IMPACT ASSESSMENT REPORT

On contract research for

SAVANNAH ENVIRONMENTAL

ARC • LNR

Proposed Construction of a 75 MW Photovoltaic Power Plant, Tutuka Power Station, Mpumalanga Province

Soils and Agricultural Potential

EIA Study

By

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DECLARATION

I hereby declare that I am qualified to compile this report as a registered Natural Scientist and that I am independent of any of the parties involved and that I have supervised the compilation of an impartial report, based solely on all the information available.

D G Paterson

September 2015

CONTENTS **Page**

1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by Savannah Environmental to undertake a soil investigation near Amersfoort, in Mpumalanga Province. The purpose of the investigation is to contribute to the Environmental Impact Assessment (EIA) process for a proposed Photovoltaic (PV) power generation facility at Eskom's Tutuka Power Station.

EIA Report

The purpose of the EIA Report is to elaborate on the issues and potential impacts identified during the scoping phase of the proposed projects. This is achieved by site visits and research in the site-specific study area as well as a comprehensive assessment of the impacts identified during the scoping phase.

The EIA report must include:

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

» Mitigation measures and management recommendations to be included in the Environmental Management Programme to be submitted with the FEIR

The objectives of the study are;

- To obtain all existing soil information and to produce a soil map of the specified area as well as

- To assess broad agricultural potential and the potential impacts that might result from the proposed PV development.

2. SITE CHARACTERISTICS

2.1 Location

The study area (Figure 1) is located approximately 30 km north-east of Standerton. The area is 176 ha in extent and lies immediately to the south of Tutuka Power Station, between 26^{o} 46’ and 26^{o} 47’ S and between 29^{o} 20’ and 27^{o} 21’ E

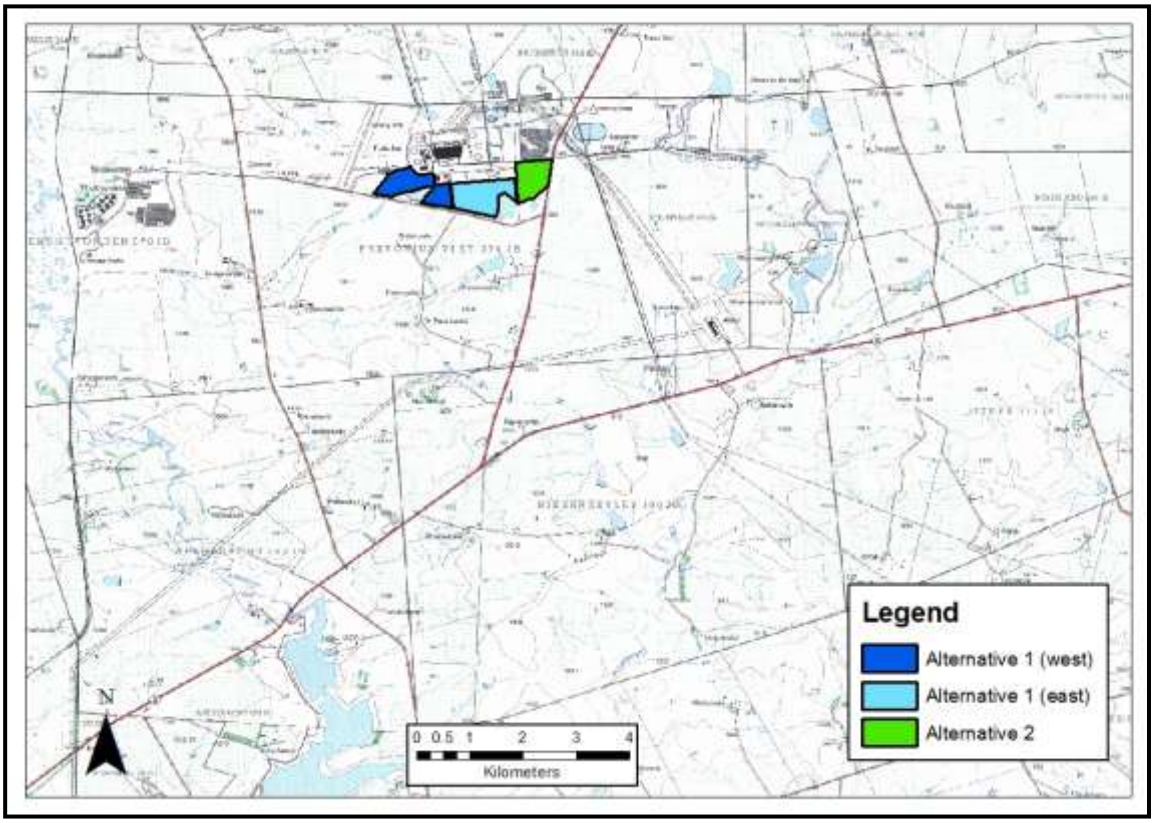

Figure 1 Locality map

Two alternative sites were investigated, namely the larger Alternative 1 (two adjoining portions shown in blue in Figure 1) and the smaller Alternative 2 site to the east (shown in green).

At the time of the field visit (September 2015), the site was not being utilized. The site consisted of virtually continuous grass cover.

2.2 Terrain

The study area lies at a height of approximately 1 600 metres above sea level. The slope of the area is flat. There are two wetland zones upstream of dams in the southern and south western parts of the site.

2.2 Climate

Long-term average climate data was obtained from the national Land Type Survey (Kotzé, 1985).

The climate has warm, moist summers with cool, dry winters. On average, 85% of the annual average rainfall of 720.3 mm falls in the growing season (October to March).

Frost, often severe, occurs in winter. The extreme maximum temperature is 35.6°C and the extreme minimum –11.1°C

The climatic data is given in Table 1 below.

Table 1 Long-term climate data for study area

Month	Rainfall (mm)	Min. Temp (°C)	Max. Temp (°C)	Average frost dates
Jan	154.2	14.2	27.6	Start date: 06/01 End date: 11/11 Days with frost: ±46
Feb	92.8	13.1	28.0	
Mar	73.7	11.6	27.2	
Apr	46.1	8.0	24.5	
May	15.0	2.9	22.3	
Jun	10.6	-0.4	20.0	
Jul	2.9	-1.8	19.5	**Heat units (hrs > 10°C)**
Aug	10.1	1.9	22.6	Summer (Oct-Mar): 1308.34
Sep	9.3	6.0	26.3	
Oct	79.8	10.4	27.1	Winter (Apr-Sept): 603.27
Nov	104.6	12.5	26.5	
Dec	136.5	13.7	27.1	
Year	**735.6**	**(Average) 14.9°C**		

2.4 Parent Material

The geology of the study area consists of extensive dolerite intrusions into the sandstone and shale of the Vryheid Formation, of the Karoo Sequence (Geological Survey, 1984). The dolerite occurs mainly in the east, with the sandstone and shale occurring in the west and north.

3. METHODOLOGY

The area was investigated using a hand-held soil auger to a maximum depth of 1.2 m. The grid of observation was approximately 200 x 200 m, with the positions controlled by GPS. At each soil observation point, the most important soil characteristics, including texture, colour, structure, mottling, coarse fragments and internal drainage were identified and noted. The soils were then classified (Soil Classification Working Group, 1991) and similar soils grouped into mapping units, whose distribution is shown in the soil map in the Appendix.

In addition, samples of topsoil and subsoil were collected at three localities and taken for analysis at the laboratories at ARC-ISCW. Parameters analyzed include particle size (sand, silt and clay), exchangeable cations (Ca, Mg, Na, Mg) and cation exchange capacity (CEC), organic carbon, pH (H_2O) and P (Bray 1). The positions of the sampling sites are shown as S1 to S3 on the map in the Appendix.

4. SOILS

The soils occurring in the study area are mostly structured, black clay soils (Arcadia form, map unit **Ar**) with shrink-swell properties. Two zones of shallow, dark brown soils on rock (Mispah soil form, map unit **Ms**) also occur, as well as some wetter clay soils in the lower parts (Sepane form, map unit **Se**).

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

Table 1 Soil legend

Map Unit	Dominant soils	Sub-dominant soils	Depth (mm)	Characteristics	Area (ha)
Ar	Arcadia	Rensburg	500-1200+	Dark brown to black, moderately to strongly structured, shrink-swell clay soils on weathering rock. In the lower landscape positions, the subsoil is grey and mottled, showing signs of wetness (Rensburg form).	**114.32**
Ms	Mispah	Glenrosa	0-200	Brown, weakly structured, sandy clay loam topsoils over hard (occasionally weathering) rock.	**35.09**
Se	Sepane	Tukulu, Katspruit	300-1200+	Brown to grey-brown, weakly structured, sandy clay loam topsoil on brown, moderately structured clay subsoil on grey, mottled gleyed clay. In the lowest parts, the gleyed subsoil occurs closer to the surface, with signs of wetness (Katspruit form).	**21.16**
Bu	Buildings			Built up area with structures	**5.59**
				Totals	**176.16**

4.1 Soil Analyses

The results of the soil analyses are given in Table 2.

Table 2 Soil analyses (Majuba)

Sample No.	S1 (Se)		S2 (Ar)		S3 (Ar)	
	0-300 mm	300-900 mm	0-300 mm	300-650 mm	0-300 mm	300-600 mm
Co-ordinates	26° 47′ 03.4″ S 29° 24′ 04.3″ E		26° 47′ 09.0″ S 29° 24′ 40.6″ E		26° 46′ 54.1″ S 29° 24′ 03.7″ E	
Sand (%)	54	34	42	46	46	34
Silt (%)	12	20	22	8	16	24
Clay (%)	34	46	36	46	38	42
Na (cmol (+) kg $^{-1}$)	0.086	0.809	0.124	0.535	0.912	2.226
K (cmol (+) kg $^{-1}$)	0.708	0.507	1.301	0.895	0.282	0.292
Ca (cmol (+) kg $^{-1}$)	10.672	8.673	9.897	10.738	8.451	11.648
Mg (cmol (+) kg $^{-1}$)	3.196	8.030	6.111	8.349	5.674	8.930
CEC* (cmol (+) kg $^{-1}$)	18.444	23.555	27.219	26.033	21.448	29.011
$P^{\#}$ (ppm)	1.10	0.49	4.26	1.11	0.84	0.44
Organic C (%)	1.96	1.05	2.87	1.56	1.32	0.87
pH (H_2O)	6.74	6.83	5.92	6.41	6.52	7.86

= Bray No. 1 Method
* = Cation Exchange Capacity

The analysis results reflect the clay-rich nature of the soils, with high base status (shown by the high CEC values), relatively high pH values, moderate organic carbon levels and low P values due to the lack of any recent cultivation.

No unexpected or abnormal values were obtained.

5. AGRICULTURAL POTENTIAL

The area consists of a mixture of soils ranging from moderately deep to deep, black, shrink-swell clay soils to shallow soils on rock.

The broad agricultural potential is summarized in Table 3 below.

Table 3 Agricultural potential

Agric. Potential Class	Map Unit(s)	Limitations	Area (ha)
Low to moderate	Ar	Moderately deep to deep vertic soils, can be waterlogged (especially in lower parts) but if well managed they can be productive soils.	**114.32**
Low	Se	B horizons with clay cutans and mottles which have a potential for waterlogging during rainy seasons.	**21.16**
Very Low	Ms	General shallow depth to underlying hard rock or weathering rock.	**35.09**
		Totals	**170.57**

From Table 3, it can be seen that most of the area (67%) has low to moderate agricultural potential with the remainder being low to very low.

6. IMPACTS

The major impact on the natural resources of the study area would be the loss of arable land due to the construction of the various types of infrastructure. With the lack of high potential soils in the vicinity, this impact would in all probability have a limited significance. 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.

These impacts can be summarized as follows:

Table 4 Impact significance

Nature: Loss of agricultural potential		
	Without mitigation	**With mitigation**
Extent (E)	Low (2)	Low (2)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Slight (4)	Minor (2)
Probability (P)	Probable (3)	Improbable (2)
Significance (E+D+M)*P	**Low (24)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes
Mitigation: The main mitigation measure will be to develop the facility on low potential soils, wherever possible		
Cumulative impacts: Little or none foreseen at this time		
Residual Risks: Little or none, as long as proper rehabilitation measures are carried out.		

6.1 Evaluation of Alternatives

If all low-lying areas in the landscape (where wetland soils pose a flooding hazard) are avoided, the most suitable soils for the establishment would be the shallow soils (**Ms** map unit), which are most prevalent in the central portion of the study area. A comparative assessment of the alternatives would be as follows:

- Alternative 1 (west) – preferred
- Alternative 1 (east) – **most preferred**
- Alternative 2 – not preferred

Soils with high clay content and swelling properties will need to be borne in mind for planning purposes (e.g foundations).

6.2 Cumulative impacts

Due to the fact that the soils in the area are not of high potential, as well as the fact that the agricultural resources are already impacted by the proximity of the power station, it is unlikely that there will be any significant cumulative impacts.

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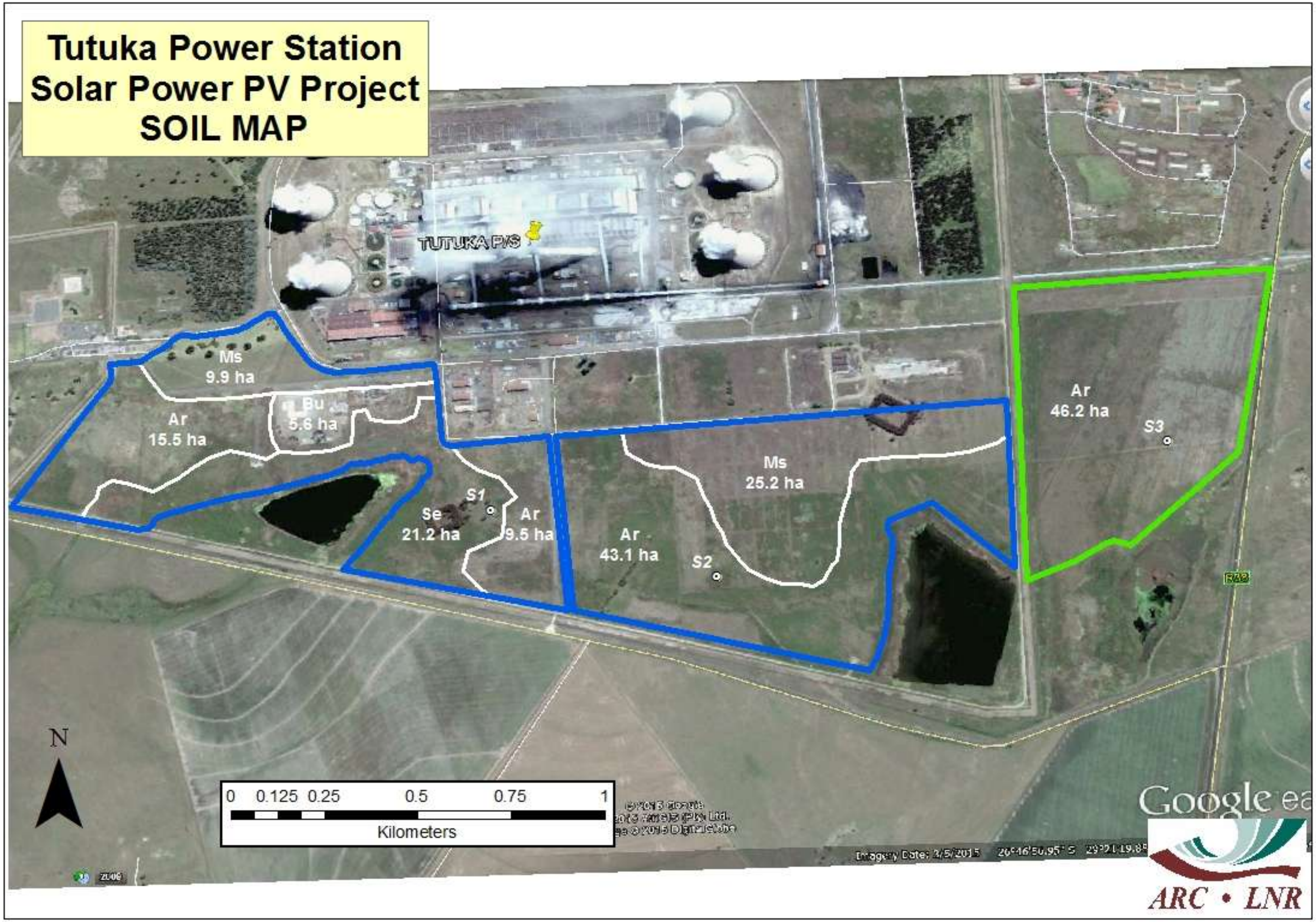
APPENDIX A

SOIL MAP

(Tutuka P/S PV facility)


Tutuka Power Station
Solar Power PV Project
SOIL MAP
TUTUKA P/S
Ms
9.9 ha
Bu
5.6 ha
Ar
15.5 ha
Se
21.2 ha
S1
Ar
9.5 ha
Ar
43.1 ha
S2
Ms
25.2 ha
Ar
46.2 ha
S3
N
0 0.125 0.25 0.5 0.75 1
Kilometers
Imagery Date: 3/5/2015
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