DOORNHOEK 2 SOLAR FACILITY

TECHNICAL LAYOUT DEVELOPMENT REPORT FOR DOORNHOEK 2 SOLAR FACILITY

Prepared for:

Cape Environmental Assessment Practitioners (Pty) Ltd

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Compiled By:

Doornhoek PV (Pty) Ltd
101, Block A, West Quay Building, 7 West Quay Road
Waterfront, 8000

L: +27 (0) 21 418 2596
E: michael@atlanticep.com

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1. INTRODUCTION

The Applicant, Doornhoek PV (Pty) Ltd, is proposing the construction of a photovoltaic (PV) solar energy facility (known as the Doornhoek 2 PV facility) located on a site approximately 11km north of Klerksdorp in the North West Province. The solar PV facility will comprise several arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 50MW. The development area is situated within the City of Matlosana Local Municipality within the Dr Kenneth Kaunda District Municipality.

The proposed Doornhoek 2 PV facility and associated infrastructure will be located on Portion 18 of the Farm Doornhoek No. 372-IP. The project site is located within the Klerksdorp Renewable Energy Development Zone (REDZ).

The technology under consideration are photovoltaic (PV) modules mounted on either fixed-tilt or tracking structures. Other infrastructure includes inverter stations and transformers, internal electrical reticulation, Battery Energy Storage System (BESS), site access and internal roads, a substation/switching station (facility substation and Eskom switching station), a 132 kV overhead distribution line (OHL), auxiliary buildings, temporary and permanent laydown areas, perimeter fencing, and security infrastructure. The substation will locate the main power transformer/s that will step up the generated electricity to a suitable voltage level for transmission into the national electricity grid, via the OHL. Auxiliary buildings include, inter alia, a control building, offices, a canteen, staff lockers and ablution facilities, a gate house and security offices, warehouses and workshops for storage and maintenance. The figure below depicts the typical layout of a solar PV energy facility.

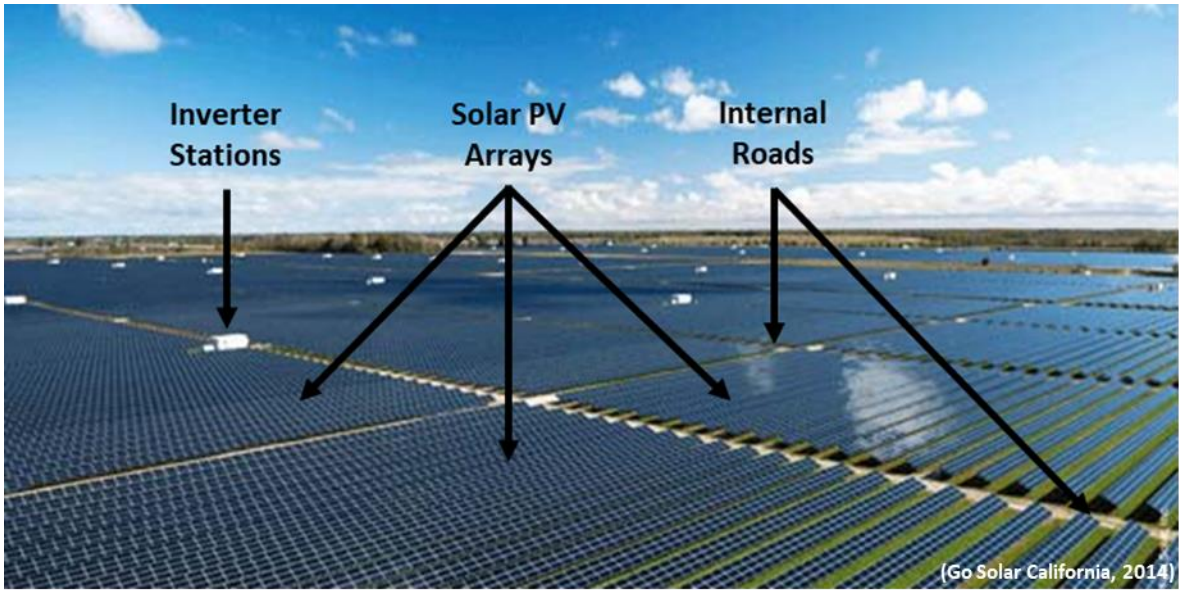

Figure 1: Typical Layout of a Solar PV Energy Facility.

Doornhoek 2 will have a net generating capacity of up to 50 MW_{AC} with an estimated maximum footprint of ± 80 ha. The approximate area that each component of Doornhoek 2 will occupy is summarised in Table 1 below.

Table 1: Approximate area of each component

SEF Component	Estimated Area	% of Total Area (± 80 ha)	% of Farm Area (608.58 ha)
PV array	± 66,5 ha	83,13%	10,93%
Temporary construction laydown	Up to 3 ha	3,75%	0,49%
Permanent laydown	Up to 1 ha	1,25%	0,16%
Auxiliary buildings	± 1 ha	1,25%	0,16%
Internal roads	± 5 ha	6,25%	0.82%
Substation/switching station	± 1 ha	1,25%	0,16%
Main Access Road	Approx. 1,5 ha	1,88%	0,25%
BESS	Up to 3 ha	3,75%	0,49%

2. LAYOUT DEVELOPMENT

It is customary to develop the final / detailed construction layout of the Solar Facility only once an Independent Power Producer (IPP) is awarded a successful bid under the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), after which major contracts are negotiated and final equipment suppliers identified. However, for the purpose of the Basic Assessment Report in accordance with the minimum requirements prescribed by the Department of Environmental Affairs (DEA), the details of the proposed layout are included below.

2.1 INITIAL ASSESSMENT AREA

Initially three properties, situated near Klerksdorp, were identified for the potential solar energy development. These included

- Portion 18 of the Farm Doornhoek No. 372-IP;
- Portion 21 of the Farm Doornhoek No. 372-IP; and
- Remainder of Portion 2 of the Farm Doornhoek No. 372-IP.

This was based on the favourable location characteristics which included: a strong solar resource; location within a REDz; a viable grid connection; close proximity to towns with a need for socio-economic upliftment; land availability; land owner support; flat topography; no conflict to on-site and surrounding land use practices; easy accessibility; favourable wind and dust considerations; and distance from airports (refer to the *Doornhoek Site Selection Motivation Report*).

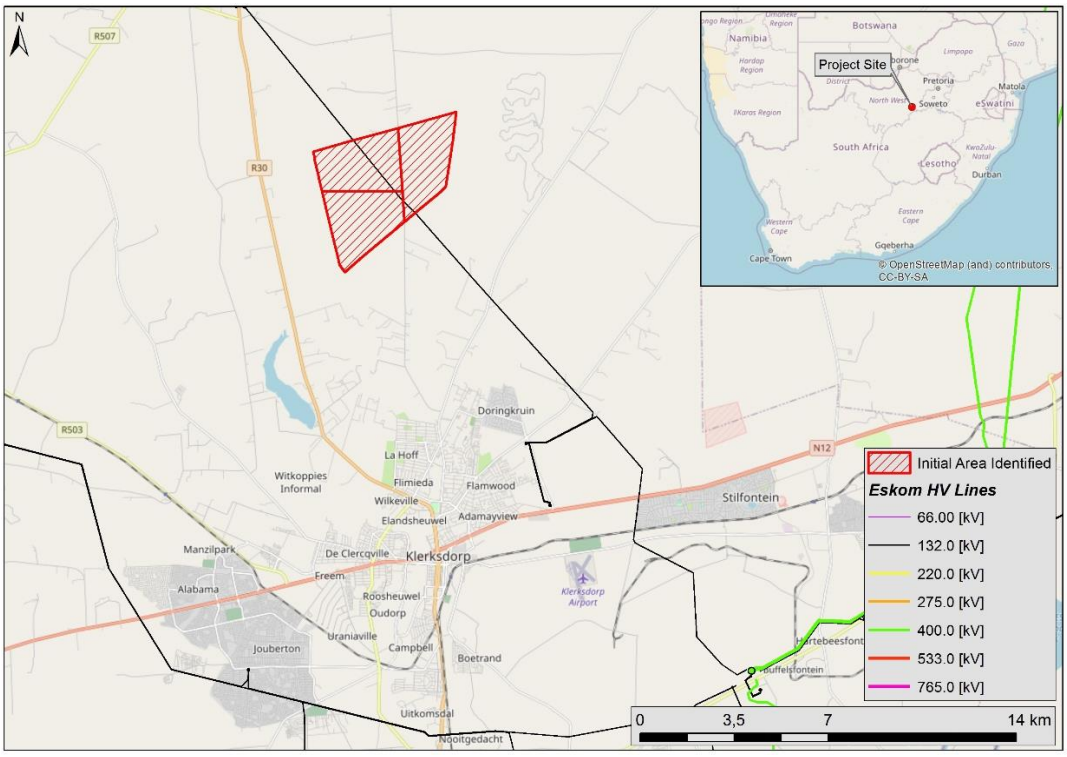

Figure 2: Locality of the Property.

An initial conceptual area of ± 1790 ha was identified during the planning phase of the project. This area is illustrated in Figure 3.

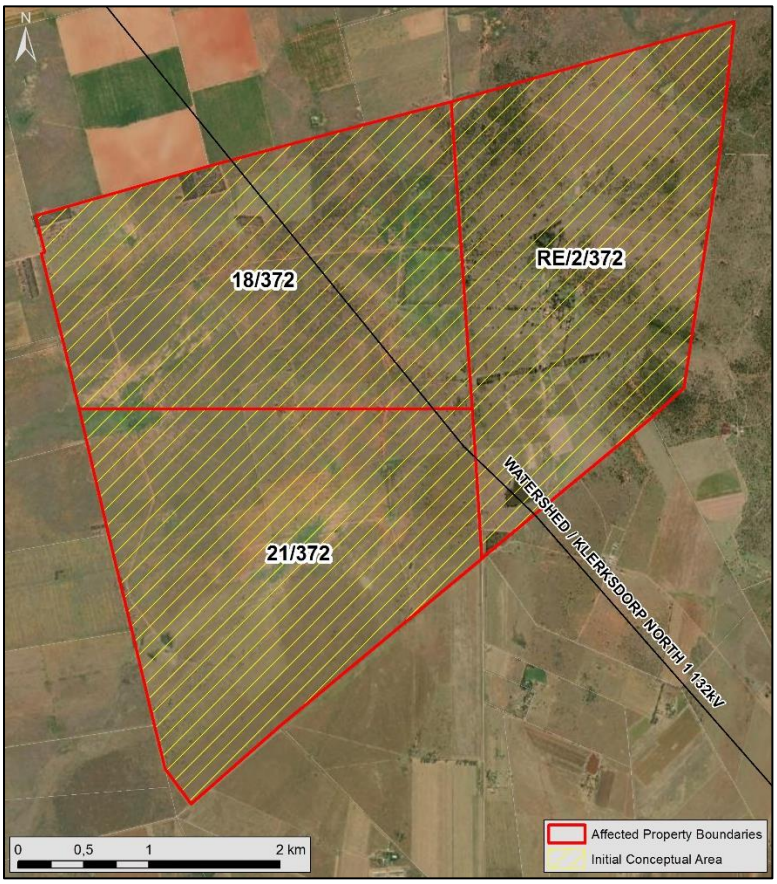

Figure 3: Initial Conceptual Area

Following the identification of the initial conceptual area, a detailed environmental and technical screening exercise was undertaken. This included site assessments and sensitivity mapping by various specialists. The outcome of the screening exercise is illustrated in Figure 4 below.

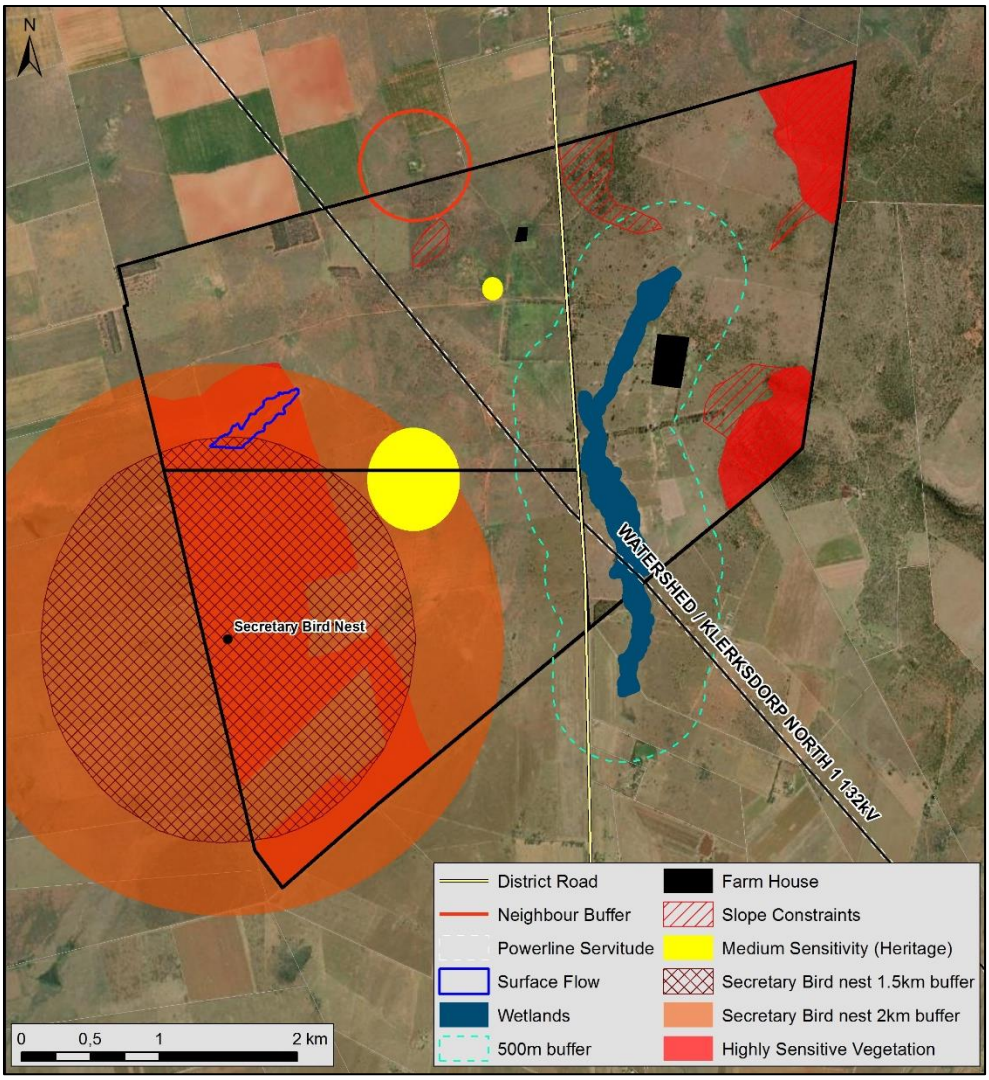

Figure 4: Potential constraints identified.

Following the initial site screening exercise, it was envisaged to develop three solar facilities across all available areas that were not highly sensitive (approximately 600 ha), on the western side of the district road. However, after further consultation with the visual specialist and considering the potential visual massing effect of 600 ha of solar PV panels, it was decided to reduce the footprint significantly and develop two solar facilities covering 280 ha on Portion 18 of the Farm Doornhoek No. 372-IP (see Figure 5).

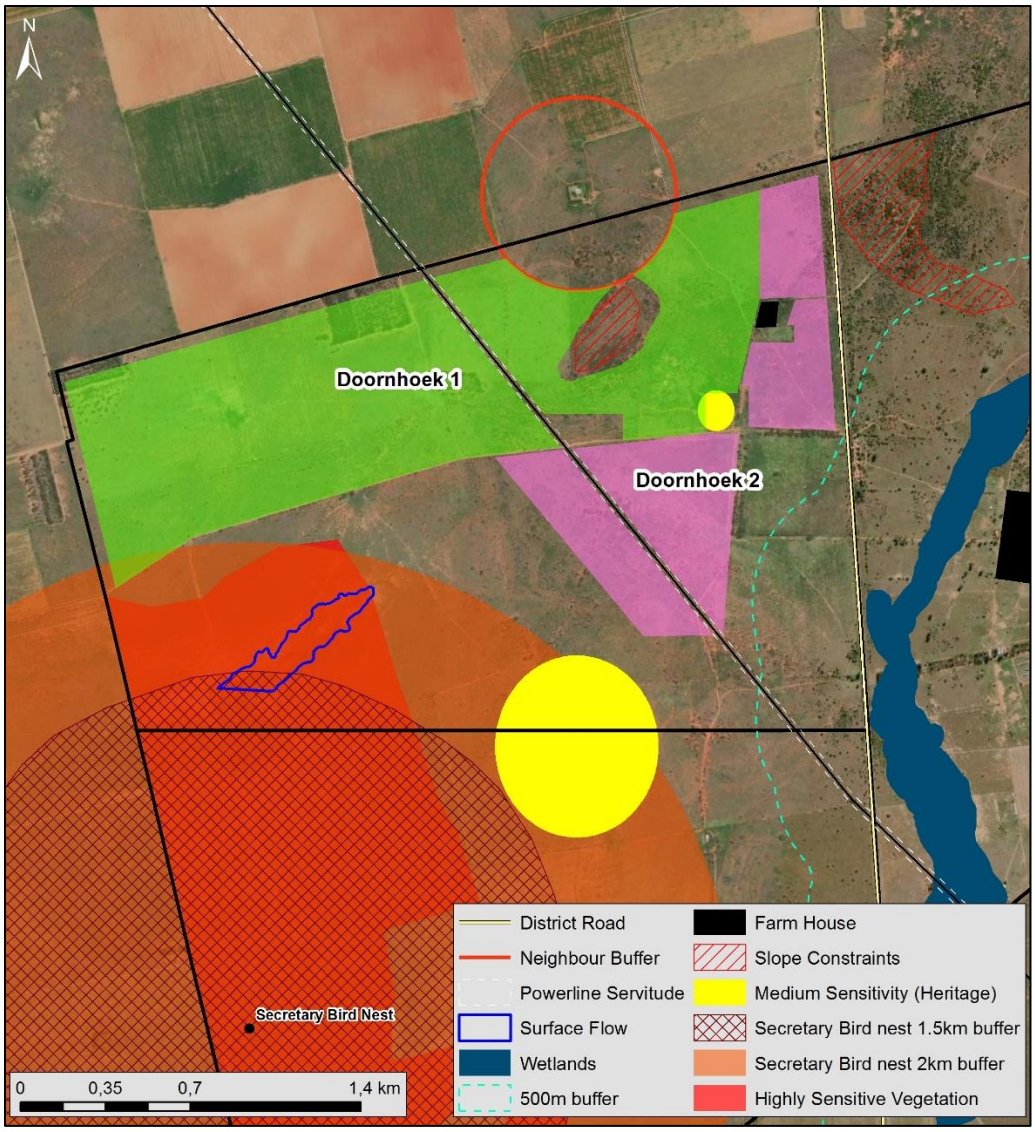

Figure 5: Proposed Doornhoek 2 footprint (80 ha) located adjacent to the proposed Doornhoek 1 footprint (200 ha).

2.2 PROPOSED LAYOUT

Doornhoek 2 is to consist of solar photovoltaic (PV) technology with fixed, single or double axis tracking mounting structures, with a net generation (contracted) capacity of up to 50 MW_{AC} as well as associated infrastructure, which will include:

- Inverters and transformers
- Battery Energy Storage System (BESS);
- Site and internal access roads (up to 8 m wide);
- Operation and Maintenance buildings including a gate house and security building, control centre, offices, warehouses and workshops for storage and maintenance.
- Temporary and permanent laydown area;
- Perimeter fencing and security infrastructure;

- Rainwater Tanks; and
- Grid connection infrastructure, including:
    - 33kV cabling between the project components and the facility substation
    - A 132kV facility substation
    - A 132kV Eskom switching station
    - A Loop-in-Loop out (LILO) overhead 132kV power line between the Eskom switching station and the existing Watershed–Klerksdorp 1 132kV power line.

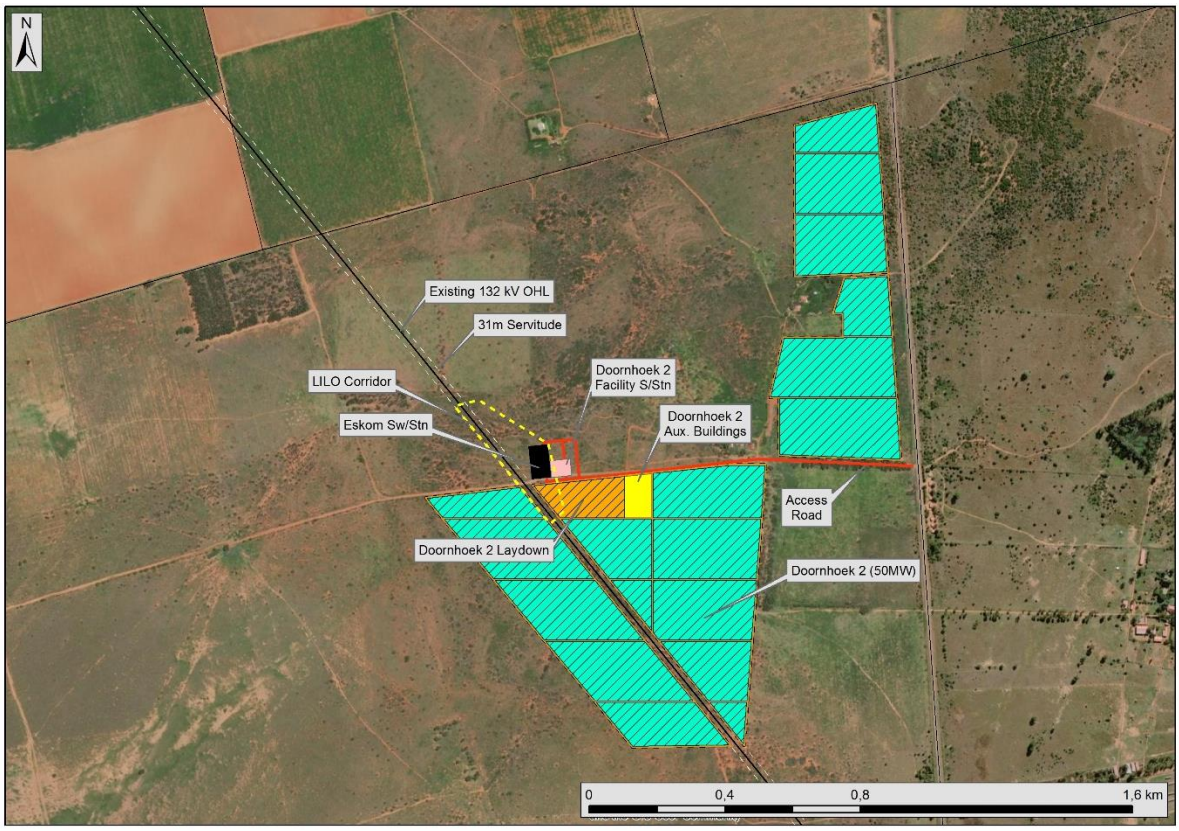

Figure 6: Proposed Doornhoek 2 Layout

3. PROJECT ALTERNATIVES

3.1 LOCATION ALTERNATIVES

The site selection process for a PV facility is almost always underpinned by a good solar resource. Other key considerations include environmental and social constraints, proximity to various planning units and strategic areas, terrain and availability of grid connection infrastructure.

Based on the above site-specific attributes (discussed in more detail in the *Site Selection Motivation report*) the study area is considered to be highly preferred in terms of the development of a solar PV facility. As such, no location alternatives will be considered.

3.2 SITE LAYOUT ALTERNATIVES

For the purpose of the Basic Assessment (BA), site layout alternatives will not be comparatively assessed. The layout has already been designed based on specialist input (as described in Section 2 above) and will continue to be refined as additional information becomes available throughout the BA process (e.g. further specialist input, additional site surveys, ongoing stakeholder engagement).

The development area presented in the Basic Assessment has been selected as a practicable option for the facility, considering technical preference and constraints, as well as initial No-Go layers informed by specialist site surveys.

4. OVERVIEW OF THE SOLAR ENERGY FACILITY

The following section presents an overview of the main components of a solar PV facility.

4.1 SOLAR ARRAY

Solar PV modules are connected in series to form a string. A number of strings are then wired in parallel to form an array of modules. PV modules are mounted on structures that are either fixed, north-facing at a defined angle, or mounted to a single or double axis tracker to optimise electricity yield.

4.2 MOUNTING STRUCTURES

Various options exist for mounting structure foundations, which include cast / pre-cast concrete, driven / rammed piles, or ground / earth screws mounting systems (Figure 7).

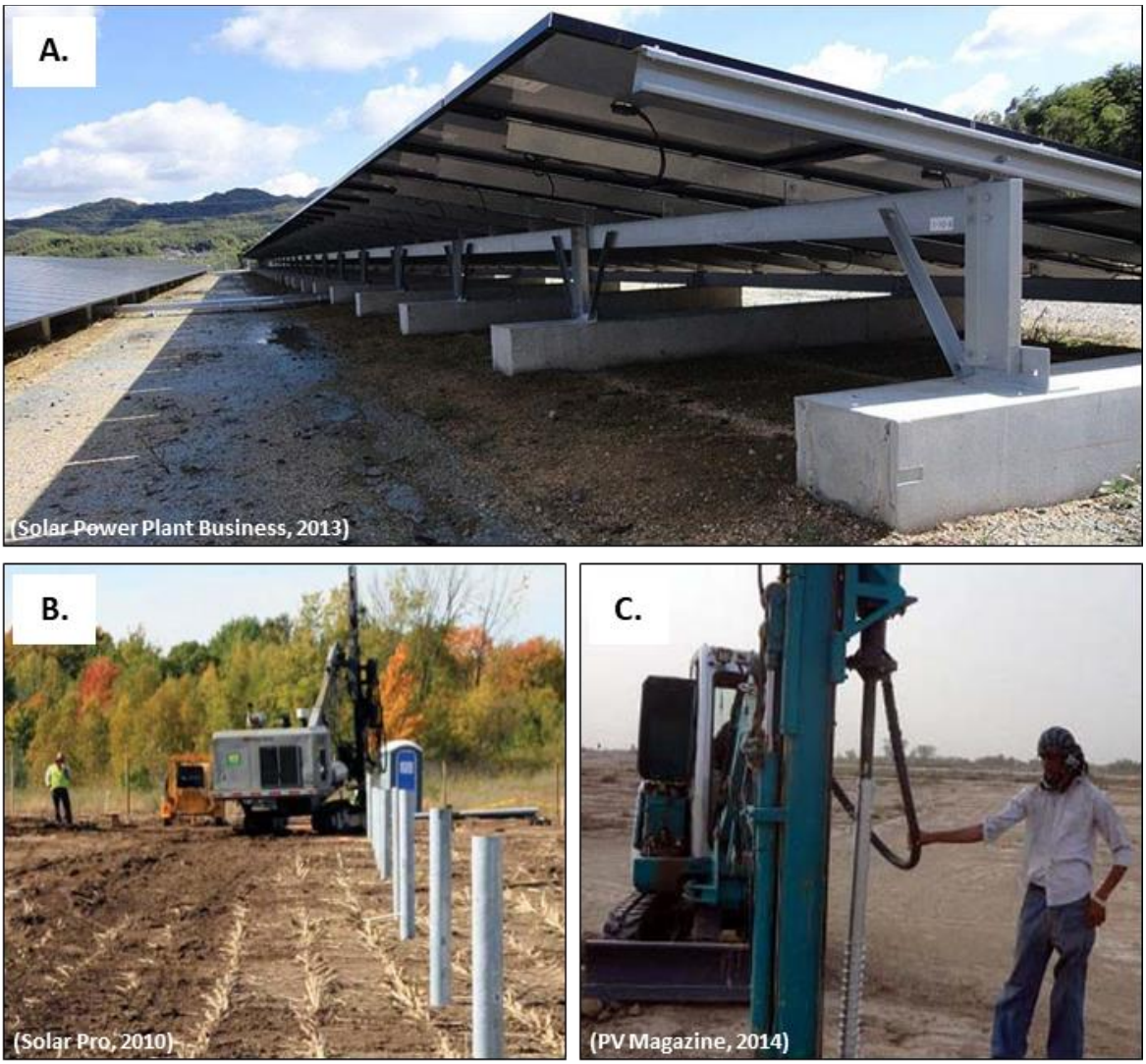

Figure 7: Mounting Structures. A) Cast Concrete Foundation. B) Driven/ Rammed Steel Pile. C) Ground / Earth Screw.

The impact on agricultural resources and production of these options are considered to be the same, however concrete is least preferred due the effort required at a decommissioning phase in order to remove the concrete from the soil, and therefore its impact on the environment. Doornhoek 2 will therefore aim to make the most use of either driven / rammed piles, or ground / earth screws mounting systems, and only in certain instances resort to concrete foundations should geotechnical studies necessitate this.

4.3 AUXILIARY BUILDINGS

The auxiliary buildings will comprise of the following as a minimum:

- Control Building / Centre;
- Offices;
- Warehouses and workshops for storage and maintenance;
- Staff Lockers and ablutions; and

- Gate house / security offices.

The total area occupied is approximately 1 ha, excluding the facility substation / switching station.

4.4 GRID CONNECTION AND CABLING

It is proposed to connect the Doornhoek 2 Solar Facility to the National Grid via a new overhead 132kV electrical transmission line, which will connect via a Loop in Loop out (LILO) connection into the existing Watershed–Klerksdorp 1 132kV powerline. The powerline will have a maximum length of 200m, a maximum height of 32m and maximum servitude width of 52m. The Doornhoek 2 substation / switching station will be up to approximately 1 ha in size. An assessment corridor for the LILO connection has been proposed to allow for micro-siting.

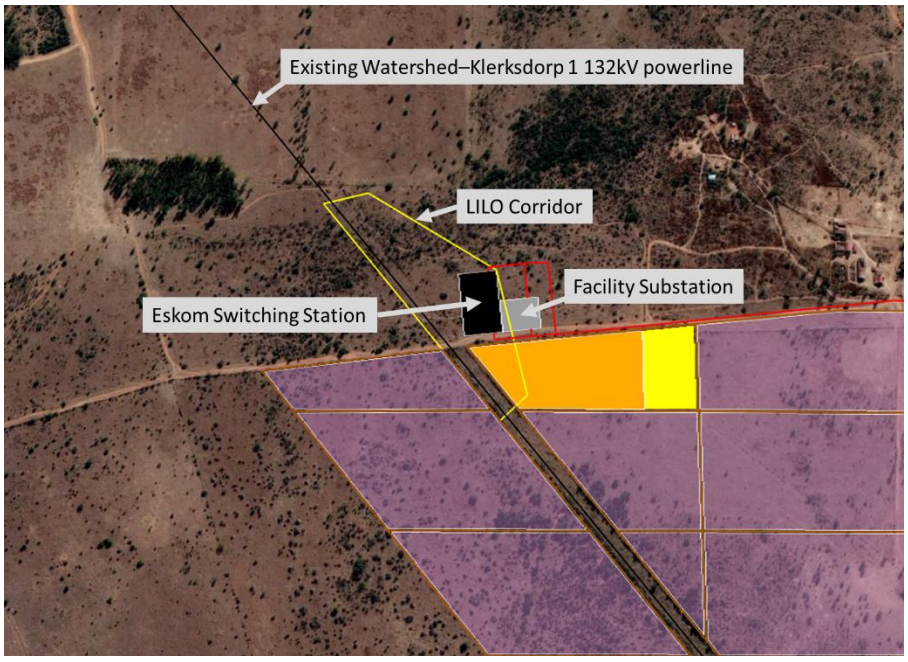

Figure 8: Proposed Grid Connection

A 50 MW_{AC} installation will require specific electrical components to meet the national grid code requirements in order to generate and supply electricity into the national grid.

The conversion from DC (modules) to AC is achieved by means of inverter stations. A single inverter station is connected to a number of solar arrays and will be placed along the internal service roads for ease of access. A number of inverter stations will be installed for the solar facility (either centralized or string inverters), each of which is connected to the substation/switching station.

Final placement of the inverter stations and substation/switching station will need to take ground conditions into consideration. Interconnecting electrical cabling will be trenched where practical and will follow internal access roads to the greatest extent. Sensitive areas will consequently be avoided as far as possible, or alternatively, cables will be fastened above ground to the mounting structures so as to avoid excessive excavation works and clearing of vegetation.

4.5 BATTERY STORAGE

Renewable energy can currently achieve lower costs than fossil fuels. By incorporating energy storage technologies into renewable energy facilities, electricity can be stored during generation peaks and supplied during demand peaks.

Lower costs coupled with improved efficiencies, high energy density, lightweight design and low environmental risks, make non-liquid/ solid-state (e.g. Lithium battery technologies) the preferred alternative (refer to standalone Battery Storage Technical Development Report).

Doornhoek 2 BESS will cover a maximum area of approximately 3 ha.

4.6 ACCESS AND INTERNAL ROADS

The project site will be accessed from an unnamed district road, which runs along the eastern boundary of the site. The proposed access road will mostly follow an existing gravel farm road that may require widening up to 10 m (inclusive of storm water infrastructure). Where new sections of road need to be constructed (or lengthened), this will be gravel/hard surfaced access road and only tarred if necessary.

The internal road network of the solar facility will be gravelled roads, approximately 5m in width.

A detailed transport and traffic plan is currently being compiled for the project. Traffic impacts will be assessed in the impacts tables of the Environmental Impact Report. Precautionary measures will be taken to mitigate the risk of ground disturbances where access roads will be constructed. Special attention will be given to drainage, water flow and erosion by applying appropriate building methods.

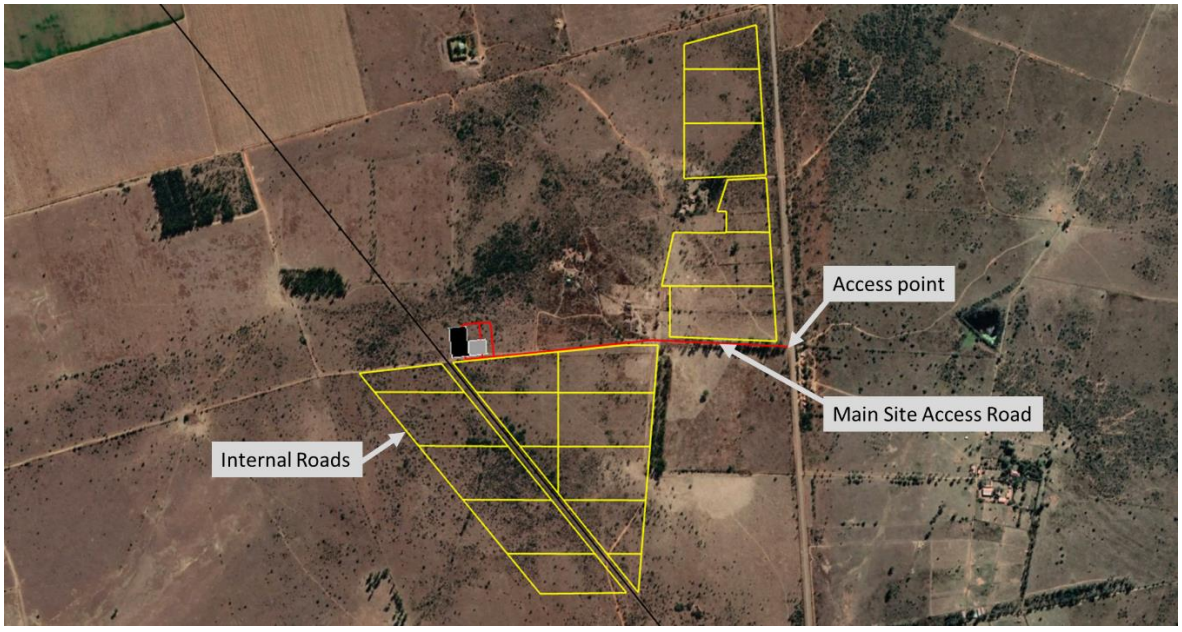

Figure 9: Site Access

4.7 SERVICES REQUIRED

4.7.1 Water

Water required during the construction and operation phases will be sourced from (in order of priority):

1. The Local Municipality (LM) - Specific arrangements will be agreed with the LM in a Service Level Agreement (SLA). Most likely the water will be either trucked in, or otherwise made available for collection at their Water Treatment Plant via a metered standpipe.
2. Investigation into a third-party water supplier which may include a private services company.
3. The investigation of drilling a borehole on site, which includes complete geohydrological testing, groundwater census and a Water Use License Application (WULA) in terms of section 21a of the National Water Act, 1998.

4.7.2 Electricity

Electricity will be needed during the construction period as well as the operation period in the support offices, security systems etc. Electricity supply during construction will be arranged with either the LM or Eskom Distribution, via an 11kV or 22kV feeder line.

In addition, diesel/petrol generators for electricity generation may be used during the construction period.

4.7.3 Waste Management

Solid waste

During the construction phase, solid waste will mainly be in the form of construction material, excavated substrate and domestic solid waste. All waste will be disposed of in scavenger proof bins and temporarily placed in a central location for removal by the contractor. Any other waste and excess material will be removed once construction is complete and disposed of at a registered waste facility. Excess excavation material will either be spoiled offsite at a registered facility or used for landscaping berms within the overall PV footprint.

Sewerage

During the construction phase, chemical ablution facilities will be utilised. These ablution facilities will be maintained, serviced and emptied by an appointed contractor, who will dispose of the effluent at a licensed facility off site. Once construction is complete, the chemical ablution facilities will be removed from the construction site. A conservancy tank which will be regularly emptied by a registered service provider will be installed at the Operations & Maintenance building and on-site substation.

Hazardous substances

During the construction phase, use of the following hazardous substances is anticipated:

- Cement associated with the piling activities and construction of buildings and inverter station plinths;
- Petrol/diesel for construction plant; and
- Limited amounts of lubricants and transformer oils.

Temporary storage and disposal of hazardous waste will be done in compliance with relevant legislation (i.e. stored in covered containers with appropriate bunding). Refuelling areas to be in designated positions, with suitable mitigation to reduce the risk of hydrocarbon spills.

5 CONCLUSION

The layout proposed has been developed based on key criteria identified above, including inter alia, accessibility, proximity to a viable grid connection, as well as consideration of sensitive areas to minimise impacts.

Further assessment, during the Basic Assessment for Doornhoek 2, will determine if there are any further environmental sensitivities within the project site. Specialists will provide recommendations and mitigation measures required to avoid or reduce any identified impacts.

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