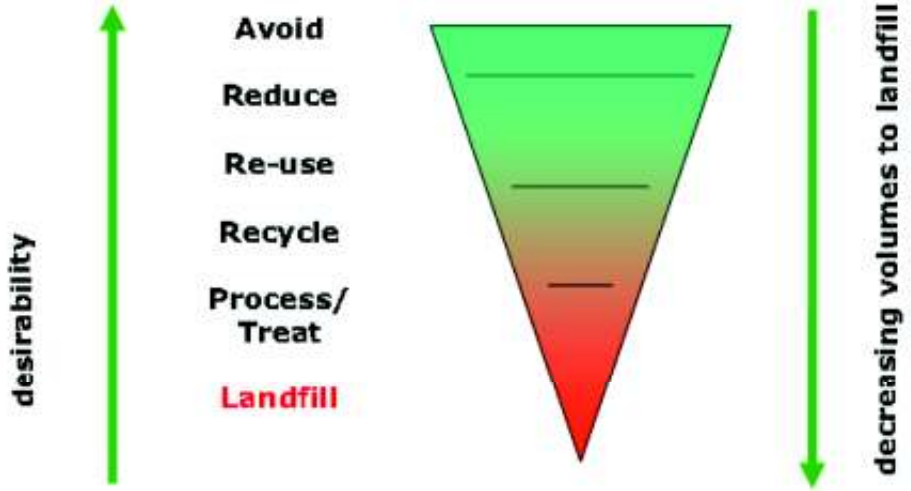


Figure 1: Waste Management Hierarchy

4. GENERAL

This Waste Management Plan specifies the procedure for the management, control and disposition of items designated as waste material for the proposed **Photovoltaic Generation Facility in De Aar**. The following is a list of the different categories of materials that will be generated during the project:

a. Recyclable Materials

b. Waste/Refuse Materials

c. Reusable Materials

The procedures for the management, control and disposition of these items are described in subsequent sections of this plan. All **Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd** (later referred to as Mulilo) subcontractors are required to identify, maintain proper control, and provide documentation for the disposition of materials described in this plan. The intension of this plan is to minimize the amount of waste generated on this project to the extent practicable. The goal for this project is to ensure that at least 50% to 75% of all waste material generated will be recycled, re-used, or otherwise diverted from direct landfill disposal. To accomplish this goal Mulilo intends to recycle and reuse as many types of construction material as possible. Each subcontractor is required to follow this plan for the disposition of the waste generated by the subcontractor's activity. Waste Management will be an agenda item at the weekly/monthly construction meeting that Mulilo conducts. The waste management activities described in this plan will be maintained until substantial completion has been agreed upon by the Engineer.

5. WASTE MINIMIZATION

Mulilo is dedicated to maintaining a stringent set of guidelines to control the amount of construction waste and debris disposed in a landfill. Mulilo will be responsible for communication between field personnel and subcontractors regarding minimization requirements during internal weekly/monthly construction meetings.

5.1 Housekeeping

Housekeeping activities must minimize the amount of waste and maximize the amount of recyclable material that can be efficiently gathered at the local collection points and minimize the amount of refuse materials. Mulilo will assign housekeeping responsibility to an on-site employee who will oversee and manage the field operations with regards to housekeeping and waste management. Any issues identified by this person will be discussed during internal weekly/monthly construction meetings.

5.2 Maximizing Product Use

Layout and cutting procedures should be used to minimize the amount of waste materials. Cut-offs and other scrap materials should be applied on this project to the extent practicable. This procedure will be emphasized to all subcontractors during internal weekly/montly construction meetings.

5.3 Materials Management

All material should be stored in weatherproof containers or otherwise protected from contamination and deterioration prior to use. Containers should be opened as needed and work should be sequenced to use materials efficiently and in a timely fashion. This ensures that the material meets the specified requirements and that unused or off-spec product will not become a waste. This procedure will be emphasized to all subcontractors during internal weekly/monthly construction meetings.

6. LICENSES, PERMITS, FEES, AND TAXES

6.1 All subcontractors working on the **Photovoltaic Generation Facility** will be required to maintain and be responsible for all fees, licenses, permits, and taxes needed to comply with National, Provincial, and Local Regulations and requirements.

6.2 Each subcontractor will identify haulers or trucking firms they will be using on this project.

7. MATERIAL DISPOSITION

Appendix A provides an estimation of the waste material types and quantities to be generated during the construction of the **Photovoltaic Generation Facility**. Appendix B identifies the disposition pathway for each waste material type to be generated during the construction of the **Photovoltaic Generation Facility**.

7.1 Recyclable Material

All material for recycling will be placed in designated containers furnished by the contractor and Mulilo. These containers will be labelled clearly according to types of material. Material must be stored and handled so it is acceptable to the recycler. Mulilo will ensure containers protect the contents from environmental contamination.

7.1.1 Contractor Furnished Dumpsters

The contractor will provide individual appropriate containers at the job site for local collection of material as indicated in the Material Disposition worksheet in Appendix B. The location of the containers and pickup/delivery will be coordinated between Mulilo and the contractor Pollution Prevention personnel. The Contractor will haul the furnished containers and must provide Mulilo with weight information for each load.

7.1.2 Mulilo Furnished Dumpsters

Mulilo will provide individual appropriate containers at the job site for local collection of material as indicated in the Material Disposition worksheet in Appendix B. The location of the containers and pickup/delivery will be coordinated by Mulilo. Mulilo will haul the containers to the location designated in the Material Disposition Table and will maintain the weight information for each load.

7.1.3 Pick-Up Frequency

Recycled material containers will be hauled on an as needed basis, with coordination required between Mulilo field staff and the environmental control officer.

7.2 Empty Containers

A container that held any chemical or hazardous material, except a substance identified as an acute hazardous waste, is defined as an empty container if both of following criteria are met:

1. All material has been removed that can be removed using the practices commonly employed to remove material from that type of container, such as pumping, pouring, or aspirating.

Any containers that hold an acutely hazardous substance shall be regarded as and managed as a hazardous waste.

7.3 Non Recyclable or Refuse Materials

All materials not identified in the material disposition table categories will be considered refuse material. It will be the responsibility of each Mulilo subcontractor to load and transport all material identified as refuse to a designated landfill site. This material may either be demolition debris or construction waste. Any permits required by the designated landfill site, will be the responsibility of each subcontractor. Mulilo will ensure that all procedures are followed. Permits will be valid throughout the duration of the project.

Personal trash such as papers, food containers, beverage cups, etc., shall be bagged, removed from the site, and properly disposed of by each subcontractor

7.4 Documentation

A record of each disposition activity (permits, landfill receipts, weights, weight tickets, and any other receipts) will be maintained at the Mulilo Site Office by the Construction Site Manager. A waste diversion/landfill log (refer to Appendix C) will be maintained and a waste management progress report worksheet (refer to Appendix D) will be completed bi-annually and at end of project to track and summarize the quantities of waste generated by the

project. This documentation will be used to calculate the percent of material diversion achieved. It is the responsibility of Mulilo to collect and maintain documentation.

7.5 Measurement of Waste Material

Haulers of refuse and recyclable/reusable materials must provide weight documentation for all shipments from the project site. If methods other than weighing are used, the proposed method of generating the weight must be approved (for example: density times volume estimation).

APPENDIX A

WASTE MATERIAL ESTIMATING WORKSHEET

Instructions: *1) Edit material/item list in left hand column as appropriate.*

2) Include all waste material types to be generated.

3) Fill in columns with relevant recycling/disposal data

Material/Item	Total Amount Generated (tons)	Amount Diverted from Landfill by Reuse, Salvage, or Recycle (tons)	Amount Sent to Landfill (tons)	Percent Diverted from Landfill (%)
Misc. Concrete/Asphalt				
Wood				
Dirt				
Paper				
Cardboard				
Aluminum				
General Construction Waste				

APPENDIX B

WASTE MATERIAL DISPOSITION WORKSHEET

Instructions:

1) Edit material/item list in left hand column to match Waste Material Estimating worksheet.

2) Include all waste material types to be generated.

3) Edit remaining worksheet contents with relevant collection, transportation, disposition, and contact information as appropriate to suit project-specific requirements.

Material/Item	Local Collection Point	Hauler	Disposition	Disposition Location	Contact Name / Phone #
Mixed Metals/ Steel			Recycle		
Misc. Concrete/Asphalt			Recycle		
Wood			Re-use		
Wood			Recycle		
Wall Board			Recycle		
Clean Fill (Dirt)			Recycle		
Paper			Recycle		
Cardboard			Recycle		
Aluminum			Recycle		
General Construction Waste			Disposal		

APPENDIX C

WASTE DIVERSION/LANDFILL LOG

Project: _____

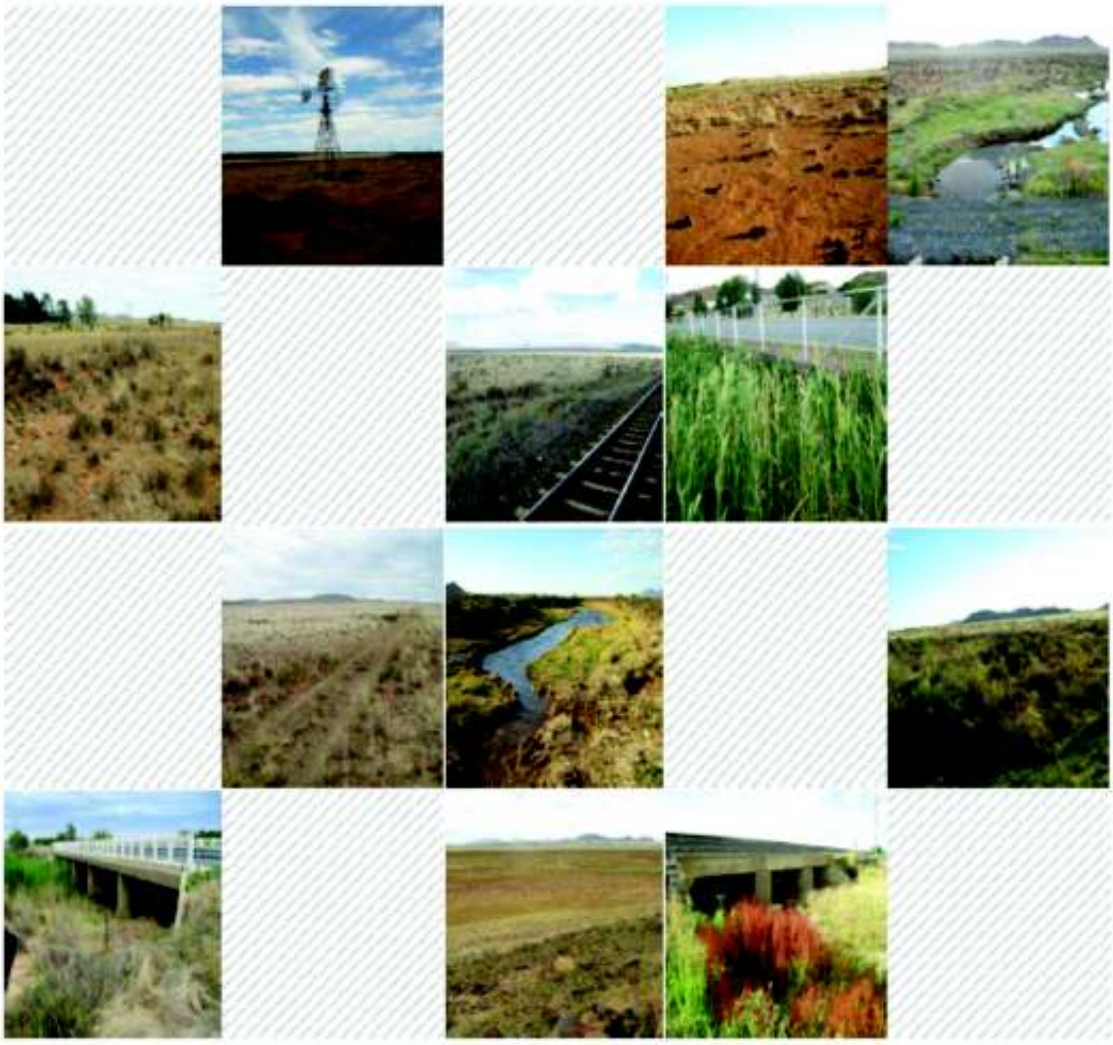
Period: _____ to _____

Instructions: 1) Complete and maintain Log at Mulilo site office.

Material/Item	Quantity (tons)	Disposed, Reused, Salvaged, or Recycled	Destination	Date
List materials and items as appropriate	*Fill in as appropriate for each load or shipment of materials/items.*			

APPENDIX 9

STORMWATER MANAGEMENT PLAN



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Proposed Photovoltaic (Solar) Energy Facility De Aar, Northern Cape

Stormwater Management Report

Submitted by:
Aurecon
Aurecon Centre
1 Century City Drive
Waterford Precinct
Century City
South Africa

Contact Person:
Ruan Gilau
T: +27 12 427 2289 F: +086 723 2766
E: Ruan.Gilau@aurecongroup.com

Submitted to:

Mulilo Renewable Energy
Solar PV De Aar (Pty) Ltd

Submission date: 09 May 2012

Aurecon Report No.: 6126/1098451

aurecon

Report Control Sheet

CLIENT:	Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd
PROJECT No.:	108451
REPORT No.:	6126/108451
REPORT TITLE:	Proposed Photovoltaic (Solar) Energy Facility De Aar, Northern Cape Stormwater Management Report
REPORT STATUS:	Final
PREPARED BY:	Aurecon South Africa (Pty) Ltd (www.aurecongroup.com)
AUTHORS:	**Mr R Gilau** *Pr. Tech. Eng.*
DATE:	09 May 2012

.....

Ruan Gilau Pr. Tech Eng.
Associate, Aurecon, Gauteng, RSA

Contents

Figures

Tables

STORMWATER MANAGEMENT REPORT PROPOSED SOLAR ENERGY FACILITY, DE AAR

1. Introduction

Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd (Mulilo) has received approval from the Department of Energy to construct a 10MW solar energy facility, which utilizes photovoltaic (PV) technology, near De Aar in the Northern Cape. The location of the planned PV facility is indicated in Figure 1 and Figure 2.

Aurecon South Africa (Pty) Ltd was requested to carry out a flood risk assessment for the site addressing stormwater related aspects that had been identified in the previously completed Technical Due Diligence Review.

The methodology used for the analyses and assessments is described in Chapter 2 of this report. Alterations to the site, as a result of the development of the facility, are discussed in Chapter 3. Chapters 4 and 5 report on the stormwater assessment, and measures to be taken during construction to prevent pollution. Chapter 6 summarizes the impacts and provides recommendations.

1.1 Scope of work

The scope of work can be summarized as follows:

- Investigate storm runoff and topsoil migration from the site and the risk this poses to the railway line to the south of the site.
- Investigate the impact of impervious or saturated soils on runoff from the solar facility.
- Investigate the impact of impervious PV panels and other "hardening" of the site on runoff from the site. This includes recommendations and conceptual design of a drainage system for the site.
- Investigate soil erosion (generally) on the site.
- Consider impacts of climate change in relation to the above flood risks.

Figure 1. Site Location Plan

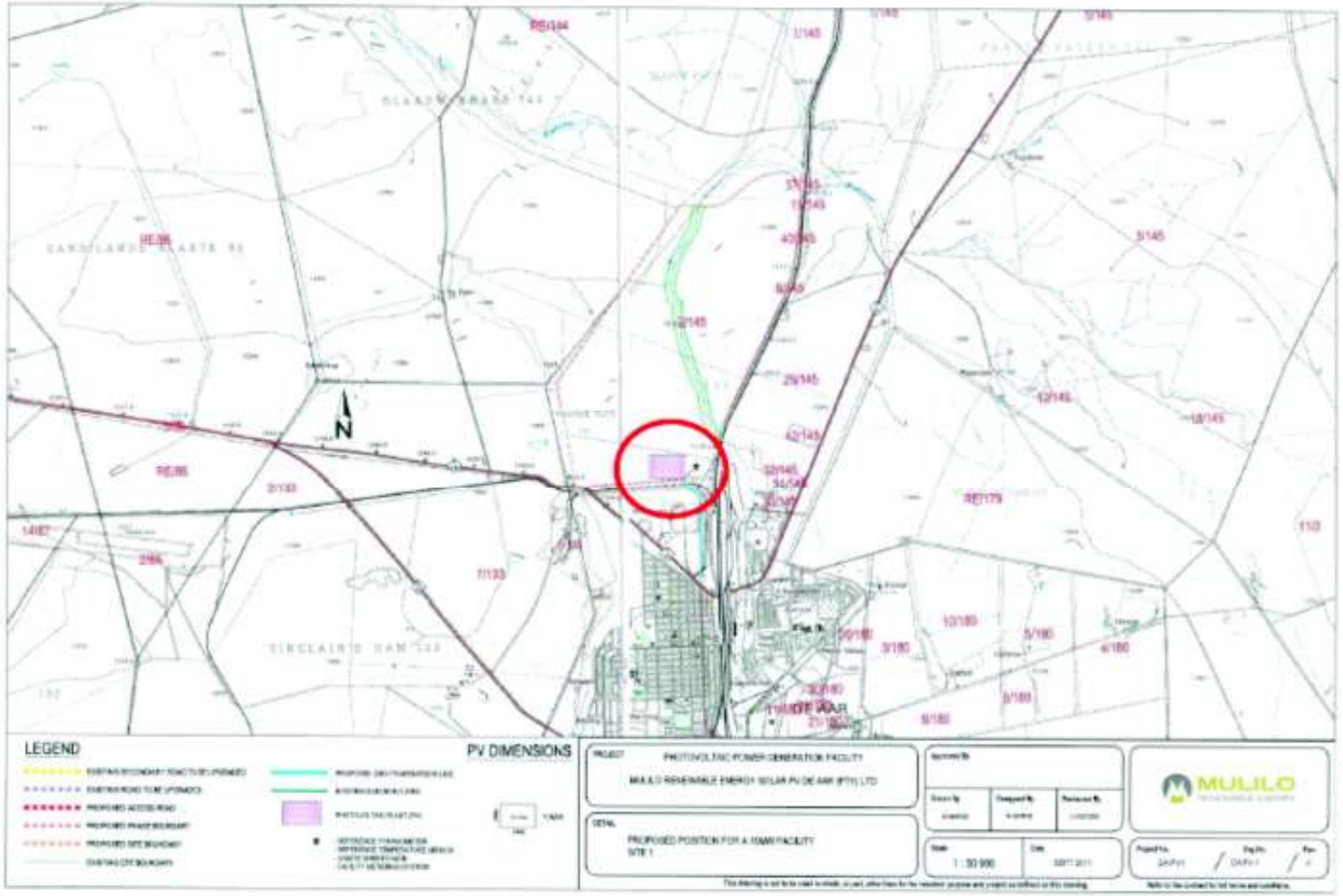

Figure 2. Locality of proposed 10MW facility (circled in red)

1.2 Climate

The study area has a semi-arid continental climate with a rainfall regime confined to summer and early autumn. The area has a low Mean Annual Precipitation (MAP) of 300 mm (Aurecon, 2012).

Figure 3. Mean Monthly Rainfall for the De Aar area (Source: Levoyageur)

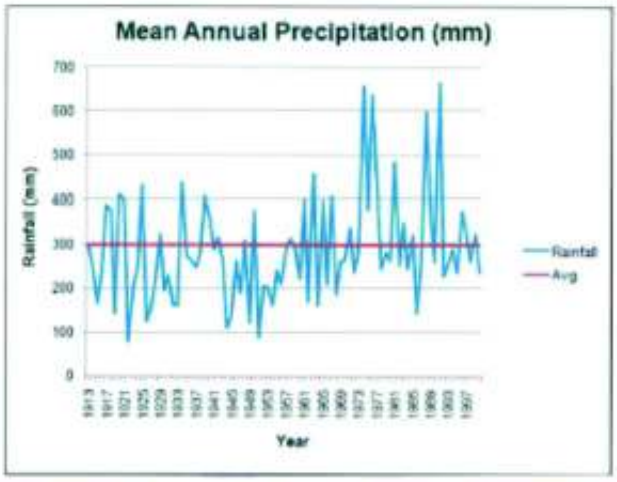

Figure 4. Long term annual rainfall (1913 – 1997) with long term average indicated (red line) (Source: Sivest Report, May 2011)

The region typically experiences hot days and cold nights with the average summer high temperature of approximately 40 °C and the average winter night time temperature of approximately -8 °C.

1.3 Topography

The study area is characterized by flat and gently sloping topography with an average gradient of 10%. This is categorized as a flat to medium sloped site.

1.4 Land use

Virtually all of the De Aar Site is classified as natural / vacant and is used as grazing land for sheep. Vast grazing land is interspersed with pans to the east of the study area. There is however limited signs of formal agricultural fields near the eastern boundary of the site (Sivest 2010). The soils are not suitable for arable agriculture but can still be used as grazing land, the current land use.

1.5 Soil Characteristics

According to the ENPAT database the site is dominated by red apedal soil types formed predominantly from shale parent material. These are highly fertile and well drained soils, but with a lack of well-formed peds and are weakly structured. The site area is classified as having an effective soil depth, depth to which roots can penetrate the soil, of less than 0.45 m deep (Sivest 2010).

Figure 5. Soil map - De Aar (Source: Sivest 2010)

1.6 Drainage and sub-soil drainage

The proposed site will not be affected by a permanent water table with the development of a seasonal perched water table on the impervious hardpan calcrete horizon below. Infiltration of groundwater will be slow due to the clayey nature of the transported horizon and the practically impervious hardpan horizon. Surface water will collect in subdued drainage depressions noted on and around the site. Some grading is therefore proposed to prevent ponding on the surface (Geotechnics Africa, 2010). The site has a natural south west to north east drainage direction towards a tributary of the Brak River. A report by Aurecon, (Aurecon, 2012) on the flood potential of various PV sites in the area, concluded that the site will not be subject to flooding from the 1:100 year event in a nearby (unnamed) tributary of the Brak River (Figure 6).

Figure 6. 1:100 year floodline along tributary of Brak River (Source: Aurecon 2012)

The site is situated on a slight ridge with an identifiable drainage path on eastern side and another, barely distinguishable in the survey, to the north west (Figure 7). Any influence these drainage paths may have on the site can be readily negated by the construction of low berms as described in Section 4.3.2 below. Runoff in the eastern drainage path is via a rectangular culvert (2/1.8 x 1.2 – approximately) (Figure 8) beneath the railway line which receives runoff from the De Aar Show Grounds with an estimated catchment size of 1.24 km^2 (assuming that the SW-NE drainage channel to the south of the Show Grounds has adequate capacity to divert runoff to the east) (Figure 9). The catchment draining via the north west drainage path is approximately 0.410 km^2 in size and drains an open area upstream of the site (Figure 9). Stormwater runoff across the PV site is predominantly overland with no clear watercourses or drainage paths having formed.

2. Methodology

The potential flood risks have been assessed by analysing storm runoff generated by storms of 5-year and 100-year recurrence interval. The 5-year runoff has been used for assessing storm drainage on the PV Site while the 100-year runoff has been used to assess the risks associated with external drainage paths and stormwater control measures. Assessment of the external drainage paths and the railway culvert required analysis of the upstream catchments. The analyses have been undertaken using the Rational Method.

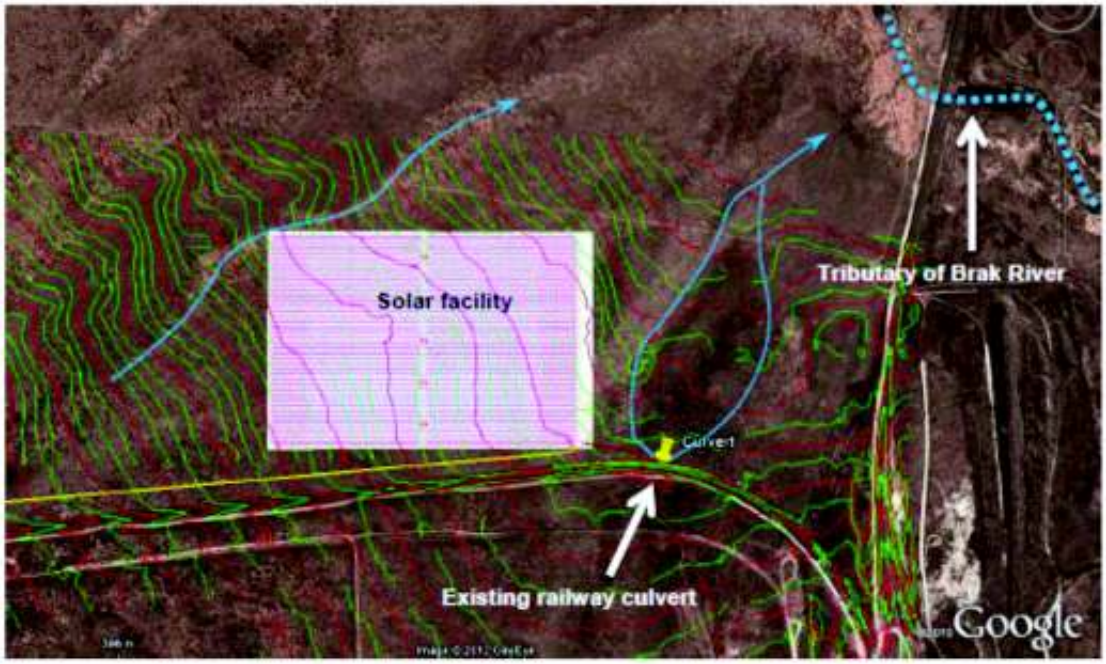

Figure 7. Drainage paths in vicinity of site

Figure 8. Existing Railway Culvert at south eastern corner of PV Site (approximately 2/ 1.8 x 1.2m)

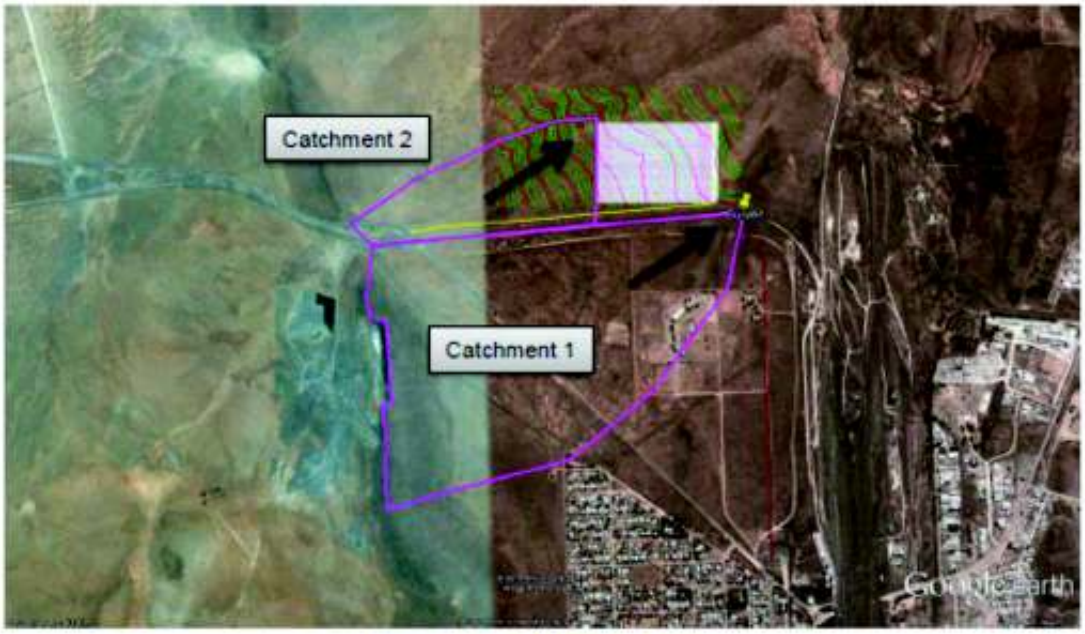

Figure 9. External catchment areas

2.1 Design Rainfall

For a deterministic design flood approach a crucial input is the design rainfall. The design rainfall is associated with a particular recurrence interval (RI) and critical storm duration. For the Rational Method, the critical design storm duration is usually set equal to the "Time of Concentration" (Tc) of the catchment. The design point rainfalls for the 1:5 and 1:100 year RI storm events were obtained from the Smithers and Schulze database (Smithers / Schulze, 2002) and appropriate design rainfall intensities were determined using the HRU 2/78 "inland" rainfall distribution (Midgley, 1978). The value of Tc and the 1:5 and 1:100 rainfall intensities used in the study are detailed below:

- Time of concentration: 1.30 hours
- 1:5 year rainfall intensity: 19 mm/hr
- 1:100 year rainfall intensity: 47 mm/hr

2.2 Runoff Determination

The Rational Method was used for determining runoff from the PV site and surrounding catchments. The Rational Method has been successfully used for catchments up to 80 km^2 in Southern Africa and is represented by the following relationship:

$$Q = \frac{CIA}{3.6}$$

Q = design flood peak (m^3/s)

C= runoff coefficient (dimensionless)

I = average rainfall intensity over catchment (mm/hour)

A = effective area of catchment (km^2)

3.6 = conversion factor

The Rational Method yields a design flood peak only (i.e. no hydrograph). The flood response of the catchment is expressed by two quasi-physical parameters: (i) the Runoff Coefficient (C), which is a function of average catchment slope, permeability of the soils, land-use, Mean Annual Precipitation (MAP) and RI; and (ii) the Time of Concentration (T_c), which is a function of the length of the longest watercourse and the average slope of that watercourse. This study utilised the C-value guide derived by the Department of Water Affairs (Alexander, 1990).

3. Proposed Physical Land Alterations

In general, the proposed development will not alter the existing site grades significantly. The solar panels will be installed in rows. Each panel section will be mounted on concrete plinths (Figure 10). The plinths will be approximately 500 mm deep and are planned to be buried.

Figure 10. Example of solar panel installation (Alkantpan Village pilot study – Geotechnics Africa, 2010)

Based on the pilot study installation, the existing site will be ripped, compacted and gravel roadways (Figure 11) will be provided. It is unlikely that the site will be vegetated after construction to prevent the risk of fire damage to the solar facility.

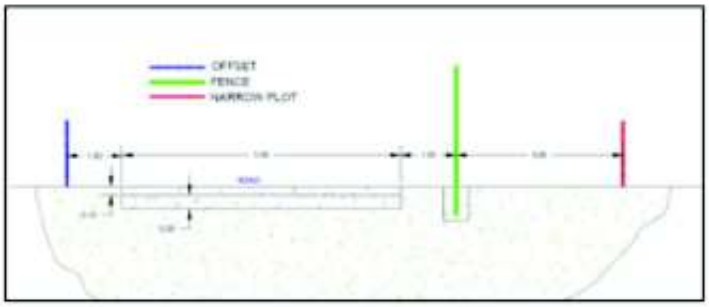

Figure 11. Gravel roadways between panel sections

With the solar panels being impervious, rainwater will land on the panels and run off directly onto the ground below the individual panels. Minimal erosion is anticipated beneath each solar panel but erosion is likely to occur as runoff is incremented and concentrated due to the site layout and topography (Figure 10 and Figure 12). V-drains should be provided to intercept and convey the runoff.

It is anticipated that the native grass and shrub covers will be removed. In addition to the above features, the site will be fenced off.

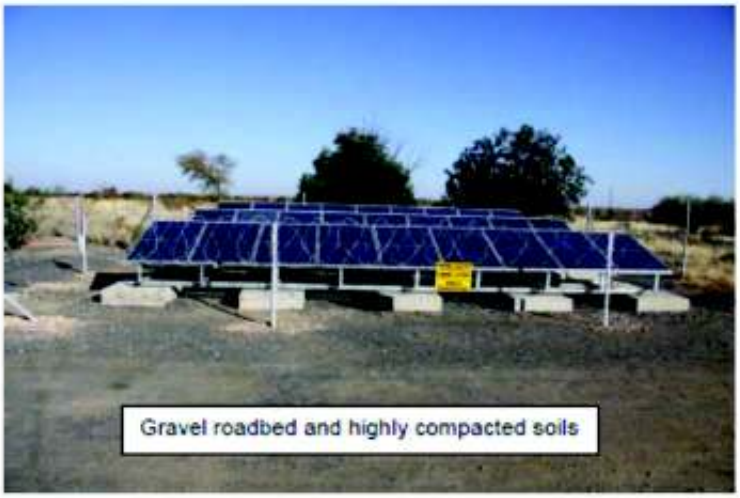

Figure 12. Example of pilot study installation (Alkantpan Village – Geotechnics Africa, 2010)

4. Stormwater Assessment

4.1 Site Characteristics

The proposed 10 MW solar farm will cover approximately 17.5ha (500m x 350m). It is assumed that the entire site will be cleared, graded and compacted for the solar array installation. The solar panels will be installed on concrete plinths the same as the pilot study for Copperton (see Figure 10 and Figure 12, above). Although planned to be buried it is expected that a portion will protrude above ground. It is not foreseen that a gravel wearing course will be provided on areas other than the access roads between the panels. The site slopes on average 10% which is an indication that the site will not require excessive grading.

4.2 Assessment of Impacts

The increase in impervious area associated with construction of the solar farm was calculated and Rational Method Runoff Coefficients, for existing and post-development conditions determined. The existing site is undeveloped and comprises sparse grass and small brush cover (Figure 13 below). The Rational Method runoff coefficient for the undeveloped site was calculated to be 0.29. This was for the total catchment area of 1.8 km^2 which includes the PV Site (Figure 14, below). The 10MW facility covering an area of approximately 17.5ha will increase the runoff coefficient to 0.33.

The runoff coefficients are noted below in Table 1.

Table 1. Runoff Coefficients (pre- vs post-development)

Runoff Coefficient	Factor
$C_{Pre\text{-}development}$	0.29
$C_{Post\text{-}developed}$	0.33
$C_{Solar\ Facility\ only}$	0.60

Figure 13. Typical vegetation cover

Figure 14. Catchments analysed for 1:100 year storm event

Relative runoff flows generated from the site under existing and developed conditions are estimated and summarised in Table 2.

Table 2. Run-off peak flows (entire catchment)

Condition	Peak flows (m^3/s)	
	5-Year	100-Year
Pre-development	2.3	7.2
Post-developed	2.7	8.2

The directly contributing catchment is 1.8 km^2 in size as indicated in Figure 14 (i.e. draining to point 1). The expected 1:5 year runoff from the solar facility (0.175 km^2 in area) will be 0.6 m^3/s. The area will be sub-divided into smaller sub-catchments and the runoff accordingly distributed (Figure 15). It is thus anticipated that the overland flow paths under developed conditions will be slightly longer but the expected influence on the overall runoff to be in the order of 4.2% (Table 1).

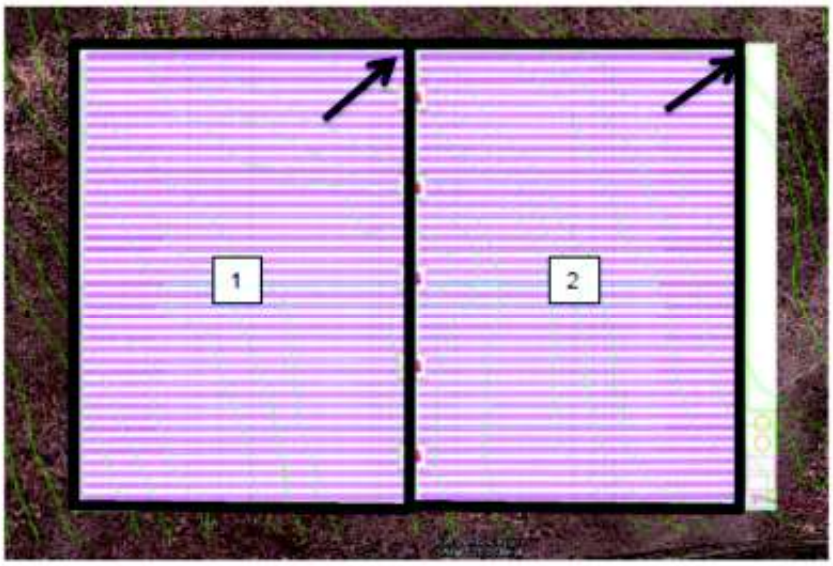

Figure 15. Sub-catchments and drainage directions

The 1:5 Year runoff peaks from the solar facility are summarized in Table 3, below

Table 3. 1:5 year peaks (see Figure 15)

Catchment	Size (ha)	1:5 year (m^3/s)
1	7.5	0.29
2	7.5	0.29

4.3 Discussion and proposed measures to alleviate drainage problems

4.3.1 Solar facility – internal drainage

The site has a rolling topography with mild to flat slopes. A drainage scheme is presented in Figure 17, below. The topography determines the positioning of the proposed drainage spines (solid lines). Cross drainage in the form of v-drains should be provided (dashed lines) to intercept overland flow and to direct this to the spines. The cross drainage will also assist with erosion control. These v-drains can take the form of road side drains and must be lower than the surrounding area to intercept flows. The channels can be compacted earth channels but will require maintenance on a regular basis and after each rainfall event due to possible scouring. Although more expensive, the construction of a concrete lined system is advised for use. The channels must be at least 300 mm deep, v-shaped, with a left side slope of 1:1 and right side slope of 1:3 when looking in the downstream direction.

Erosion around concrete plinths and supporting structures is a concern and is dependent on the erodibility of the material. It is recommended that the surfaces around plinths be compacted well graded gravel with a 38mm gravel capping layer (Figure 16). Erosion protection in the form of packed stones with average diameters of 200 mm is required at the drain outfalls from the solar facility (points 4 and 7 in Figure 17, below) for a distance of no less than 12 m. Alternatively two gabion mattresses, 6.0 m long x 2 m wide x 0.3 m thick can be installed at the outfalls.

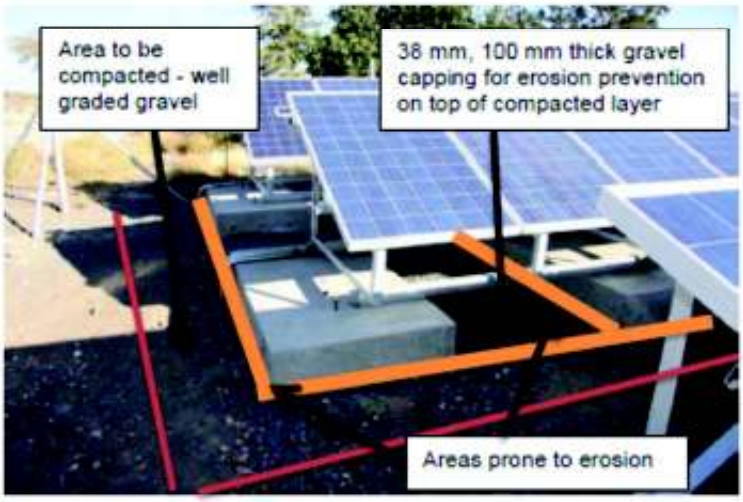

Figure 16 Erosion prevention around plinths

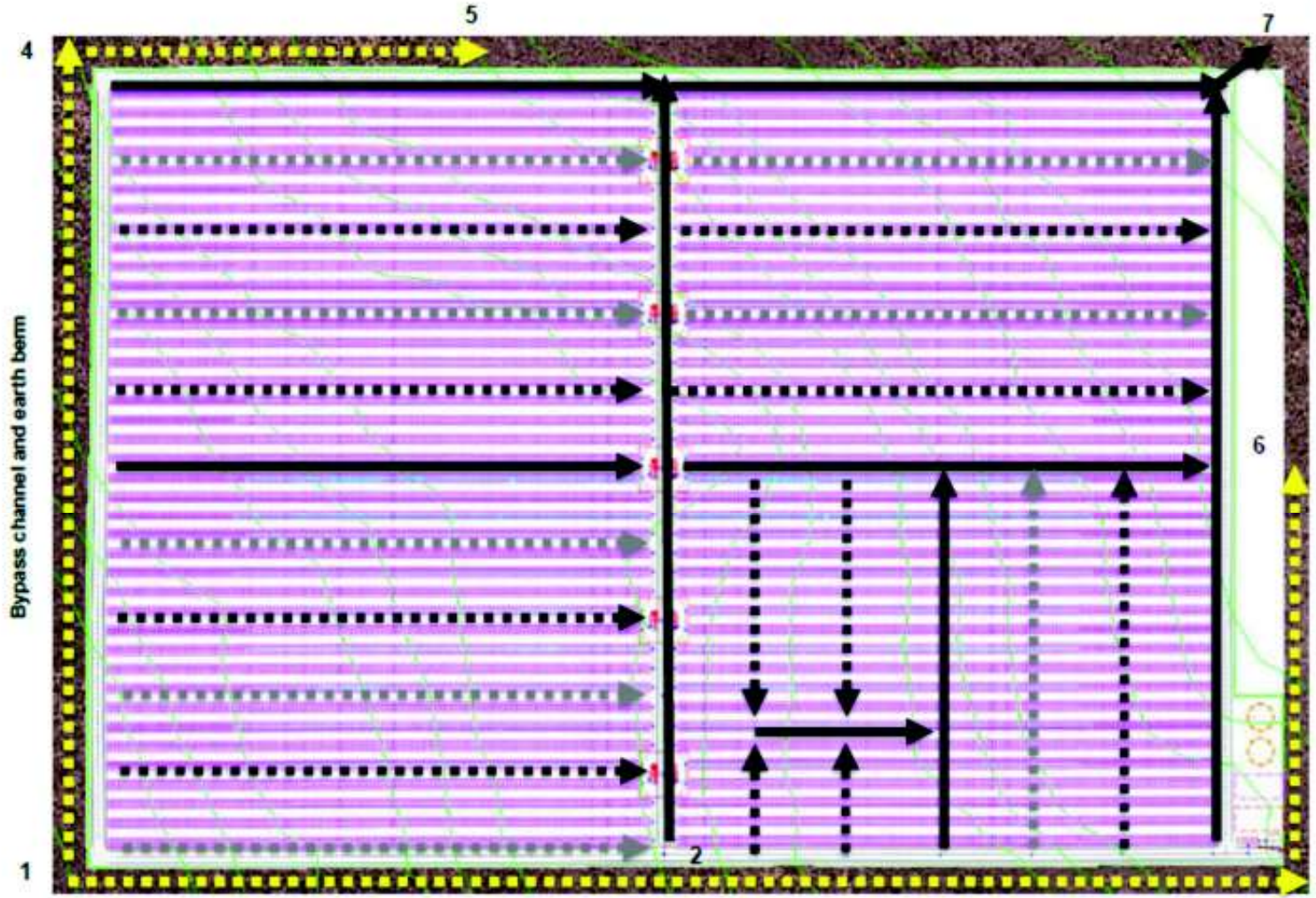

Figure 17. Proposed drainage scheme

Drainage spines (preferably concrete lined)
Cross drainage (alternative linings)
Minor drainage ditches
Earth berms

4.3.2 Solar facility – external drainage

Overland flow from the upstream catchments discharges past the PV site on the north western and eastern sides. Bypass channels and earth berms must be provided along the outside boundaries (western, eastern, and southern sides) to intercept and direct overland flow away from the site as well as decrease soil erosion. These berms must be at least 0.6 m in height to prevent possible overtopping. The railway culvert at the south eastern corner of the facility has a capacity of 7.2 m^3/s (3.6 m^3/s per cell). This is more than the 1:100 year discharge expected from the upstream catchment (Catchment 1, Figure 9), a peak of 5.0 m^3/s (assuming the SE_NW channel performs to capacity and earth berms are placed to divert and retain flow away from the railway culvert). The discharge increases to 6.2 m^3/s with expected developments in the upstream catchment. The water level at the outlet side of the culvert is expected to remain below 1230 m.a.s.l based on the drainage path cross-section profile. The ground levels at the south eastern corner of the site drop to approximately 1229.75 m requiring a low berm (0.6 m) to be constructed. The earth berm on the western boundary of the facility will prevent overland flow into the solar facility. The earth berms must be trapezoidal in shape with 1:2 side slopes and constructed of well compacted cohesive material that will resist erosion. The berms could be planted with indigenous grasses to further resist erosion. The following berm dimensions are required (refer to Figure 17):

Table 4: Suggested Berm Dimensions

Berm Section	Dimension
1-2	Height = 0.5m ; Top Width = 0.5m ; Side Slopes = 1:2
2-3	Height = 1.0m ; Top Width = 1.0m ; Side Slopes = 1:2
3-6	Height = 0.6m ; Top Width = 1.0m ; Side Slopes = 1:2
1-4	Height = 1.0m ; Top Width = 1.0m ; Side Slopes = 1:2
4-5	Height = 0.5m ; Top Width = 1.0m ; Side Slopes = 1:2

It should be noted that while a single (maximum) height is detailed above, the height of the berms could be made to vary (commencing lower increasing to the maximum height) in the direction of flow. The final berm profiles should be determined in the detailed design stage of the project. Provision will have to be made for access roads across crossing the berms.

5. Erosion Abatement for Construction Period

Because of the existing soil conditions and disturbances associated with construction activities it can be expected that soil erosion will occur, resulting in an increased loading of Total Suspended Solids (TSS). To

minimize the potential for impairment of the quality of receiving waters during construction the following measures should be taken, both as erosion prevention and control measure:

- Straw barriers should be installed in drainage paths to intercept suspended solids carried by overland flow. These are erosion barriers placed at intervals of 25-50 m apart in the drainage paths which will intercept suspended solids from entering the natural drainage paths.
- Packed stone (also known as rip-rap) must be placed as liners for channel spines (solid black lines of Figure 17). These comprise packed stones with an average diameter of 100 mm, packed in the channels as lining material to control flow velocities and hence erosion.
- Earth cut-off berms at boundaries of the facility. These will assist in directing flow away from the site and reduce the possibility of flooding from runoff origination from outside the site.
- Provide erosion protection at channel outfalls and positions of high flow concentration. These comprise packed stones with an average diameter of 200 mm, packed in the drainage path to control flow velocities and hence erosion.

These measures, listed above, and this report should form part of the Environmental Management Plan compiled for this project.

6. Summary and Recommendations

The impact and overall change to the imperviousness of the PV Site are minimal (Table 1). It is anticipated that the site will be graded to accommodate the development. It is also anticipated that the site will not be vegetated following the development to reduce any risk of fire due to the nature of the environment. The study indicated that this will result in an approximate increase of 4.2% in the rate of stormwater runoff (Table 1 and 2, above). The values listed include a possible increase due to climate change. Because data is limited on the prediction of the influence in this region, the increase is minimal. It is therefore proposed that qualitative protection in the form of rip-rap and stone pitching, measures be taken to minimize erosion both during and after construction. Internal drainage can be controlled through the construction of channels and ditches. On-site attenuation will not be required as the influence on the total catchment is minimal.

Report signed on behalf of Aurecon by:

R Gilau Pr Tech Eng
Associate

References

Alexander, WRJ. 1990. Flood Hydrology for South Africa. SANCOLD, PO Box 3404, Pretoria, RSA

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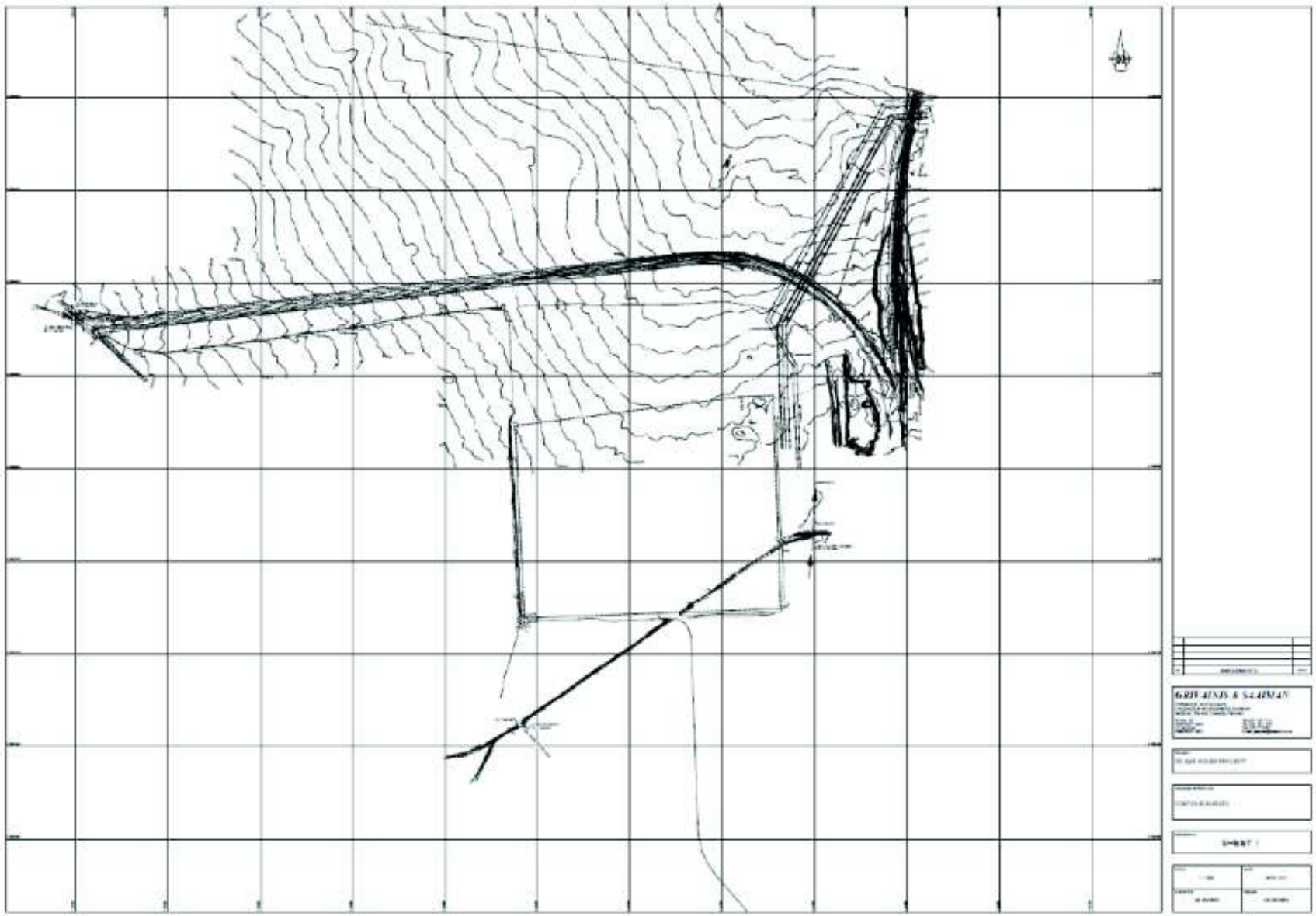
Sivest 2011. Draft Report. Environmental Impact Report. Construction of a CSP and CPV/PV Plant in De Aar, Northern Cape Province of South Africa. Report to Mulilo Renewable Energy, May, 2011.

Appendix A: Topographical Map (Surveyed for purposes of this report)



Gestamp Solar	EMERGENCY PLAN	FM04-01/00

DESCRIPTION OF POTENTIAL ACCIDENT	FLOOD
ENVIRONMENTAL ASPECTS ASSOCIATED TO THE ACCIDENT	Non-hazardous wastes Hazardous wastes Spillage of contaminated elements

ASSOCIATED PREVENTIVE MEASURE

DESCRIPTION	FREQUENCY	PERSON IN CHARGE
Inspect **proper conditions of the installations** (cocks, tanks, etc.).	Quarterly supervision of this measure	SITE MANAGER
Contact number list must be available at the site/maintenance hut **in case of emergency.**	Quarterly supervision of this measure	SAFETY MANAGER
Simulations to verify the emergency plan efficiency.	As per GESTAMP SOLAR, S.L. planning	MIS MANAGER
Current incident plan **revision.**	Annual	MIS MANAGER

IN CASE OF OCCURRENCE

ACTIONS	PERSON IN CHARGE
Find the source of the problem, and immediately advise your supervisor and the rest of the personnel.	SITE MANAGER
In the case of offices, and when flood comes from the upper floor, inform the owner of the said.	SITE MANAGER
Take away everything that may be affected by the flood, start by turning off and removing electronic equipment.	SITE MANAGER
Report the incident to the Integrated Management System Manager.	Person who detects the flood
Record the environmental **accident.**	Integrated Management System Manager

ADDITIONAL INFORMATION

Emergency number: 112
Fire Brigade: 080
GESTAMP SOLAR, S.L. MIS Manager: **608 58 84 47**

Prepared and approved by: Integrated Management System Technician

Date: 01/05/2010

APPENDIX 10

FINAL SAHRA COMMENT

De Aar PV 2 - 1673

Our Ref: 9/2/025/0001

Enquiries: Kathryn Smuts
Tel: 021 462 4502
Email: ksmuts@sahra.org.za
CaseID: 194

Date: Tuesday October 02, 2012

Final Comment

In terms of section 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: Quinton Terhoven
DJ Environmental Consultants
Postnet Suite 66
Private Bag X15
Somerset West
7130

PROPOSED PHOTOVOLTAIC POWER GENERATION FACILITY IN DE AAR NORTHERN CAPE

Archer, W. June 2012. *Archaeological Impact Assessment: proposed photovoltaic power generation facility in De Aar, Northern Cape*

Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd is proposing a 20 MW Photovoltaic power generation facility in the Northern Cape, close to De Aar. Two alternative options, one North West of the city and one South East of it, have been identified.

The total energy production will be 20 MW and the footprint for the power plant will be 400 x 400 m (16 ha). Two AIAs have been previously commented on by SAHRA, but these both considered sites that have been decided against by the developer. A new site has been identified as the preferred site location.

A one day survey was conducted by the archaeologist who identified scatters of *ex situ* material occurring in deflated contexts particularly in the west of the study area. These artefacts were predominantly on heavily patinated hornfels, with several pieces showing dual patination, indicating repeated use of the landscape through time. The scatter occurred over a wide area, was amorphous and lacked typological markers or formal tools, with the exception of a reworked bifacial point and two prepared platform cores. The presence of prepared platform flakes indicates a Middle Stone Age component, although it is likely much of the material may have been brought to the area during the Later Stone Age.

Decision:

Although the AIA calls for mitigation in the form of recording and collecting of artefacts, the author explicitly states that the artefacts have shifted considerably both vertically and horizontally and that there is no potential for *in situ* material or deposit and no possiblity of dating the site. The archaeologist concludes that the site is of low significance and of no research potential and SAHRA therefore considers mitigation unnecessary.

SAHRA Archaeology, Palaeontology and Meteorites Unit has no objection to the development (in terms of the archaeological component of the heritage resources) on condition that, if any new evidence of archaeological sites or artefacts, palaeontological fossils, graves or other heritage resources are found during development, construction or mining, SAHRA and an archaeologist and/or palaeontologist, depending on the nature of the

finds, must be alerted immediately.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Kathryn Smuts
Heritage Officer: Archaeology
South African Heritage Resources Agency

Colette Scheermeyer
SAHRA Head Archaeologist
South African Heritage Resources Agency

ADMIN:
(DEA, Ref: 12/12/20/1673)

Terms & Conditions:

1. This approval does not exonerate the applicant from obtaining local authority approval or any other necessary approval for proposed work.
2. If any heritage resources, including graves or human remains, are encountered they must be reported to SAHRA immediately.
3. SAHRA reserves the right to request additional information as required.