Appendix E:

Agricultural Potential Study

REPORT

On contract research for

SAVANNAH ENVIRONMENTAL

ARC • LNR

DETAILED SOIL SURVEY FOR THE PROPOSED WATERBERG PHOTOVOLTAIC PLANT, LIMPOPO PROVINCE

EIA Study

By

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Report Number GW/A/2010/60

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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 compiled an impartial report, based solely on all the information available.

D G Paterson
July 2010

CONTENTS

1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by Savannah Environmental to undertake a soil investigation for Thupela Energy in the Waterberg area of Limpopo Province. The purpose of the investigation is to look at the soils and associated agricultural potential occurring on a site earmarked for the proposed establishment of a photovoltaic (PV) facility.

The first stage of the investigation involved a scoping study, based on the national Land Type Survey at 1:250 000 scale (Paterson, 2010). However, due to the probable occurrence of high potential soils on the site (as confirmed by the reconnaissance study), it was necessary to visit the site and carry out a more detailed soil survey. This report deals with the detailed soil investigation.

2. SITE CHARACTERISTICS

2.1 Location

The study area covers an area of approximately 49 ha and lies on Portion 2 of the farm Goedgevonden 104KR. It is located next to the Melk River, to the east, approximately 25 km north-east of the town of Vaalwater, as shown in Figure 1.

The area has been used for irrigation in the past, as two existing centre-pivot lands which are currently used for the production of planted pasture (*Eragrostis*) can be seen, although the irrigation equipment has been removed.

The more detailed map of the area is given in the Appendix.

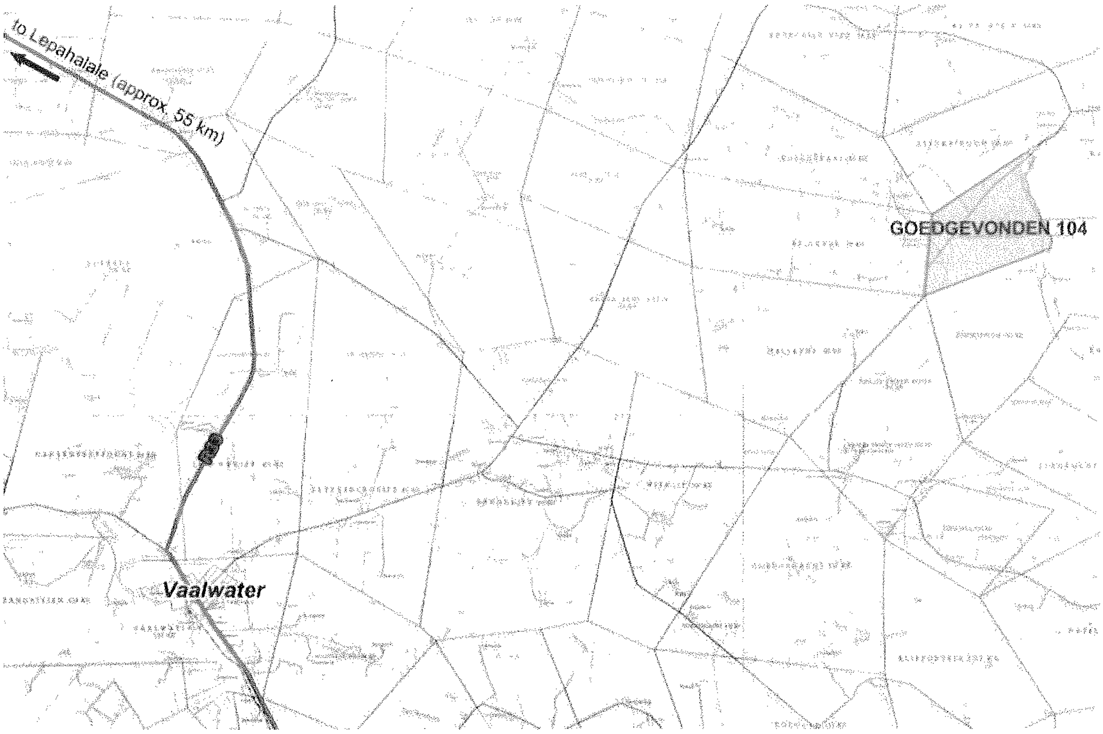

Figure 1 Locality map

2.2 Terrain

The study area lies within the broad plateau of the Waterberg mountain range. The area consists of almost flat to gently undulating terrain (2-3% slopes), at an altitude of around 1 360 m.

The study area lies on the west bank of the Melk River, a perennial river which flows northward out of the Waterberg towards the Limpopo River.

2.3 Climate

The climate of the area can be regarded as typical of the Bushveld, with mild to cool, dry winters and warm to hot, moist summers (Koch, 1988).

The prevailing climatic parameters are given in Table 1.

Table 1 Climate Data

Month	Rainfall (mm)	Min. Temp (°C)	Max. Temp (°C)	Average frost dates
Jan	119.2	16.5	30.0	Start date:
Feb	92.6	16.3	29.8	End date:
Mar	75.9	14.5	28.5	Days with frost:
Apr	37.2	10.4	26.4	
May	15.6	6.5	24.2	
Jun	4.5	3.1	21.4	
Jul	5.0	3.6	21.0	**Heat units (hrs > 10°C)**
Aug	3.3	5.7	23.8	Summer
Sep	13.8	9.4	27.1	(Oct-Mar): 2203
Oct	40.3	12.9	28.1	
Nov	78.3	14.9	28.8	Winter
Dec	96.8	15.8	29.5	(Apr-Sept): 957
Year	**582.5 mm**	**18.7°C (Average)**		

The extreme high temperature that has been recorded is 39.2°C and the extreme low -4.0ºC. Frost will occur at times in the winter, but usually not severely.

2.4 Parent Material

The study area is underlain by coarse-grained sandstone of the Cleremont Formation of Waterberg Group (Geological Survey, 1978).

3. METHODOLOGY

Based on information that was obtained from the national Land Type Survey, published at 1:250 000 scale, the dominant soils in the area were recorded under land type **Bb87** (non-red, low to medium base status soils with plinthic subsoils, usually deep), which indicated that almost two-thirds of the area might contain high potential soils.

Therefore, a soil survey was carried out, using a hand-held soil auger. Soil observations, which were controlled by position on a GPS, were made on a grid of 150 x 150 m, to a maximum depth of 1.2 m (or shallower, if a restricting layer such as rock was encountered).

The soils were classified using the latest version of the South African soil classification system (Soil Classification Working Group, 1991) and similar soils were grouped into mapping units, the distribution of which are shown on the map in the Appendix.

4. SOILS

A summary of the various classes of agricultural potential, based on the soils and/or rock occurring in each land type, is given in **Table 2** below.

Table 2 Soil legend

Map Unit	Dominant Soil Form & Family	Depth (mm)	Soil Characteristics	Area (ha)
dCv	Clovelly 3100	>1200	Brown, structureless, sandy loam topsoil on yellow, structureless, freely-drained, sandy loam subsoil	32.52
mGc	Glencoe 3100	700-900	Brown, structureless, sandy loam topsoil on yellow, structureless, sandy loam subsoil on cemented ferricrete	16.88
			Total	49.40

From the soil map in the Appendix, it can be seen that the deeper soils (map unit **dCv**) occur closer to the Melk River in a downslope position, while the somewhat shallower soils (map unit **mGc**) occur slightly higher up the slope, further from the river.

The soils are friable, with little clay increase from the topsoil to the subsoil and have an extremely homogeneous colour, with little mottling.

5. AGRICULTURAL POTENTIAL

The prevailing dryland agricultural potential of each map unit is shown in Table 3 below.

Table 3 Agricultural potential

Map Unit	Soil characteristics	Agricultural Potential
dCv	Deep soil, favourable texture, no structural restriction	High
mGc	Moderately deep soil, favourable texture, depth restriction due to ferricrete layer at depth	Moderate to high

The prevailing climate of the area is reasonably well suited to dryland, or rain-fed agriculture, although the rainfall (long-term average of 582 mm) is slightly on the low side and may prove somewhat risky for profitable enterprises. However, the soils are generally very suitable for cultivation and have a favourable depth and texture. Another advantage of the site is that it lies immediately adjacent to the Melk River, so that supplementary irrigation should be available.

The **mGc** map unit has a somewhat shallower depth than the **dCv** unit, and the soils are underlain by cemented ferricrete (hard plinthite or "ouklip"), which provides a barrier to water and/or root penetration. However, this layer occurs at a depth from the soil surface of between 700 and 900 mm, so that the soil limitation is generally slight, and good yields may be still expected for most crops.

The properties of the soils occurring, in addition to the adjacent source of irrigation water, means that the soils on the site, especially in the areas closest to the river, have a high potential for cultivation and should be reserved for agriculture

5.1 Impacts

The proposed solar energy project consists of photovoltaic units (solar panels) and associated infrastructure which is planned to occupy around 20 ha (but not more than 30 ha) of the study area of 50 ha. The infrastructure will not involve any significant earth-moving processes or large-scale topsoil removal. Nevertheless, the loss of agricultural land will be total for the life of the project, although the site should be able to be returned to its natural state at a future stage without significant problems.

An impact table summarising the significance of impacts (with and without mitigation) is shown below.

Table 4 Impact assessment

Nature of impact: Loss of agricultural land		
	Without mitigation	**With mitigation**
Extent	High (3)	Low (2)
Duration	Medium-term (4)	Medium-term (4)
Magnitude	Moderate (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**33 (Medium)**	**30 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: It is recommended that construction of infrastructure be confined, as far as possible, to the higher parts of the study area (map unit **mGc** on the soil map), where soils of slightly lower agricultural potential are located.		

Direct, indirect, and cumulative impacts are assessed in terms of the following criteria:

- The nature of the impact - what causes the impact, what will be impacted and how it will be impacted;
- The extent of the impact - whether it is local (limited to the immediate area or site of the development) or regional (on a scale of 1 to 5);
- The duration of the impact – whether it will be very short (less than 1 year), short (1-5 years), medium (5-15 years), long (>15 years) or permanent (on a scale of 1 to 5, respectively);
- The magnitude, quantified on a scale of 0-10, where 0 is small and will have no impact on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will have a slight impact on processes, 6 is moderate and will result in processes continuing, but in a modified way, 8 is high and processes are altered the extent that they temporarily cease, and 10 is very high and results in complete destruction of patterns and permanent cessation of processes;

- The probability of occurrence, which describes the likelihood of the impact actually occurring (on a scale of 1 to 5 – very improbable to definite);
- The significance, which is determined through a synthesis of the characteristics described above and is assessed as low, medium or high.
- The status, which is described as positive, negative or neutral;
- The degree to which the impact can be reversed;
- The degree to which the impact may cause the irreplaceable loss of resources;
- The degree to which the impact can be mitigated;
- The possibility of significant cumulative impacts of a number of individual areas of activity; and
- The possibility of residual impacts existing after mitigating measures have been put in place.

The significance is calculated by combining the criteria in the following formula:

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

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

The significance weightings for each potential impact are as follows:

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

REFERENCES

Geological Survey, 1978. 1:250 000 scale geological map 2428 Nylstroom. Department of Mineral and Energy Affairs, Pretoria.

Koch, F.G.L., 1988. Climate data. In: Land types of the map 2428 Nylstroom. *Mem. Agric. nat. Res .S. Afr*. No.10. ARC-Institute for Soil, Climate and Water, Pretoria.

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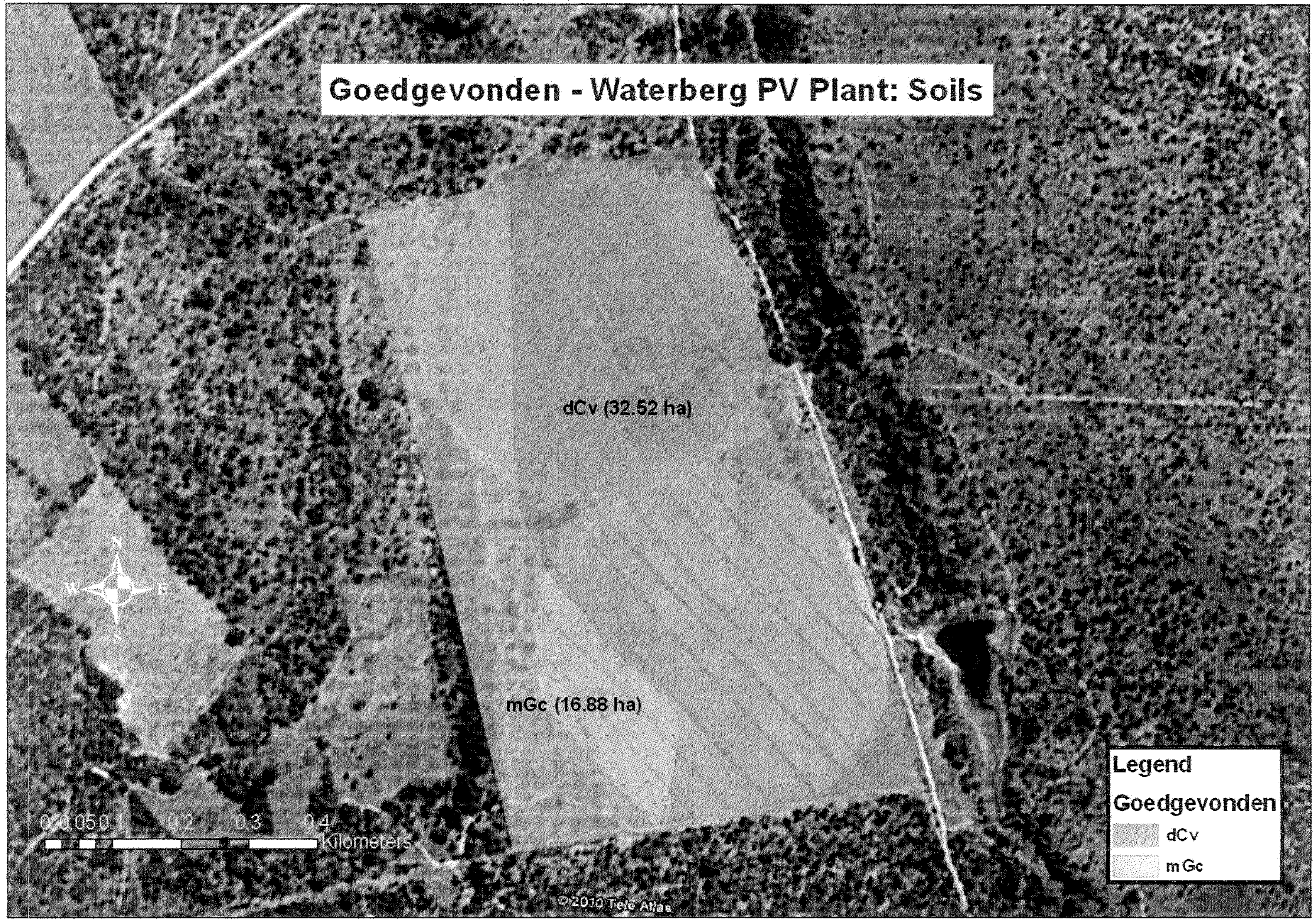
APPENDIX 1

SOIL MAP


Goedgevonden - Waterberg PV Plant: Soils
dCv (32.52 ha)
mGc (16.88 ha)
N
W
E
S
0 0.05 0.1 0.2 0.3 0.4
Kilometers
Legend
Goedgevonden
dCv
mGc
©2010 Tele Atlas

GEOLOGICAL REPORT

SPECIALIST INPUT FOR THE ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED WATERBERG PHOTOVOLTAIC PLANT NEAR VAALWATER, LIMPOPO PROVINCE

Technical Report No: OGS2010-08-12-3

August 2010

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List of abbreviations and definitions

The study area:	The area as delineated on **Figure 1**
EIA:	Environmental Impact Assessment
PV:	Photovoltaic
EMP:	Environmental Management Plan
AMSL:	Above mean sea level
NGL:	Natural Ground Level
ECO:	Environmental Control Officer
Ma:	Million years ago
Mokolian:	The geological time period from 2050 to 900 Ma

1. INTRODUCTION

1.1. Background

Thupela Energy is in the process of carrying out the Environmental Impact Assessment (EIA) phase for the proposed Waterberg Photovoltaic Plant near Vaalwater in the Limpopo Province. The proposed activity is defined as the establishment of a photovoltaic plant including an array of photovoltaic panels and associated infrastructure, including:

- A switching station for the "turn in" into Eskom's existing Mink Power Line
- An extraction point and low volume water supply pipeline for the extraction of water from existing on-site boreholes
- Access roads within the site for the purposes of construction and limited maintenance
- Workshop, laydown and storage areas
- A Visitors Centre

The proposed activity is located on Portion 2 of the Farm Goedgevonden KR 104, which lies approximately 24 km north east of the town of Vaalwater in the Limpopo Province. No alternative site have been proposed as the identified site has been selected following an extensive site selection process.

1.2. Legislation

In terms of the EIA regulations published in terms of Section 24(5) of the National Environmental Management Act (NEMA, No 107 of 1998), the applicant requires environmental authorisation from the National Department of Environmental Affairs (DEA) (in consultation with the Limpopo Department of Economic Development, Environment and Tourism) for the undertaking of the proposed project. This specialist study fulfils the requirements under section 33 of the EIA regulations i.t.o. NEMA, published in Government Gazette R385 of 2006.

1.3. Terms of reference

Savannah Environmental (Pty) Ltd has been appointed by Thupela Energy (i.e. the applicant) to carry out the EIA process for the proposed activity. Specialist geological input is required in order to assess the environmental impacts on the geology and soil profile over the identified study area. Savannah Environmental (Pty) Ltd has appointed Outeniqua Geotechnical Services to conduct a specialist geological study of the study area.

The following broad scope of work has been given:

- Carry out a desk-top study of available information pertaining to the geology and soil types of the study area and the environmental impacts on the geological environment that are likely to be associated with the proposed activity. This was undertaken as part of the Scoping Phase.
- Conduct a site visit to collect visual data pertaining to the geology, soil types and potential soil degradation issues.

- Conduct a geological impact assessment and prepare a report on the findings, the results of which will be used to compile the EIA Report.

The following aspects are covered in this report:

- A description of the environment that may be affected by the activity (the study area);
- A description of the geology and soil types in the study area;
- Assess the potential environmental impacts that may arise from the establishment of the proposed facility on the soil profile and other geological features (with emphasis on erosion and soil degradation);
- Provide mitigating measures for the Environmental Management Plan (EMP) to manage and/or mitigate potential impacts.

In addition to this, a preliminary indication of the potential geotechnical constraints on the proposed project is provided. These constraints may impact on the engineering design of access roads and foundations, and include such issues as founding conditions and problem soils, groundwater problems, excavatability, sources of natural construction material, etc.

1.4. Limitations

Information provided in this specialist report has been based on information provided by Savannah Environmental (Pty) Ltd, published scientific literature and maps. The study area was visited briefly but no detailed soil investigation (trial pits, soil testing), geomorphological or geohydrological assessment or verification of the existing geological mapping was conducted. The information provided in this report is deemed adequate for the EIA process and preliminary planning phase but further geotechnical information may be required for the detailed design phase.

1.5. Authors credentials & declaration of independence

The author of this report, Iain Paton of Outeniqua Geotechnical Services cc (OGS), is a professional engineering geologist registered with the South African Council of Natural and Scientific Professions (Pr Sci Nat # 400236/07) with 12 years experience in the mining, petroleum and construction industries and is a member of the South African Institute of Engineering and Environmental Geologists. Iain Paton declares that he does not have any financial interest in the undertaking of the activity, other than remuneration for work performed in the compilation of this specialist report.

2. SITE DESCRIPTION

2.1. Location

The facility is proposed to be established on agricultural land on a portion of Portion 2 of the Farm Goedgevonden KR 104, located approximately 24 km east of Vaalwater within the Modimolle Local Municipality, Limpopo Province (see **Figure 1**). The study area can be accessed via the R33 from Modimolle to Lepahalale. Pretoria is the nearest major commercial centre, 200km to the south. The site falls outside of the boundary of the Waterberg Biosphere Reserve. The larger site covers an area of approximately 50 ha, with the development footprint for the proposed facility being approximately 20 ha, but not more than 30 ha. The location of the facility within the larger site will be informed by the outcomes of the EIA process.

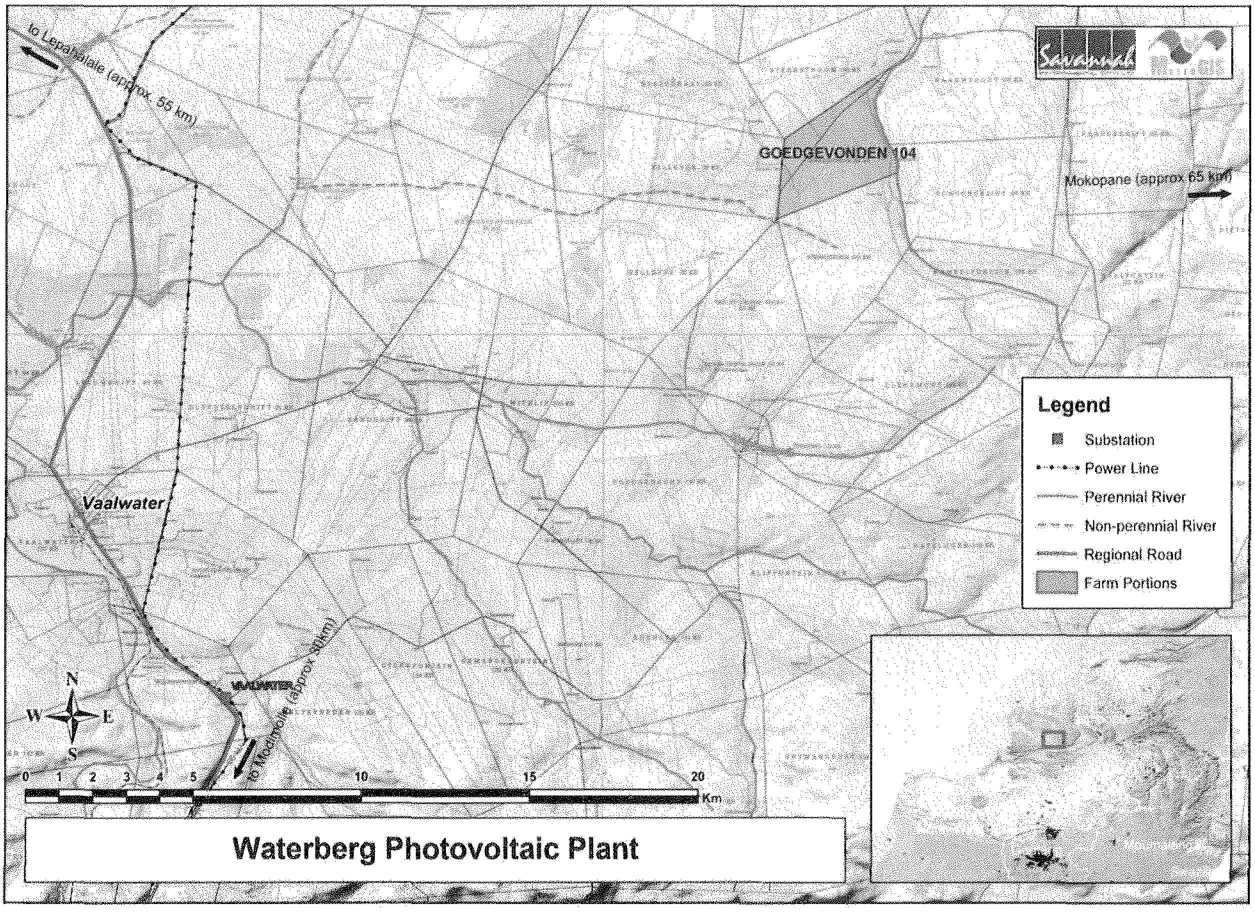

Figure 1: Locality map of Farm Goedgevonden KR 104 (blue shaded area)

2.2. Topography, climate & vegetation cover

The study area is located on the Waterberg massif which can best be described as an "inverted saucer" stretching from Modimolle and Mokopane in the east to Thabazimbi and Lephalale in the west. Within the central core is a vast basin plateau dissected by numerous rivers.

The topography of the study area slopes gently from southwest to northeast from 1400m to 1360m AMSL. A gravel road runs along the eastern border of the study area, parallel with the Melkrivier which drains the area.

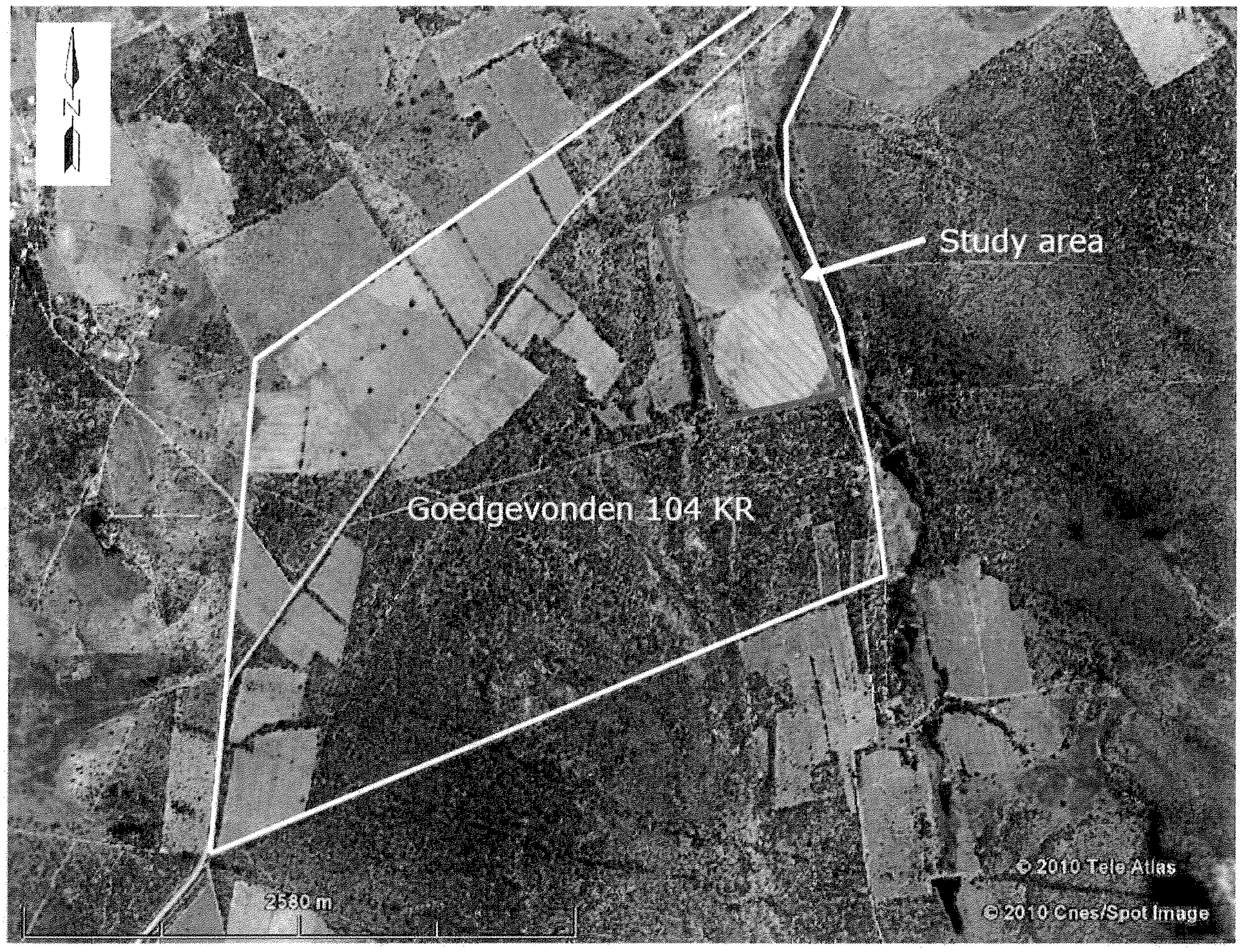

Figure 2: Aerial photo of the study area (red line) within the Farm Goedgevonden KR104 (white lines)

The Weinert Climatic N-number[7] for the area, which is between 4 and 5, indicates that the climate is semi-humid and chemical and mechanical weathering processes are at play, the former being slightly dominant. Mean annual precipitation for this region is approximately 500-700mm, falling mainly in October to April.[2]

The study area is cultivated ground which has been almost completely cleared of natural bushveld vegetation and is presently covered with grass. Anti-erosion berms have been constructed across the fields parallel to the contours. These berms are visible in the circular cultivated fields in **Figure 2**.

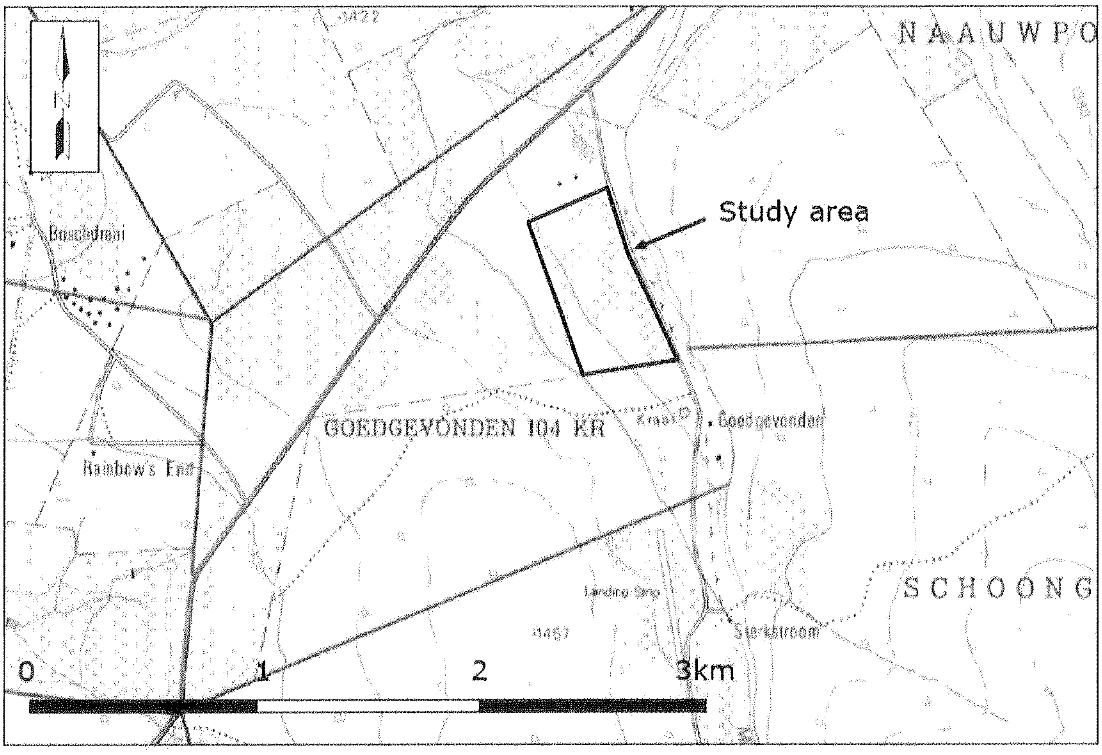

Figure 2: Topographical map of the study area

2.3. Geology & soil types

The plateau that makes up the Waterberg consists of a thick sequence of sandstone and conglomerate, dated at 1900Ma. According to the 1:250 000 Geological Map published by the Council for Geoscience (see **Figure 3**), the bedrock geology of the study area is Cleremont Formation of the Kransberg Subgroup, Waterberg Group (Mokolian Stage of the Precambrian era) which predominantly consists of coarse grained sandstone.

Outcrops of dark to light red orange or light brown, profusely cross-bedded sandstone occur only in the northwestern corner of the site. On the remaining majority of the site, this sandstone bedrock is covered by dark red orange to light brown, fine to medium grained, silty sand which is more than 1m thick (see **Figure 4**).

Surficial soil permeability is expected to be moderate to high with a perched water table potentially developing on weathered sandstone at a depth exceeding 1m over most of the site.

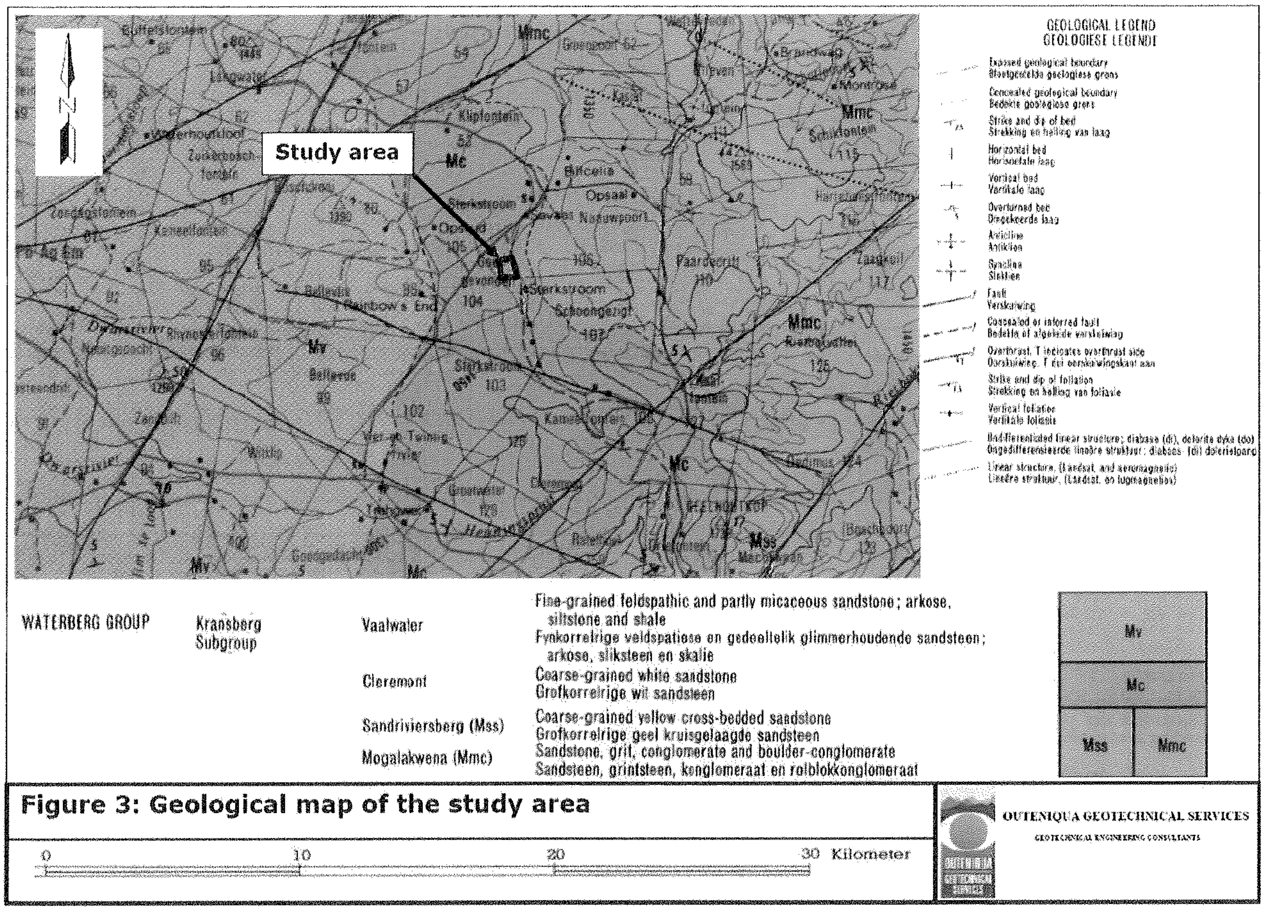

Figure 3: Geological map of the study area.

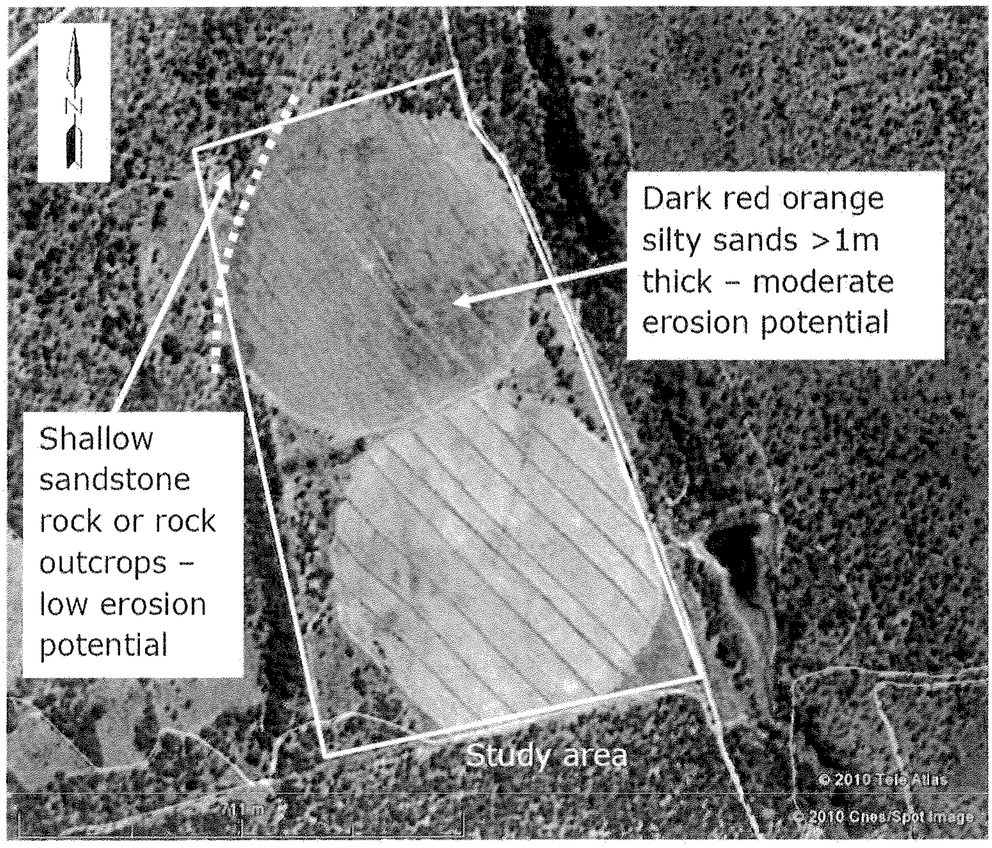

Figure 4: Soil types and erosion sensitivity map of the study area.

2.4. Hydrology

Surface runoff is the water flow that occurs when soil is infiltrated to full capacity and excess water from rain or other sources flows over the land. This run-off is a major contributing factor influencing potential erosion. Infiltration into the sandy soils on this site is likely to be high but will be restricted, to a certain extent, by the silt content which is variable. Sandy soils with high silt content are not be as permeable as sandy soils with low silt content.

The hydrology of the study area will play an important role in the erosion potential. Rainfall, if not intercepted by vegetation or artificial surfaces, falls on the earth where it may evaporate, infiltrate, lie in depression storage, or end up as surface run-off. The permeability of the ground influences the percentage of rainfall which infiltrates. Where soil cover is thin or impermeable, infiltration will tend to be lower and vice versa. Surface run-off is generally inversely proportional to infiltration, ceteris paribus. Rainfall intensity, infiltration, and slope gradient influence the volume, velocity, and energy of surface run-off. The energy of the hydraulic system and the soil texture and consistency are the main determining factors of the erosion potential. The presence of vegetation and other erosion inhibitors tend to reduce the energy of the hydraulic system as well as providing an anchoring effect on the soil mass.

In this particular area, the soils are moderate to highly permeable, the slope gradients are low and the vegetation cover is fairly well established which means that run-off is likely to be low. However, if vegetation is removed, serious erosion can occur during heavy downpours.

3. GEOLOGICAL IMPACT ASSESSMENT

The geological impact assessment aims to assess the impact that the proposed development will have on the geological environment which includes the parent rock and the natural soil profile. Important or prominent geological features (geosites) that contribute to the aesthetic scenery or geological interest in the area, such as fossil sites, prominent rock outcrops or features are also considered in the impact study. Geological features, such as caves, addits, middens, worship rocks, etc. which are important from an historical, cultural, archaeological or religious heritage standpoint are not assessed in this report as they are generally covered in the Heritage Impact Assessment. Geohydrological assessments also do not form part of this study.

At this stage, there are no known important or prominent geological features and the parent rock is unlikely to be detrimentally affected by the proposed activity, as no deep excavations are planned. Therefore, the impact on the natural soil profile is the primary focus of this study as it is important for the sustainability of the surrounding ecosystems.

3.1. Soil degradation

Soil degradation is the removal, alteration, or damage to soil and soil forming processes, usually due to human activity. The stripping of vegetation or disturbance to the natural ground level over disturbance areas will negatively affect soil formation, natural weathering processes, moisture levels, soil stability, humus levels, and biological activity. Soil degradation includes erosion (due to water and wind), salinisation, acidification, water-logging, pollution, soil mining and burial, compaction, and crusting[9].

Soil erosion is a natural process whereby the ground level is gradually lowered by wind or water action and may occur as a result of inter alia chemical or mechanical processes and/or physical transport on the land surface. Soil erosion that has been induced or increased by human activity is termed "accelerated erosion" and is an integral element of global soil degradation. Accelerated soil erosion is generally considered the most important geological impact in any development due to its potential impact on a local and regional scale (i.e. on and off site) and as a potential threat to agricultural production and self sufficiency. Soil erodibility is the susceptibility of soil to erosion and is a complex variable, not only because it depends on soil chemistry, texture and characteristics, but because it varies with time and other conditions[9]. In general, erodibility potential is increased where low-plasticity, fine grained soils occur. The Erosion Index for South Africa[10] indicates that the area where the study site is located has a moderate to low-moderate susceptibility to erosion. The erodibility index is determined by combining the effects of slope, geology and soil type, rainfall intensity and land use.

The proposed activity will include shallow excavation or displacement of soil, stockpiling, mixing, wetting and compaction of soil and pollution. These activities carry potential negative direct impacts contributing to soil degradation. These activities could also cause negative indirect impacts such as increased siltation into the Melkrivier to the east of the site causing negative impact on water sources and agriculture with socio-economic repercussions. The severity or significance of the potential impacts is related to the nature and extent of the proposed activity. There are no known positive impacts relating to the geological environment and the impacts are dominantly related to the construction phase with very little additional impacts in the post construction and decommissioning phases.

The soil erosion potential for the site is moderate due to the presence of erodible soils, but at present there is no sign of erosion taking place and this is largely due to the stabilising effect of the vegetation cover. Erosion will occur if vegetation is cleared and soil is loosened by construction activity. It is the aim of the environmental impact assessment to evaluate this impact and attempt to provide mitigating measures to manage the impact.

3.2. Degradation of parent rock

Apart from the impact on the overlying soil, excavations into bedrock may result in unsightly scars, resulting in potential visual impacts. However, it is unlikely that there will be any deep excavations into bedrock and therefore the impact is likely to be insignificant.

3.3. Assessment of impacts

The proposed activity involve minor earthworks associated with the construction of PV arrays, pipelines and foundations for structures such as a workshop, visitors centre, etc. Due to the very sandy nature of the soil at the study site, it is most likely that the buildings (i.e. the visitors centre) will be constructed with raft-type foundations. In this design no deep foundations are constructed, but instead a complete interconnected, re-enforced, 'raft' foundation is constructed on which the buildings can sit. If the sands should shift, the whole building will move with the raft, preventing cracking. The raft is positioned typically no more than 30 cm deep into the sand.

Concrete foundations will be constructed for the 'feet' of the PV panels. Foundation holes will be mechanically excavated to a depth of approximately 30 - 50 cm. The concrete foundation will be poured and will then be left up to a week to cure.

The most important geological issues are the direct impacts of soil degradation and erosion of topsoil from the area of activity. Other direct impacts would include the loss of agricultural potential of the area (not discussed in this report).

Indirect impacts could include increased siltation in nearby Melkrivier caused by an increase in erosion from the site and socio-economic impacts resulting from the loss of topsoil and lower agricultural potential.

Direct, indirect, and cumulative impacts are assessed in terms of the following criteria:

- The nature of the impact - what causes the impact, what will be impacted and how it will be impacted;
- The extent of the impact - whether it is local (limited to the immediate area or site of the development) or regional (on a scale of 1 to 5);
- The duration of the impact – whether it will be very short (less than 1 year), short (1-5 years), medium (5-15 years), long (>15 years) or permanent (on a scale of 1 to 5, respectively);
- The magnitude, quantified on a scale of 0-10, where 0 is small and will have no impact on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will have a slight impact on processes, 6 is moderate and will result in processes continuing, but in a modified way, 8 is high and processes are altered the extent that they temporarily cease, and 10 is very high and results in complete destruction of patterns and permanent cessation of processes;
- The probability of occurrence, which describes the likelihood of the impact actually occurring (on a scale of 1 to 5 – very improbable to definite);
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- The degree to which the impact can be reversed;
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- The degree to which the impact can be mitigated;
- The possibility of significant cumulative impacts of a number of individual areas of activity; and
- The possibility of residual impacts existing after mitigating measures have been put in place.

The significance is calculated by combining the criteria in the following formula:

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

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

The significance weightings for each potential impact are as follows:

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

3.3.1. Direct impacts

An assessment of the individual direct potential impacts associated with the proposed activity is outlined in Table 1.

Table 1: Assessment of potential direct impacts

Nature: Soil degradation – Removal of vegetation and topsoil under footprint of structures and access roads affecting soil formation processes on the site.		
	Without mitigation	**With mitigation**
Extent	Local (1)	N/A
Duration	Permanent (5)	N/A
Magnitude	Low (4)	N/A
Probability	Definite (5)	N/A
Significance	Moderate (50)	N/A
Status	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	No	
Mitigation:	N/A	
Cumulative impacts:	The surrounding area is largely undeveloped agricultural land and there is no other development planned for the near future. The cumulative impact is therefore considered low at this stage.	
Residual impacts:	**N/A**	

Nature: Soil degradation – Pollution, salinisation, acidification, or water-logging of natural soil in construction areas affecting soil formation processes.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	Moderate (30)	Low (21)
Status	Negative	Negative

Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Minor	Insignificant
Can impacts be mitigated?	Yes	
Mitigation:	• Minimise disturbance areas by limiting construction act ivies to designated construction areas • Minimise activity within disturbance areas • Rehabilitate soil and vegetation • Stage earthworks in phases across site so that exposed areas are minimised • Keep to existing roads, where practical, to minimise impacts on undisturbed ground	
Cumulative impacts:	The surrounding area is undeveloped agricultural land and there is no other development planned in the near future. Therefore the cumulative impact is considered low at this stage.	
Residual impacts:	Minor negative – slow regeneration of vegetation & soil	

Nature: Soil degradation – Mixing, stockpiling and compaction of topsoil affecting soil formation processes.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Very short term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	Moderate (40)	Low (24)
Status	Negative	Negative
Reversibility	Partially reversible	Partially reversible
Irreplaceable loss of resources?	Yes	Yes, minor
Can impacts be mitigated?	Yes	
Mitigation:	• Minimise disturbance areas over which mixing, stockpiling occurs • Minimise activity within disturbance areas (prevent unnecessary excavations and stockpiling) • Re-use soil from excavations for landscaping or remove off site – don't leave stockpiles after construction on-site • Restrict number of access roads and minimise traffic • Rehabilitate soil and vegetation in areas of activity • Keep to existing roads, where practical, to minimise impact on undisturbed ground • Stage earthworks in phases to minimise exposed ground	
Cumulative impacts:	The surrounding area is undeveloped agricultural land and there is no other development planned in the near future. The cumulative impact is considered low at this stage.	
Residual impacts:	Minor negative – slow regeneration of soil processes in and under topsoil	

Nature: Soil degradation – Increased sheet, rill or gulley erosion and deposition down-slope due to the removal of vegetation and other activity in construction areas		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium term (3)	Medium term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	Moderate (40)	Moderate (32)
Status	Negative	Negative

Reversibility	Practically irreversible	Practically irreversible
Irreplaceable loss of resources?	Moderate	Minor
Can impacts be mitigated?	Yes	
Mitigation:	• Restrict the size of disturbance areas • Minimise activity within designated disturbance areas • Implement effective erosion control measures, such as log terraces, erosion barriers/silt fences, etc. • Stage construction in phases to minimise exposed ground • Keep to existing roads, where practical, to minimise impact on undisturbed ground • Ensure stable slopes of stockpiles/excavations to minimise slumping	
Cumulative impacts:	The surrounding area is undeveloped agricultural land and there is no other development planned in the foreseeable future. The cumulative impact is considered low at this stage.	
Residual impacts:	Minor – Localised movement of sediment and slow regeneration of soil processes	

Nature: Degradation of parent rock – Excavations and or blasting causing degradation to local geology and instability.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (3)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	Low (18)	Low (16)
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Insignificant	Insignificant
Can impacts be mitigated?	To a certain degree	
Mitigation:	• Restrict zone of disturbance and plan excavations carefully. • Keep to existing roads, where practical, to minimise impacts on undisturbed ground.	
Cumulative impacts:	The surrounding area is undeveloped agricultural land and there is no other development planned in the foreseeable future. The cumulative impact is considered low at this stage.	
Residual impacts:	Insignificant	

The direct impacts range from a moderate to low significance, but if mitigated successfully the impact will be reduced to an overall low significance.

3.3.2. Indirect impacts

An assessment of the potential indirect impacts associated with the proposed activity is outlined in **Table 2** below.

Table 2: Assessment of potential indirect impacts

Nature: Soil degradation – Deposition/siltation down-slope affecting soil forming processes and siltation of waterways and dams		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (4)	Probable (3)
Significance	Moderate (48)	Low (30)
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Moderate	Minor
Can impacts be mitigated?	Yes	
Mitigation:	• Minimise size and distribution of disturbance areas • Minimise activity within disturbance areas (no unnecessary activity) • Install anti-erosion measures such as silt fences in disturbance areas	
Cumulative impacts:	The surrounding area is undeveloped agricultural land and there is no other development planned in the near future. The cumulative impact is therefore considered low at this stage.	
Residual impacts:	Minor localised movement of soil across site	

The indirect impacts will have a moderate significance but can be mitigated to have an overall low significance.

3.3.3. Cumulative impacts

The cumulative impact is considered low owing to the undeveloped nature of the immediate surrounding area.

3.3.4. Impact statement

The presence of shallow rock or low rock outcrops has a significant reducing effect on the erosion potential on the northwestern corner of the site and therefore this area has a low erosion potential. The rest of the site has a moderate erosion potential, but with effective implementation of mitigating measures the impacts can be reduced to a low level and therefore there is no compelling reason, from a geological perspective, why environmental authorisation for the proposed activity cannot be granted.

3.4. Mitigating measures

Negative impacts can be mitigated and/or managed to a large degree by the implementation of an appropriate and effective EMP.

The objectives, impacts, risks, and mitigating measures that are required for inclusion in the EMP are outlined in **Table 3** below:

OBJECTIVE: Soil/rock degradation and erosion control

The natural soil on the site needs to be preserved as far as possible to minimise impacts on the environment. Soil degradation including erosion (by wind and water) and subsequent deposition elsewhere is of a concern across the entire site which is underlain by fine grained soil which can be mobilised when disturbed, even on relatively low slope gradients (accelerated erosion). Uncontrolled run-off relating to construction activity (excessive wetting, etc.) will also lead to accelerated erosion. Degradation of the natural soil profile due to the proposed shallow excavation, stockpiling, compaction, pollution and other construction activities will affect soil forming processes and associated ecosystems. Degradation of parent rock is considered low as there are no deep excavations envisaged.

A set of strictly adhered mitigation measures are required to effectively limit the impact on the environment. The disturbance areas where human impact is likely are the focus of the mitigation measures laid out below.

Project components	PV array modules
	Access roads
	Dining and kitchen facilities, visitors centre, crèche, offices, workshops and security buildings
	Underground and overhead pipes and power cabling
Potential Impact	Soil and rock degradation
	Soil erosion
	Increased deposition of soil into drainage systems
	Increased run-off over the site
Activities/risk sources	Construction activity – Removal of vegetation, excavation, stockpiling, compaction and pollution of soil
	Rainfall - water erosion of disturbed areas
	Wind erosion of disturbed areas
	Concentrated discharge of water from construction activity
Mitigation: Target/Objective	To minimise extent of disturbance areas
	To minimise activity within disturbance areas
	To minimise soil degradation (mixing, wetting, compaction, etc.)
	To minimise soil erosion
	To minimise deposition of soil into drainage lines
	To minimise instability of embankments/excavations

Mitigation: Action/control	Responsibility	Timeframe
Identify disturbance areas and restrict construction activity to these areas.	ECO/Contractor	Before and during construction

Restrict construction activity within disturbance areas.	ECO/Contractor	Before and during construction
Access roads to be carefully planned and constructed to minimise the impacted area and prevent unnecessary excavation, placement, and compaction of soil.	Engineer/ECO/ Contractor	Before and during construction
Dust control on construction site: Wetting of denuded areas.	Contractor	During construction
Minimise removal of vegetation which adds stability to soil.	ECO/Contractor	During construction
Rehabilitate disturbance areas as soon as an area is vacated.	Contractor	During and after construction
Soil conservation: Stockpile topsoil for re-use in rehabilitation phase. Protect stockpile from erosion.	Contractor	Before and during construction
Erosion control measures: Run-off attenuation on slopes (sand bags, logs), silt fences, stormwater catch-pits, shade nets or temporary mulching over denuded areas.	Contractor/ECO	Erection: Before construction Maintenance: Duration of contract
Where access roads cross natural drainage lines, culverts must be designed to allow free flow. Regular maintenance must be carried out.	Engineer/ECO/ Contractor	Before construction and maintenance over duration of contract
Control depth of excavations and stability of cut faces/sidewalls.	Engineer/ECO/ Contractor	Before construction and maintenance over duration of contract

Performance Indicator	• No activity outside disturbance areas • Acceptable level of activity within disturbance areas • Acceptable level of soil erosion around site • Acceptable level of increased siltation in drainage lines • Acceptable level of soil degradation • Acceptable state of excavations • No activity in restricted areas
Monitoring	• Regular inspections of the site • Fortnightly inspections of sediment control devices • Fortnightly inspections of surroundings, including drainage lines • Immediate reporting of ineffective sediment control systems

	• An incident reporting system will record non-conformances

Table 3: EMP guidelines

4. GEOTECHNICAL CONSTRAINTS

A basic preliminary assessment of the geotechnical nature of the study area affords the opportunity to identify any potential fatal flaws with the proposed site, in terms of the suitability of the site for development. A basic assessment of the main geotechnical constraints that may impact on the civil engineering design is given in **Table 4**.

Geotechnical Constraint	Effect on the proposed development	Severity	Comment & recommendations
Collapsible & compressible soil	Soil horizons with a potentially collapsible and/or compressible fabric hazardous to foundations.	Medium	Unconsolidated transported soils are potentially compressible and collapsible under load. Conventional compaction of soil will be adequate for light structures.
Differential settlement (DS)	Foundations placed across different soil types or rock may settle differentially.	Low-Medium	Recommend sound individual structures on same soil types.
Bearing capacity	Soils with low in situ bearing capacity resulting in high settlements of structures if not engineered properly	Medium	Transported sands: 50-80kPa, depending on level of consolidation.
Saturated soils, groundwater problems, perched or permanent water tables	Seepage from sidewalls of excavations affecting stability or dewatering of trenches necessary.	Low	No groundwater problems expected in shallow excavations.
Active soil	Heaving clays affecting foundation stability	Low	No active clay expected.
Excavations	Boulders or rock affecting excavations	Low	Difficult excavations (rock) expected in northwest corner only.
	Unstable excavations requiring shoring	Low-medium	Sidewalls of excavations exceeding 1m in unconsolidated sandy soils will be unstable. Temporary slopes to be battered to 1:2.
Slope stability	Geological instability causing damage to structures founded on slopes	Low	No unstable slopes in development footprint.
Seismic activity	Structures at risk of damage due to seismicity	Low	Limpopo Province is a potentially active seismic area but this is unlikely to affect development.
Flood potential or storm water damage	Low lying areas affected by poor drainage.	Low	Site is well drained.
	Steep slopes affected by uncontrolled run-off	Low	No steep slopes which could be unstable.
Unconsolidated fill	Unconsolidated fill material affecting foundations	Low	Minor fill along berms and pipelines

Geotechnical Constraint	Effect on the proposed development	Severity	Comment & recommendations
Availability of local construction material	Large distances to nearest quarry for sources of suitable construction material negatively affect construction costs	High	Nearest *major* centre is Pretoria (200km). Potential local sources of construction material (on site) are restricted to selected fill (sand).
Mining Activity	Past, present or future mining activity which may affect development of the site	Low	No known mining activity

Table 4: Geotechnical constraints on the proposed development

The above classification highlights some basic potential constraints, none of which are considered insurmountable. A detailed geotechnical investigation should be undertaken before the engineering design phase to provide more information. Geotechnical supervision or input is recommended during construction.

5. CONCLUSIONS

The site is underlain by transported silty sands and the soil erosion potential for the site is moderate. However, the topography is favourable and the vegetation is aiding the stability of the soil and as a result there is no sign of significant erosion on the site. This will change during construction and the envisaged impacts will carry a moderate significance which can be mitigated to a resultant low significance through effective implementation of the EMP.

A basic assessment of the potential geotechnical constraints on the project indicates no insurmountable problems or "fatal flaws" which have may have an impact on the design and construction processes.

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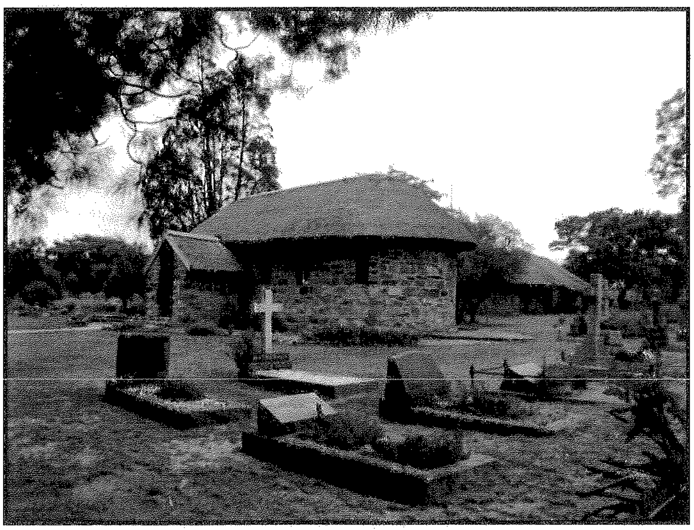
Appendix G:

Heritage Study

Heritage Impact Assessment for the
PROPOSED WATERBERG PHOTOVOLTAIC PLANT, WATERBERG MAGISTERIAL DISTRICT, LIMPOPO PROVINCE



HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED WATERBERG PHOTOVOLTAIC PLANT, WATERBERG MAGISTERIAL DISTRICT, LIMPOPO PROVINCE

Report No: 2010/JvS/074
Status: Final
Revision No: 0
Date: September 2010

Prepared for:
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Declaration:

I, J.A. van Schalkwyk, declare that I do not have any financial or personal interest in the proposed development, nor its developers or any of their subsidiaries, apart from the provision of heritage assessment and management services.

J A van Schalkwyk (D Litt et Phil)
Heritage Consultant
September 2010

EXECUTIVE SUMMARY

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED THUPELA WATERBERG PHOTOVOLTAIC PLANT, WATERBERG MAGISTERIAL DISTRICT, LIMPOPO PROVINCE

Thupela Energy is proposing the establishment of a commercial solar electricity generating facility and associated infrastructure on a site located north east of the town of Vaalwater in Limpopo Province.

The facility is proposed to be established on degraded pasture land on a portion of Portion 2 of the Farm Goedgevonden KR 104, located approximately 24 km east of Vaalwater within the Modimolle Local Municipality, Limpopo Province. The site falls outside of the boundary of the Waterberg Biosphere Reserve. The larger site covers an area of approximately 50 ha, with the development footprint for the proposed facility being approximately 20 ha.

The aim of the survey was to locate, identify, evaluate, and document sites, objects and structures of cultural significance found within the area in which it is proposed to develop the solar power plant.

As very few systematic surveys have been done, little is known about the heritage resources in the region. Available information indicates that few sites would occur in or close to the study area.

- As no heritage sites exist in the study area, there would be no impact resulting from the proposed development.

Therefore, from a heritage point of view it is recommended that the proposed development be allowed to continue. However, it is requested that should archaeological sites or graves be exposed during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.

J A van Schalkwyk
Heritage Consultant
September 2010

TECHNICAL SUMMARY

Property details						
Province	Limpopo					
Magisterial district	Waterberg					
Topo-cadastral map	2428AB					
Closest town	Vaalwater					
Farm name/s	Goedgevonden 104KR					
Portions/Holdings	Portion 2					
Coordinates	Centre point					
	No	Latitude	Longitude	No	Latitude	Longitude
	1	S 24.19641	E 28.32098			

Development criteria in terms of Section 38(1) of the NHR Act	Yes/No
Construction of road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length	No
Construction of bridge or similar structure exceeding 50m in length	No
Development exceeding 5000 sq m	Yes
Development involving three or more existing erven or subdivisions	No
Development involving three or more erven or divisions that have been consolidated within past five years	No
Rezoning of site exceeding 10 000 sq m	Yes
Any other development category, public open space, squares, parks, recreation grounds	No

Development	
Description	Development of a solar power plant
Project name	Waterberg Photovoltaic Plant

Land use	
Previous land use	Farming: crop production
Current land use	Farming: crop production

Heritage sites assessment		
Site type	*Site significance*	*Site grading (Section 7 of NHRA)*
None	None	None

Impact assessment		
Impact	*Mitigation*	*Permits required*
None	None	None

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GLOSSARY OF TERMS AND ABBREVIATIONS

TERMS

Study area: Refers to the entire study area as indicated by the client in the accompanying Fig. 1 - 2.

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.

Early Stone Age	2 000 000 - 150 000 Before Present
Middle Stone Age	150 000 - 30 000 BP
Late Stone Age	30 000 - until c. AD 200

Iron Age: Period covering the last 1800 years, when new people brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and they herded cattle as well as sheep and goats. These people, according to archaeological evidence, spoke early variations of the Bantu Language. Because they produced their own iron tools, archaeologists call this the Iron Age.

Early Iron Age	AD 200 - AD 900
Middle Iron Age	AD 900 - AD 1300
Late Iron Age	AD 1300 - AD 1830

Historical Period: Since the arrival of the white settlers - c. AD 1840 - in this part of the country

ABBREVIATIONS

ADRC	Archaeological Data Recording Centre
ASAPA	Association of Southern African Professional Archaeologists
CS-G	Chief Surveyor-General
EIA	Early Iron Age
ESA	Early Stone Age
LIA	Late Iron Age
LSA	Later Stone Age
HIA	Heritage Impact Assessment
MSA	Middle Stone Age
NASA	National Archives of South Africa
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
SAHRA	South African Heritage Resources Agency

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED WATERBERG PHOTOVOLTAIC PLANT, WATERBERG MAGISTERIAL DISTRICT, LIMPOPO PROVINCE

1. INTRODUCTION

Thupela Energy is proposing the establishment of a commercial solar electricity generating facility and associated infrastructure on a site located north east of the town of Vaalwater in Limpopo Province.

The facility is proposed to be established on degraded pasture land on a portion of Portion 2 of the Farm Goedgevonden KR 104, located approximately 24 km east of Vaalwater within the Modimolle Local Municipality, Limpopo Province. The site falls outside of the boundary of the Waterberg Biosphere Reserve. The larger site covers an area of approximately 50 ha, with the development footprint for the proposed facility being approximately 20 ha but not more than 30 ha.

The facility is proposed to have a generating capacity of up to 5 MW which will be achieved through the use of an array of photovoltaic (PV) panels. The facility is also proposed to have the following associated infrastructure:

- A **switching station** for the "turn in" into Eskom's existing Mink Power Line (it has been determined this line has spare capacity to receive the power from the proposed solar facility)
- An **extraction point** and low volume **water supply pipeline** for the extraction of water from existing on-site boreholes. This will only be for the purpose of ablution facilities on site as the photovoltaic panels will be cleaned using pressurised air
- **Access roads** within the site (for the purposes of construction and limited maintenance)
- **Workshop, laydown** and **storage areas**
- A **Visitors Centre** utilising Eco-Loos for the purpose of sanitation

South Africa's heritage resources, also described as the 'national estate', comprise a wide range of sites, features, objects and beliefs. However, according to Section 27(18) of the National Heritage Resources Act (NHRA), No. 25 of 1999, no person may destroy, damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site without a permit issued by the heritage resources authority responsible for the protection of such site.

In accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by **Savannah Environmental** to conduct a Heritage Impact Assessment to determine if any sites, features, or objects of cultural heritage significance occur within the boundaries of the area where it is planned to develop the solar power plant.

2. TERMS OF REFERENCE

The scope of work for this study consisted of:

- Conducting of a desk-top investigation of the area, in which all available literature, reports, databases and maps were studied
- A visit to the proposed development area

The objectives were to

- Identify possible archaeological, cultural and historic sites within the proposed development area
- Evaluate the potential impacts of construction, operation and maintenance of the proposed development on archaeological, cultural and historical resources
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance

Type of study	Aim	SAHRA involved	SAHRA response
Heritage Impact Assessment	The aim of a full HIA investigation is to provide an informed heritage-related opinion about the proposed development by an appropriate heritage specialist. The objectives are to identify heritage resources (involving site inspections, existing heritage data and additional heritage specialists if necessary); assess their significances; assess alternatives in order to promote heritage conservation issues; and to assess the acceptability of the proposed development from a heritage perspective. The result of this investigation is a heritage impact assessment report indicating the presence/ absence of heritage resources and how to manage them in the context of the proposed development. Depending on SAHRA's acceptance of this report, the developer will receive permission to proceed with the proposed development, on condition of successful implementation of proposed mitigation measures.	Provincial Heritage Resources Authority	Comments on built environment and decision to approve or not
		SAHRA Archaeology, Palaeontology and Meteorites Unit	Comments and decision to approve or not

3. HERITAGE RESOURCES

3.1 The National Estate

The NHRA (No. 25 of 1999) defines the heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations that must be considered part of the national estate to include:

- Places, buildings, structures and equipment of cultural significance;
- Places to which oral traditions are attached or which are associated with living heritage;
- Historical settlements and townscapes;
- Landscapes and natural features of cultural significance;
- Geological sites of scientific or cultural importance;
- Archaeological and palaeontological sites;
- Graves and burial grounds, including-
    - Ancestral graves;
    - Royal graves and graves of traditional leaders;
    - Graves of victims of conflict;
    - Graves of individuals designated by the Minister by notice in the Gazette;
    - Historical graves and cemeteries; and
    - Other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- Sites of significance relating to the history of slavery in South Africa;
- Movable objects, including-
    - Objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
    - Objects to which oral traditions are attached or which are associated with living heritage;
    - Ethnographic art and objects;
    - Military objects;
    - Objects of decorative or fine art;
    - Objects of scientific or technological interest; and
    - Books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

3.2 Cultural significance

In the NHRA, Section 2 (vi), it is stated that "cultural significance" means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. This is determined in relation to a site or feature's uniqueness, condition of preservation and research potential.

According to Section 3(3) of the NHRA, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of:

- Its importance in the community, or pattern of South Africa's history;
- Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;

- Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- Its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- Its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
- Sites of significance relating to the history of slavery in South Africa.

4. STUDY APPROACH AND METHODOLOGY

4.1 Extent of the Study

This survey covers the area as presented in Section 5 and as illustrated in Figures 1 - 2.

4.2 Methodology

4.2.1 Preliminary investigation

4.2.1.1 Survey of the literature

A survey of the relevant literature was conducted with the aim of reviewing the previous research done and determining the potential of the area. In this regard, various anthropological, archaeological and historical sources were consulted.

- One study done in the region to the south of the study area was identified (De Jong 2005).

4.2.1.2 Data bases

The *Heritage Atlas Database,* the *Environmental Potential Atlas*, the *Chief Surveyor General,* and the *National Archives of South Africa* were consulted.

- Database surveys produced a number of sites located in the larger region of the proposed development.
- The original Title Deed for the farm was located in the records of the Chief Surveyor-General and indicated that the farm was originally surveyed in 1896. No references to the property were traced in the National Archives of South Africa.

4.2.1.3 Other sources

Aerial photographs and topocadastral and other maps were also studied - see the list of references below.

Information of a very general nature were obtained from these sources

4.2.2 Field survey

The area that had to be investigated was identified by **Savannah Environmental** by means of maps.

4.3 Limitations

None at present

5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

5.1 Site location and description

The study area is located to the north east of the town of Vaalwater in the Waterberg magisterial district of Limpopo Province. For more detail, please see the Technical Summary presented above.

The geology or the region is made up of arenite. The original vegetation consists of Mixed Bushveld, some of which has been replaced due to the making of agricultural fields. The topography of the area is classified as lowlands with hills, with the Melkrivier passing through the area and forming the eastern boundary of the study area.

The area under consideration has been used as agricultural fields, irrigated by means of a centre pivot system. Having been ploughed over in the past, it is highly likely that any heritage sites, features or objects that might have occurred here in the past, were destroyed.

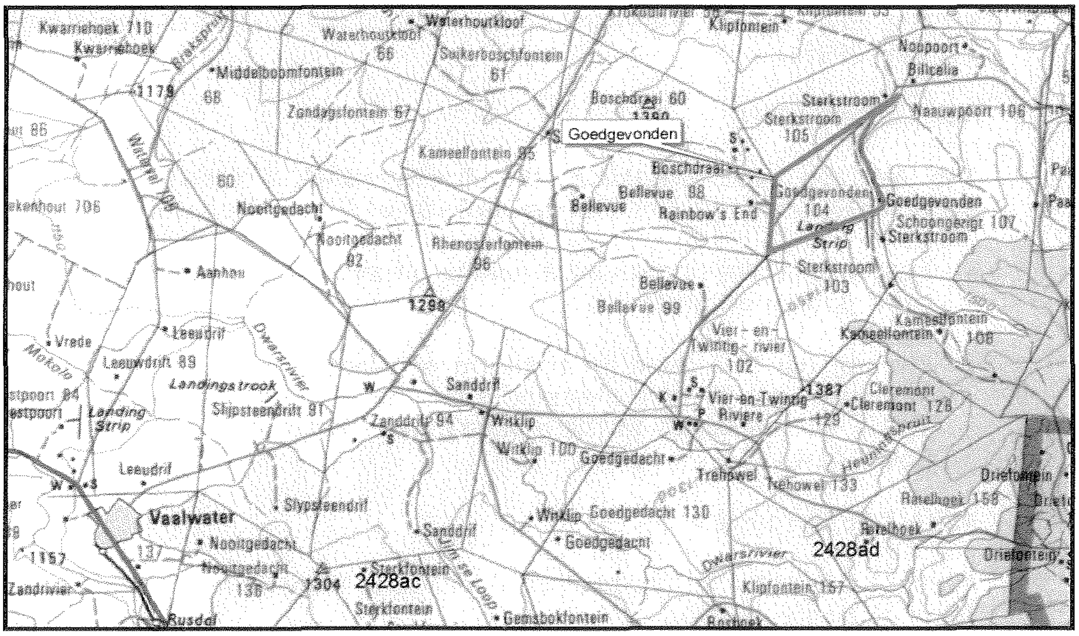


Figure 1: Location of the study area (green outline) in regional context (Map 2428: Chief Surveyor-General)

5.2 Regional overview

Nothing much is known as no systematic surveys have been done in the region. However, some sites dating to the Stone Age are known to occur to the north and west of the study region. Some of these also contain rock art. These sites are usually found in river valleys where small rock shelters were carved out by streams.

In addition, it can be expected that some Iron Age sites can be identified in the more flat open regions near the river. However, as yet there are no reports on the existence of such sites.

Lastly, sites dating to historic times are known to exist all over. Typical of these would be farmsteads with old buildings and associated farming related features, as well as informal cemeteries. An exception is the St. Johns Anglican Church at Vier-en-Twintig- Rivier south of the study area (see front page). This church was designed by Sir Herbert Baker and consecrated in 1914.

6. SITE SIGNIFICANCE AND ASSESSMENT

6.1 Heritage assessment criteria and grading

The NHRA stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

- **Grade I**: Heritage resources with qualities so exceptional that they are of special national significance
- **Grade II**: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region
- **Grade III**: Other heritage resources worthy of conservation on a local authority level

The occurrence of sites with a Grade I significance will demand that the development activities be drastically altered in order to retain these sites in their original state. For Grade II and Grade III sites, the applicable of mitigation measures would allow the development activities to continue.

6.2 Statement of significance

A matrix was developed whereby the above criteria, as set out in Sections 3(3) and 7 of the NHRA, No. 25 of 1999, were applied for each identified site (see Appendix 1). This allowed some form of control over the application of similar values for similar sites. Three categories of significance are recognised: low, medium and high. In terms of Section 7 of the NHRA, all the sites currently known or which are expected to occur in the study area are evaluated to have a grading as identified in the table below.

Table 1: Summary of identified heritage resources in the study area.

Identified heritage resources	
Category, according to NHRA	*Identification/Description*
Formal protections (NHRA)	
National heritage site (Section 27)	None
Provincial heritage site (Section 27)	None
Provisional protection (Section 29)	None
Place listed in heritage register (Section 30)	None
General protections (NHRA)	
Structures older than 60 years (Section 34)	None
Archaeological site or material (Section 35)	None
Palaeontological site or material (Section 35)	None
Graves or burial grounds (Section 36)	None
Public monuments or memorials (Section 37)	None
Other	
Any other heritage resources (describe)	None

6.3 Impact assessment

Impact analysis of cultural heritage resources under threat of the proposed development, are based on the current understanding of the development.

Table 2: Summary of identified sites

Heritage sites assessment		
Site type	*Site significance*	*Site grading (Section 7 of NHRA)*
None	None	None
Impact assessment		
Impact	*Mitigation*	*Permits required*
None	None	None

As there are no sites, features, or objects of cultural significance in the study area, there would be no impact from the proposed development.

7. CONCLUSIONS

The aim of the survey was to locate, identify, evaluate, and document sites, objects and structures of cultural significance found within the area in which it is proposed to develop a PV plant.

As very few systematic surveys have been done, little is known about the heritage resources in the region. Available information indicates that few sites would occur in or close to the study area.

As no heritage sites in the study area, there would be no impact resulting from the proposed development.

Therefore, from a heritage point of view it is recommended that the proposed development be allowed to continue. However, it is requested that should archaeological sites or graves be exposed during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.

8. REFERENCES

8.1 Data bases

Chief Surveyor General

Environmental Potential Atlas, Department of Environmental Affairs and Tourism.

Heritage Atlas Database, Pretoria.

National Archives of South Africa

8.2 Literature

Acocks, J.P.H. 1975. *Veld Types of South Africa*. Memoirs of the Botanical Survey of South Africa, No. 40. Pretoria: Botanical Research Institute.

Coetzee, C.B. (ed.) 1976. *Mineral resources of the Republic of South Africa*. Handbook No. 7, Geological Survey. Pretoria: Government Printer.

De Jong, R.C. 2005. *Level 2 (Heritage scooping) report: proposed development of full title deed units on Portions of the farms Buffelsfontein 55KR, Buffelshoek 54Kr, Matjesgoedfontein 57KR and Zondagsloop 56KR (collectively known as Nyathi Game Reserve, north of Vaalwater, Limpopo Province*. Unpublished report. Pretoria: Cultmatrix.

Holm, S.E. 1966. *Bibliography of South African Pre- and Protohistoric archaeology*. Pretoria: J.L. van Schaik.

8.4 Maps and aerial photographs

1: 50 000 Topocadastral maps: 2428AB

Google Earth

APPENDIX 1: CONVENTIONS USED TO ASSESS THE IMPACT OF PROJECTS ON HERITAGE RESOURCES

Significance

According to the NHRA, Section 2(vi) the **significance** of heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Matrix used for assessing the significance of each identified site/feature

1. Historic value	
Is it important in the community, or pattern of history	
Does it have strong or special association with the life or work of a person, group or organisation of importance in history	
Does it have significance relating to the history of slavery	
2. Aesthetic value	
It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group	
3. Scientific value	
Does it have potential to yield information that will contribute to an understanding of natural or cultural heritage	
Is it important in demonstrating a high degree of creative or technical achievement at a particular period	
4. Social value	
Does it have strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	
5. Rarity	
Does it possess uncommon, rare or endangered aspects of natural or cultural heritage	
6. Representivity	
Is it important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects	
Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class	
Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.	

7. Sphere of Significance	High	Medium	Low
International			
National			
Provincial			
Regional			
Local			
Specific community			

8. Significance rating of feature		
1.	Low	
2.	Medium	

3.	High	

Significance of impact:

- low where the impact will not have an influence on or require to be significantly accommodated in the project design
- medium where the impact could have an influence which will require modification of the project design or alternative mitigation
- high where it would have a "no-go" implication on the project regardless of any mitigation

Certainty of prediction:

- Definite: More than 90% sure of a particular fact. Substantial supportive data to verify assessment
- Probable: More than 70% sure of a particular fact, or of the likelihood of that impact occurring
- Possible: Only more than 40% sure of a particular fact, or of the likelihood of an impact occurring
- Unsure: Less than 40% sure of a particular fact, or the likelihood of an impact occurring

Recommended management action:
For each impact, the recommended practically attainable mitigation actions which would result in a measurable reduction of the impact, must be identified. This is expressed according to the following:

1 = no further investigation/action necessary
2 = controlled sampling and/or mapping of the site necessary
3 = preserve site if possible, otherwise extensive salvage excavation and/or mapping necessary
4 = preserve site at all costs
5 = retain graves

Legal requirements:
Identify and list the specific legislation and permit requirements which potentially could be infringed upon by the proposed project, if mitigation is necessary.

APPENDIX 2. RELEVANT LEGISLATION

All archaeological and palaeontological sites, and meteorites are protected by the National Heritage Resources Act (Act no 25 of 1999) as stated in Section 35:

(1) Subject to the provisions of section 8, the protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority: Provided that the protection of any wreck in the territorial waters and the maritime cultural zone shall be the responsibility of SAHRA.

(2) Subject to the provisions of subsection (8)(a), all archaeological objects, palaeontological material and meteorites are the property of the State. The responsible heritage authority must, on behalf of the State, at its discretion ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in so doing establish such terms and conditions as it sees fit for the conservation of such objects.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority-

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

In terms of cemeteries and graves the following (Section 36):

(1) Where it is not the responsibility of any other authority, SAHRA must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit.

(2) SAHRA must identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with the grave referred to in subsection (1), and must maintain such memorials.

(3) No person may, without a permit issued by SAHRA or a provincial heritage resources authority-

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.

APPENDIX 3: SURVEY RESULTS

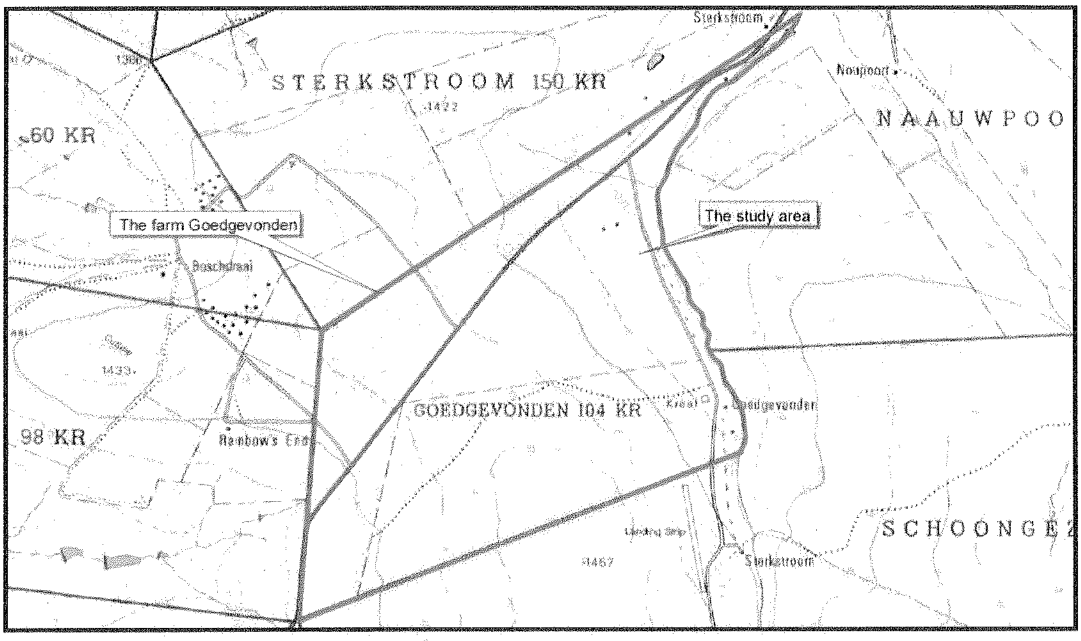


Fig. 2. The study outlined in green.
(Map 2428AB: Chief Surveyor-General)

Sites identified in the study area: Nil

APPENDIX 4: ILLUSTRATIONS

Fig. 3. The study area seen from the air.
(Photo: Google Earth)

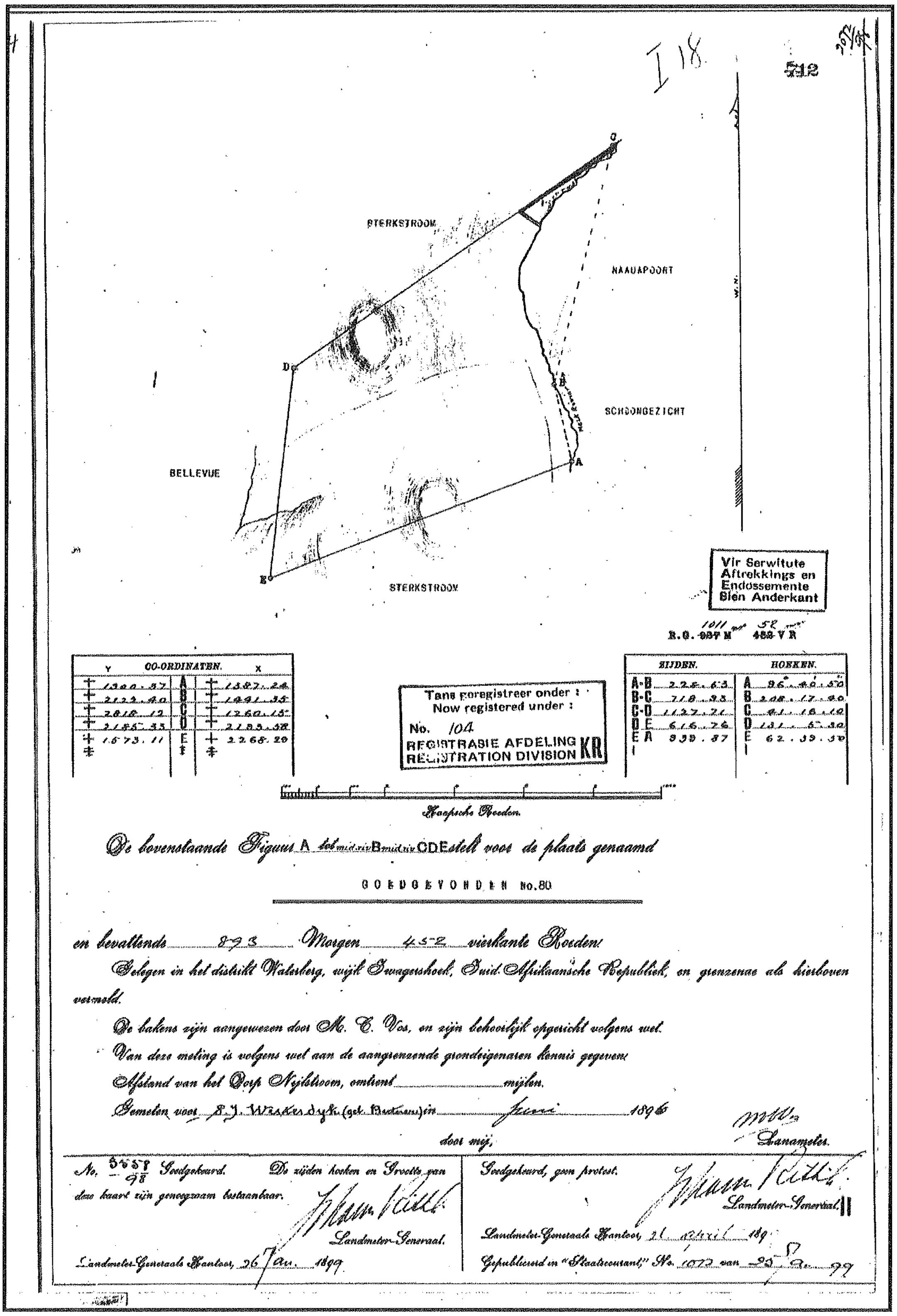


Fig. 4. Original Title Deed for the farm, dating to 1896.

Fig. 5. The study area looking west.

Fig. 6. The study area looking east.

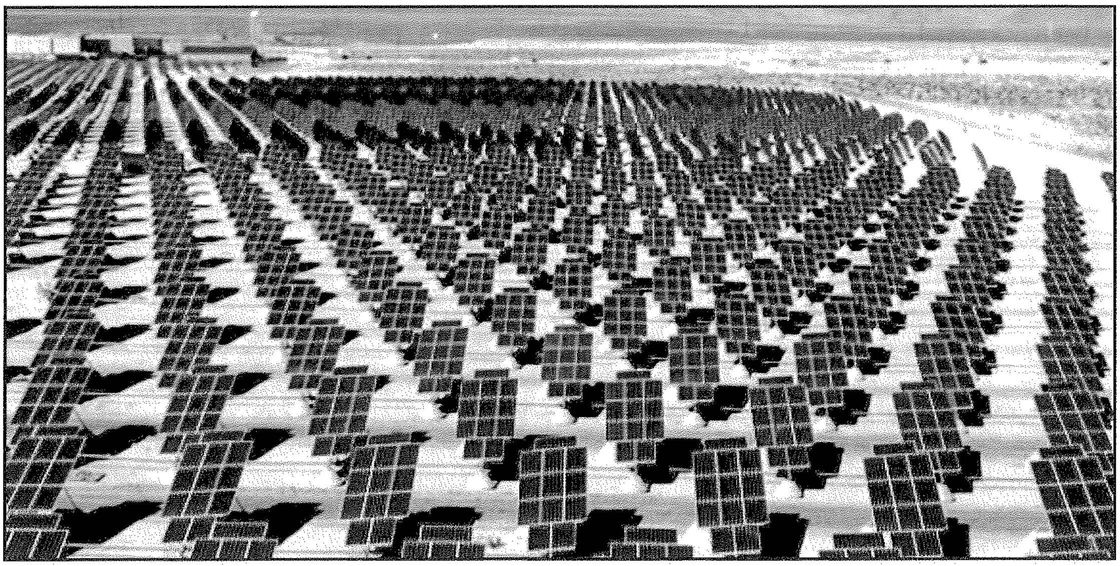
Fig. 7. The study area looking south.

Appendix H:

Visual Study

PROPOSED WATERBERG PHOTOVOLTAIC PLANT, VISUAL IMPACT ASSESSMENT

Produced for:
Thupela Energy



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- October 2010 -

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MetroGIS (Pty) Ltd, specialising in visual assessment and Geographic Information Systems, undertook this visual assessment in collaboration with V&L Landscape Architects CC.

Lourens du Plessis, the lead practitioner undertaking the assessment, has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990.

The team undertaking the visual assessment has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. The expertise of these practitioners is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

The visual assessment team is familiar with the "Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes" (Provincial Government of the Western Cape: Department of Environmental Affairs and Development Planning) and utilises the principles and recommendations stated therein to successfully undertake visual impact assessments. Although the guidelines have been developed with specific reference to the Western Cape province of South Africa, the core elements are more widely applicable.

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the proposed Waterberg Photovoltaic plant. Neither the author, MetroGIS or V&L Landscape Architects will benefit from the outcome of the project decision-making.

1. INTRODUCTION

Thupela Energy is proposing the establishment of a photovoltaic (PV) facility and associated infrastructure for electricity production on Portion 2 of the Farm Goedgevonden KR 104, within the Modimolle Local Municipality within the Waterberg District Municipality in the Limpopo Province.

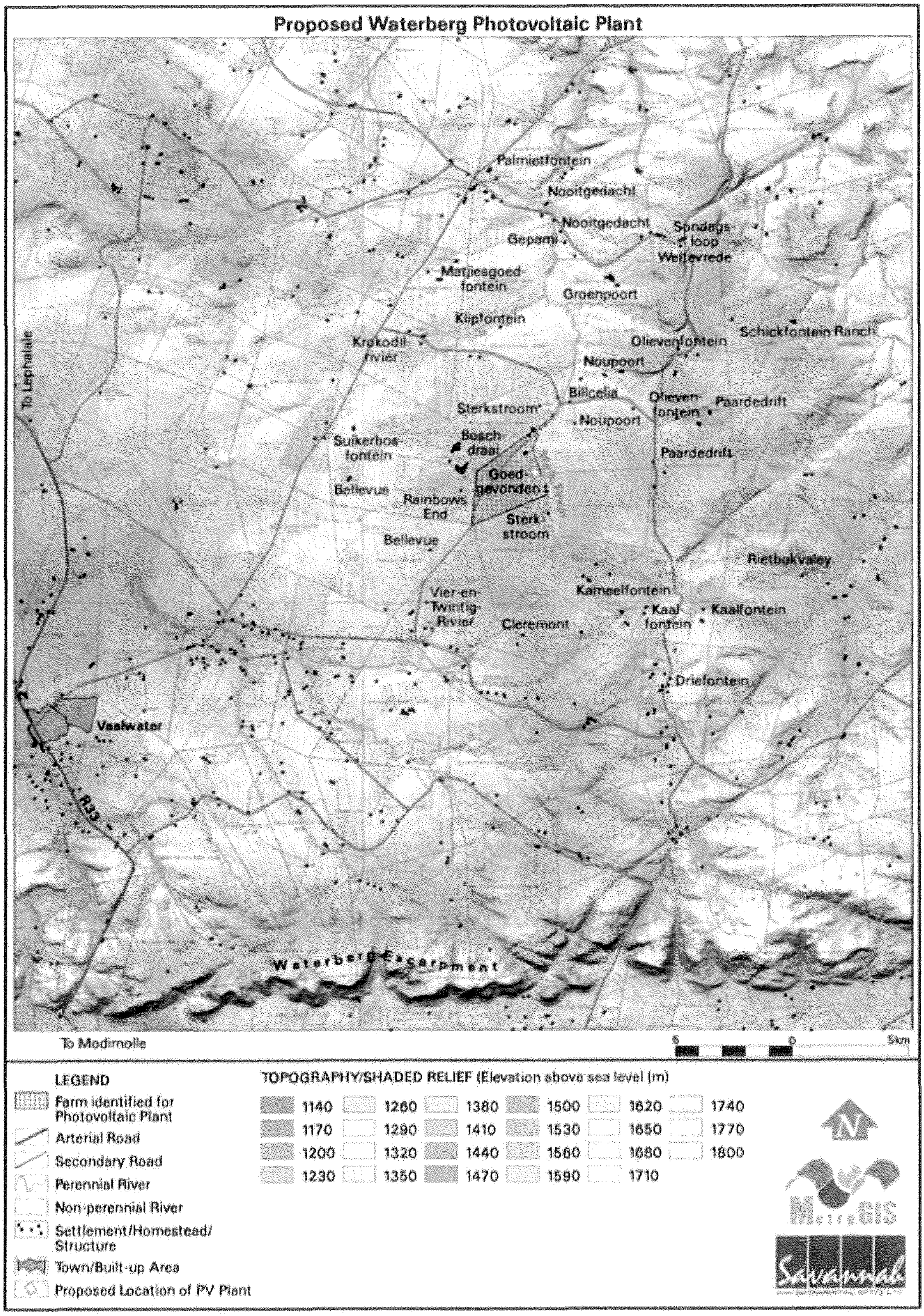
The proposed site is located approximately 20km (at the closest) north-east of Vaalwater. The locality of the proposed PV plant is shown on **Map 1**.

Photovoltaic technology is used to generate electricity by converting solar radiation into direct current electricity using semiconductors (i.e. silicon) through the photovoltaic effect. PV technology refers to the use of multiple PV cells which are linked together to form PV panels. The proposed PV panels will have a tracking functionality which will allow them to follow the movement of the sun during the day.

Thupela Energy intends to utilise the PV panels to generate up to 5MW of electricity by strategically placing the PV panels within the identified site in order to maximise electricity generation via exposure to the solar resource.

Additional infrastructure is expected to include a switching station adjacent to the Mink overhead power line (to allow for the evacuation of the electricity into the Eskom grid), internal access roads, and a low volume water supply pipeline from an on-site borehole, workshop/storage area, and a visitor's centre.

The construction phase of the proposed facility is expected to be 6-8 months whilst the lifespan of the facility is anticipated to be 20 to 30 years.



Map 1: Locality map of the proposed Waterberg PV plant showing shaded relief (topography and elevation above sea level)

2. SCOPE OF WORK

The study area for the visual assessment encompasses a geographical area of 1,657km^2 and includes a minimum 16km buffer zone from the proposed development area. It includes the town of Vaalwater as well as sections of the R33 arterial road and a number of secondary (local) roads.

The scope of work includes the assessment of potential visual impacts in terms of their nature, extent, duration, magnitude, probability, and significance during the construction and operation of the proposed facility.

In this regard, specific issues related to the potential visual impact were identified during a site visit to the affected environment. Issues related to the proposed Photovoltaic plant include:

- The visibility of the facility to, and potential visual impact on, observers travelling along the secondary roads in close proximity of the proposed facility.
- The visibility of the facility to, and potential visual impact on, individual/isolated landowners/homesteads located within areas of potential visual exposure. Some of these may include *Kameelfontein, Kaalfontein, Sterkstroom, Goedgevonden, Paardedrift, Kasjet*, etc.
- The potential visual exposure of the facility to protected areas in close proximity to the proposed PV plant (i.e. specifically the farms Kasjet 59 KR and Olievenfontein 111 KR that form part of the Waterberg Biosphere Reserve's buffer areas).
- The visibility of the facility to, and potential visual impact on tourist routes and destinations within the region, with specific reference to the scenic Waterberg Meander.
- The potential visual impact of the construction of ancillary infrastructure (i.e. the switching station, internal access roads and low volume water supply pipeline) on observers in close proximity to the facility.
- The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in close proximity to the facility.
- The visual absorption capacity of the natural vegetation (if applicable).
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts.

3. METHODOLOGY FOR THE ASSESSMENT OF THE VISUAL IMPACT

The study was undertaken using Geographic Information Systems (GIS) software as a tool to generate viewshed analyses and to apply relevant spatial criteria to the proposed facility. A detailed Digital Terrain Model (DTM) for the study area was created from 20m interval contours supplied by the Surveyor General.

Site visits were undertaken to source information regarding land use, vegetation cover, topography, and general visual quality of the affected environment. It further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact.

The procedure utilised to identify issues related to the visual impact includes the following activities:

- The creation of a detailed digital terrain model (DTM) of the potentially affected environment.

- The sourcing of relevant spatial data. This includes cadastral features, vegetation types, land use activities, topographical features, site placement, etc.
- The identification of sensitive environments upon which the proposed facility could have a potential impact.
- The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

This report (visual impact assessment) sets out to identify and quantify the possible visual impacts related to the proposed Waterberg Photovoltaic plant and its related infrastructure, as well as to offer potential mitigation measures, where required.

The following methodology has been followed for the assessment of visual impact:

- **Determine potential visual exposure**

  The visibility or visual exposure of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed PV plant and associated infrastructure were not visible, no impact would occur.

  Viewshed analyses of the proposed PV plant facility and the related infrastructure, based on a 20 m interval digital terrain model of the study area, indicate the potential visibility.

- **Determine visual distance / observer proximity to the facility**

  In order to refine the visual exposure of the facility on surrounding areas/receptors, the principle of reduced impact over distance is applied in order to determine the core area of visual influence for the facility.

  Proximity radii for the proposed development site are created in order to indicate the scale and viewing distance of the facility and to determine the prominence of the structures in relation to their environment.

  The visual distance theory and the observer's proximity to the facility are closely related, and especially relevant, when considered from areas with a high viewer incidence and a predominantly negative visual perception of the proposed facility.

- **Determine viewer incidence / viewer perception**

  The number of observers and their perception of a structure determine the concept of visual impact. If there are no observers or if the visual perception of the structure is favourable to all the observers, there would be no visual impact.

  It is therefore necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed PV plant and its related infrastructure.

  It would be impossible not to generalise the viewer incidence and sensitivity to some degree, as there are many variables when trying to determine the perception of the observer; regularity of sighting, cultural background, state of mind, and purpose of sighting which would create a myriad of options.

- **Determine the visual absorption capacity of the natural vegetation**

  This is the capacity of the receiving environment to absorb or screen the potential visual impact of the proposed facility. The VAC is primarily a function of the vegetation, and will be high if the vegetation is tall, dense and continuous. Conversely, low growing sparse and patchy vegetation will have a low VAC.

  The digital terrain model utilised in the calculation of the visual exposure of the facility does not incorporate the potential visual absorption capacity (VAC) of the natural vegetation of the region. It is therefore necessary to determine the VAC by means of the interpretation of the vegetation cover, supplemented with field observations.

- **Determine the visual impact index**

  The results of the above analyses are merged in order to determine where the areas of likely visual impact would occur. These areas are further analysed in terms of the previously mentioned issues (related to the visual impact) and in order to judge the severity of each impact.

4. THE AFFECTED ENVIRONMENT

The proposed location for the PV plant is situated approximately 24km by secondary road north-east of Vaalwater on portion 2 of the farm Goedgevonden 104 KR.

The site covers an area of approximately 50 ha, with the development footprint for the proposed facility being approximately 20 ha (but no more than 30 ha). This development site of 20 ha will be situated within the greater 50 ha footprint.

This farm (surface area 7.5km^2) is located on the Waterberg plateau (table land) at elevations ranging between 1360m and 1420m above mean sea level.

The farm has an even slope gradient and the site-specific terrain morphological description is *lowlands with hills.*

The Melk River (which drains into the Lephalale River sub-catchment) forms the eastern boundary of the farm, which straddles the watershed boundary between this river and the Dwars River sub-catchment. The latter converges with the Mokolo River near Vaalwater. See **Map 1.**

The predominant economic activity within the study area is cattle and game farming with some irrigated and dryland agriculture occurring at a less intensive degree.

The study area has a low population density (less than 10 people per km^2) with the highest concentration occurring at the small town of Vaalwater. The proposed site location can be described as remote.

The only arterial road is the R33 in the east of the study area. This road also forms part of the *Waterberg Meander* tourist route. The remainder of roads are secondary (local) roads.

The area is rural in character with very few structures impinging on the general sense of place. Farming homesteads dot the countryside at irregular intervals.

Vegetation cover is defined as natural *woodland* and *thicket and bushland*, while large tracts of land, including parts of the proposed farm, have been transformed (fallow land, old agricultural fields or overgrazed land) through agricultural or cattle farming practises. See **Map 2** for the broad land cover types map of the study area.

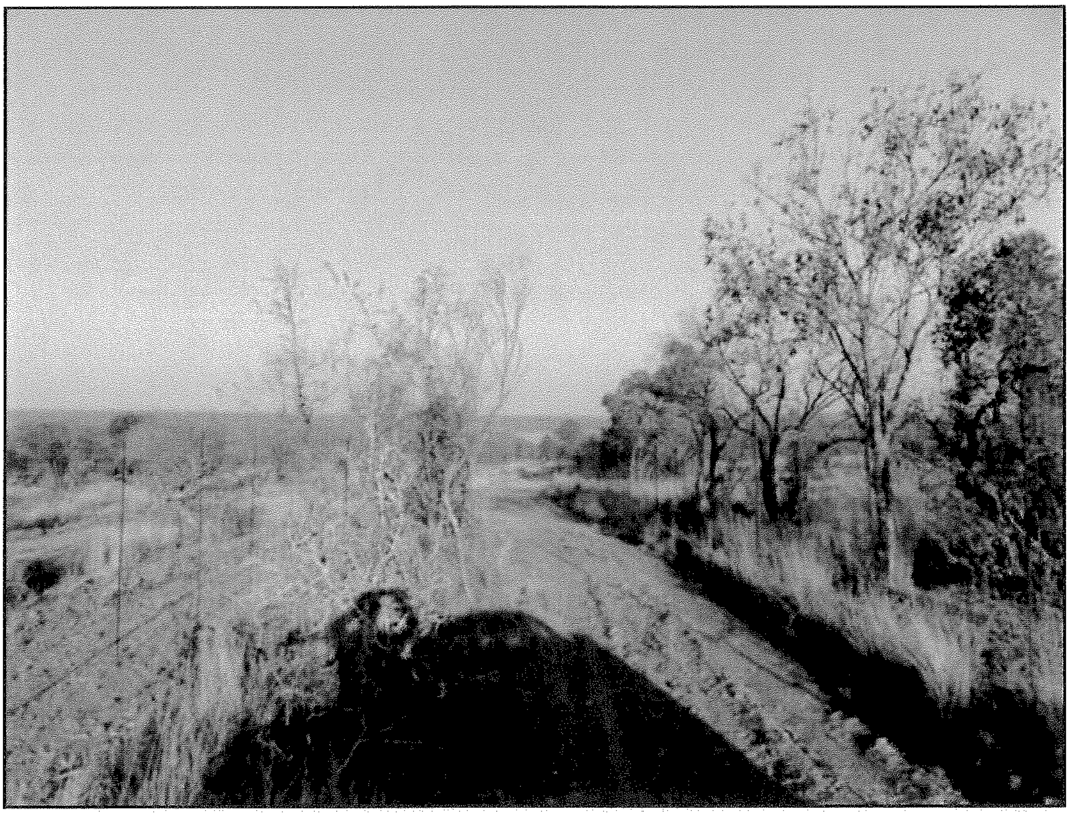


Figure 1: General environment surrounding the proposed Waterberg PV Plant.

Figure 2: Natural vegetation cover surrounding the proposed Waterberg PV Plant.

The Waterberg Biosphere Reserve (buffer and transition area) is located in the north west of the study area.

Biosphere Reserve ***core areas*** represent *"securely protected sites for conserving biological diversity, monitoring minimally disturbed ecosystems, and undertaking non-destructive research and other low-impact uses"*. Biosphere Reserves further include ***buffer zones*** that *"surrounds or adjoins the core areas, and is used for co-operative activities compatible with sound ecological practices, including environmental education, recreation, and eco-tourism and applied and basic research"* and ***transition zones*** that *"contain a variety of agricultural activities, settlements and other uses".*[1]

A small section of the site (north west of the secondary road) is located within the transition zone of the Biosphere Reserve. However, the facility footprint (i.e. the location of the PV plant infrastructure on the site) falls outside of this zone. See **Map 3.**

In the south of the study area is an area identified as an *Important Bird Area* although it does not enjoy any statutory protection.

Source: Department of Environmental Affairs and Tourism (2001), CSIR/ARC NLC (2000) and site observations.

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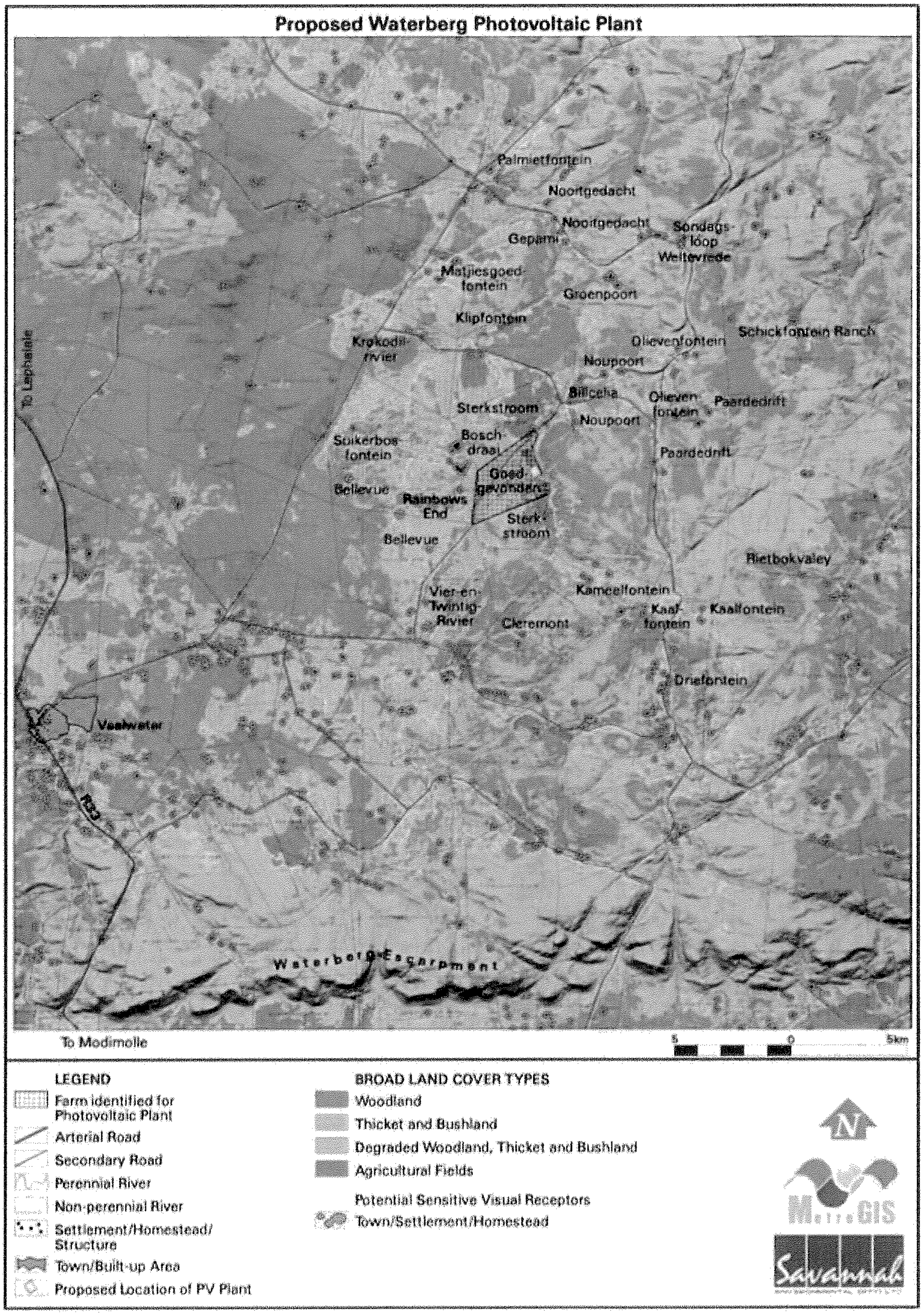
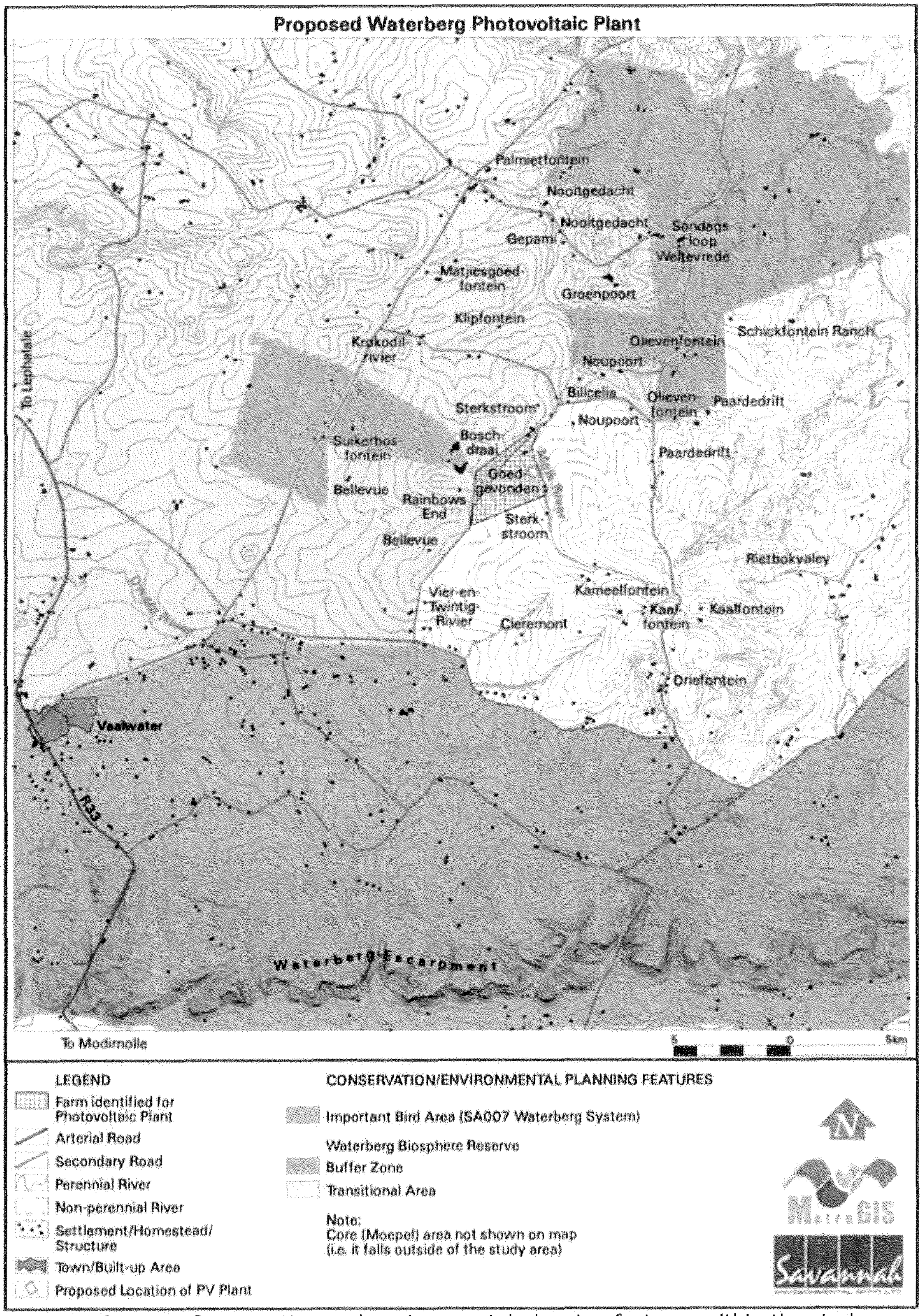
[1] *Cape Nature, 2008. (Joint statement by biosphere reserve managers/coordinators regarding developments within the core, buffer and transition areas).*



Map 2: Broad land cover and land use including potential sensitive visual receptors within the study area



Map 3: Conservation and environmental planning features within the study area.

5. RESULTS

5.1. Potential visual exposure

The visibility analysis was undertaken from actual ground level at an offset of 6m (the approximate maximum height of the structures) above average ground level. As no formal layout of the PV plant is available yet, the entire area of the proposed development footprint was used in order to simulate a worst-case scenario.

The potential visual exposure of the facility is indicated on **Map 4**. The shading indicates areas from which the facility would potentially be visible.

It is clear from the viewshed analysis that the facility would be exposed to a relatively small and localised geographical area within this region due to the small dimensions of the facility's components.

A scattered area of visual exposure will be limited to higher lying areas (e.g. hilltops and ridges) located to the north-east and south-east of the proposed PV plant. This is due to the plant's proposed location on agricultural land adjacent to the Melk River (i.e. at a relatively low elevation in relation to other areas within the farm) as well as the structure dimensions (i.e. a maximum height of 6m).

The PV plant is not expected to be visible from any major roads (i.e. the R33 arterial road) but may be visible from limited sections of the secondary roads near the site (i.e. from the secondary road traversing the farm Goedgevonden 104 KR). Visibility may be possible from the following homesteads/settlements where the natural vegetation cover permits (i.e. where the natural vegetation had been removed):

- Kameelfontein
- Kaalfontein
- Goedgevonden
- Billcelia
- Paardedrift
- Noupoort
- Olievenfontein

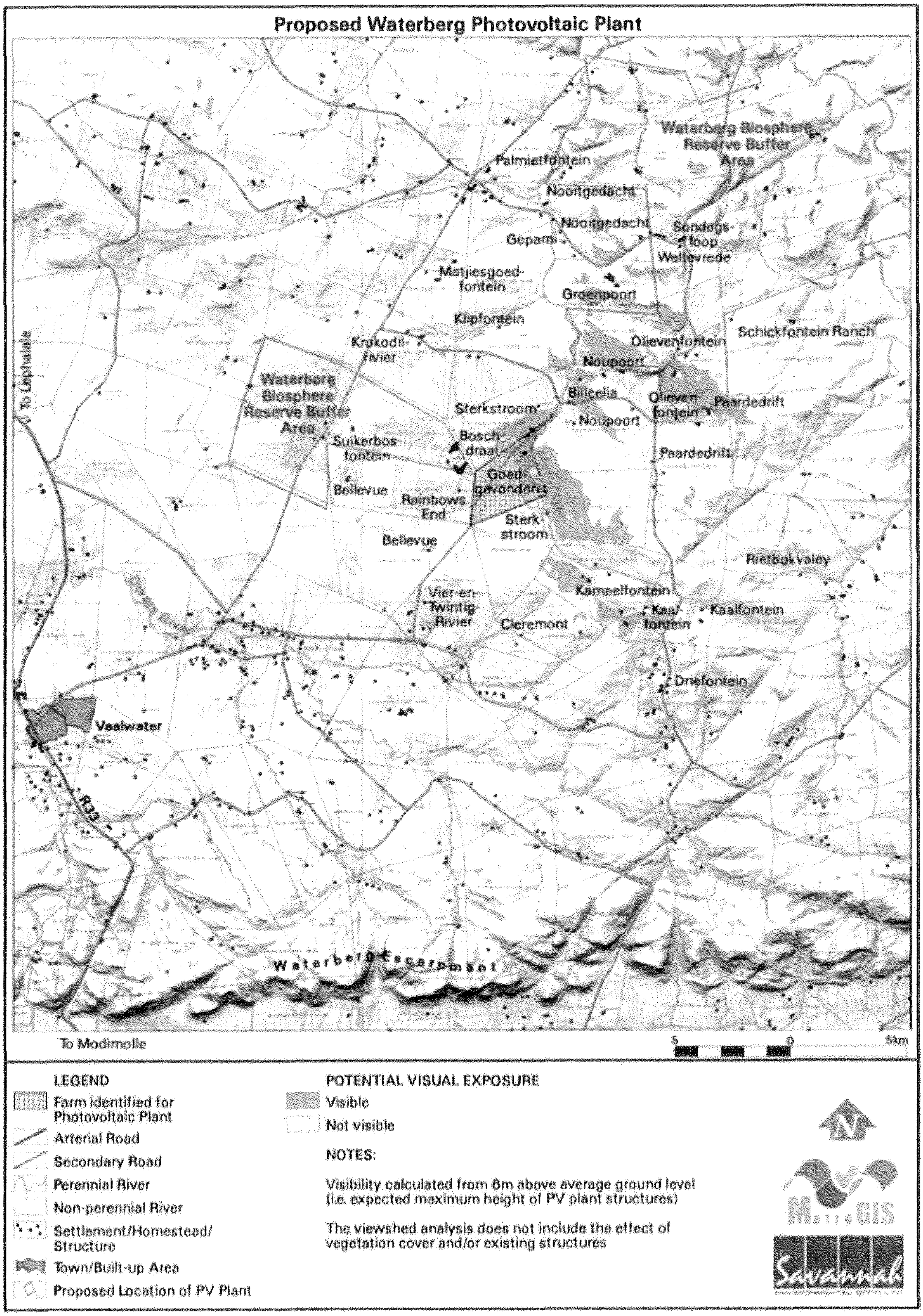
The proposed PV plant will not be visible from Vaalwater.

It is envisaged that the structures, **where visible from short distances**, would be easily and comfortably visible to observers travelling along secondary roads or from residences located nearby, especially within a 4km radius of the PV plant.

What would be visible is a relatively expansive surface area (approximately 20ha) utilised by the PV infrastructure, notwithstanding the constrained vertical dimensions of the PV plant.

A portion of the property on which the proposed development is located falls within the transition zone of the Waterberg Biosphere Reserve, although the proposed development footprint for the facility itself does not.

The development will, however, potentially be visible from a section of the Waterberg Biosphere Reserve's buffer zone.



Map 4: Potential visual exposure of the proposed Waterberg PV plant.

5.2 Visual distance/observer proximity to the facility

MetroGIS determined the proximity radii based on the anticipated visual experience of the observer over varying distances. The distances are adjusted upwards for larger facilities and downwards for smaller facilities (i.e. depending on the size and nature of the proposed infrastructure). MetroGIS developed this methodology in the absence of any known and/or acceptable standards for South African solar facilities.

The proximity radii (calculated from the boundary of the proposed development footprint for the PV plant) are shown on **Map 5** and are as follows:

- 0 - 4km. Short distance view where the PV plant would dominate the frame of vision and constitute a very high visual prominence.
- 4 - 8km. Medium distance view where the structures would be easily and comfortable visible and constitute a high visual prominence.
- 8 - 16km. Medium to longer distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.
- Greater than 16km. Long distance view of the facility where the facility could potentially still be visible though not as easily recognisable. This zone constitutes a medium to low visual prominence for the facility.

It is envisaged that the nature of the structure within the natural state of the regional environment would create a significant contrast that would make the facility visible and recognisable from within the determined viewshed.

5.3 Viewer incidence/viewer perception

Refer to **Map 5**. Viewer incidence is calculated to be the highest along corridor/roads within the study area. Although these corridors do not carry many observers per se, they do represent the highest *potential concentration* of observers within the study area.

Viewer incidence is relatively low within a 16 km radius of the proposed PV plant. However, the region has a high tourism value and inherent sense of place based on culture, game farming and history. A plethora of lodges, accommodation, community linked projects and scenic vantage points occur within the region.

In addition, the so-called 'Waterberg Meander' is routed along the R33, which bypasses the site some 20km to the west. This route falls outside of the potential viewshed zone (see **Map 4**), but some of the tourist destinations within the study area are listed attractions as part of the Meander.

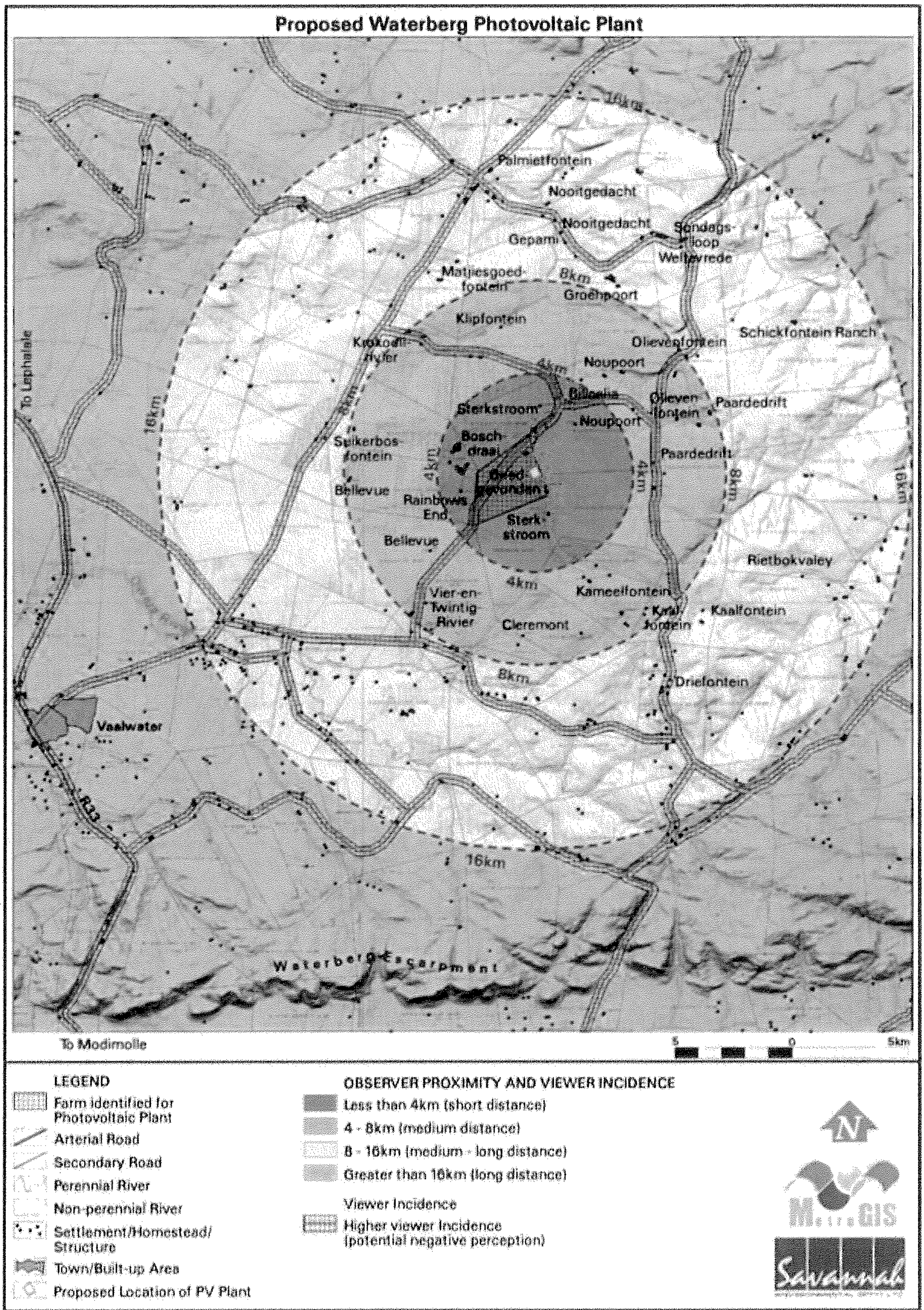
Residents and visitors to this area are considered to be potentially sensitive visual receptors upon which the proposed facility could have a negative visual impact. This is specific for observers in close proximity to the facility, who fall within the potential viewshed zone, as the severity of the visual impact decreases with increased distance from the proposed facility.

These observers may have potentially negative perceptions of the PV plant, especially if they are hospitality operators or their guests staying at, or travelling to and from tourist destinations in the region.

Receptors residing in this area are accustomed to the wide natural and agricultural expanses. Developments, especially industrial style structures, visible from their homesteads/settlements may constitute a negative visual impact. The property of Mr Willie Van Rooyen (i.e. Sterkstroom Farm) represents such a receptor. Land use on this farm includes both cattle ranching and tourism facilities. The latter will be visually affected by the proposed PV plant.

The Waterberg Biosphere Reserve transition and buffer zones also represent potentially sensitive visual receptor sites due to the nature oriented tourism activities taking place within. This having been said, the following is of relevance:

- The proposed development footprint lies outside of the Waterberg Biosphere Reserve's buffer and transitional areas. A portion of the broader property falls within the transition area, but no infrastructure is proposed for this portion (i.e. the developmental footprint falls outside the Waterberg Biosphere area).
- The extent of the potential visual exposure is very limited within the Waterberg Biosphere Reserve buffer zone.



Map 5: Observer proximity to the proposed Waterberg PV plant and areas of potentially high viewer incidence.

5.4. Visual absorption capacity of the natural vegetation

The visual absorption capacity (VAC) of the natural vegetation cover (*woodland* and *thicket and bushland*) is considered high for this study area.

Refer to **Figure 3**, which shows a view from a point opposite Kataba Ranch (on the southern side of the D2416 road, just west of *Billcelia*) an area that is shown to be visually exposed in the viewshed analysis (Map 2). The proposed development site lies directly within line of sight from where the photo was taken, but the dense bush (even after a burn) will not allow for a view of the facility.

Similarly, it may be assumed that all receptor sites within the potential viewshed may be similarly screened from the visual impact of the proposed facility, provided the natural vegetation *in close proximity to the receptor* is intact, and the receptor is not positioned on an elevated vantage point looking down onto the PV plant.

Figure 3: Photograph depicting the potentially high Visual Absorption Capacity of the vegetation in the study area.

5.5. Visual impact index

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed PV plant are displayed on **Map 6.** Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values were assigned for each potential visual impact per data category and merged in order to calculate the visual impact index. The vegetation absorption capacity of the surrounding vegetation is not included in the calculation of these indices.

An area with short distance, high frequency of visual exposure to the proposed facility, a high viewer incidence and a predominantly negative perception by affected receptors (i.e. they have complained or raised concerns) would therefore have a higher value (greater impact) on the index. This helps in focusing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

The index immediately gives a strong indication that observers in close proximity to the facility (within 4 km) would have the highest visual experience of the facility and would be exposed to a **high** visual impact.

Observers travelling along the limited stretch of the access road to the facility and on the D2747 secondary road could experience **very high** visual impact. Although these roads do not carry a large number of motorists, they provide thoroughfare and access to a number of tourism destinations and stopping points off the Waterberg Meander.

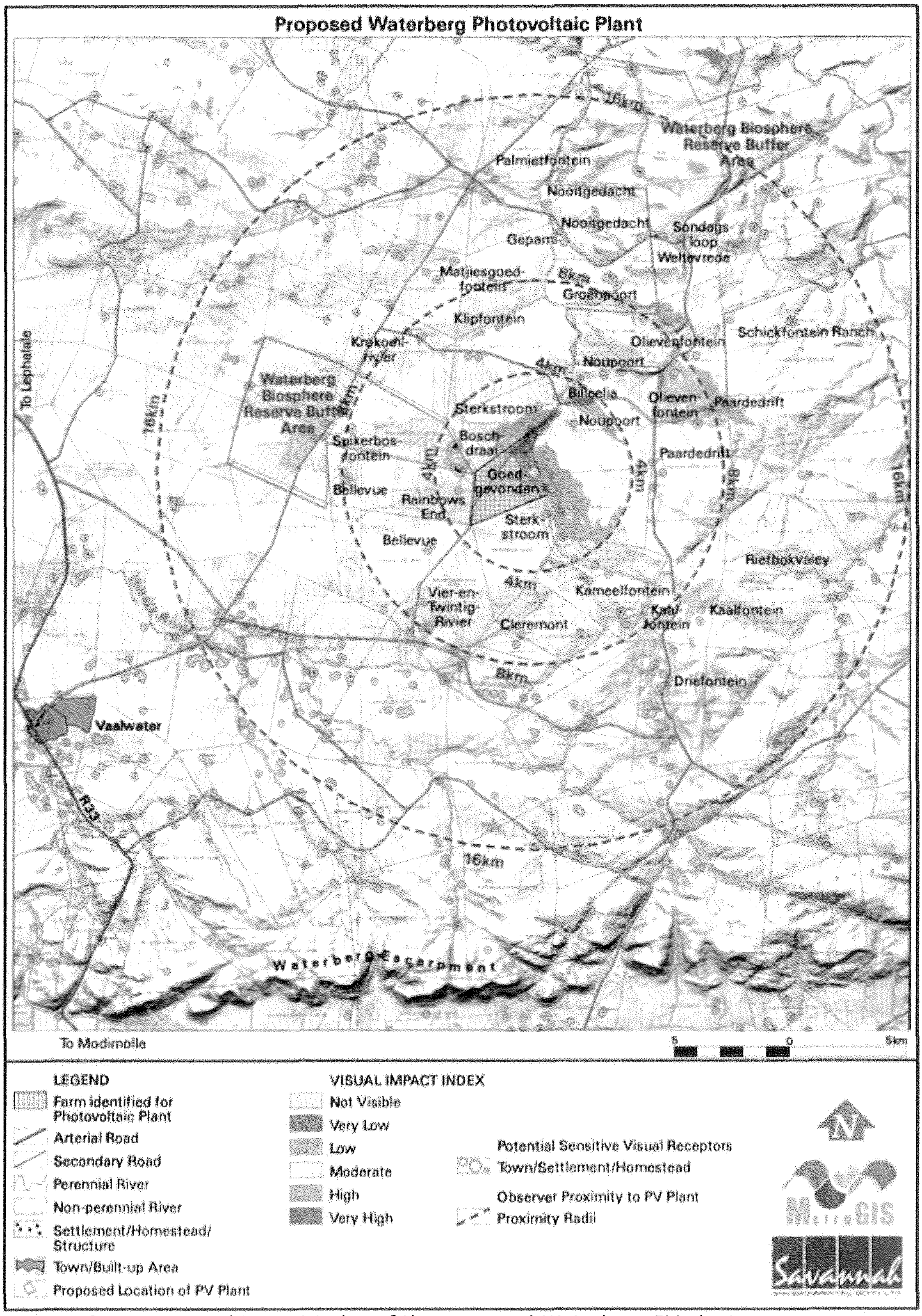
It is, however, envisaged that many people travelling along this road would more than likely be visiting the facility (which would be an attraction of sorts) or be local farmers/workers travelling to town.

Other areas highlighted by the visual impact index are the settlements and farmsteads surrounding the facility (mostly concentrated to the north-east). These areas would be impacted on at distances of between 4 and 8 km and may experience **moderate** visual impact.

It is interesting to note that the other smaller settlements and farmsteads (some as close as 2 to 3 km from the facility) as well as settlements and sites along the D579, D2416 and D1959 secondary roads would either not be able to see the PV plant or would at best catch glimpses of the facility. This is due the plant's low-lying location in the landscape (i.e. close to the Melk River).

Very limited parts of the Waterberg Biosphere Reserve transition zone could be subject to **high** visual impact.

At this point, it is important to consider the high VAC of the vegetation in the study area. Where present, this high VAC will reduce the probability of the above visual impacts occurring. The effect of the VAC is thus taken into account during the impact assessment which follows.



Map 6: Visual impact index of the proposed Waterberg PV plant.

5.6. Visual impact assessment

The previous section of the report identified specific areas where likely visual impacts would occur. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the identified issues (see Chapter 2: SCOPE OF WORK) related to the visual impact.

The methodology for the assessment of potential visual impacts states the **nature** of the potential visual impact (e.g. the visual impact on users of major roads near the proposed PV plant) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent** - site only (very high = 5), local (high = 4), regional (medium = 3), national (low = 2) or international (very low = 1)
- **Duration** - very short (0-1 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5)
- **Magnitude**- None (= 0), minor (= 1), low (= 2), medium/moderate (= 3), high (= 4) and very high (= 5)
- **Probability** - none (= 0), improbable (= 1), low probability (= 2), medium probability (= 3), high probability (= 4) and definite (= 5)
- **Nature** (positive, negative or neutral)
- **Reversibility** - reversible (= 1), recoverable (= 3) and irreversible (= 5)
- **Significance** - low, medium, or high.

The **significance** of the potential visual impact is equal to the **consequence** multiplied by the **probability** of the impact occurring, where the consequence is determined by the sum of the individual scores for magnitude, reversibility, duration and extent (i.e. **significance = consequence (magnitude + reversibility + duration + extent) x probability**).

The significance weighting for each potential visual impact (as calculated above) is as follows:

- <30 points: Low (where the impact would not have a direct influence on the decision to develop in the area)
- 31-60 points: Medium/moderate (where the impact could influence the decision to develop in the area)
- >60: High (where the impact must have an influence on the decision to develop in the area)

*Please note that due to the declining visual impact over distance, the **extent** (or spatial scale) rating is reversed (i.e. a localised visual impact has a higher value rating than a national or regional value rating). This implies that the visual impact is highly unlikely to have a national or international extent, but that the local or site-specific impact could be of high significance.*

5.6.1 The PV plant

Potential visual impact on users of secondary roads and settlements in close proximity to the PV plant

It has been established that the PV plant would be visible from various secondary roads and potential tourist routes within the region, although not from the R33.

The observers' purpose for visiting the region (nature oriented tourism) and the industrial nature of the facility's structure will be in conflict. This applies to the D2747, D2416, and D579 that will have a short distance view (i.e. within 4km) of the proposed development site, constituting a **high** visual impact. If VAC and mitigation are taken into account, this impact is expected to be **medium.**

The settlement of *Billcelia* in close proximity of the proposed PV plant may experience a **high** visual impact. Similarly, this impact will be **medium** if VAC and mitigation are taken into account.

The table below illustrates this impact assessment.

Table 1 Impact table summarising the significance of visual impacts on users of secondary roads in close proximity of the PV plant.

Nature of Impact: Potential visual impact on users of secondary roads in close proximity of the PV plant			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Very High **(5)**	Very High **(5)**	Very High **(5)**
Probability	High **(4)**	Medium **(3)**	Low **(2)**
Significance	High **(64)**	Medium **(48)**	Medium **(32)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

Potential visual impact on residents of settlements within the region

The proposed PV plant not will be visible from any built up areas within close proximity of the development site. The closest town (Vaalwater) to the facility is situated approximately 30km away as the crow flies. Settlements located beyond the 8km radius have not been reflected in the table below.

Other settlements in the region (i.e. between 4km and 8km from the proposed PV plant) may experience a **medium** visual impact, even with VAC being taken into account. These include *Kameelfontein* and *Kaalfontein.* This impact may be mitigated to **low**.

Many of the settlements that are not envisaged to be visually affected are situated behind hillocks/undulations and are effectively shielded by the topography.

The table below illustrates this impact assessment.

Table 2 Impact table summarising the significance of visual impacts on residents of settlements within the region.

Nature of Impact: Potential visual impact on residents of settlements within the region			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Regional **(3)**	Regional **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(3)**	Moderate **(3)**	Moderate **(3)**
Probability	High **(4)**	Medium **(3)**	Low **(2)**
Significance	Medium **(52)**	Medium **(39)**	Low **(26)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

Potential visual impact on protected areas in close proximity of the PV plant

The PV plant will potentially affect very limited parts of the transition zone of the Waterberg Biosphere Reserve. Within these very limited areas, visual impact is anticipated to be **low.**

The table below illustrates this impact assessment.

Table 3 Impact table summarising the significance of visual impacts on protected areas in close proximity of the PV plant.

Nature of Impact: Potential visual impact on protected areas in close proximity of the PV plant			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	High **(4)**	High **(4)**	High **(4)**
Probability	Low **(2)**	Improbable **(1)**	Improbable **(1)**
Significance	Low **(30)**	Low **(15)**	Low **(15)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

Potential visual impact on tourist routes and destinations within the region

Some of the farms adjacent to the proposed facility have been set aside for game farming/cattle farming and tourism destinations. These and other 'points of interest' off the Waterberg Meander could result in a **medium** visual impact. Certain stretches along the D579, D2416, D2747, and D1959 may be similarly impact on. This impact remains of **medium** significance when considering VAC, and may be mitigated to **low.**

The table below illustrates this impact assessment.

Table 4 Impact table summarising the significance of visual impacts on tourist routes and destinations within the region.

Nature of Impact: Potential visual impact on tourist routes and destinations within the region			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Regional **(3)**	Regional **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	High **(4)**	High **(4)**	High **(4)**
Probability	High **(4)**	Medium **(3)**	Low **(2)**
Significance	Medium **(56)**	Medium **(42)**	Low **(28)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

5.2.2 Ancillary infrastructure

Potential visual impact of on-site ancillary infrastructure on visual receptors in close proximity of the PV plant.

The ancillary infrastructure associated with the PV plant includes a switching station, internal access roads, and a low volume water supply pipeline from an on-site borehole, workshop/storage area, and a visitor's centre.

These structures will not significantly add to the visual impact of the PV plant, as they will all be modestly sized, and will thus not exceed the visual exposure of the primary PV infrastructure.

The anticipated impacted of this ancillary infrastructure is expected to be **medium**. This impact has a **low** significance when taking VAC into account.

The table below illustrates this impact assessment.

Table 5 Impact table summarising the significance of visual impacts of ancillary infrastructure on visual receptors in close proximity of the PV plant.

Nature of Impact: Potential visual impact of ancillary infrastructure on visual receptors in close proximity of the PV plant			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	High **(4)**	High **(4)**	High **(4)**
Probability	Medium **(3)**	Low **(2)**	Low **(2)**
Significance	Medium **(45)**	Low **(30)**	Low **(30)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

5.3. Secondary visual impacts

5.3.1. Lighting impacts

Potential visual impact of lighting on visual receptors in close proximity of the PV plant.

The area earmarked for the placement of the PV Plant has a relatively small number of populated places (towns, settlements and farmsteads).

Although these are not densely populated areas, the light trespass and glare from the security and after-hours operational lighting will have some significance. Furthermore, the sense of place and cultural ambiance of the local area increases its sensitivity to such lighting intrusions

However, it is reported that in terms of security lighting, no high mast lights will be installed on site as these would interfere with the operations of the plant due to shading. It is planned that infrared security cameras will be used, and that maintenance activities would likely be undertaken with the use of torches.

The anticipated impacts of lighting are expected to be **moderate**, and becomes of **low** significance when considering VAC.

The table below illustrates this impact assessment.

Table 6 Impact table summarising the significance of visual impacts of lighting on visual receptors in close proximity of the PV plant.

Nature of Impact: Potential visual impact of lighting on visual receptors in close proximity of the PV plant			
	VAC not considered	***VAC considered***	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Low **(2)**	Low **(2)**	Low **(2)**
Probability	Medium **(3)**	Low **(2)**	Low **(2)**
Significance	Medium **(39)**	Low **(26)**	Low **(26)**
Status (positive or negative)	Negative	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No	No
Can impacts be mitigated during operational phase?	No	No	No
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 30 years.			
Cumulative impacts: None.			
Residual impacts: None. The visual impact will be removed after decommissioning			

5.3.2. Potential visual impacts associated with the construction phase

The construction phase of a project is potentially the phase that causes the most disturbances. During this time there will be a noticeable increase in heavy vehicles utilising the roads to the development site that may cause, at the very least, a visual nuisance to other road users and landowners in the area.

Visual impacts associated with the construction phase, albeit temporary, should be managed according to the following principles:

- Reduce the construction period through careful planning and productive implementation of resources.
- Restrict the activities and movement of construction workers and vehicles to the immediate construction site.
- Ensure that the general appearance of construction activities, construction camps (if required) and lay-down areas are maintained by means of the timely removal of rubble and disused construction materials.
- Restrict construction activities to daylight hours (if possible) in order to negate or reduce the visual impacts associated with lighting.

5.4 The potential to mitigate visual impacts

- The primary visual impact, namely the appearance of the PV plant (mainly the solar panel field) is not possible to mitigate. Although the functional design of the structures cannot be changed in order to reduce visual impacts, it is proposed that the standard height of the units be set at 3-4m and that a 6m height should only be used on exception where absolutely necessary. This will reduce the facility's visual intrusion and increase the vegetations' ability to mask the facility.

The proposed placement of the proposed facility on the site is the best spot in terms of minimising potential visual impact (i.e. low down in the landscape, visually shielded by topography).

The high VAC of the natural vegetation also goes far in reducing the significance of potential visual impacts. Similarly, it may be assumed that receptor sites exposed to visual impact may mitigate this impact by planting a vegetation screen similar in form and density to the natural vegetation of the receiving environment. It should be noted, however, that this measure will only be effective if the screen is planted *in close proximity to the receptor*. This means that the visual impact must be screened at the property which is experiencing the impact, rather than at the development site itself.

It is recommended that the visual screen be planned and specified by a planning professional in order to maximise the screening benefit. In addition, it is imperative that the species of plants utilised be ecologically appropriate for the natural environment.

- Mitigation of secondary visual impacts associated with the construction of roads include proper planning and construction of roads with adequate drainage structures in place to forego potential erosion problems.

  The pipeline should be placed underground to avoid additional visual clutter. Proper re-instatement and re-vegetation is recommended for the pipeline.

  Also, the construction areas, including road servitudes, must be appropriately rehabilitated after construction. This rehabilitation must also be monitored and maintained in order to minimise the visual impact of the access roads.

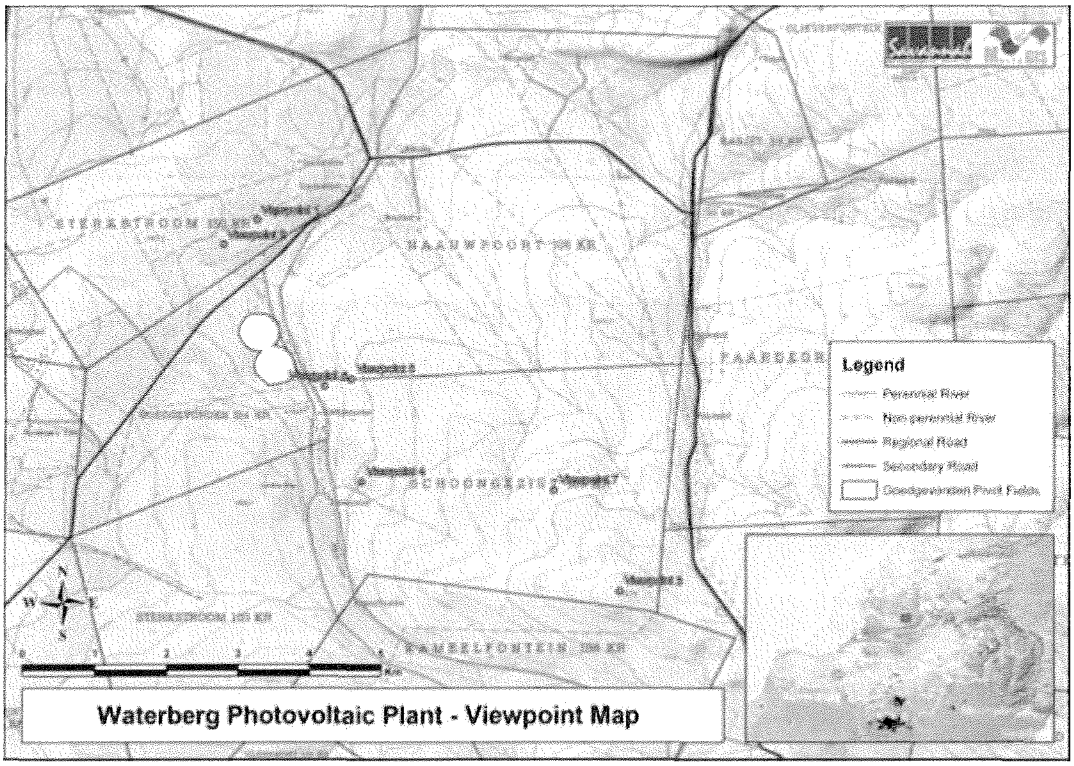
- Visual impacts associated with the construction phase, albeit temporary, should be managed according to the following principles:
  - Reduce the construction period through careful planning and productive implementation of resources.
  - Restrict the activities and movement of construction workers and vehicles to the immediate construction site.
  - Ensure that the general appearance of construction activities, construction camps (if required) and lay-down areas are maintained by means of the timely removal of rubble and disused construction materials.
  - Restrict construction activities to daylight hours (if possible) in order to negate or reduce the visual impacts associated with lighting.

The possible mitigation of both primary and secondary visual impacts as listed above should be implemented and maintained on an ongoing basis.

6. PHOTOGRAPHIC VIEWS

Photographs were taken (in addition to the above spatial analyses) in order to aid the visualisation of the potential visual impact that the facility would have on the receiving environment. Various points as highlighted in the scoping phase (through input from I&APs) as well as sites indicated by specialists' comments were visited and photographs were taken of the potential view of the development site.

The photograph positions are indicated on **Map 8** below and should be referenced with the photograph being viewed in order to place the observer in spatial context. The approximate viewing distances indicated were measured from the closest aspect of the facility to the vantage point.



Map 8: Photograph positions

Figure 4: **Viewpoint 1:** Panoramic view of the development site looking from the western boundary of the Farm Sterkstroom 105/4.

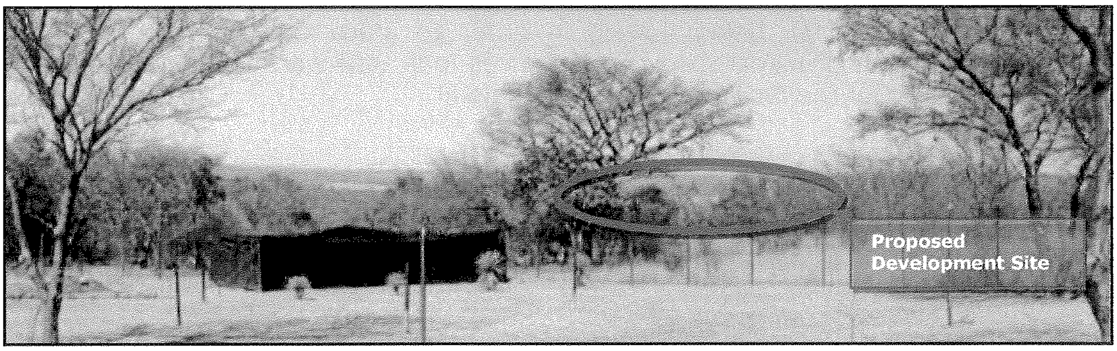


Figure 5: **Viewpoint 2:** Panoramic view looking south-east from the lodge situated on the Sterkstroom Farm 105/4

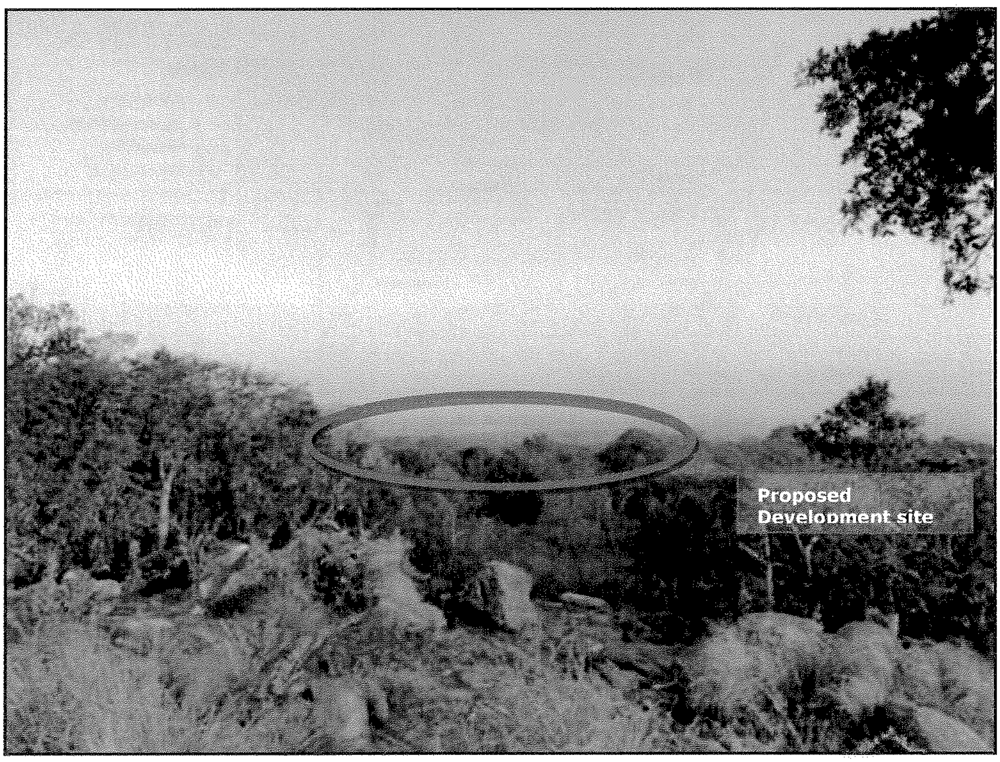


Figure 6: **Viewpoint 3:** Photographic view of the proposed site from a koppie within the Farm Schoongezigt 107 (proposed site for future lodge).

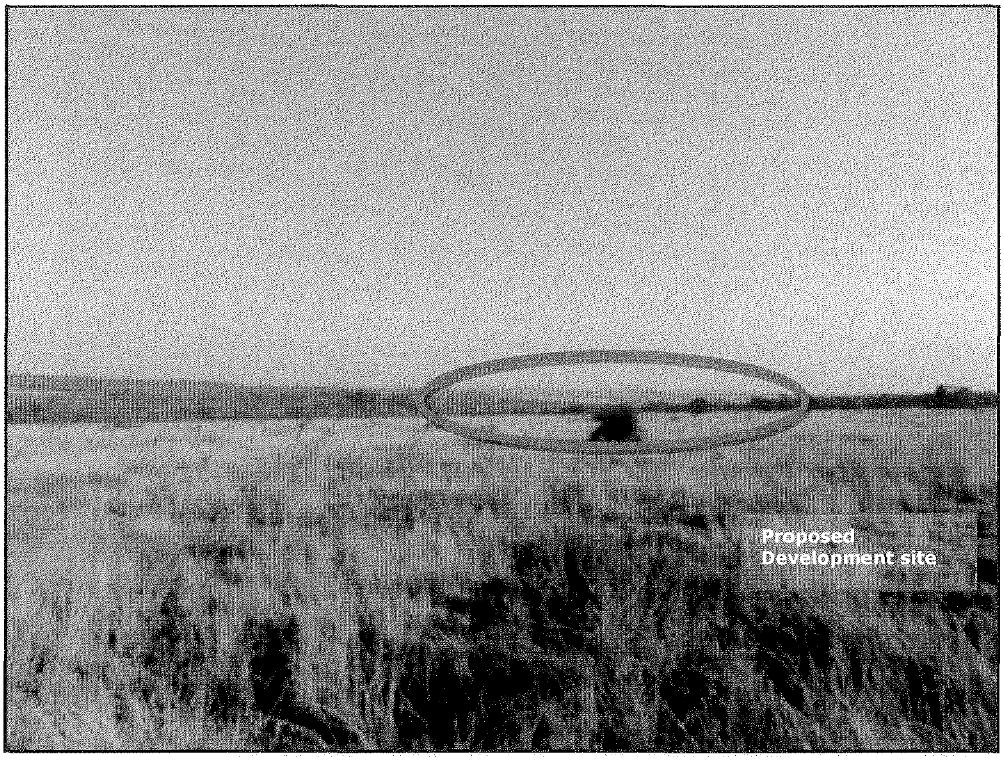


Figure 7: **Viewpoint 4:** Photographic views of the proposed site from the road next to an existing lodge undergoing renovation. Farm Schoongezigt 107.

Figure 8: **Viewpoint 5:** Photographic view of the proposed site from a road running along the farm boundary between the farms Schoongezigt 107 and Naauwpoort 106

Figure 9: **Viewpoint 6:** Photographic views of the proposed site from a road close to the south-easterly corner of the development site.

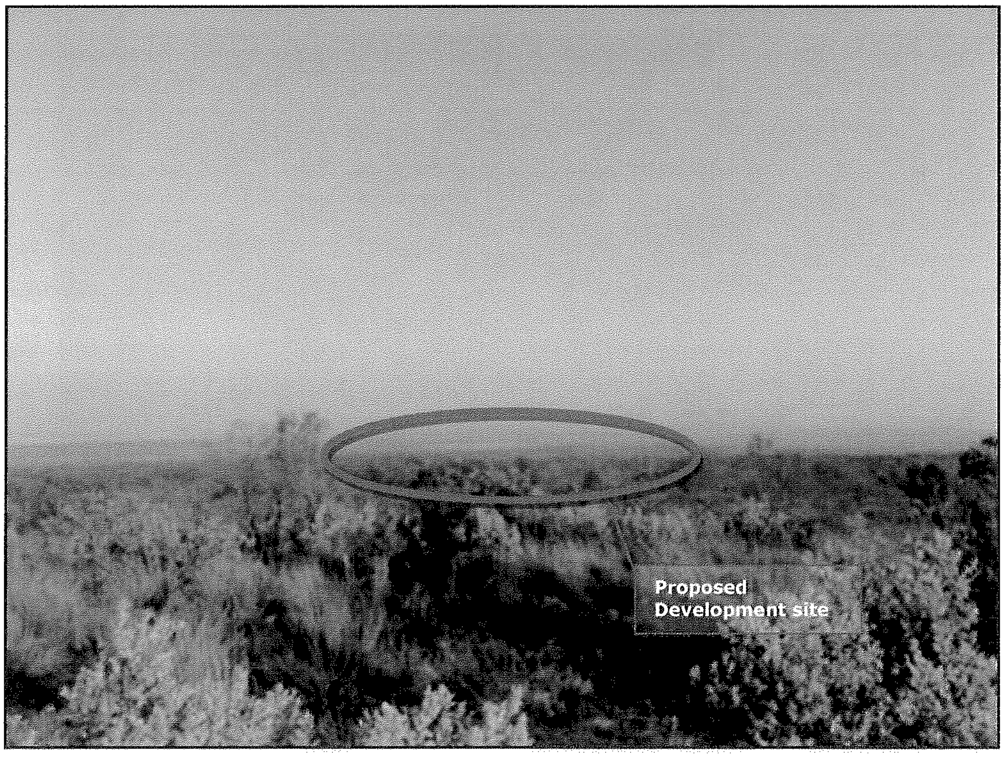


Figure 10: **Viewpoint 7** Photographic view of the proposed site from high ground within the Farm Schoongezigt 107.

7. CONCLUSIONS AND RECOMMENDATIONS

The placement of the proposed Waterberg Photovoltaic Plant and its associated structures will have a visual impact on the natural scenic resources of this region. The natural and relatively unspoiled views surrounding the PV plant will be transformed for the entire operational lifespan (approximately 30 years) of the plant.

The author is, however, of the opinion that the PV plant has an advantage over other more conventional power generating plants (e.g. coal-fired power stations). The facility utilises a renewable source of energy to generate power and is therefore generally perceived in a more favourable light. It does not omit any harmful byproducts or pollutants and is therefore not negatively associated with possible health risks to observers.

The PV plant further has a novel and futuristic design that invokes a curiosity factor not present with other conventional power generating plants. The advantage being that the PV plant can become an attraction or a landmark within the region that people would actually want to come and see.

However, this opinion should not distract from the fact that the PV plant would be visible within an area that incorporates various sensitive visual receptors that should ideally not be exposed to industrial style structures.

The area potentially affected by the proposed development is generally seen as having a high scenic value and the proposed PV plant is expected to form a noticeable contrast within this predominantly natural and agricultural region.

There are also not many options as to the mitigation of the visual impact of the facility.

Although the functional design of the structures cannot be changed in order to reduce visual impacts, it is proposed that the standard height of the units be set at 3-4m and that a 6m height should only be used on exception where absolutely necessary. This will reduce the facility's visual intrusion and increase the vegetations' ability to mask the facility.

Receptor sites exposed to visual impact may mitigate this impact by planting a vegetation screen similar in form and density to the natural vegetation of the receiving environment. It should be noted, however, that this measure will only be effective if the screen is planted *in close proximity to the receptor*. This means that the visual impact must be screened at the property which is experiencing the impact, rather than at the development site itself.

It is recommended that the visual screen be planned and specified by a planning professional in order to maximise the screening benefit. In addition, it is imperative that the species of plants utilised be ecologically appropriate for the natural environment.

Ancillary infrastructure (i.e. the switching station, the internal access roads, the pipeline, the workshop/storage area, and the visitor's centre) must be properly planned with due cognisance of the topography, that all disturbed areas be properly rehabilitated, and that all infrastructure and the general surrounds be maintained in a neat and appealing way.

The construction phase of the facility should be sensitive to potential observers in the vicinity of the construction site. The placement of lay-down areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility.

Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The use of dust-suppression techniques on the access roads (where required), timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.

The pipeline should be placed underground to avoid additional visual clutter. Proper re-instatement and re-vegetation is recommended for the pipeline.

The facility should be dismantled upon decommissioning and the site and surrounding area should be rehabilitated to its original (current) visual status.

8. IMPACT STATEMENT

In light of the results and findings of the Visual Impact Assessment undertaken for the proposed Waterberg PV plant, it is acknowledged that existing high quality natural and rural views from receptors surrounding the site will be transformed for the entire operational lifespan (approximately 30 years) of the facility.

The potential visual impact on users of secondary roads in close proximity to the proposed PV plant will be of medium significance after VAC and mitigation have been taken into account.

Within the region, the potential visual impact on residents and on tourist routes and destinations will be of low significance after VAC and mitigation have been taken into account. The significance of the potential visual impact on protected areas in close proximity to the facility will also be low.

This anticipated visual impact is not, however, considered to be a fatal flaw from a visual perspective, considering the relatively low incidence of visual receptors in the region, and the contained area of potential visual exposure.

Furthermore, it is the opinion of the author that this impact is not likely to detract from the regional tourism appeal, numbers of tourists or tourism potential of the existing centers and destinations. The facility may, in fact add to the plethora of attractions within the region. Within natural areas, the nature of recreational activities (game viewing, quad biking, arts and crafts viewing etc) undertaken in the region is not likely to be influenced[2].

It is therefore recommended that the development of the facility as proposed be supported, subject to the recommended mitigation measures (chapter 7) and management actions (chapter 9).

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[2] *The Waterberg Meander Brochure – volume 1: http://www.waterbergbiosphere.org/News_1_Waterberg+Meander+brochure.htm*

9. MANAGEMENT PLAN

The management plan table aims to summarise the key findings of the visual impact report and to suggest possible management actions in order to mitigate the potential visual impacts. The management plan primarily focuses on the mitigation and management of potential secondary visual impacts, due to the fact that the primary visual impact has very low or limited mitigation potential.

Table 7: Management plan – Waterberg Photovoltaic plant

OBJECTIVE: The mitigation and possible negation of the additional visual impacts associated with the construction and operation of the Waterberg Photovoltaic plant.		
Project component/s	Construction site, access roads, substations and internal power lines.	
Potential Impact	Potential scarring and erosion due to the unnecessary removal of vegetation	
Activity/risk source	The viewing of the abovementioned by observers on or near the site	
Mitigation: Target/Objective	Minimal disturbance to vegetation cover in close vicinity to the proposed PV plant and its related infrastructure	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas thereby limiting the removal of natural vegetation to the minimum.	Thupela Energy/contractors	During construction
Limit access to the construction sites to existing access roads.	Thupela Energy /contractors	During construction
Rehabilitate all disturbed areas to acceptable visual standards.	Thupela Energy /contractors	During construction
Maintain the general appearance of the facility in an aesthetically pleasing way.	Thupela Energy	During Operation
Performance Indicator	Vegetation cover that remains intact with no erosion.	
Monitoring	Monitoring of vegetation clearing during the construction phase.	

9. REFERENCES/DATA SOURCES

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National Botanical Institute (NBI), 2004. *Vegetation Map of South Africa, Lesotho and Swaziland (Unpublished Beta Version 3.0)*

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Appendix I:
Road Study

Savannah Environmental Pty (Ltd)

CONSTRUCTION OF THE PROPOSED WATERBERG PHOTOVOLTAIC PLANT

ROAD IMPACT ASSESSMENT REPORT

CONTENTS LIST

CONTENTS

Savannah Environmental Pty (Ltd)

CONSTRUCTION OF THE PROPOSED WATERBERG PHOTOVOLTAIC PLANT

ROAD IMPACT ASSESSMENT REPORT

1. GENERAL

The above-mentioned project is located in the Modimolle Local Municipality, situated in the south-astern of the Waterberg District Municipality, Limpopo Province. The project will be established on degraded pasture land on Portion 2 of the Farm Goedgevonden KR 104, located 24 km north east of Vaalwater. The roads under investigation are gravel roads D2416, D973 and D2747. Both roads D2416 and D973 have intersections with surfaced road D972 (R33). Road D2747 is the north-south link road between roads D973, to the south, and D2416, to the north. Access to Farm Goedgevonden KR 104 is off road D2416.

2. BACKGROUND

The work performed in this assessment consists of the following:

» An assessment of the required transport modes and trip frequencies on routes;
» Existing geometric layout and identification of shortcomings;
» Desktop and visual inspection of prevailing road conditions.

As part of the assessment a site inspection was carried out on 18 October 2010. This was used to determine and evaluated the transportation routes and usage, and the existing road conditions.

3. FINDINGS

3.1. Road Users

3.1.1. Transportation modes and trip frequencies

The transport modes and frequency to the proposed site during the operational phase is estimated as follows:

» 1 Small vehicle transporting security personnel, 3 trips/day, from Vaalwater to Goedgevonden and back;
» 1 Security patrol vehicle on site.

- Bus 1 - 2 trips/ day (22 people/bus), from Boschdraai village to Goedgevonden and back;
- Bus 2 - 2 trips/day, from Vaalwater to Goedgevonden and back;

3.1.2. Transportation routes

The routes for the busses will be as follows (see Figure 1 – Route Layout Plan):

- Bus 1 - Boschdraai Village to Goedgevonden will be on 4 km gravel farm road, to the east, through Bellevue to D2747 gravel road. Turn left and travel north on D2747 for 3.3km to Goedgevonden Gate on the right. Total distance 7.3km.
- Bus 2 and Security Vehicle - Vaalwater to Goedgevonden. There are two possible routes to Goedgevonden as is described below:

  - Alternative 1: From Vaalwater, travel 24.1km northeast on D972 tar road. Turn right and travel east for 9km on D2416 gravel road (Sterkstroom turnoff). Turn right and travel south for 2km on D2747 gravel road to Goedgevonden entrance on the left. The total distance is 35.1km with a 24.1km paved section of road and 11km gravel section.

  - Alternative 2: From Vaalwater, travel 9.6km northeast on the D972 tar road. Turn right and travel east for 8.3km on the D973 gravel road (24 Rivers turnoff). Turn left and travel north for 10.5km on the D2747 gravel road to Goedgevonden entrance on the right. The total distance is 28.4km with a 9.6km paved section and 18.8 km gravel section.

3.2. Geometric Layout

The geometric layout appears to be within the standards. The only issues identified were localised flat spots which promote the ponding of water on the road. These flat spots are due to two factors. Firstly the vertical profile of the road may be at the bottom of sag curve or where the road is flat. In the later scenario, it is often the case that the road has been worn and/or graded to such a degree that there is no longer a centreline crown present to drain water to the sides of the road.

No further issues could be identified with the visual inspection. A detailed topographical survey will be required to identify any further geometric issues.

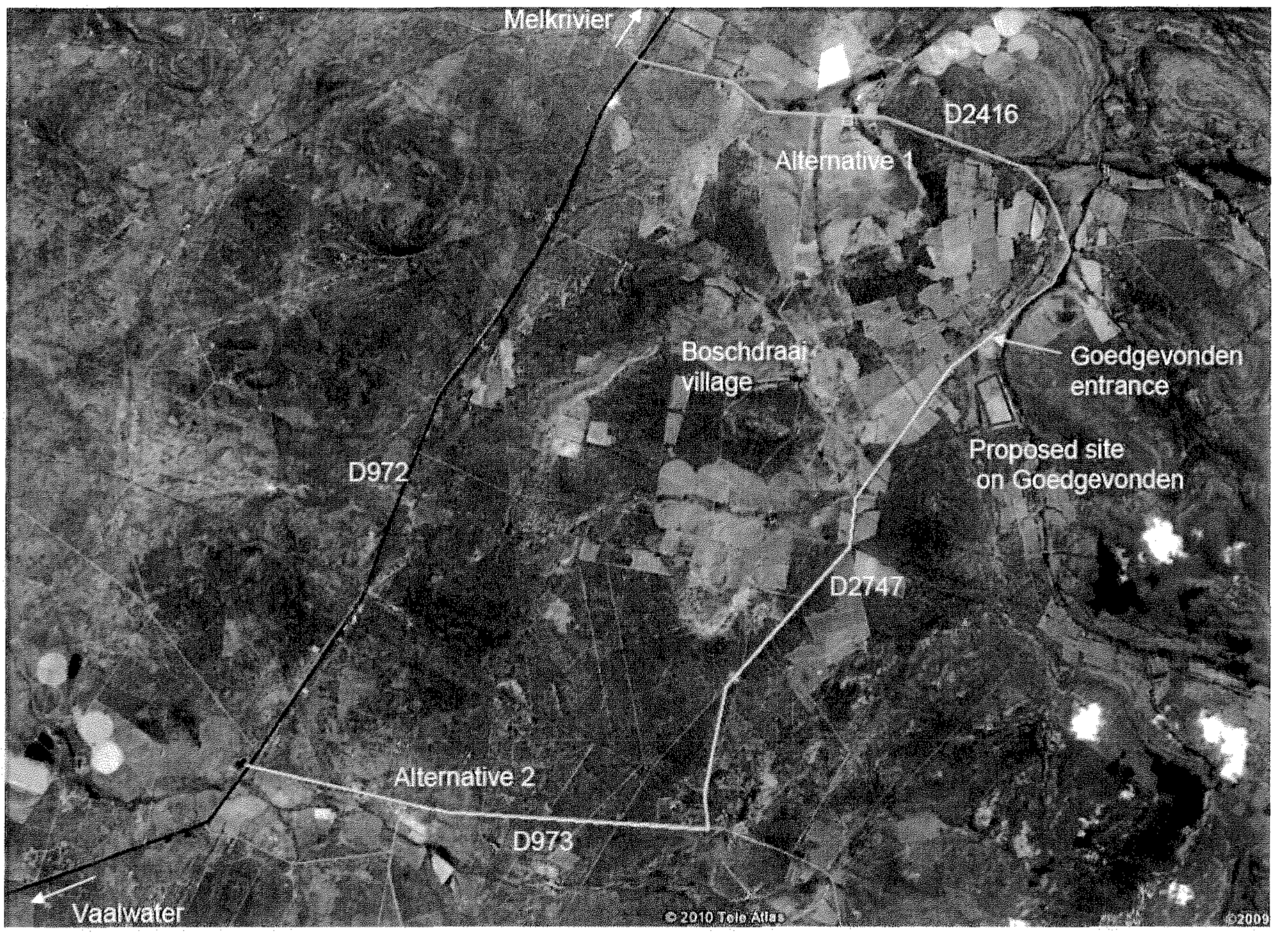

Figure 1 – Route Layout Plan

3.3. Prevailing Road Conditions

During the site visit it was observed that there is corrugation along the gravel roads of both the alternative routes from Vaalwater. A portion of Road D 2747 had recently been graded and therefore appeared in a fair condition. The remainder of Road D2747, Road D973 and Road D2416 are in a poor condition due to the lack of maintenance, with sections of the roads having extensive corrugation and isolated potholes.

See

Table 3.1 ROADS D2416 AND D2747 (Alternative 1) and

Table 3.2 ROADS D973 AND D2747 (Alternative 2) for the visual findings and status of the roads:

Table 3.1 ROADS D2416 AND D2747

Km distance from D 972 (Sterkstroom turnoff to Goedgevonden entrance)	Defects
1 - D2416	Loose silt and gravel, Excessive Corrugation Deg5, Ext 5
2 - D2416	Drainage problems, Loose silt and gravel, Corrugation Deg5, Ext 5
3 - D2416	Same as km 2 But Corrugation Deg4, Ext 5
4 - D2416	Loose silt and gravel, potholes, corrugation Deg 5, Ext 5, drainage problems
4-6 - D2416	Loose sand and gravel, corrugation
7-8 - D2416	Corrugation Deg 5, Ext 5, the condition is worse, pothole, Km 7.4 - 8.0 sight distance bad
8-10 - D2416/2747	Corrugation reduced Deg 3, Ext 5 Dust Reduced, Loose sandy gravel. T Junction at km 10.1
10 - 11 - D2747	Just being graded, riding quality is sound, No Corrugation, dust reduced Deg3, Ext 5

Photo 1 - Gravel on Road D2747

Photo 2 - Intersection D972 and D2747

Table 3.2 ROADS D973 AND D2747

Km distance from D 972 (R33) (from Goedgevonden entrance to 24 Rivers turnoff)	Defects
1 - D973	Loose silt sand, drainage not adequate, potholes on the road, road camber not good Deg 5, Ext 5
1-3 - D973	Loose silt sand, drainage not adequate, isolated potholes on the road, road camber not good on isolated section, Boschdraai entrance at km 3.4
4-5 - D973	Corrugation Deg3, Ext5, Loose sand, @ km 4.1 - 4.2 curve, corrugation at curve Deg 5, Ext 5
5-8 - D973	The road is looking sound, minor corrugation Deg2 Ext 5, isolated potholes Deg 3, Ext 3, Dust is sound
8-9 - D2747	Silt sand, Deg 5 Ext 4 Dust Severe
9-10.6 - D2747	T Junction, silt Deg 5, Ext 5, Potholes severe D5 Ext 4 Dust is severe, Riding quality bad, T Junction is at KM 10.6
10.6-17 - D2747	Silt and corrugation, Deg5, Ext5 Riding quality bad, dust is severe.
17-18 - D2747	Corrugation Deg5, Ext 5, Riding quality bad,
18-19.1 - D2747	Corrugation Deg5, Ext 5, Riding quality bad

Photo 3 – Silt on Road D2747

Photo 4 – Corrugation on Road D2747

Table 3.3

DEGREE	DESCRIPTION	CONDITION
1	Slight unevenness, still smooth and comfortable	Sound
3	Visible, effect on riding quality	warning
5	Uncomfortable and unsafe	severe

Table 3.4

Extent.	Extent is how long or how wide the condition is.
1	For a short section
3	Half section
5	Full section

4. ASSESSMENT OF IMPACTS

From the above information and evaluations it is expected that the nature of the impact of the additional vehicles will be to add to the wear and tear of the gravel roads. This will increase the severity of the corrugation and occurrence of potholes.

Due to the short period over which busses and trucks will be carting workers and materials to and from the construction site, the impact it will have on these isolated local gravel roads is estimated to be low in magnitude. Be that as it may, without the correct attention to the prevailing conditions, and similar future issues with the gravel roads, it is highly probable that the impact of these vehicles will add the further deterioration of the road conditions.

If the correct remedial and maintenance measures are applied over the construction period it is highly likely that all of the above issues can be negated.

The Significance of the impact is calculated as follows:

S=(E+D+M)P

S = Significance weighting
E = Extent (1)
D = Duration (2)
M = Magnitude (4)
P = Probability (4)

S=24

This is below 30 thereby indicating that the effect of the impact will have no influence on the decision to continue with the development.

Assessment of impacts during construction is summarised in the following table format.

Table 4.1

Nature: Impact of the Construction Vehicles will be to add to the wear and tear to the gravel roads		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (4)	Probable (2)
Significance	**28 (Low)**	**10 (Low)**
Status (positive or negative)	Neutral	Positive
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: Immediate blading of road, repairing of potholes, adding extra gravel materials were indicated by engineer and cutting of drainage furrows. Planning a maintenance schedule for the period during construction.		
Cumulative impacts: Vehicles will worsen existing conditions of road thereby making it unsafe for large vehicles (busses) to transport passengers and goods.		
Residual Impacts: Farms and local businesses can not operate effectively and added wear and tear to vehicles using roads		

It is foreseen that during the operation phase of the facility the effect of the daily traffic will be negligible. If required, contributions will be made in so far as the maintenance policy that is already in place. This may be a agreement between the local residents, farmers and businesses using the road or the local roads authority.

5. ENVIRONMENTAL MANAGEMENT PLAN

Project component/s	Gravel Roads D973, D2416, and D2747
Potential Impact	Contribute to the prevailing sub-standard road conditions
Activity/risk source	If the present conditions are left untreated the road will be unsafe for the transportation of people and materials. Delays will also be experienced in the delivery processes.
Mitigation: Target/Objective	The roads need immediate remedial measure to repair and improve their riding conditions. Furthermore a maintenance programme needs to be implemented to mitigate the recurrence of these conditions.

Mitigation: Action/control	Responsibility	Timeframe
Remedial: Improve road drainage, blade roads to remove corrugation, add gravel wearing course. Maintenance: implement maintenance programme for period of construction	Modimolle Local Municipality and Waterberg District Municipality	Remedial measures prior to construction. Maintenance programme during construction

Performance Indicator	Transportation and Delivery schedules and reported delays, Road riding quality reports/feedback, Vehicle and pedestrian incident reports, Visible water ponding on roads, Visible failures in road structure.
Monitoring	Visual inspection of road surface and drainage corrective measures, wearing course material quality tests, visual inspections during construction, geotechnical material tests during construction of wearing course. Visual inspections of road during construction of facility.

6. IMPACT STATEMENT

There will be a negative impact on the existing gravel roads discussed above due to the large vehicles using these roads daily in the construction phase. Prevailing conditions will deteriorate further, thereby affecting the road safety for the local community and businesses. It will also have a financial impact by increasing the delivery times and vehicles wear and tear.

7. RECOMMENDATION

Even though Alternative 1 (D2416 and D2747) is longer in total distance, the gravel roads have fewer defects and require less attention and maintenance. The distance travelled on the gravel roads is also shorter, thereby reducing initial road works costs and increasing the overall travel speed of the route. It is therefore recommended that Alternative 1 be used as the preferred transportation route during construction of the Waterberg Photovoltaic Plant on Portion 2 of the Farm Goedgevonden KR 104.

Regardless of the route chosen from Vaalwater to Farm Goedgevonden, it is recommended that the following remedial measures be applied to the gravel roads:

- Apply a NEW 200mm wearing course to the existing road structure after the roads have been bladed and water mixed in;
- Cut diagonal drainage furrows (mitre drains) from road shoulder, to drain water away from road edge, at regular intervals and at critical points;
- Prepare a maintenance schedule for the gravel roads during construction. It is recommended that all the gravel roads used be bladed and watered once a month.

These roads are district roads which fall under the authority of either the Modimolle Local Municipality or Waterberg District Municipality. These local authorities should be informed of these recommendations for them to include in there maintenance programmes and road upgrade planning. It is ultimately the responsibility of the local roads authorities to ensure that there is safe passage for local residents and businesses using these roads. It should be highlighted that it will be essential to remedy these roads to further encourage economic development of the area.

Appendix J:
Social Specialist Study

PROPOSED CONSTRUCTION OF THE WATERBERG PHOTOVOLTAIC PLANT ON A SITE NEAR, VAALWATER, LIMPOPO PROVINCE

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September 2010

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ACRONYMS

DEA:	Department of Environmental Affairs
EIA:	Environmental Impact Assessment
EMP:	Environmental Management Programme
EPC:	Engineering, Procurement, Construction
HDSA:	Historically Disadvantaged South African
IDP:	Integrated Development Plan
I&AP:	Interested and Affected Party
LM:	Local Municipality
MLM:	Modimolle Local Municipality
PV:	Photovoltaic
SIA:	Social Impact Assessment
SDF:	Strategic Development Framework
StatsSA:	Statistics South Africa
SMME:	Small to Medium Size Enterprise
WDM:	Waterberg District Municipality

1. INTRODUCTION

Thupela Energy appointed Savannah Environmental (Pty) Ltd, as the Environmental Assessment Practitioner (EAP), to conduct an Environmental Impact Assessment (EIA) for the proposed construction of the Waterberg Photovoltaic Plant on a site, near Vaalwater in the Limpopo Province.

Before a project of this nature can proceed an EIA needs to be undertaken. The EIA process consists of two phases, namely the Scoping Phase and a detailed EIA Phase. As part of the EIA process, a Social Impact Assessment (SIA) is required to be undertaken.

The purpose of this report is therefore to provide the findings of the SIA undertaken during the EIA Phase. The report thus aims to assist the project proponent, consultants, and communities to identify social issues that have to be noted, addressed, mitigated, and incorporated as part of the planning process.

1.1 Background to the proposed project

Thupela Energy is proposing the establishment of a commercial photovoltaic solar electricity generating facility and associated infrastructure on Portion 2 of the Farm Goedgevonden KR 104, near Vaalwater in the Limpopo Province. This project is known as the Waterberg Photovoltaic Plant.

The facility is proposed to be established on transformed pasture land. The larger site covers an area of approximately 50 ha, with the development footprint for the proposed facility being approximately 20 ha in size. The location of the facility within the larger site will be informed by the outcomes of the EIA process.

The solar facility is proposed to be comprised of an array of Photovoltaic (PV) panels with a generating capacity of up to 5 MW. The facility is also proposed to have the following associated infrastructure:

- A switching station for the "turn in" into Eskom's existing Mink Power Line
- An extraction point and low volume water supply pipeline for the extraction of water from existing on-site boreholes
- Access roads within the site (for the purposes of construction and limited maintenance)
- A Visitors Centre

1.2 Construction Process of the proposed PV facility

The construction of the facility will commence with the erection of the security fence around the site and the creation of fire breaks. This would be followed by Eskom's inputs whereby they would determine the tie in point on the existing line. The connection point can then be installed. The other activities listed below would be undertaken in parallel with the work undertaken by Eskom and the entire construction process is expected to be completed within six to nine months after construction has started:

- Cable laying to connect the panels to the switching station;
- Mount installation, as the panel mounts would require assembly on site after which these panels would be secured in place, possibly with concrete mounts or with a pile system. The mount installation would be undertaken during the entire construction phase;
- Once a mount is installed, the panels will be attached one by one;
- In parallel with the above, the inverters and other associated electronics will be installed.

Other issues that would be attended to during the construction process would include lightning protection and the construction of the required buildings such as the office, eating hall and kitchen, crèche facilities, ablutions, the visitors' centre and possibly a small fire prevention facility (Personal communication: Dr. P. Calcott: August 2010).

1.3 Operation and Management of the proposed PV facility

The main operational task will be the manual adjustment of the solar panel mounts. A staff component of approximately forty (40) individuals will be on site from before sunrise until just before sunset. Maintenance would include emergency repairs and routine panel maintenance and cleaning during the night whereby large dusters or compressed air would be used. When necessary the panels would have to be cleaned with water.

Personnel at the facility would include supervisors, managers, security personnel, cooks, cleaning and administrative personnel, and panel/mount operators. It is anticipated that approximately eighty (80) employees would be permanently employed, although a maximum of forty (40) personnel would be on site on a daily basis.

Security measures on site would involve CCTV monitoring, infra-red cameras, a minimum of three security personnel on site (full-time) and security back-up from a larger armed security organisation.

The canteen facility proposed would be a small facility where food can be prepared for the personnel.

The visitors centre's main aim would be educational. The following activities are anticipated to form part of the educational experience:

- A tour of the site and the opportunity to experience the operation of the facility;
- An audio visual display focusing on the construction and operation of the facility and solar power and climate change in general, and so forth;
- An opportunity to manipulate a solar panel and experience the generation of electricity; and
- Visitors would have the opportunity to buy and/or even make their own souvenirs which use solar power to take with them.

The initial visitors to the visitors centre would probably be school children who will be brought to site by bus. Visitors could come for a short tour of the above, but visits can also be extended with additional activities. The latter would link with the existing educational tours undertaken in the area. Should these visitors need overnight accommodation, facilities are already available on the farms Goedgevonden KR 104 (Kudu Lodge) and on the farm Naauwpoort KR 106 (Personal communication: Dr. P. Calcott, 2010).

No new power lines will be constructed to link the PV facility into the Eskom grid. The facility will be connected to the grid via a turn in and turn out design into the existing Mink power line which crosses the proposed development site (Minutes of the meeting held with adjacent property owners, 2010).

1.4 Site Location

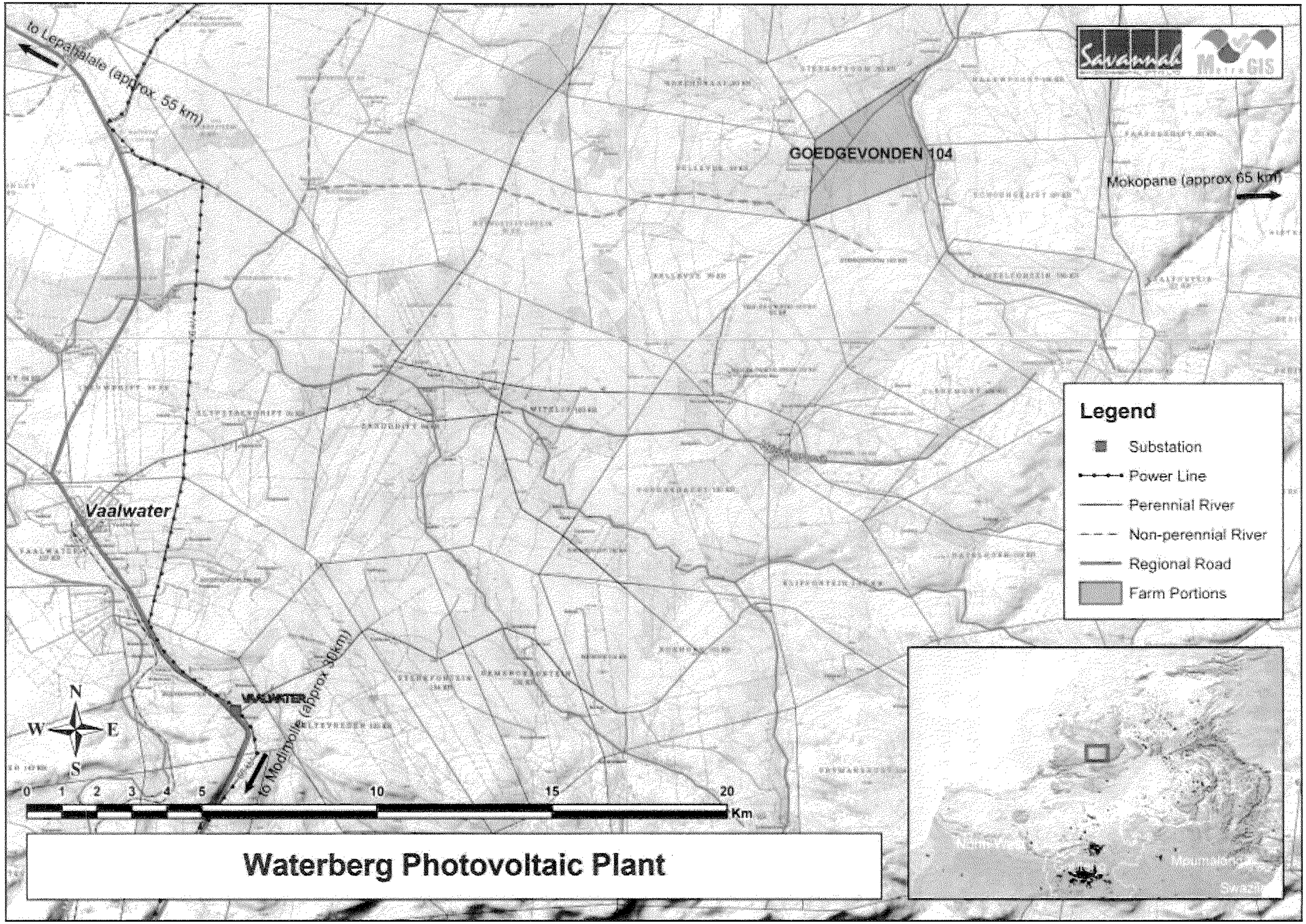
The farm Goedgevonden KR 104 is approximately 24 km north east of the town of Vaalwater in the Limpopo Province. The study area where the plant will be situated falls under the jurisdiction of the Waterberg District Municipality and the Modimolle Local Municipality, Ward 3.

Neighbouring farms include the following:

- Boschdraai KR 60/1;
- Sterkstroom KR 105;
- Sterkstroom KR 103;
- Naauwpoort KR 106;
- Schoongezigt KR 107;
- Bellevue KR 98 and Bellevue KR 99; and
- Vier-en-Twintig-Rivier KR 102

1.5 Map of study area

Herewith a map of the study area:


to Lephalale (approx. 55 km)
GOEDGEVONDEN 104
Mokopane (approx 65 km)
Vaalwater
VAALWATER
to Modimolle (approx 30km)
N
W
E
S
0
1
2
3
4
5
10
15
20
Km
Legend
Substation
Power Line
Perennial River
Non-perennial River
Regional Road
Farm Portions
Waterberg Photovoltaic Plant

2. DEFINITION OF A SOCIAL IMPACT ASSESSMENT

Burdge (1995) describes a Social Impact Assessment as the "...systematic analysis in advance of the likely impacts a development event (or project) will have on the day-to-day life (environmental) of persons and communities." An SIA therefore attempts to predict the probable impact of a development (before the development actually takes place) on people's way of life (how they live, work, play, and interact with one another on a daily basis), their culture (their shared beliefs, customs, and values) and their community (its cohesion, stability, character, services, and facilities), by:

- Appraising the social impacts resulting from the proposed project;
- Relating the assessed social impacts of the project to future changes in the socio-economic environments that are not associated with it. This would serve to place the impacts of the project into context;
- Using the measurements (rating) to determine whether the impacts would be negative, neutral or positive;
- Determining the significance of the impacts; and
- Proposing mitigation measurements.

An SIA is thus concerned with the human dimensions of the environment, as it aims to balance social, economic, and environmental objectives and seeks to predict, anticipate, and understand the potential impacts of development.

The usefulness of an SIA as a planning tool is immediately clear, in that it can assist the project proponent to conceptualise and implement a project in a manner which would see the identified negative social impacts addressed through avoidance or mitigation and the positive impacts realised and optimised. It would also allow the community to anticipate, plan for, and deal with the social changes once they come into effect. In this sense then, the SIA is an indispensable part of the EIA process, the Environmental Management Plan (EMP), and any participative activity (e.g. community involvement in mitigation and monitoring during planning and implementation).

3. PURPOSE OF THE SOCIAL IMPACT ASSESSMENT REPORT

The aim of the SIA report is to:

- Determine the current socio-economic status of the area and the social characteristics of the receiving environment;
- Indicate the anticipated core impact categories and impact areas (possible hot spots);

- Identify anticipated positive socio-economic impacts of the proposed project, including positive impacts and provide management measures for these impacts;
- Identify and highlight negative socio-economic impacts (social hot spots) of the proposed project and indicate mitigation measures to deal with these impacts;
- Present the findings, recommendations, and conclusions of the social study.

4. METHODOLOGY

The broad steps followed as part of the SIA are discussed below.

4.1 Scope of the Assessment

Based on information received from Thupela Energy and Savannah Environmental, the scope of the assessment was determined. A site visit was undertaken on 11 May 2010 to enable the consultants to familiarise themselves with the area and the social characteristics of the receiving environment.

4.2 Literature Review, Analysis and Desktop Studies

The literature review and desktop studies assisted the consultants in establishing the social setting and characteristics of the study area, as well as the key economic activities.

4.3 Data Gathering

4.3.1 *Primary Data*

Primary data assisted the consultants in establishing the social setting and characteristics of the study area, as well as the key economic activities. Interviewing of 'key' persons also formed part of the research process. This included telephonic and personal interviews with e.g. property owners, businesses, tourism office, representatives of the Modimolle Local Municipality, Waterberg District Municipality, and so forth.

4.3.2 *Secondary Data*

Secondary data, which was not originally generated for the specific purpose of the study, were gathered and analysed for the purposes of the study. Such data included the census data, project maps, local histories, planning documentation such as the draft Integrated Development Plan (IDP) and the Strategic Development Framework (SDF) of the Modimolle Local Municipality.

4.3.3 *Consultation*

Information gathered and social issues identified and verified during the public participation process (focused on the host community) undertaken as part of the detailed EIA, also served as key input to the social assessment.

In addition to the above, specific focused consultation sessions were held with the surrounding residents (host community). The aim of this consultation was to further explore and verify issues thus enabling a more detailed social analysis. These Interested and Affected Parties (I&APs) were also consulted to determine their perceptions and attitudes regarding the proposed development in general and anticipated changes associated with it. Refer to Section 10.3 for a list of the individuals contacted.

4.4 Profiling

Profiling serves to build on information generated during the Scoping phase. It involves a description of the social characteristics and history of the area being assessed, an analysis of demographic data, changes in the local population, and the land-use pattern in the study area, as well as any other significant developments in the area and thus social character over time. The profiling process is a combination of secondary and primary research, site visits, and consultation. This could include information on:

- Historical background;
- Social characteristics;
- Culture, attitudes and socio-psychological conditions;
- Population characteristics;
- Community and institutional structures;
- Community resources; and
- Broad economic impacts.

The broad profiling will typically include descriptions regarding the following:

- The social trends and current conditions;
- The land-use in the area;
- The demographical profile and social characteristics of the host community;
- Other potential developments in the area;
- The local and regional economy; and

- Potential economic links between the proposed project and its environs.

4.5 Projection and Estimation of effects

A baseline assessment indicates the current reality in the social and related aspects of the affected environment. A baseline assessment is necessary to enable a logical and theoretically sound analysis of social impacts. It forms part of the process of identifying important cause-and-effect relationships and a comparative framework for anticipated changes and impacts.

The output of this phase is the impact matrix and mitigation measures.

4.6 Variables

The following variables are typically assessed (Burdge, 1995) as part of the SIA:

- Population impacts;
- Community/institutional arrangements;
- Conflicts between local residents and newcomers;
- Individual and Family level impacts;
- Community infrastructure needs; and
- Intrusion impacts.

For the purpose of assessing the impacts associated with the proposed project, the above variables were adapted to allow the assessment of the full range of social impacts relevant to the specific project. These variables would relate to the construction and operational phases of the proposed project.

4.7 Significance Criteria

During the EIA Phase, the anticipated social impacts were rated according to a rating approach used and specified by Savannah Environmental. This rating approach is described below:

CATEGORY	DESCRIPTION
Nature	A description of what causes the effect, what will be affected, and how it will be affected.
Extent	Whether the impact will be local (limited to the immediate area or site of development) or regional. A value between 1 and 5 will be assigned as appropriate (1 = low and 5 = high).
Duration	Where it will be indicated whether: • The lifetime of the impact will be of a *very short* duration of 0 – 1 years: Assigned a score of 1 • The lifetime of the impact will be of a *short* duration of 2 – 5 years: Assigned a score of 2 • Medium term of 5 – 15 years: Assigned a score of 3 • Long term (> 15 years): Assigned a score of 4 • Permanent: Assigned a score of 5
Magnitude	This is quantified on a scale of 0-10, where • 0 is *small* and will have no effect on the environment; • 2 is *minor* and will not result in an impact on processes; • 4 is *low* and will cause a slight impact on processes; • 6 is *moderate* and will result in processes continuing but in a modified way; • 8 is *high* where processes are altered to the extent that they temporarily cease; and • 10 is *very high* and results in complete destruction of patterns and permanent cessation of processes.
Probability	The probability of occurrence describes the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1-5, where: • 1 is *very improbable* (probably will not happen) • 2 is *improbable* (some possibility, but low likelihood) • 3 is *probable* (distinct possibility)

CATEGORY	DESCRIPTION
	• 4 is *highly probable* (most likely) • 5 is *definite* (impact will occur regardless of any prevention measures)
Significance	The significance shall be determined through a synthesis of the characteristics described above and can be assessed as *low, medium or high*. The significance weightings for each potential impact are as follows: • < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area) • 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated) • > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area) The significance is calculated by combining the criteria in the following formula: $S = (E+D+M)P$ S= Significance weighting E= Extent D= Duration M= Magnitude P= Probability
Status	The Status will be described as *positive, negative, or neutral*.
Reversibility	The degree to which the impact can be reversed.
Irreplaceable loss of resources?	The degree to which the impact may cause irreplaceable loss of resources.
Can impacts be mitigated?	The degree to which the impact can be mitigated.
Mitigation	Description of mitigation measures.

CATEGORY	DESCRIPTION
Cumulative impacts	Identification of cumulative impacts.
Residual impacts	Identification of residual (remaining) impacts after mitigation.

5. BASELINE DESCRIPTION OF THE RECEIVING ENVIRONMENT

5.1 General Description of the Study Area

The Modimolle Local Municipality is a category B municipality within the Waterberg District. A category B municipality refers to a "local" municipality which shares municipal executive and legislative authority in its area with a category C (district) municipality (www.demarcation.org.za). The Modimolle Local Municipality area consists mainly of agricultural areas with a number of small concentrations of communities scattered over vast distances. Towns and settlements within the municipal boundaries include Alma, Antjiesdrift, Kraalingen, Loubad, Melkrivier, Middelfontein, Modimolle (Nylstroom), Palala, Rankin's Pass, Sondagsloop, Vaalwater and Vier-en-Twintig Riviere.

Vaalwater, the town nearest to the proposed development, is seen as a service centre of the municipality. It is situated in the upper reaches of the Mokolo River, and is the major town in the Waterberg area.

Due to the Waterberg's diversity in plant and animal species, as well as its beauty, various eco-tourism projects such as the Waterberg Biosphere Reserve have been established.

5.2 Municipal profile

5.2.1 *Waterberg District Municipality*

The Waterberg District Municipality (WDM), located in the western part of the Limpopo Province, comprises six local municipalities, namely the Mogalakwena LM, Lephalale LM, Bela-Bela LM, Modimolle LM, Thabazimbi LM, and Mookgopong LM. Agriculture, tourism, and mining are key sectors within the area and play an important role in the district economy (www.waterberg.gov.za).

The WDM struggles with unemployment, challenges associated with HIV/Aids, especially among the youth, high levels of poverty and poor educational outcomes. The dispersed settlement patterns furthermore makes the provision of infrastructure and services difficult and expensive (WDM IDP, 2010).

The tourism potential of the district is high due to its rich history and cultural heritage resources as well as bio-physical features. Tourism activities are well developed and the main destinations and activities are concentrated within and around the Waterberg Biosphere Reserve, the Makapan Caves (Valley) and the Nylsvlei wetland (WDM IDP 2010).

5.2.2 *Modimolle Local Municipality*

The Modimolle Local Municipality (MLM) is situated in the WDM within the Limpopo Province. The MLM is at the centre of the WDM and therefore functions as the administrative capital of this district municipality (DM).

The MLM consists of towns, smaller settlements, informal settlements and farms and can therefore be classified as predominantly rural in nature, with vast areas of land either under cultivation or being utilised for game farming purposes. Most of the land is privately owned which leaves little room for development. Modimolle/Phahameng is the nodal growth point of the municipality, while Vaalwater (Mabatlane) and Alma (Mabaleng) act as service points (MLM IDP, 2010).

The proposed study area falls within Ward 3, although attention would also be given to Ward 1 (Vaalwater and Leseding) due to its close proximity to the site and possible source of local labour.

Ward 3 consists mainly of farm areas which include WitKlip (Vier-en-Twintig-Riviere), Boschdraai (Tretson/Melkrivier farms), Doorfontein (Driefontein farms), and Loubad (Nylstene factory area). Due to the characteristics of the ward, most agricultural projects are concentrated within its boundaries. This ward is thus predominantly rural in nature, and is characterised by gravel roads and extraction of water from boreholes. According to the MLM IDP (2009) Ward 3 has been identified as an agricultural hub in the Spatial Development Framework (SDF) of Modimolle.

Ward 1 includes Leseding extension 1, 2 and 3. Extension 1 and 2 are more formalised than Extension 3 as the first two do have a formal township layout with brick and cement dwellings. Extension 3 can be classified as an informal settlement with the majority of dwellings being tin houses (shacks). These settlements are in very close proximity to the Vaalwater landfill site, and lack basic water, electricity and sewage infrastructure and services. Unemployment amongst the Leseding community is high and a large section of this community lives in poor conditions (MLM IDP, 2010).

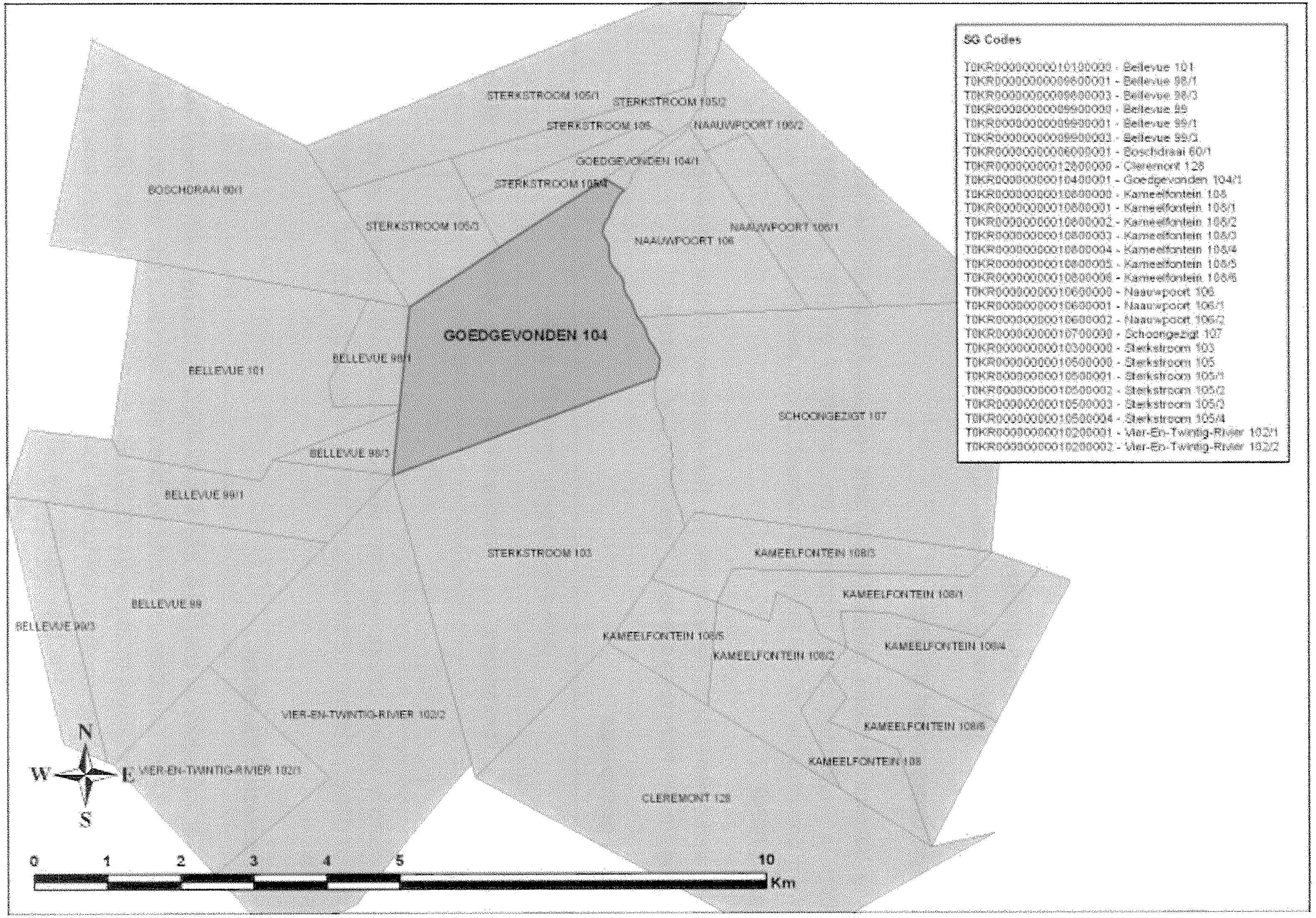
Crime in the MLM area, as well as the study area is said to be low, which creates an encouraging environment for economic growth, especially concerning tourism facilities and recreational activities (MLM IDP, 2010).

5.3 Site Profile and neighbouring property owners

The proposed site for the development of the proposed PV facility is located on the farm Goedgevonden KR 104, approximately 24 km north east of the town of Vaalwater in the

Limpopo Province. The site and surrounds are characterised by rural bushveld. Farms surrounding the site are mainly used for agricultural and game farming activities.

Find herewith a map of the surrounding properties:



SG Codes
T0KR00000000010100000 - Bellevue 101
T0KR00000000009800001 - Bellevue 98/1
T0KR00000000009800003 - Bellevue 98/3
T0KR00000000009900000 - Bellevue 99
T0KR00000000009900001 - Bellevue 99/1
T0KR00000000009900003 - Bellevue 99/3
T0KR00000000006000001 - Boschdraai 60/1
T0KR00000000012800000 - Cleremont 128
T0KR00000000010400001 - Goedgevonden 104/1
T0KR00000000010800000 - Kameelfontein 108
T0KR00000000010800001 - Kameelfontein 108/1
T0KR00000000010800002 - Kameelfontein 108/2
T0KR00000000010800003 - Kameelfontein 108/3
T0KR00000000010800004 - Kameelfontein 108/4
T0KR00000000010800005 - Kameelfontein 108/5
T0KR00000000010800006 - Kameelfontein 108/6
T0KR00000000010600000 - Naauwpoort 106
T0KR00000000010600001 - Naauwpoort 106/1
T0KR00000000010600002 - Naauwpoort 106/2
T0KR00000000010700000 - Schoongezigt 107
T0KR00000000010300000 - Sterkstroom 103
T0KR00000000010500000 - Sterkstroom 105
T0KR00000000010500001 - Sterkstroom 105/1
T0KR00000000010500002 - Sterkstroom 105/2
T0KR00000000010500003 - Sterkstroom 105/3
T0KR00000000010500004 - Sterkstroom 105/4
T0KR00000000010200001 - Vier-En-Twintig-Rivier 102/1
T0KR00000000010200002 - Vier-En-Twintig-Rivier 102/2
GOEDGEVONDEN 104
STERKSTROOM 105/1
STERKSTROOM 105/2
STERKSTROOM 105
NAAUWPOORT 106/2
GOEDGEVONDEN 104/1
STERKSTROOM 105/4
BOSCHDRAAI 60/1
STERKSTROOM 105/3
NAAUWPOORT 106/1
NAAUWPOORT 106
BELLEVUE 101
BELLEVUE 98/1
SCHOONGEZIGT 107
BELLEVUE 98/3
BELLEVUE 99/1
STERKSTROOM 103
KAMEELFONTEIN 108/3
KAMEELFONTEIN 108/1
BELLEVUE 99
BELLEVUE 99/3
KAMEELFONTEIN 108/5
KAMEELFONTEIN 108/4
KAMEELFONTEIN 108/2
VIER-EN-TWINTIG-RIVIER 102/2
KAMEELFONTEIN 108/6
KAMEELFONTEIN 108
VIER-EN-TWINTIG-RIVIER 102/1
CLEREMONT 128
N
W
E
S
0 1 2 3 4 5 10
Km

5.4 Social Profile

5.4.1 *Population Figures*

The MLM has a total population of approximately 52 605 people according to the Community Survey undertaken in 2007 (MLM IDP, 2009). The figures from the Department of Local Government and Housing's (DLGH) Settlement Database, however, indicated the total population as 80 043 individuals which varies slightly from the Statistics South Africa's (StatsSA) data of 2001 where the MLM's population was estimated at 72 810 (MLM IDP 2010).

The MLM is currently undertaking a data verification process while the data of the 2001 census are being used for their planning and budgeting purposes (MLM IDP, 2010).

According to Stats SA's Census undertaken in 2001, Ward 3 has a total population of 8 883 individuals and Ward 1 (Vaalwater and Leseding) houses a population count of 9 217.

5.4.2 *Age Groups and Gender*

There is a balance between males (49%) and females (51%) in the MLM area. Gender distribution is important as it provides an indication of the availability of jobs and employment opportunities or the extent of migrant labour (where males left an area in search of work elsewhere).

Based on a settlement database compiled for the Waterberg District Municipality in 2008, the age groupings in the MLM area are as follows (MLM SDF, 2010):

Table 1: Age groupings

Age groupings in the MLM area				
Pre- and Primary	**Secondary**	**Young adult**	**Adult**	**Elderly**
33%	11%	27%	24%	5%

The large sectors which make up the youth indicates the critical need for sufficient educational facilities, future infrastructure and services, as well as employment creation opportunities.

5.4.3 *Population Stability*

The majority of residents in the area are South African citizens, with a very low influx of citizens from the SADC countries. It therefore does not seem as if the area is challenged by a massive inflow of immigrants to the area. This could be due to the lack of urbanisation in the area and limited job opportunities, compared to urbanised and industrialised areas. One should, however, note that accurate figures are difficult to obtain because a large number of immigrants enter the country illegally. Estimations indicate that there are a high number of immigrants in the Limpopo Province and planning in the Modimolle area should consider this.

5.4.4 *Education and Skills Levels*

According to the 2001 statistics, the majority of the population completed some form of schooling, although 11% has completed no schooling. As only 12% of the population have completed school, it has led to a large population without skills (MLM IDP, 2010). The MLM SDF (2010) provides the following figures based on a settlement database compiled for the Waterberg District Municipality in 2008:

Table 2: Education levels (2008)

Education levels in the MLM area				
No schooling	**Primary**	**Secondary**	**Tertiary**	**Tertiary plus**
30%	39%	28%	3%	1%

From the more recent figures, it thus does not seem as if the overall education levels have improved in the last couple of years.

In Ward 3 only 7% of the population completed school, while 23% have some form of secondary education. 32% of the Ward's population have only some form of primary education (StatsSA Census, 2001). Ward 1 has a similar profile where 31% have some form of primary education, 22% have some form of secondary education, and 8% have matriculated.

According the Waterberg Biosphere Reserve, there are 180 school leavers each year in the Vaalwater area, of which approximately 50% do not have a school leaver's certificate (Waterberg Biosphere Reserve: Skills training facilitation project, 2010).

The MLM area has 59 primary schools and 7 secondary schools. Due to the lack of secondary schools and tertiary education facilities, it is unlikely that the youth can easily obtain a higher level of education. Limited services at the schools worsen the situation (MLM IDP, 2010). The nearest Further Education and Training College is located within Lephalale which is approximately 80 km from Vaalwater (Waterberg Biosphere Reserve: Skills training facilitation project, 2010).

The above figures and status of the educational facilities give a clear indication of the unskilled labour force within and surrounding the study area. As a result of the above a large part of the population in the MLM and the study area are employed in semi-skilled and unskilled positions (approximately 53%) (MLM IDP, 2010).

5.5 Employment and Income

5.5.1 *Employment Status*

The MLM IDP (2010) stated that the unemployment rate in the municipal area is 22% and the employment rate is 60%. The percentage of the population which falls within the not economically active group is 18%, which includes those persons that are either not able to work or those who choose not to work.

An analysis of the 2008 school leavers from the area done in 2010 indicates a worse scenario than the above. According to the analysis, 73% were unemployed, 15% were unpaid volunteers seeking work experience, 9% were in higher education or skills training, 0% had started their own businesses, and 2% were formally employed (Waterberg Biosphere Reserve: Skills training facilitation project, 2010).

The unemployment of locals in the area thus remains a concern. A large part of school leavers also move away from the area due to the lack of tertiary institutions. There is thus still a great need for poverty alleviation projects and employment creation, especially in the rural areas under the Modimolle Local Municipal's jurisdiction due to the relative "young" population in the area.

5.5.2 *Employment Sectors*

Together, the community services and agriculture sectors employ the majority of the people (53%) within the MLM. Of this percentage, the agricultural sector contributes 24% to the employment in the area and community services (including government services) are responsible for employing 27% of the population with employment. Other economic sectors that also contribute largely to employment are trade (16%) and manufacturing (10.8%) (MLM IDP, 2010).

From 1996 to 2007, the community services, finance, trade and construction sectors have shown an increase in employment. During the same period, however, the transport, electricity, manufacturing, mining, and agricultural sectors have shown a decline in employment contribution.

A concerning factor is the decline in the agricultural sector (MLM IDP, 2010). This leads to limited absorption capacity within the local economy. No reasons for this decline were provided, although it could be attributed to the conversion of agricultural practices to game farming industries which, in most cases, employ fewer individuals.

5.5.3 *Income*

The majority of the households (88%) within the MLM are living below the poverty level, which means that a large percentage of the households are earning less than R3 200 per month (approximately R38 400 per annum). The large no income households group, within the municipality, can be a reflection of the relatively young population (MLM SDF, 2010) & (MLM IDP, 2010).

The majority of households in Ward 1 and Ward 3 earn between R2001 and R6 000 per year (StatsSA Census, 2001). Even if there has been a slight improvement in this situation since 2001 it is fair to state that the majority of households in the study area thus still live under severe poor conditions.

5.6 Community Resources

5.6.1 *Natural Resources and Land-Use*

The MLM is characterised by prominent rivers, such as the Mokolo River and Nylsvlei, which dominates the landscape, as well as settlement patterns characterised by townships, farms and informal settlements (MLM IDP, 2010).

5.6.2 *Infrastructure*

The town of Modimolle is strategically located in close proximity to the N1. The town further developed next to the R33 which connects the eastern section of the municipality to the western section. The R33 is mainly used to access Vaalwater, Alma, Thabazimbi, and Lephalale. Due to the high volumes of heavy vehicles and other smaller vehicles making use of this road, it is in a poor state. The road, however, is being upgraded to a national road (MLM IDP, 2010), but the extent of heavy vehicles that services the development in Lephalale causes problems and leads to deteriorating road conditions and dangerous driving conditions. At this stage it does not seem as if the upgrades improved the overall condition of the road.

The rest of the MLM area is serviced by gravel roads linking farms and rural areas to the major routes and towns.

Local roads in the study area include the tarred Vaalwater-Melkrivier Road (R518), a gravel turn-off from this road (Sterkstroom Road) and the "Naaupoort-Olievenfontein" gravel road which links with the Sterkstroom Road and the Vier-en-Twintig-Riviere Road.

5.6.3 *Housing*

The municipal area is characterised by townships, farms, and informal settlements with different types of housing structures. The housing backlog (approximately 3 000 structures), which is worsened by displaced families evicted from farms due to the shift from general agricultural practices to game farming, remains challenging (MLM IDP, 2009).

5.6.4 *Electricity*

Both Eskom and the municipality provide electricity in the area. The MLM is thus an electricity service provider in the urban core and currently has a total of 23MVA capacity to supply the community. Out of the 23MVA, Modimolle town has 20MVA of which its optimum utilisation is 18MVA. Vaalwater has a transformer of 3MVA and is currently using 2.8 MVA. There is a need for additional capacity of 20 MVA in Modimolle Town and 10 MVA in Vaalwater to enable further development. A huge backlog in terms of electricity provision exists as the MLM needs to supply 2 555 households with electricity and according to a representative of the MLM approximately 80% of the settlements and proposed townships within the MLM do not have electricity. In addition, the MLM has to contribute R36 million to Eskom for the upgrading of the substation near Modimolle (MLM IDP, 2010 & Minutes of meeting, 2 August 2010).

Eskom provides the rural and farm areas with electricity although various property owners indicated that they do experience frequent power outages from this supply. The majority of farmers thus own generators for back-up purposes.

5.6.5 *Water*

The MLM is a water service authority municipality and has approximately 17,000 registered households. The following table provides a summary of the water provision and usage within the MLM area (MLM IDP, 2010):

Table 3: Water Provision and Usage

WATER USAGE AND PROVISION IN MLM				
	Piped water inside dwellings	**Piped water inside the yard**	**Access to water on a community stand**	**Access from boreholes**
PERCENTAGE OF HOUSEHOLDS	23%	28%	13%	3%

The Vaalwater area has a shortage of sufficient water supply. In some extensions water carts are used to supply the community. The situation is unlikely to improve in the near future as sufficient water sources have been identified on private farms and due to the high property prices, it is doubtful that the MLM would easily obtain these sources (MLM IDP, 2010).

5.6.6 *Waste and Sanitation*

Modimolle and the town of Vaalwater each have one landfill site. The legal status of the landfill in Vaalwater is compromised by the encroachment of Leseding onto the site. Rehabilitation of the landfill, however, is under way (MLM IDP, 2010). The formal areas in the urban core are thus the only areas to receive conventional refuse removal services (MLM SDF, 2010).

The Modimolle sewer treatment plant is currently running at its full capacity of 3ML/day. Expansions have been undertaken although it seems as if these would not fully address the remaining demand. This issue poses challenges with respect to future development in the municipality. Vaalwater are currently using sewer ponds, but the plant is still over flowing with possible negative environmental consequences (MLM IDP, 2010).

5.6.7 *Community Health and Safety Services*

The MLM has four clinics, two hospitals and two mobile clinics. More than half of the population (59%) are approximately fifteen minutes (2.5 km) away from the nearest health facilities (MLM IDP, 2010). The HIV/AIDS prevalence levels in the WDM have been the highest since 2004 when compared with other districts in the province. Young people between the ages of 18 and 35 years are especially vulnerable, although Vaalwater is less of a hotspot than Lephalale and Thabazimbi. This could be attributed to the mines in those areas (WDM IDP, 2010).

There are three police stations in the municipal area, namely at Modimolle, Vaalwater and Alma (MLM IDP, 2010). Fire fighting services are a district function and the MLM only provides the service at an agency level. The unit is currently understaffed and there is a definite need to settle personnel in the Vaalwater area to effectively provide this service (MLM IDP, 2010).

5.7 Tourism Sectors

The main tourism activities in the MLM area are mainly concentrated around the Waterberg Biosphere Reserve and to a lesser extent around the towns in the area. The towns thus form an important link in the tourism support chain as indicated in the MLM SDF (2010). Most of these tourism activities are also dependent on private initiatives, such as the numerous game farms of varying sizes within the area, which limit access to information regarding these initiatives.

5.7.1 *Waterberg Biosphere*

Biosphere Reserves are areas of terrestrial and coastal eco-systems which are internationally recognised within the framework of the United Nations Education, Scientific, and Cultural Organisation's (UNESCO's) Man and Biosphere Programme. The Waterberg Biosphere Reserve was established in 2001 as one of five biospheres in South Africa, and stretches from Marakele National Park in the south west to Wonderkop nature reserve in the north east. Entry to the area is usually through Vaalwater (www.waterbergbiosphere.org).

The biosphere consists of three areas, namely the core area (114 571ha); the buffer zone (150 000ha) and a transition zone of 150 000ha. The core area comprises proclaimed nature reserves with the buffer and transition zones filling the areas in between. These areas are currently being reviewed (MLM SDF, 2010). A small portion of the farm Goedgevonden KR 104 is located within the transition zone of the Biosphere Reserve and the north-western beacon of the farm boundary borders the Waterberg Biosphere Reserve's buffer zone. However, the area to be utilised for the proposed facility does not fall within the Biosphere

Reserve. Within the transitional zone limited agricultural and infrastructural developments are permitted. (Savannah Environmental: Draft Environmental Scoping Report, 2010). Please refer to the maps below (Source: www.waterbergbiosphere.org and Savannah Environmental).

The Biosphere's Environmental Management Framework which is currently being compiled could change the boundaries of the Biosphere as it is expected that it would extend to the south-east and to a lesser extent to the north-west. An Environmental Management Plan for the Waterberg Biosphere Reserve is also being compiled under the guidance of the WDM and the Department of Environmental Affairs (DEA) (Personal communication: Dr. R. Baber: 2 August 2010).

The biosphere covers a substantial part of the MLM area in the north and plays a critical role in the conservation efforts and eco-tourism sector in the district (MLM SDF, 2010). Usually a biosphere can only protect its environment through the commitment of the communities, farmers, conservation agencies, and local government departments. The long-term vision is thus focused on conservation efforts, enhancing the potential of eco-tourism in the area, conserving the sense of place of the Waterberg and the potential establishment of conservancies (Personal communication: Dr. R. Baber: 2 August 2010).

The proposed Waterberg Biosphere Reserve's skills development programme is focused on the communities on the plateau, including Leseding and other rural communities in the study area. The aim is to create individuals with a readiness for work. School leavers thus receive short courses, learnerships, and apprenticeships. The aim is to have 420 beneficiaries of this skills training and capacity building programme per year (Personal communication: Dr. R. Baber: 2 August 2010).

Biospheres are usually environmentally unique areas that could be negatively affected by human activities that may physically change the natural environment. According to the MLM's SDF it was stated that "The biospheres do not necessarily exclude any development but it is sensitive to development other than conservation and eco-tourism. There are however, extensive development in the area such as rural villages and formally proclaimed towns. Parts of the biosphere are also areas showing a high potential for crop farming" (MLM SDF, 2010).