Basic Assessment Level

SJM Investment Group
&

ARC • LNR

SOIL INFORMATION FOR PROPOSED ORANIA PV SOLAR PROJECT, NORTHERN CAPE

By

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DECLARATION

This report was prepared by me, DG Paterson of ARC-Institute for Soil Climate. I have a PhD degree in Soil Science from University of Pretoria and have considerable experience in soil studies and agricultural assessments since 1981. I have compiled more than 200 such surveys for a variety of purposes.

This specialist report was compiled on behalf of SJM Investment Group (Pty) Ltd for their use in undertaking a Scoping and Environmental Impact Assessment process for the proposed Orania PV Solar Power Project in the Northern Cape Province.

I hereby declare that I am qualified to compile this report as a registered Natural Scientist (Reg. No. 400463/04) and that I am independent of any of the parties involved and that I have compiled an impartial report, based solely on all the information available.

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1. INTRODUCTION AND TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by SJM Investment Group (Pty) Ltd to undertake a soil investigation near on **Portion 2 of Farm Roode Pan 150 in Orania**, in the Northern Cape Province. The purpose of the investigation is to contribute to the basic assessment process of the for the proposed Orania Photovoltaic Solar Power Project.

The study should:

- Describe the baseline conditions that exist on site and identify any sensitive areas that would need special consideration;
- Identify and assess potential impacts;
- Identify and list all legislation and permit requirements that are relevant to the development proposal;
- Identify areas where issues could combine or interact with issues likely to be covered by other specialists, resulting in aggravated or enhanced impacts;
- Indicate the reliability of information utilised in the assessment of impacts as well as any constraints to which the assessment is subject (e.g. any areas of insufficient information or uncertainty);
- Identify feasible ways in which impacts could be mitigated and benefits enhanced giving an indication of the likely effectiveness of such mitigation and how these could be implemented in the construction and management of the proposed development;
- Comply with DEA guidelines as well as any other relevant guidelines on specialist study requirements for EIAs.

The objectives of the study are;

- Identify, map and describe the soil patterns on site that could be affected by the proposed project based on available literature;
- Assess the broad agricultural potential of the site;
- Assess the significance of potential impacts of the proposed project on the soil and agricultural potential; and
- Identify practicable mitigation measures to reduce impacts and indicate how these could be implemented in the construction and management of the proposed project.

2. SITE CHARACTERISTICS

2.1 Location

The area that was investigated lies immediately to the south-east of the town of Orania, on Portion 2 of the farm Roode Pan 150. The area lies between 29° 49′ and 29° 53′ S and between 24° 24′ and 24° 28′ E. The position of the site is shown by the orange area on the map in Figure 1.

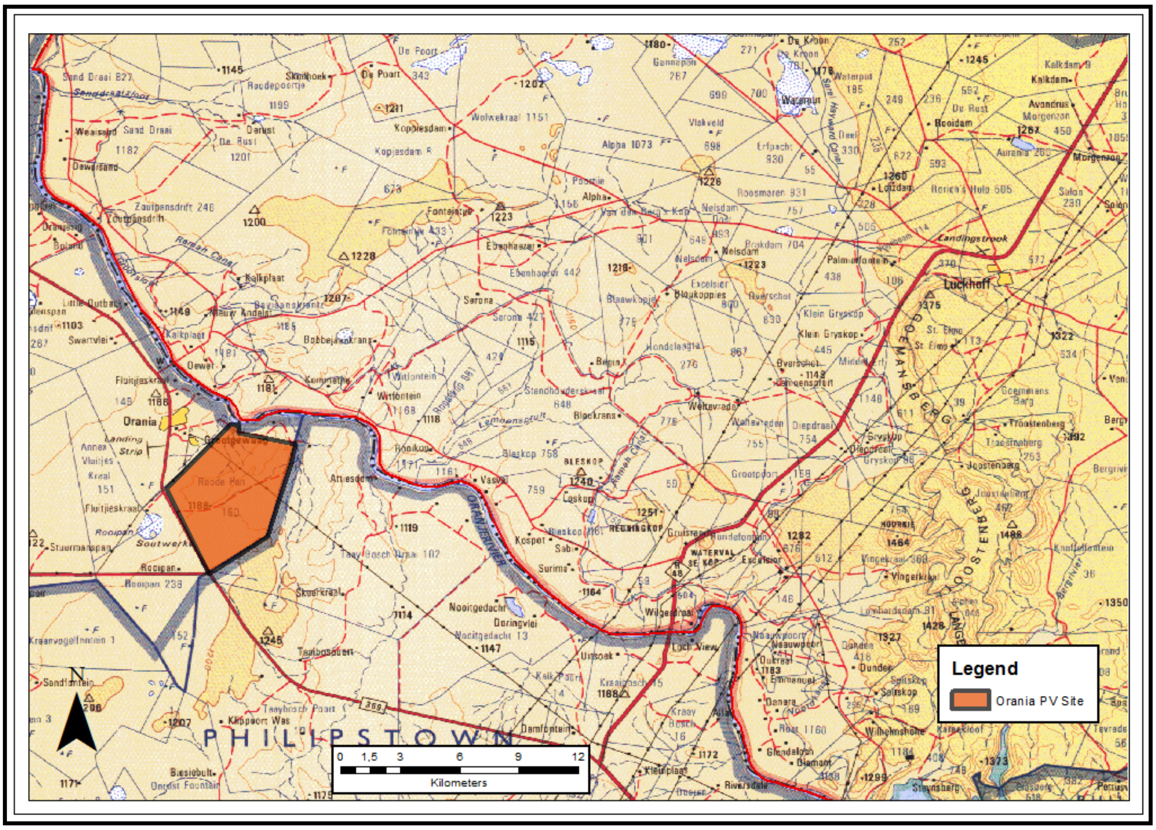

Figure 1 Locality map: Orania PV project

2.2 Terrain

The site lies at a height of approximately 1 100 to 1 200 metres above sea level, and is predominantly flat to gently undulating. No permanently wet drainageways are present in the area, although several small non-perennial streams flow to the north and north-east.

2.3 Climate

The climate of the study area (ARC-ISCW, unpublished) can be regarded as warm to hot with rain in summer and dry winters. The long-term average annual rainfall in this region of the Northern Cape is only 380 mm, of which 290 mm, or 76%, falls from November to April. Rainfall is erratic, both locally and seasonally and therefore cannot be relied on for agricultural practices. The average evaporation is over 2 500 mm per year, peaking at 12.3 mm per day in January.

Temperatures vary from an average monthly maximum and minimum of 33.0ºC and 17.1ºC for January to 18.3ºC and 1.0°C for July respectively. The extreme high temperature that has been recorded is 41.6°C and the extreme low –11.9ºC. Frost occurs most years on around 36 days on average between late May and late August.

2.4 Parent Material

The geology of the area (Figure 2) comprises shale of the Volksrust Formation, Karoo Sequence, with dolerite intrusions (Geological Survey, 1997).

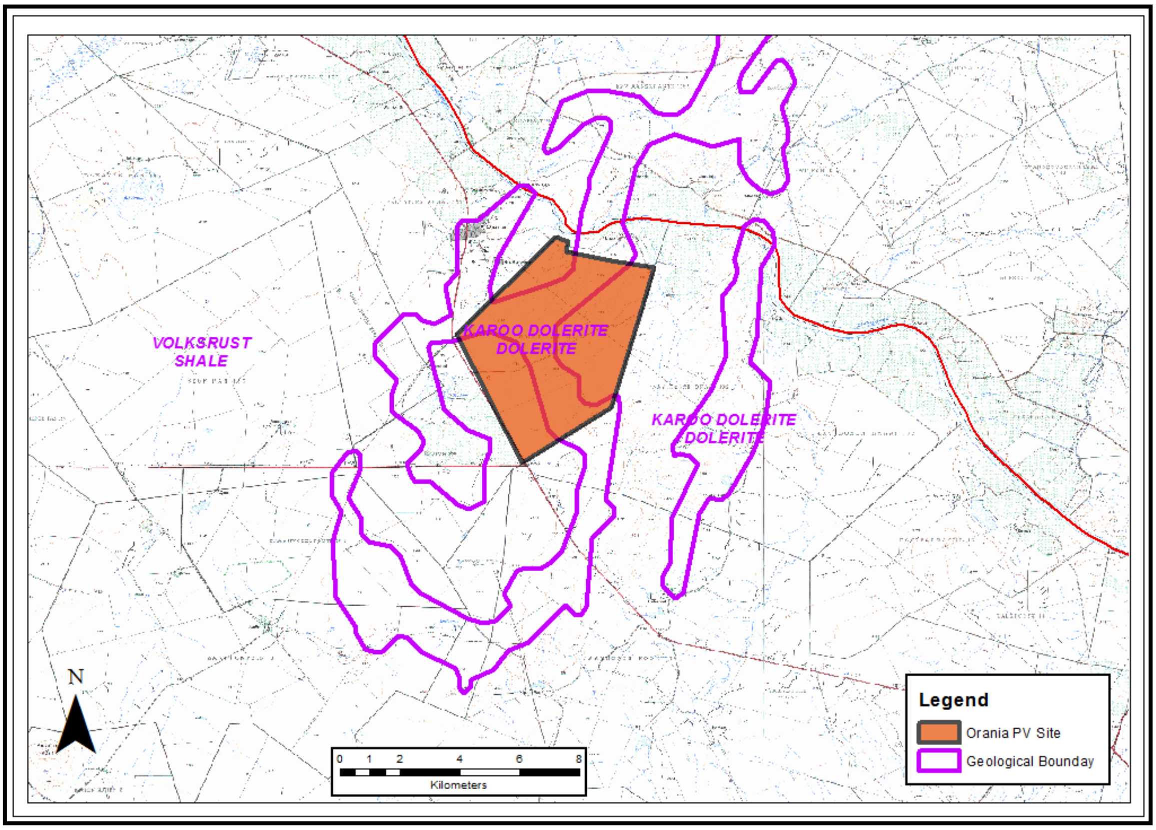

Figure 2 Geology, Orania PV site

3. METHODOLOGY

Existing soil information was obtained from the map sheet 2924 Koffiefontein (Bennie *et al.*, 1990) from the national Land Type Survey, published at 1:250 000 scale. A land type is defined as an area with a uniform terrain type, macroclimate and broad soil pattern. The soils are classified according to MacVicar *et al* (1977).

The area under investigation is covered by three land types, as shown on Figure 3, namely:

- **Ae135** Red, freely-drained soils, high base status
- **Da78** Duplex soils (sandy topsoil abruptly overlying structured, clay subsoil), mainly red
- **Fb85** Shallow soils, occasional lime

It should be clearly noted that, since the information contained in the land type survey is of a reconnaissance nature, only the general dominance of the soils in the landscape can be given, and not the actual areas of occurrence within a specific land type. Also, other soils that were not identified due to the scale of the survey may also occur. The site was not visited during the course of this study, and so the detailed composition of the specific land types has not been ground-truthed.

4. SOILS

A summary of the dominant soil characteristics is given in **Table 1** below.

The distribution of soils with high, medium and low agricultural potential within the land type is also given, with the dominant class shown in **bold type**.

Note: the agricultural potential refers to the ***soil characteristics only***, with climatic restrictions not taken into account.

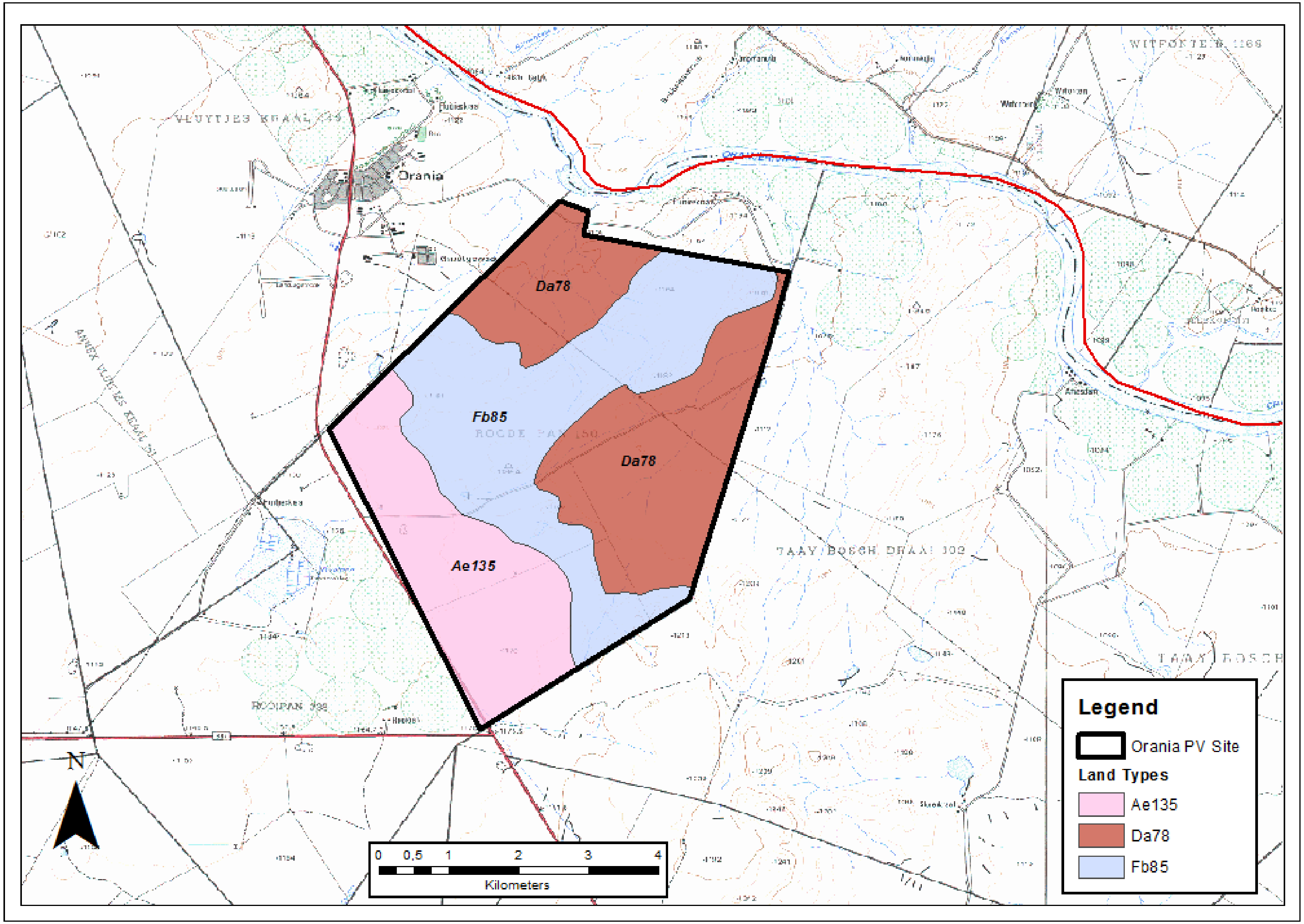

Figure 3 Land type map, Orania PV site

Table 1 Land types occurring (with soils in order of dominance)

Land Type	Dominant soils	Depth (mm)	Percent of land type	Characteristics	Agric. Potential (%)
Ae135	Hutton 33/36 Hutton 36 Oakleaf 26/46	600-1200 100-300 600-1200	72% 11% 9%	Red, sandy to sandy loam structureless soils on rock Red, sandy to sandy loam structureless soils on rock Red-brown, sandy clay loam alluvial soils, calcareous	**High: 81.3** Mod: 2.3 Low: 15.4
Da78	Valsrivier 21/41 Oakleaf 26/27/46/47 Hutton/Clovelly 33/36	>1200 600-1200 800-1200	50% 23% 16%	Red-brown, structured, sandy clay to clay duplex soils, calcareous Red-brown, sandy clay loam alluvial soils, calcareous Red and yellow-brown, sandy to sandy loam structureless soils on rock	High: 38.3 Mod: 0.8 **Low: 58.9**
Fb85	Mispah 10/22 Rock Glenrosa 13/16	50-100 - 50-200	70% 11% 10%	Red-brown, occasionally calcareous topsoils on rock/calcrete Brown, sandy loam topsoils on weathering rock	High: 0.0 Mod: 4.5 **Low: 95.5**

5. AGRICULTURAL POTENTIAL

As listed in Table 1, the area comprises a mixture of soil types, with varying agricultural potential. Land type **Ae135**, occurring in the south-west, comprises largely deep, structureless sandy loam soils which are well suited for cultivation. However, the limitation is the low rainfall in the area (section 2.3). If a source of water is available for irrigation, these soils are highly productive, which is supported by the occurrence of centre pivot irrigation fields immediately to the south-west of the study site (Figure 4). Land type **Fb85**, which runs through the centre of the area, comprises mainly shallow soils with rock, with a very low potential for any type of cultivation, while land type **Da78**, occurring in the east and north-west, has a large component of highly erodible duplex soils. In these areas on Figure 4, a network of fine erosion channels can be seen, indicating how the soils easily lose the topsoil layer and are susceptible to removal by water.

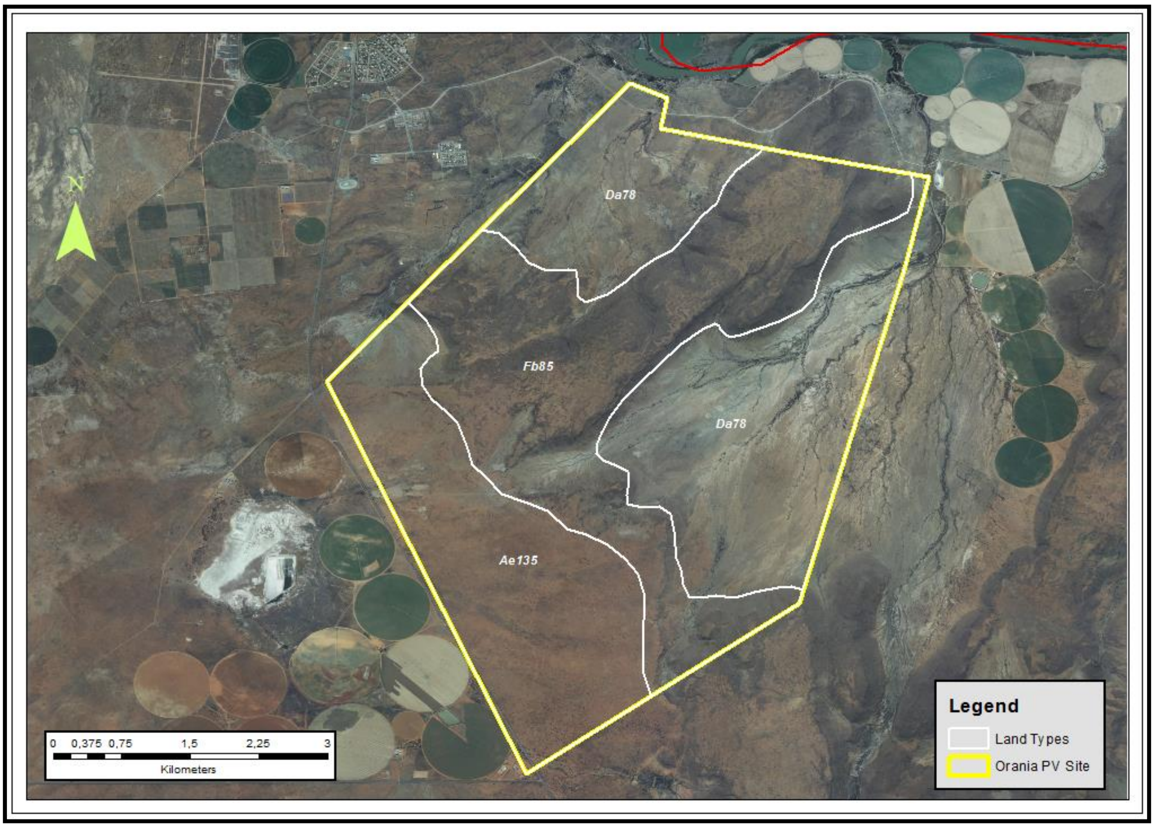

Figure 4 Google Earth image of study area

The climatic restrictions mean that this part of the Northern Cape is suited at best for grazing and here the grazing capacity is low, around 25-30 ha/large stock unit (ARC-ISCW, 2004).

6. IMPACTS

The two major impacts on the natural resources of the study area would be:

- the loss of potentially arable land due to the construction of the various types of infrastructure, and
- increased susceptibility to water erosion due to removal of vegetation cover.

However, due to the dry and hot climate of the region (Section 2.3), the first impact would in all probability be of limited significance and would be local in extent.

The erosion hazard may well be more significant, given the nature of the soils in the Da78 zones. Indeed, almost any soil will erode to some degree if vegetation cover is removed, so care should be taken in the construction phase to minimize both the extent of excavations and time involved to the absolute minimum.

There are no "fatal flaw" or "no-go" aspects regarding the soils of the study area. The nature of the planned infrastructure would mean that grazing of livestock or game species between the solar panels should still be possible (if desired), so that the actual area lost to this form of agriculture would be small. At the end of the project life, it is anticipated that removal of the structures would enable the land to be returned to more or less a natural state following rehabilitation, with little impact, especially given the low prevailing dryland agricultural potential.

The impacts can be summarized as follows:

Table 3a Impact Assessment table

IMPACT	Loss of agriculturally productive soils and land that can no longer be utilized due to construction of infrastructure.	
CRITERIA	**WITHOUT MITIGATION**	**WITH MITIGATION**
Extent	Local	Local
Duration	Long Term	Long Term
Intensity	Low	Low
Probability	Probable	Probable
Confidence	High	High
Significance	Low	Low
Cumulative impact	Low	Low
Nature of Cumulative impact	This is assessed in terms of other solar energy projects in the vicinity, where larger combined areas will be affected. However, the prevailing land in the area has a very low dryland potential	
Degree to which impact can be reversed	Fully reversible. Removal of infrastructure at the end of the project should enable the site to be returned to close to its natural state.	
Degree to which impact may cause irreplaceable loss of resources	The low potential for arable agriculture, caused by a combination of shallow soils in many places and the hot, dry climate, means that the area has a low potential for cultivation and the resources are not irreplaceable.	
Degree to which impact can be mitigated	The main mitigation would be to ensure that as little pollution or other non-physical disturbance occurs. Part of the site (land type **Ae135**) has deep, friable soils that could be utilized for cultivation if a source of water is obtained, so it is recommended that no infrastructure be placed on these soils.	

Table 3a Impact Assessment table

IMPACT	Increased susceptibility to topsoil erosion by water due to construction of infrastructure.	
CRITERIA	**WITHOUT MITIGATION**	**WITH MITIGATION**
Extent	Surrounding area	Local
Duration	Permanent	Long Term
Intensity	High	Low
Probability	Probable	Possible
Confidence	High	High
Significance	Medium to high	Low
Cumulative impact	High	Low
Nature of Cumulative impact	This is assessed in terms of other solar energy projects in the vicinity, where larger combined areas will be affected. If any project-related activities, especially in the **Da78** zones, are not controlled, significant erosion could occur.	
Degree to which impact can be reversed	Not reversible. Soil erosion, if allowed to continue unchecked, can lead to permanent loss of topsoil and extreme difficulty in re-establishing vegetation.	
Degree to which impact may cause irreplaceable loss of resources	The low potential for arable agriculture, caused by a combination of shallow soils in many places and the hot, dry climate, means that the area has a low potential for cultivation and the resources are not irreplaceable.	
Degree to which impact can be mitigated	The main mitigation would be to ensure that as little pollution or other non-physical disturbance occurs. If any construction takes place in the zone with erodible soils, great care should be taken to restrict the area which is cleared of vegetation, to prevent excess runoff and to re-vegetate any disturbed areas as soon as possible, using soil conservation measures such as geotextiles, contours, runoff channels etc.	

7. CONCLUSION

It is recommended that, if the project proceeds,

- Infrastructure is not established on the zone of deeper soils indicated by land type **Ae135**,
- Development be confined, as far as possible to the shallow soils of land type **Fb85** and,
- Any development in the **Da78** zones be controlled and monitored closely to ensure that excessive soil erosion does not occur.

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