Appendix 6B:

Avifauna Assessment

BIRD IMPACT ASSESSMENT STUDY

Proposed Sendawo Solar Photovoltaic (PV) Project 2 near Vryburg in the North-West Province

MAY 2015

Prepared by

AFRIMAGE Photography (Pty) Ltd t/a
Chris van Rooyen Consulting
VAT#: 4580238113
email: vanrooyen.chris@gmail.com
Tel: +27 (0)82 4549570 cell

Prepared for

SiVEST

DECLARATION OF INDEPENDENCE

I, Chris van Rooyen as duly authorised representative of Chris van Rooyen Consulting, and working under the supervision of and in association with Albert Froneman (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003, hereby confirm my independence (as well as that of Chris van Rooyen Consulting) as a specialist and declare that neither I nor Chris van Rooyen Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Sivest was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Environmental Impact Assessment for the Sendawo Solar Photovoltaic (PV) Project 2 near Vryburg in the North-West Province.

Full Name: Chris van Rooyen
Title / Position: Director

RELEVANT EXPERTISE

Chris van Rooyen

Chris has 20 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in more than 160 power line and 30 renewable energy projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

Albert Froneman (Pr.Sci.Nat)

Albert has an M. Sc. in Conservation Biology from the University of Cape Town, and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). He is a registered Professional Natural Scientist in the field of zoological science with the South African Council of Natural Scientific Professionals (SACNASP). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – EWT Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and they are currently jointly coordinating pre-construction monitoring programmes at several wind farm facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

EXECUTIVE SUMMARY

The proposed BioTherm PV 2 facility is located in the endemic region with the fourth highest number of endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring at the core study area and immediate surroundings, the application site and immediate surroundings as a whole should be regarded as moderately sensitive from an avifaunal perspective.

No potentially high sensitive, no-go areas were identified in the core study area. A small concrete impoundment at a natural spring, a borehole and the Dry Harts River were identified as potential high sensitive areas in the immediate surroundings, as these micro-habitats are potential focal points of bird activity. It is important to note that the sensitivity of the study area could be influenced by the development itself, in that the construction of the solar panels at the adjacent PV 1 facility will result in the relocation of the impoundment, currently located at the natural spring, which means that the 250m zone currently classified as high sensitive around the impoundment could fall away. The potential impact of displacement of priority species due to disturbance associated with construction of the PV 2 plant and associated infrastructure are rated as high, and will remain so after mitigation. The potential impact of displacement of priority species due to habitat transformation associated with construction of the PV 2 plant and associated infrastructure, is also rated as high and will remain so after mitigation. The impact of mortality of priority species due to collisions with solar panels is rated as low and could be further reduced through mitigation. The impact of displacement of priority species due to disturbance associated with de-commissioning of the PV 2 plant and associated infrastructure is likewise rated as low and could be further reduced through mitigation.

In view of the very dry conditions which prevailed at the site during the pre-construction monitoring which was implemented from November 2015 to February 2016, the low number of birds recorded should not necessarily be taken as an absolutely representative snapshot of the typical avifaunal dynamics at the core study area under all conditions.

Contents

1. INTRODUCTION & BACKGROUND

Sendawo Solar will consist of three (3) 75MW solar PV facilities, namely Sendawo Solar 1, Sendawo Solar 2 and Sendawo Solar 3 and will be located approximately 10km south of Vryburg, in the Dr Ruth Segomotsi Mompati District of the North West Province. The PV facilities will be connected to the proposed Sendawo substation via a 132kV sub-transmission line. Panels will be either fixed axis mounting or single axis tracking solutions, and will be either crystalline silicon or thin film technology.

This report deals with the potential bird impacts associated the envisaged Sendawo Solar 2 (referred to as PV 2 in the report).

In addition to the PV panels each project will consist of:

- An onsite switching station, with the transformers for voltage step up from medium voltage to high voltage;
- The panels which will be connected in strings to inverters and inverter stations which will be required throughout the site. Inverter stations will house 2 x 1MW inverters and 1 x 2MVA transformers. DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to 22-33kV (medium voltage) in the transformers.
- The 22-33kV cables which will be run underground in the facility to a common point before being fed to the onsite switching station where the voltage will be stepped up to 132kV.
- A power line with a voltage of 132kV to the proposed Sendawo substation (the subject of a separate authorisation process);
- A laydown area for the temporary storage of materials during the construction activities;
- Access roads and internal roads;
- A car park and fencing; and
- Administration, control and warehouse buildings.

See Figures 1 - 3 below for maps of the study area.

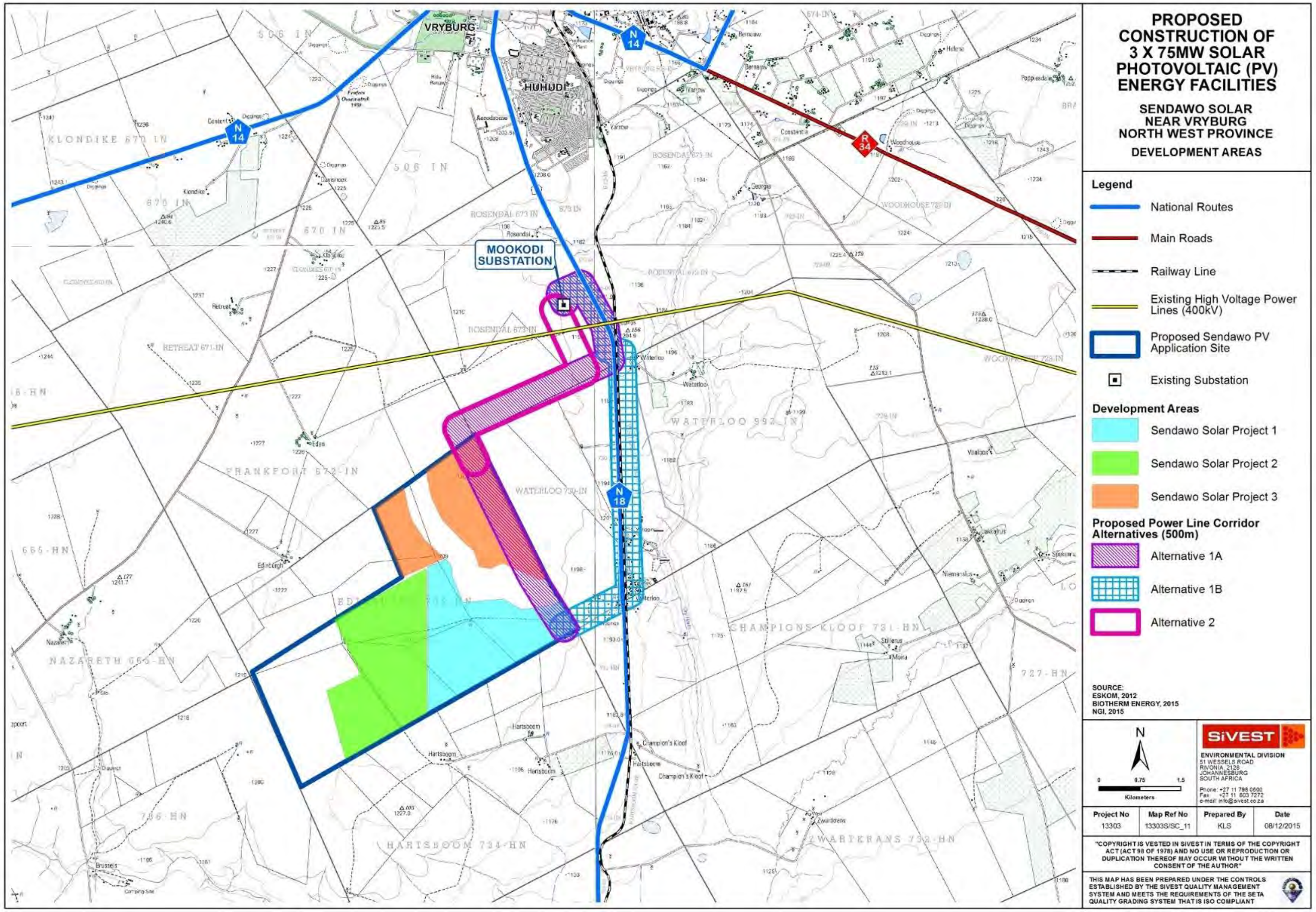


Figure 1: Map of the proposed PV 2 site (green area).

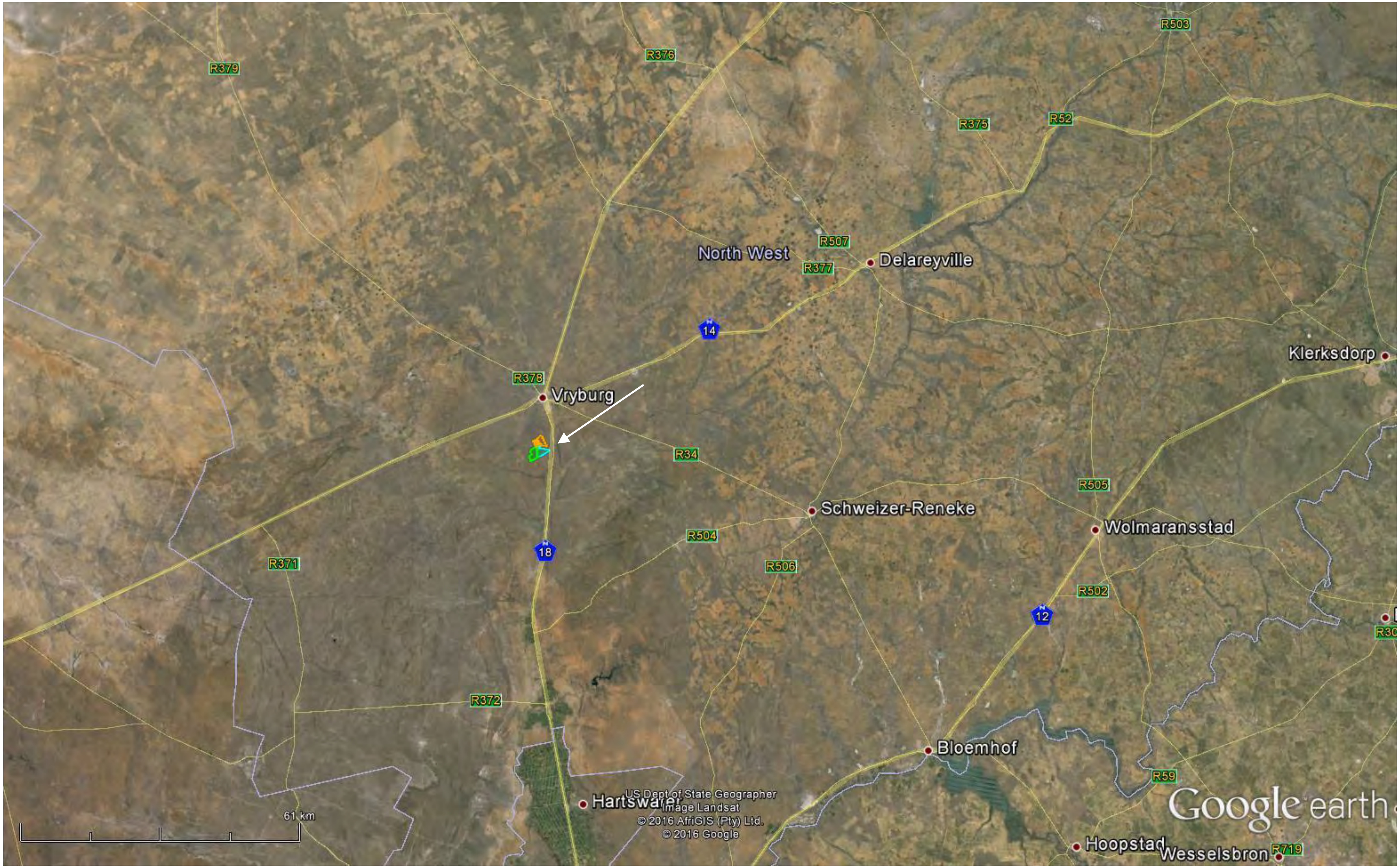


Figure 2: Regional map indicating the location of the proposed PV 2 site.

2. TERMS OF REFERENCE

The terms of reference for this bird impact assessment study are as follows:

- Describe the affected environment;
- List information sources and discuss gaps in baseline data;
- List, describe, and assess the expected impacts on avifauna;
- Provide a sensitivity map of the proposed development site from an avifaunal perspective; and
- Provide recommendations for mitigation.

3. SOURCES OF INFORMATION

The following information sources were consulted in order to conduct this study:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town, as a means to ascertain which species occurs within the broader area i.e. within a block consisting of nine pentad grid cells within which the proposed solar facilities are situated. The nine pentad grid cells are the following: 2655_2435, 2655_2440, 2655_2445 2700_2435, 2700_2440, 2700_2445 2705_2435, 2705_2440, and 2705_2445 (see Figure 3). A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 2007 to date, a total of 53 full protocol cards (i.e. 53 surveys lasting a minimum of two hours each) have been completed for this area.
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al*. 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al*. 2005).
- The global threatened status of all priority species was determined by consulting the latest (2015.4) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).
- The Important Bird Areas of Southern Africa (Barnes 1998; Marnewick *et al.* 2015) was consulted for information on Important Bird Areas (IBAs).
- Satellite imagery was used in order to view the broader development area on a landscape level and to help identify sensitive bird habitat.
- Information on the movement of Cape Vultures in the North-West Province was obtained from Kerri Wolter at Vulpro (Phipps *et al*. 2010).
- Information on the birds actually occurring on the site was obtained from a site visit on 9 November 2015 and a subsequent monitoring programme which was implemented at the application site between November 2015 and February 2016 (see APPENDIX 1 for more information).

Figure 3: The area covered by the SABAP2 pentads, relative to the application site (white border polygon).

4. ASSUMPTIONS & LIMITATIONS

The following assumptions and limitations are applicable in this study:

- A total of 53 full protocol lists have been completed to date for the 9 pentads where the study area is located (i.e. lists surveys lasting a minimum of two hours each). The SABAP2 data was therefore regarded as a reasonably conclusive snapshot of the avifauna. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, and the results of the pre-construction monitoring.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances, especially for a new field such as solar energy.
- The focus of the study is on waterbirds, raptors, South African Red Data species, and southern African endemics and near-endemics (collectively referred to in the report as priority species).
- The impact of solar installations on avifauna is a new field of study, with only one scientific study published to date (McCrary *et al*. 1986). Strong reliance was therefore placed on the opinions of experts and the pre-cautionary principle was applied throughout.
- The core study area was defined as the area comprising the proposed PV 2 lay-out alternatives (see Figure 4).

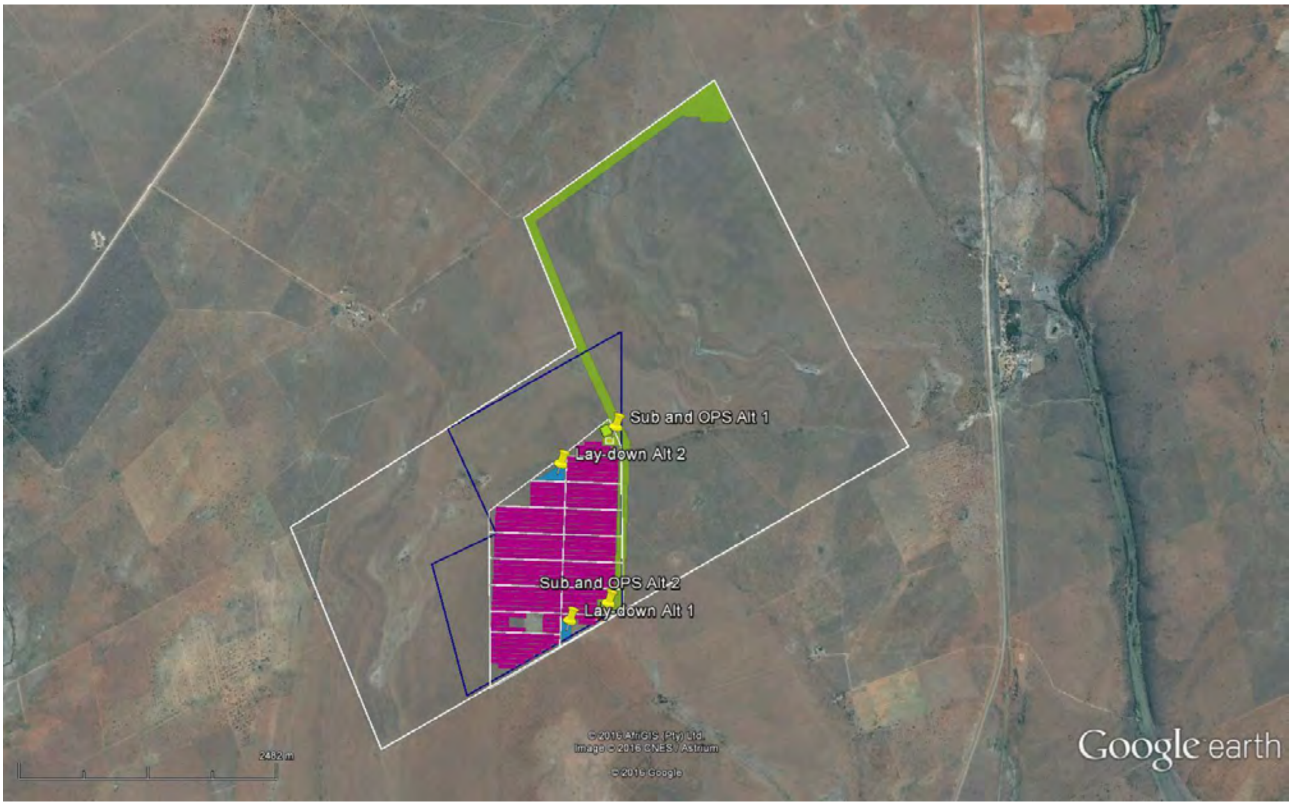


Figure 4: The lay-out alternatives for PV 2. The purple area represents the proposed PV arrays. The green area represents the powerline corridor.

5. DESCRIPTION OF AFFECTED ENVIRONMENT

5.1 Biomes and vegetation types

The proposed site is situated in a transitional zone between grassland and savanna approximately 10km south of the town of Vryburg in the North-West Province. The habitat in the core study area is highly homogenous and consists of extensive plains with grass and low shrub, with scattered, stunted *Vachellia* trees. The closest Important Bird Areas (IBAs), the Baberspan and Leeupan SA026 and the Sandveld and Bloemhof Dam Nature Reserves SA039 are located approximately 100km away (Barnes 1998, Birdlife 2014). The development is too far away from these IBAs to have any direct impact on them.

5.2 Habitat classes and avifauna in the study area

Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of the natural vegetation, it is as important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types.

The following bird habitat classes have been identified at the core study area and immediate surroundings:

5.2.1 Savanna

The dominant natural vegetation type is Ghaap Plateau Vaalbosveld. Ghaap Plateau Vaalbosveld consists of a well-developed shrub layer of *Tarchonanthus camphoratus* with very few trees. Rainfall is in summer and autumn ranging from 300mm – 500mm, with temperatures ranging from -7.5°C to 36°C (Mucina &

Rutherford 2006). Ghaap Plateau Vaalbosveld is a form of arid woodland. Arid woodland occurs where there is intermediate, though variable rainfall with hot, wet summers and cool, dry winters.

Priority species that could be found in natural savanna vegetation on the development site are Cape Sparrow, European Roller, Scaly-feathered Finch, Yellow Canary, Kalahari Scrub-robin, Red-headed Finch, Black-chested Prinia, Chestnut-vented Tit-babbler, Crimson-breasted Shrike, Cape Penduline-Tit, Bokmakierie, Eastern Clapper Lark, Pririt Batis, Southern Pale Chanting Goshawk, Chat Flycatcher, Lark-like Bunting, Namaqua Sandgrouse, Fiscal Flycatcher, Karoo Thrush, Northern Black Korhaan, Orange River White-eye, White-backed Mousebird, Cape White-eye and Ant-eating Chat. Occasional visitors to the site could include Martial Eagle, Secretarybird, Kori Bustard, Cape Vulture, White-backed Vulture and Double-banded Courser.

Pre-construction monitoring conducted over six months revealed fewer than expected priority species in the savanna habitat at the application site (see 5.2.4 below), which may indicate that the habitat may be under grazing pressure. The very dry and hot conditions which prevailed during the majority of the pre-construction monitoring further contributed to the low bird counts.

5.2.2 Surface water

The ephemeral rivers, particularly the Dry Harts River which is situated east of the core study area, is important for a variety of waterbirds, including Red-listed Black Stork and Maccoa Duck, which were recorded sparsely by SABAP2 and could be attracted to pools in the Dry Harts River. South African Shelduck could also be an occasional visitor. Namaqua Sandgrouse, also sparsely recorded by SABAP 2, could also visit pools in the river to drink and possibly also a few Burchell's Sandgrouse. Abdim's Stork could potentially forage on irrigated fields along the river channel, and in the dry river channel itself (pers. obs). Priority raptors and possibly vultures (rarely) could also use pools in the river bed for bathing and drinking.

Open water troughs are important sources of surface water in arid areas and may be used extensively by various species, including large raptors, e.g. Martial Eagles to drink and bath. Apart from priority raptors such as Southern Pale Chanting Goshawk, smaller priority species such as Sociable Weaver, Cape Sparrow, Red-headed Finch, Scaly-feathered Finch, Yellow Canary, Namaqua Sandgrouse and Lark-like Bunting congregate in large numbers around water troughs which in turn could attract Lanner Falcon. The presence of trees around surface water often attracts other priority species such as Bokmakierie, Kalahari Scrub-robin, Crimson-breasted Shrike, Chestnut-vented Tit-babbler, Fiscal Flycatcher, Karoo Thrush and White-backed Mousebird.

The core study area does not contain any surface water, but the adjacent PV 1 area contains a natural spring surrounded by shrubs and trees which is used to provide drinking water to cattle via a small, concrete impoundment. This impoundment was monitored as a focal point of bird activity during the pre-construction monitoring. Priority species recorded at the impoundment during focal point surveys included Acacia Pied Barbet, Blacksmith Lapwing, Crimson-breasted Shrike, Fiscal Flycatcher, Marico Flycatcher, Yellow Canary and African Red-eyed Bulbul. Cape Vulture and White-backed Vulture could potentially also descend to the natural spring in the study area to drink and bath. There is also a borehole situated approximately 400m to the west of the core study area which is a source of surface water. Similar patterns of avifaunal of occurrence is expected at the water through linked to the borehole.

5.2.3 High voltage lines

High voltage lines are an important potential roosting and breeding substrate for raptors in the study area. Existing high-voltage lines are used extensively by large raptors, especially Martial Eagles, for breeding purposes (Jenkins *et al*. 2006), but also smaller species such as Lanner Falcon and Greater Kestrel which often breeds in abandoned corvid nests. High voltage lines therefore hold a special importance for large raptors, but also for Sociable Weavers which often construct their giant nests within the lattice work or cross-arms of high voltage structures. One high-voltage line, the Ferrum – Mercury 400kV line, runs in an east – west direction approximately 3.8km north of the core study area. The section of the line which runs parallel to the core study area was inspected in February 2016 but no nests were recorded on any of the towers.

5.2.4 Avifauna

An estimated 221 species could potentially occur at the core study area and immediate surroundings (including the Dry Harts River). Of these, 11 are South African Red Data species, 12 are southern African endemics and 22 are near-endemics. This means that 5% of the species that could potentially occur at the core study area and immediate surroundings are Red Data species, and 15% are southern African endemics of near-endemics. Southern Africa contains 13 avifaunal endemic regions, namely Western Arid, Woodland, Evergreen Forest, Grassland, Montane, Rocky slopes and cliffs, Fynbos, Marine and Inland Waters (MacLean 1999). Of these regions, Grassland, where the study area is located, contains the fourth highest number of endemics. Overall, the core study area and immediate surroundings potentially contains a total of 33 endemics and near-endemics, which is 20% of the 167 southern African endemics and near-endemics (Hockey *et al.* 2005).

See **APPENDIX 3** for a list of all species potentially occurring in the core study area and immediate surroundings. Potential impacts on priority species are listed in Table 1 below.

Table 1: Priority species potentially occurring at the core study area and immediate surroundings (including the Dry Harts River).

CR = Critically endangered

EN = Endangered

VU = Vulnerable

NT = Near-threatened

LC = Least concern

End = Southern African Endemic

N-End = Southern African near endemic

Name	Scientific name	National Red Data Status	Global status	Collisions with PV panels	Displacement through disturbance	Displacement through habitat transformation*	Chances of occurrence in the study area
Ant-eating Chat	*Myrmecocichla formicivora*	End	LC	x	x	x	High
Ashy Tit	*Parus cinerascens*	N-end	LC	x	x	x	Low
Black-chested Prinia	*Prinia flavicans*	N-end	LC	x	x	x	High
Bokmakierie	*Telophorus zeylonus*	N-end	LC	x	x	x	High
Cape Penduline – Tit	*Anthoscopus minutus*	N-end	LC	x	x	x	Medium
Cape Sparrow	*Passer melanurus*	N-end	LC	x	x	x	High
Chat Flycatcher	*Bradornis infuscatus*	N-end	LC	x	x	x	Low
Chestnut-vented Tit-babbler	*Parisoma subcaeruleum*	N-end	LC	x	x	x	High
Double-banded Courser	*Rhinoptilus africanus*	NT	LC	x	x	x	Low
Eastern Clapper-Lark	*Mirafra fasciolata*	N-end	LC	x	x	x	High
European Roller	*Coracias garrulus*	NT	NT	x	x	x	Low
Fairy Flycatcher	*Stenostira scita*	End	LC	x	x	x	Low
Grey-backed Sparrowlark	*Eremopterix verticalis*	N-end	LC	x	x	x	Low
Kalahari-Scrub-Robin	*Cercotrichas paena*	N-end	LC	x	x	x	High
Kori Bustard	*Ardeotis kori*	NT	NT	-	x	x	High
Lark-like Bunting	*Emberiza impetuani*	N-end	LC	x	x	x	Low
Martial Eagle	*Polemaetus bellicosus*	EN	VU	-	x	x	High

Name	Scientific name	National Red Data Status	Global status	Collisions with PV panels	Displacement through disturbance	Displacement through habitat transformation*	Chances of occurrence in the study area
Namaqua Sandgrouse	*Pterocles namaqua*	N-end	LC	x	x	x	Low
Northern Black Korhaan	*Afrotis afraoides*	End	LC	x	x	x	High
Orange River White-eye	*Zosterops pallidus*	End	LC	x	x	x	High
Pririt Batis	*Batis pririt*	N-end	LC	x	x	x	Low
Red-headed Finch	*Amadina erythrocephala*	N-end	LC	x	x	x	High
Sabota Lark	*Calendulauda sabota*	N-end	LC	x	x	x	High
Scaly-feathered Finch	*Sporopipes squamifrons*	N-end	LC	x	x	x	High
Secretarybird	*Sagittarius serpentarius*	VU	VU	-	x	x	Medium
Sociable Weaver	*Philetairus socius*	End	LC	x	x	x	Low
South African Shelduck	*Tadorna cana*	End	LC	x	x	x	Low, but could be attracted by the lake effect after construction
Southern Pale Chanting Goshawk	*Melierax canorus*	N-end	LC	x	x	x	Medium
Spike-heeled Lark	*Chersomanes albofasciata*	N-end	LC	x	x	x	High
Yellow Canary	*Crithagra flaviventris*	N-end	LC	x	x	x	High
Black Stork	*Ciconia nigra*	VU	LC	x	-	-	Low, but could be attracted by the lake effect after construction
Burchell’s Sandgrouse	*Pterocles burchelli*	N-end	LC	x	-	-	Low
Barred Wren-Warbler	*Calamonastes fasciolatus*	N-end	LC	x	x	x	Low
Burchell’s Courser	*Cursorius rufus*	VU, N-end	LC	x	x	x	Low
Maccoa Duck	*Oxyura maccoa*	NT	NT	x	-	-	Low, but could be attracted by the lake effect after construction
Abdim’s Stork	*Ciconia abdimii*	NT	LC	x	-	-	Low
Crimson-breasted Shrike	*Laniarius atrococcineus*	N-end	LC	x	x	x	High
Spike-heeled Lark	*Chersomanes albofasciata*	N-end	LC	x	x	x	High

Name	Scientific name	National Red Data Status	Global status	Collisions with PV panels	Displacement through disturbance	Displacement through habitat transformation*	Chances of occurrence in the study area
Southern Pied Babbler	*Turdoides bicolor*	End	LC	x	x	x	Low
Fiscal Flycatcher	*Sigelus silens*	End	LC	x	x	x	High
White-backed Mousebird	*Colius colius*	End	LC	x	x	x	High
Karoo Thrush	*Turdus smithi*	End	LC	x	x	x	High
Cape White-eye	*Zosterops virens*	End	LC	x	x	x	Low
African Fish-Eagle	*Haliaeetus vocifer*	-	-	x	-	-	Medium
African Harrier-Hawk	*Polyboroides typus*	-	-	-	x	x	Medium
Amur Falcon	*Falco amurensis*	-	-	x	x	x	Medium
Black Crake	*Amaurornis flavirostris*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Black-headed Heron	*Ardea melanocephala*	-	-	x	x	x	Medium
Black-shouldered Kite	*Elanus caeruleus*	-	-	x	x	x	High
Blacksmith Lapwing	*Vanellus armatus*	-	-	x	x	x	High
Cattle Egret	*Bubulcus ibis*	-	-	x	x	x	High
Common Sandpiper	*Actitis hypoleucos*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Egyptian Goose	*Alopochen aegyptiacus*	-	-	x	-	-	Medium - could also be attracted by the lake effect after construction
Gabar Goshawk	*Melierax gabar*	-	-	x	x	x	Low
Greater Kestrel	*Falco rupicoloides*	-	-	x	x	x	Medium
Green-backed Heron	*Butorides striata*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Grey Heron	*Ardea cinerea*	-	-	x	-	-	Low, but could be attracted by the

							lake effect after construction
Name	**Scientific name**	**National Red Data Status**	**Global status**	**Collisions with PV panels**	**Displacement through disturbance**	**Displacement through habitat transformation***	**Chances of occurrence in the study area**
Lesser Kestrel	*Falco naumanni*	-	-	x	x	x	High
Little Egret	*Egretta garzetta*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Little Grebe	*Tachybaptus ruficollis*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Marsh Sandpiper	*Tringa stagnatilis*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Pied Kingfisher	*Ceryle rudis*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Red-billed Teal	*Anas erythrorhyncha*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Red-knobbed Coot	*Fulica cristata*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Reed Cormorant	*Phalacrocorax africanus*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Spotted Eagle-Owl	*Bubo africanus*	-	-	x	x	x	High
Spur-winged Goose	*Plectropterus gambensis*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction

Name	Scientific name	National Red Data Status	Global status	Collisions with PV panels	Displacement through disturbance	Displacement through habitat transformation*	Chances of occurrence in the study area
Steppe Buzzard	*Buteo vulpinus*	-	-	x	x	x	High
White-faced Duck	*Dendrocygna viduata*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
Yellow-billed Duck	*Anas undulata*	-	-	x	-	-	Low, but could be attracted by the lake effect after construction
White-backed Vultures	*Gyps africanus*	CR	CR	-	-	x	Low
Cape Vulture	*Gyps coprotheres*	EN	EN	-	-	x	Low

- With smaller species this impact might result in partial but not total exclusion from the site, depending on the level of vegetation transformation

Pre-construction conducted over six months at the application site revealed fewer than expected priority species. Two walk transects of 1km each were identified and each surveyed 24 times through the course of the monitoring (see APPENDIX 1), to record the diversity and abundance of avifauna. Table 2 below lists the densities and variety of priority species actually recorded at the site in this manner. The densities of priority species are indicated as mean individuals per survey, and individuals per kilometre (index of kilometric abundance - IKA). In addition to the walk transects, one vantage point was selected from which a representative sample of the proposed PV areas could be observed, to record the flight altitude and patterns of priority species. However, no priority species flight activity was recorded in 36 hours of vantage point watches.

Table 2: Priority species recorded during pre-construction monitoring at the core study area.

Species	Taxonomic name	Regional Status	Mean number of individuals per survey recorded during transect counts	Number of individuals per kilometre
Black-chested Prinia	*Petrochelidon spilodera*	Endemic	0.13	0.06
Ant-eating Chat	*Myrmecocichla formicivora*	Endemic	0.04	0.02
Bokmakierie	*Afrotis afraoides*	Endemic	0.04	0.02
Cape Sparrow	*Colius colius*	Endemic	0.13	0.06
Crimson-breasted Shrike	*Prinia flavicans*	Near-endemic	0.04	0.02
Eastern Clapper Lark	*Telophorus zeylonus*	Near-endemic	0.21	0.10
Kalahari Scrub-Robin	*Passer melanurus*	Near-endemic	0.21	0.10
Lanner Falcon	*Laniarius atrococcineus*	Near-endemic	0.25	0.13
Marico Flycatcher	*Mirafra fasciolata*	Near-endemic	0.13	0.06
Northern Black Korhaan	*Erythropygia paena*	Near-endemic	1.04	0.52
Sabota Lark	*Bradornis mariquensis*	Near-endemic	0.08	0.04
Scaly-feathered Finch	*Calendulauda sabota*	Near-endemic	0.63	0.31
Shaft-tailed Whydah	*Sporopipes squamifrons*	Near-endemic	0.08	0.04
South African Cliff-Swallow	*Vidua regia*	Breeding endemic	0.08	0.04
Spike-heeled Lark	*Chersomanes albofasciata*	Near-endemic	0.21	0.10
White-backed Mousebird	*Falco biarmicus*	VU	0.13	0.06
Martial Eagle	*Polemaetus bellicosus*	EN	Incidental	Incidental
Kori Bustard	*Ardeotis kori*	NT	Incidental	Incidental
Steppe Buzzard	*Buteo vulpinus*	-	Incidental	Incidental

As can be seen in table 2 above, the variety and density of priority species at the core study area was low during the survey period which lasted from November 2015 to February 2016. Normally this should be the period of most bird activity at the core study area, as it is in the middle of the rainy season. However, the area was experiencing a severe drought with high temperatures at the time, which is the most logical explanation for the low counts. The effect of the drought on the vegetation is further exacerbated by grazing pressure, which further depletes the grass layer, creating unfavourable conditions for grassland avifauna. The lack of flight activity at the core study area could be linked to the general unfavourable conditions for avifauna at the site at the time, but it could also be partially the due to the characteristics of the site itself, which, unlike typical wind energy sites, do not have wind resources which are typically utilised by soaring species (especially raptors).

Given the atypical conditions which prevailed at the site during the pre-construction monitoring, the results of the monitoring should not necessarily be taken as a completely representative snapshot of the typical avifaunal dynamics at the core study area under all conditions.

6. DESCRIPTION OF EXPECTED IMPACTS

6.1 Impacts of solar facilities and associated infrastructure on avifauna

A literature review reveals a scarcity of published, scientifically vetted information regarding large-scale solar plants and birds. To date, only one published scientific study has been conducted on the direct impacts of solar facilities on avifauna, namely "Avian mortality at a solar energy power plant" by McCrary, McKernan, Schreiber, Wagner & Sciarrotta 1986. This describes the results of monitoring at the experimental Solar One solar power plant in southern California (now de-commissioned), which was a 10 megawatt, central receiver solar power plant consisting of a 32-ha field of 1 818, 6.9 x 6.9m mirrors (heliostats) which concentrates sunlight on a centrally located, tower-mounted boiler, 86m in height. Since then, several much larger plants have been constructed in the Desert Southwest of the USA namely the 250MW, 1 300ha California Valley Solar Ranch PV plant (completed in 2013), the 377 MW, 1 600ha Ivanpah central receiver CSP plant (completed in 2014), the 550MW, 1 600ha Desert Sunlight PV plant (completed in 2015) and the 250MW, 1 880ha Genesis Solar Energy parabolic trough Concentrated Solar Power plant (completed in 2014). The full spectrum of impacts of solar facilities on birds is only now starting to emerge from compliance reports at these solar facilities.

These can be summarised as follows:

- Temporary displacement due to disturbance associated with the construction of the solar plant and associated infrastructure;
- Collisions with the heliostats or solar panels;
- Burning due to solar flux (only relevant to CSP plants, not relevant for PV plants);
- Permanent displacement due to habitat transformation; and
- Collisions with the associated power lines resulting in mortality (not assessed in this report).

6.1.1 Collisions with solar infrastructure

There are currently two known types of direct solar-related bird fatalities (McCrary *et al*. 1986; Hernandez *et al.* 2014; Kagan *et al*. 2014):

- Collision-related fatality—fatality resulting from the direct contact of the bird with a project structure(s). This type of fatality has been documented at solar projects of all technology types.
- Solar-flux-related fatality—fatality resulting from the burning/singeing effects of exposure to concentrated sunlight. Passing through the area of solar flux may result in: (a) direct fatality; (b) singeing of flight feathers that cause loss of flight ability, leading to impact with other objects; or (c) impairment of flight capability to reduce the ability to forage or avoid predators, resulting in starvation or predation of the individual (Kagan *et al.* 2014). Solar-flux-related fatality has been observed only at facilities employing power tower technologies.

McCrary *et al.* (1986) searched for dead birds amongst the heliostat mirrors and around the central receiver tower, and they estimated a bird fatality rate caused by bird collisions with heliostat mirrors and the tower, and by heat encountered when birds flew through the concentrated sunlight reflected toward the tower. Their forty visits (one week apart) to the facility over a two-year period revealed 70 bird carcasses involving 26 species. It was estimated that between 10% and 30% of carcasses were removed by scavengers in between visits, so the actual mortality figure may have been slightly higher. They estimated that 57 (81%) of these birds died through collision with infrastructure, mostly the heliostats. Species killed in this manner included waterbirds, small raptors, gulls, doves, sparrows and warblers. Thirteen (19%) of the birds died through burning in the standby points. Species killed in this manner were mostly swallows and swifts. However, they appeared to have under-appreciated the magnitude of the impacts caused by Solar One, likely because they did not know as much as scientists know today about scavenger removal rates and searcher detection error (Smallwood 2014). Their search pattern was not fixed, so it was not as rigorous as modern searches at wind energy projects and other energy generation and transmission facilities. They placed 19 bird carcasses to estimate the proportion remaining over the average time span between their visits to the project site, though they provided few details about their scavenger removal trial. It is known today that the results of removal trials can vary substantially for many reasons, including the species used, time since death, and the number of carcasses placed in one place at one time, etc. (Smallwood 2007). They also performed no searcher detection trials, because they concluded that the ground was sufficiently exposed that all available bird carcasses would have been found. This conclusion would not be accepted today, based on modern fatality search protocols. Smallwood (2014) recalculated the estimated fatality rate at Solar One, but this time using US national averages to represent scavenger removal rates and searcher detection rates (see Smallwood 2007, 2013). He re-calculated it as 87.4 mortalities per year with an 80% confidence interval (CI) of 69.6 to 105.5.

Although Solar One is a central receiver plant and therefore not directly comparable to the proposed PV 2 facility, the results of the Solar One study indicates that collisions with reflective surfaces are a significant impact at solar facilities in general.

Avian monitoring surveys were conducted at the 1 600ha Ivanpah Solar Electric Generating System CSP (Ivanpah) facility in accordance with the Project's Avian & Bat Monitoring and Management Plan over four seasons from 29 October 2013 to 20 October 2014 (Harvey & Associates 2015). These surveys included avian point counts, raptor/large bird surveys and facility monitoring for avian fatalities. Overall, approximately 29.2% of the facility was searched (not including offsite transects, which are outside the facility). A total of 695 avian mortalities (including 25 injured birds that died), and eight injured birds were found over the first four seasons. These avian fatality search results, along with searcher efficiency carcass removal rates from trials conducted onsite, were input into a fatality estimator model (Huso 2010) to provide an estimate of the fatalities for the facility. Overall, the estimated avian mortality was 1492 or 42.6% of birds (90% confidence interval 1,046-2,371) from known causes and 2012 or 57.4% of birds (90% confidence interval 1,450-3,334) from unknown causes. The sources of mortality for known causes were 47.4% singed, 51.9% with evidence of collision effects, and 0.7% from other Project causes. For the fatalities from unknown causes, the estimate was driven by a high number of feather spots (47.2% of all detections) which may have led to over-estimation of the number of unknowns.

The estimate of 3 504 mortalities at Ivanpah contrasts markedly with an earlier estimate by Smallwood (2014). Smallwood calculated the estimated annual mortality at Ivanpah to be potentially as high as 28 380 birds per year. In his testimony to the California Energy Commission he explains as follows: “The April searches turned up 101 fatalities and the May searches discovered another 82 fatalities. If the searches were performed according to document TB201315, which summarised a monitoring plan for Ivanpah, then weekly searches were performed at 20% of the heliostat mirrors at Ivanpah during April and May 2014. Given the size range of the birds found, including many hummingbirds, swallows and warblers, I would predict that the overall adjustment rate for searcher detection and carcass persistence would be no greater than 20%. That means the number of fatalities found would be divided by 0.2 to arrive at an adjusted estimate of 473 fatalities per month within the search areas. This number then would be divided by 0.2 (corresponding with 20% of the project being searched) to extrapolate the fatality estimate to the rest of Ivanpah, yielding 2,365 birds per month during April and May 2014. If this rate persisted yearlong, then Ivanpah might be killing 28,380 birds, which would be 3.6 times greater than the fatality rate I predicted.” With such widely differing estimates, it is clear that systematic study and efforts to standardize data through the development of systematic monitoring protocols are needed to make any conclusions about the avian risks of utility-scale solar development.

Although Ivanpah is also a CSP plant and therefore not directly comparable to the proposed PV 2 facility, it again points to collisions with reflective surfaces as a potentially significant cause of mortality at solar plants.

Weekly mortality searches at 20% coverage are also being conducted at the 1 300ha California Valley Solar Ranch PV site (Harvey & Associates 2014a and 2014b). According to the information that could be sourced from the internet (two quarterly reports), 152 avian mortalities were reported for the period 16 November 2013 – 15 February 2014, and 54 for the period 16 February 2014 – 15 May 2014, of which approximately 90% were based on feathers spots which precluded a finding on the cause of death. These figures give an estimated unadjusted 1 030 mortalities per year, which is obviously an underestimate as it does not include adjustments for carcasses removed by scavengers and missed by searchers. The authors stated clearly that these quarterly reports do not include the results of searcher efficiency trials, carcass removal trials, or data analyses, nor does it include detailed discussions.

Although the quarterly reports compiled for the California Valley Solar Ranch PV site do not attempt to identify the cause of death, the fact that collisions with reflective surfaces are a proven cause of mortality at solar plants makes this the most likely cause of death for the majority of recorded mortalities.

In a report by the National Fish and Wildlife Forensic Laboratory (Kagan *et al.* 2014), the cause of avian mortalities was estimated based on opportunistic avian carcass collections at the 1 600ha Ivanpah CSP, 1 600ha Desert Sunlight PV and 1 880ha Genesis Parabolic Trough solar plants. The results of the investigation are tabled below in Table 3:

Table 3: Comparison of avian mortality causes at three solar plants in California, USA (Kagan et al. 2014).

Cause of death	Ivanpah CSP	Genesis Parabolic trough CSP	Desert Sunlight PV	Total
Solar flux	47	0	0	47
Impact trauma	24	6	19	49
Predation trauma	5	2	15	22
Trauma of undetermined causes	14	0	0	14
Electrocution	1	0	0	1
Emaciation	1	0	0	1
Undetermined (remains in poor condition)	46	17	22	85
No evident cause of death	3	6	5	14
Total	141	31	61	233

When the results of the three solar plants are pooled, collisions with reflective surfaces (impact trauma) emerge as the highest single identifiable cause of avian mortality. In the case of Desert Sunlight PV, impact trauma and predation trauma together are the biggest identifiable causes of avian mortality.

Sheet glass used in commercial and residential buildings has been well established as a hazard for birds. A recent comprehensive review estimated between 365 – 988 million birds are killed annually in the USA due to collisions with glass panels (Loss *et al*. 2014). It is therefore to be expected that the reflective surfaces of solar panels will constitute a similar risk to avifauna. A related problem is the so-called “lake effect” i.e. it seems very likely that reflections from solar facilities' infrastructure, particularly large sheets of dark blue photovoltaic panels, may well be attracting birds in flight across the open desert, who mistake the broad reflective surfaces for water (Kagan *et al.* 2014). This could either result in birds colliding directly with the solar panels, or getting stranded and unable to take off again because many aquatic bird species find it very difficult and sometimes impossible to take off from dry land e.g. grebes and cormorants. This exposes them to predation, even if they do not get injured through direct collisions with the panels. The unusually high number of waterbird mortalities at the Desert Sunlight PV facility (44%) seems to support this hypothesis. In the case of Desert Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water.

Variables that may affect the illusory characteristics of solar panels are structural elements or markings that may break up the reflection. Visual markers spaced at distances of 28cm apart or less have been shown to reduce the number of window strike events on large commercial buildings (Kagan *et al.* 2014). A paper by Horvath *et al*. (2010) provides experimental evidence that placing a white outline and/or white grid lines on solar panels significantly reduce the attractiveness of those panels to aquatic insects, with a loss of only 1.8% in energy producing surface area. While similar detailed studies have yet to be carried out with birds, this work, combined with the window strike results, suggest that significant reductions in avian mortality at solar facilities could be achieved by relatively minor modifications of panel and mirror design (Kagan *et al.* 2014). This could be an experimental mitigation measure should results of the operational phase monitoring indicate significant mortality of priority avifauna due to collisions with the solar arrays at the proposed facility.

Sendawo PV 2

The priority species that could potentially occur in the core study area and immediate surroundings and which could potentially be exposed to collision risk at the PV site is tabled in Table 1. The so-called “lake effect” could act as an attraction to some species and it is expected that flocking species such as Namaqua Sandgrouse, mixed flocks of seed-eaters consisting of Sociable Weaver, Cape Sparrow, Red-headed Finch, Scaly-feathered Finch, Yellow Canary, Namaqua Sandgrouse and Lark-like Bunting, and several species of doves would be most susceptible to this impact as they habitually arrive in flocks at water holes to drink. Multiple mortalities could potentially result from this, which in turn could attract raptors e.g. Southern Pale Chanting Goshawk Lanner Falcon and Gabar Goshawk which will feed on dead and injured birds which could in turn expose them to collision risk, especially when pursuing injured birds. In addition, the “lake effect” produced by the solar panels may draw various water birds to the area (see Table 1), including endemics e.g. the South African Shelduck and possibly even the Red Data Black Stork. The proximity of the Dry Harts River to the site may act as an additional aggravating factor as it already holds an attraction for waterbirds.

6.1.2 Displacement due to habitat transformation and disturbance associated with the construction and operation of the plant

Ground-disturbing activities affect a variety of processes in arid areas, including soil density, water infiltration rate, vulnerability to erosion, secondary plant succession, invasion by exotic plant species, and stability of cryptobiotic soil crusts. All of these processes have the ability—individually and together—to alter habitat quality, often to the detriment of wildlife, including avifauna. Any disturbance and alteration to the desert landscape, including the construction and decommissioning of utility-scale solar energy facilities, has the potential to increase soil erosion. Erosion can physically and physiologically affect plant species and can thus adversely influence primary production and food availability for wildlife (Lovich & Ennen 2011).

Solar energy facilities require substantial site preparation (including the removal of vegetation) that alters topography and, thus, drainage patterns to divert the surface flow associated with rainfall away from facility infrastructure. Channelling runoff away from plant communities can have dramatic negative effects on water availability and habitat quality in arid areas. Areas deprived of runoff from sheet flow support less biomass of perennial and annual plants relative to adjacent areas with uninterrupted water-flow patterns (Lovich & Ennen 2011).

The activities listed below are typically associated with the construction and operation of solar facilities and could have direct impacts on avifauna (County of Merced 2014):

- Preparation of solar panel areas for installation, including vegetation clearing, grading, cut and fill;
- Excavation/trenching for water pipelines, cables, fibre-optic lines, and the septic system;
- Construction of piers and building foundations;
- Construction of new dirt or gravel roads and improvement of existing roads;
- Temporary stockpiling and side-casting of soil, construction materials, or other construction wastes;
- Soil compaction, dust, and water runoff from construction sites;
- Increased vehicle traffic;
- Short-term construction-related noise (from equipment) and visual disturbance;

- Degradation of water quality in drainages and other water bodies resulting from project runoff;
- Maintenance of fire breaks and roads; and
- Weed removal, brush clearing, and similar land management activities related to the ongoing operation of the project.

These activities could have an impact on birds breeding, foraging and roosting in or in close proximity through disturbance and transformation of habitat, which could result in temporary or permanent displacement.

At the 1 600ha Ivanpah Solar Electric Generating System CSP (Ivanpah) facility, seventeen avian use surveys were conducted at each of 80 survey points (40 in desert bajada habitat and 40 in heliostat arrays), representing more than 350 hours of survey effort. Species composition was compared between these avian use survey results and detections during standardized monitoring surveys. A total of 54 bird species were recorded on avian use surveys during the first four seasons. Total species richness was highest in the desert (47 species), and much lower in the heliostat grids (24 species).

Evidently, the same is true for PV plants. In a study comparing the avifaunal habitat use in PV arrays with adjoining managed grassland at airports in the USA, DeVault *et al.* (2014) found that species diversity in PV arrays was reduced compared to the grasslands (37 vs 46), supporting the view that solar development is generally detrimental to wildlife on a local scale. It is highly likely that the same pattern of reduced avifaunal densities will manifest itself at the proposed facility.

<u>Sendawo PV 2</u>

See Table 1 for a list of the priority species that could potentially be affected by this impact. Small birds are often capable of surviving in small pockets of suitable habitat, and are therefore generally less affected by habitat fragmentation than larger species. It is therefore likely that many of the smaller species will continue to use the habitat available within the solar facility albeit at lower densities. This will however differ from species to species and it may not be true for all of the smaller species. Larger species which require contiguous, un-fragmented tracts of suitable habitat (e.g. large raptors, korhaans and bustards) are more likely to be displaced entirely from the area of the proposed plant although in the case of some raptors (e.g. Southern Pale Chanting Goshawk, Lanner Falcon and Gabar Goshawk) the potential availability of carcasses or injured birds due to collisions with the PV panels may actually attract them to the area. The overall significance of the potential displacement impact is difficult to assess at this stage and will have to be determined through post-construction surveys.

7. IMPACT TABLES

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

7.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in the table below.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

7.2 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact has been detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district

3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		

1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question. While a single activity may itself result in a minor impact, it may, when combined with other impacts (minor or significant) in the same geographical area, and occurring at the same time, result in a cumulative impact that is collectively significant.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".

74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

7.3 Impact Assessments

7.3.1 Construction Phase

CONSTRUCTION: PV PLANT AND ASSOCIATED INFRASTRUCTURE		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.*	
Extent	*Site = 1 The displacement impact will be restricted to the site.*	
Probability	*Definite = 4 The impact will definitely occur.*	
Reversibility	*Barely reversible = 3 The impact is unlikely to be reversed as the habitat transformation after the construction phase will be significant. Many species will not be able to re-colonise the area.*	
Irreplaceable loss of resources	*Significant loss of resources = 3 The impact on priority species will result in a significant loss of resources at a site level (see also discussion on cumulative impacts below).*	
Duration	*Long term = 3 The impact is likely to continue for the duration of the operational phase.*	
Cumulative effect	*High cumulative impact = 4 The cumulative impact will be high at a site level (see also discussion on cumulative impacts below)*	
Intensity/magnitude	*High = 3 At a site level the functioning of the bird population will be severely impacted and for many species it will cease completely.*	
Significance Rating	*18 x 3 = 54* *Negative high impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	3	3
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	3	3

Significance rating	-54 (High negative)	-51 (High negative)
Mitigation measures	• *Construction activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the industry.* • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*	

7.3.2 Operational Phase

OPERATION: PV PLANT AND ASSOCIATED INFRASTRUCTURE	
Environmental Parameter	*Avifauna*
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.*
Extent	*Site = 1 The displacement impact will be restricted to the site.*
Probability	*Definite = 4 The impact will definitely occur.*
Reversibility	*Barely reversible = 3 The impact is unlikely to be reversed as the habitat transformation after the construction phase will be significant. Many species will not be able to re-colonise the area.*
Irreplaceable loss of resources	*Significant loss of resources = 3The impact on priority species will result in a significant loss of resources at a site level (see also discussion on cumulative impacts below).*
Duration	*Long term = 3 The impact is likely to continue right through the operational life-time of the facility.*
Cumulative effect	*High cumulative impact = 4The cumulative impact will be high at a site level (see also discussion on cumulative impacts below)*
Intensity/magnitude	*High = 3 At a site level the functioning of the bird population will be severely impacted and for many species it will cease completely.*
Significance Rating	*17 x 3 = 51* *Negative medium impact*

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	3	3
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	-54 (high negative)	-51 (medium negative)

Mitigation measures	• *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *The vegetation between the solar arrays should be maintained in as close a state as possible to the original vegetation.* • *The recommendations for the vegetation management as detailed in the botanical specialist report must be strictly implemented*.

OPERATION: PV PLANT AND ASSOCIATED INFRASTRUCTURE		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Mortality of priority species due to collisions with solar panels*	
Extent	*Site = 1 The impact should only affect the site*	
Probability	*Probable = 3 The impact will likely occur.*	
Reversibility	*Partly reversible = 2 The impact is partly reversible but more intense mitigation measures are required.*	
Irreplaceable loss of resources	*Marginal loss of resources = 2 The impact on priority species is likely to be moderate.*	
Duration	*Long term = 3 The impact is likely to continue right through the operational life-time of the facility.*	
Cumulative effect	*Medium cumulative impact = 3 The cumulative impact on priority species is likely to be moderate.*	
Intensity/magnitude	*Medium = 2 At a local level the functioning of the bird population will be moderately affected.*	
Significance Rating	*14 x 2 = 28* *Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	-28 (low negative)	-22 (low negative)
Mitigation measures	• *Monitoring should be implemented to search the ground between arrays of solar panels on a two-weekly basis for at least one year to determine*	

	the magnitude of collision fatalities. Searches should be done on foot. Searches should be conducted randomly or at systematically selected arrays of solar panels to the extent that equals 33% or more of the project area. Detection trials should be integrated into the searches. • *The exact protocol to be followed for the operational phase monitoring should be compiled by the avifaunal specialist in consultation with the plant operator and Environmental Control Officer before the commencement of operations. The exact scope and nature of the operational phase monitoring will be informed on an ongoing basis by the result of the monitoring and the EMP will be updated accordingly.* • *Depending on the results of the carcass searches, a range of mitigation measures will have to be considered if mortality levels turn out to be significant, including minor modifications of panel and mirror design to reduce the illusory characteristics of solar panels. What is considered to be significant will have to be established on a species specific basis by the avifaunal specialist.*

7.3.3 De-commissioning Phase

DE-COMMISSIONING: PV PLANT AND ASSOCIATED INFRASTRUCTURE		
Environmental Parameter	*Avifauna*	
Issue/Impact/Environmental Effect/Nature	*Displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure.*	
Extent	*Site = 1 The displacement impact will be restricted to the site.*	
Probability	*Definite = 4 The impact will definitely occur.*	
Reversibility	*Completely reversible = 1 The impact will be completely reversible on de-commissioning of the plant provided the solar panels are all removed and the habitat allowed to recover over time.*	
Irreplaceable loss of resources	*Marginal loss of resources = 2 The impact on priority species will result in a minor loss of resources at a site level.*	
Duration	*Short term = 1 The impact is likely to last for a short time (0-2 years).*	
Cumulative effect	*Low cumulative impact = 2 The cumulative impact will be high at a site level (see also discussion on cumulative impacts below)*	
Intensity/magnitude	*Low = 1 At a site level the functioning of the bird population will be slightly impacted.*	
Significance Rating	*11 x 1 = 11* *Negative low impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	3
Reversibility	1	1
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	-11 (low negative)	-10 (low negative)
Mitigation measures	• *De-commissioning activity should be restricted to the immediate footprint of the infrastructure.* • *Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species.* • *Measures to control noise and dust should be applied according to current best practice in the*	

	industry. • *Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.*

7.4 Impact Summary

The impacts were summarised and a comparison made between pre- and post- mitigation phases as shown in Table 4 below. The rating of environmental issues associated with different parameters prior to and post mitigation of a proposed activity was averaged. A comparison was then made to determine the effectiveness of the proposed mitigation measures. The comparison identified critical issues related to the environmental parameters (see Table 4 below). The summarised impacts tabled below are valid for both alternatively-outs, as the difference between the two lay-outs relates only to the locality of the substation, operations building and lay-down area, none of which are significant stand-alone components as far as potential impacts on the avifauna is concerned.

Table 4: Comparison of summarised impacts on environmental parameters.

Environmental parameter	Issues	Rating prior to mitigation	Rating post mitigation
Avifauna	Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.	- 54 (high negative)	-51 (high negative)
	Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure	- 54 (high negative)	-51 (high negative)
	Mortality of priority species due to collisions with solar panels	-28 (low negative)	-22 (low negative)
	Displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure.	-11 (low negative)	-10 (low negative)
	Average	**36.7 (medium negative)**	**33.5 (medium negative)**

The 2010 EIA regulations also specify that alternatives must be compared in terms of impact assessment.

Table 5 below sets out the comparative assessment of the various alternatives.

Table 5: Comparison of lay-out alternatives

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons
OPERATIONS BUILDING AND SUBSTATION		
Sendawo PV 2 Operations Building and Substation Alternative 1	**NO PREFERENCE**	The extent of the impacts of the two lay-out alternatives is identical for all practical reasons, as the difference between the two lay-outs relates only to the locality of the substation, operations building and lay-down area, none of which are significant stand-alone components as far as potential impacts on the avifauna is concerned. Both alternatives should therefore result in equal impacts.
Sendawo PV 2 Operations Building and Substation Alternative 2	**NO PREFERENCE**	The extent of the impacts of the two lay-out alternatives is identical for all practical reasons, as the difference between the two lay-outs relates only to the locality of the substation, operations building and lay-down area, none of which are significant stand-alone components as far as potential impacts on the avifauna is concerned. Both alternatives should therefore result in equal impacts.

LAYDOWN AREA		
Sendawo PV 2 Laydown Area Alternative 1	**NO PREFERENCE**	The extent of the impacts of the two lay-out alternatives is identical for all practical reasons, as the difference between the two lay-outs relates only to the locality of the substation, operations building and lay-down area, none of which are significant stand-alone components as far as potential impacts on the avifauna is concerned. Both alternatives should therefore result in equal impacts.
Sendawo PV 2 Laydown Area Alternative 2	**NO PREFERENCE**	The extent of the impacts of the two lay-out alternatives is identical for all practical reasons, as the difference between the two lay-outs relates only to the locality of the substation, operations building and lay-down area, none of which are significant stand-alone components as far as potential impacts on the avifauna is concerned. Both alternatives should therefore result in equal impacts.

8. CUMULATIVE IMPACTS

The proposed renewable energy developments (known to the author) within a 25km radius around the site is listed in table 3 below (see also Figure 6):

Table 3: Renewable energy developments proposed within a 25km radius from the Sendawo PV application site

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Scoping and EIA processes underway.	Kabi Solar (Pty) Ltd	75MW	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390	Environmental authorisation received	Sediba Power Plant (Pty) Ltd	75MW	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308	Environmental authorisation received and preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75MW	Southern portion of the Farm Waterloo 992

Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	Environmental authorisation received	Cronos Energy (Pty) Ltd	75MW	Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	Environmental authorisation received 29 June 2013. Amended to 75MW on 4 April 2014.	Carocraft (Pty) Ltd	75MW	Portion 1 and the Remainder of the Farm Weltevrede 681
Expansion of the Carocraft Solar Park	14/12/16/3/3/2/699	Scoping and EIA processes underway.	Carocraft (Pty) Ltd	75MW	Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 1 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 1 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729
Woodhouse Solar 2 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 2 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729

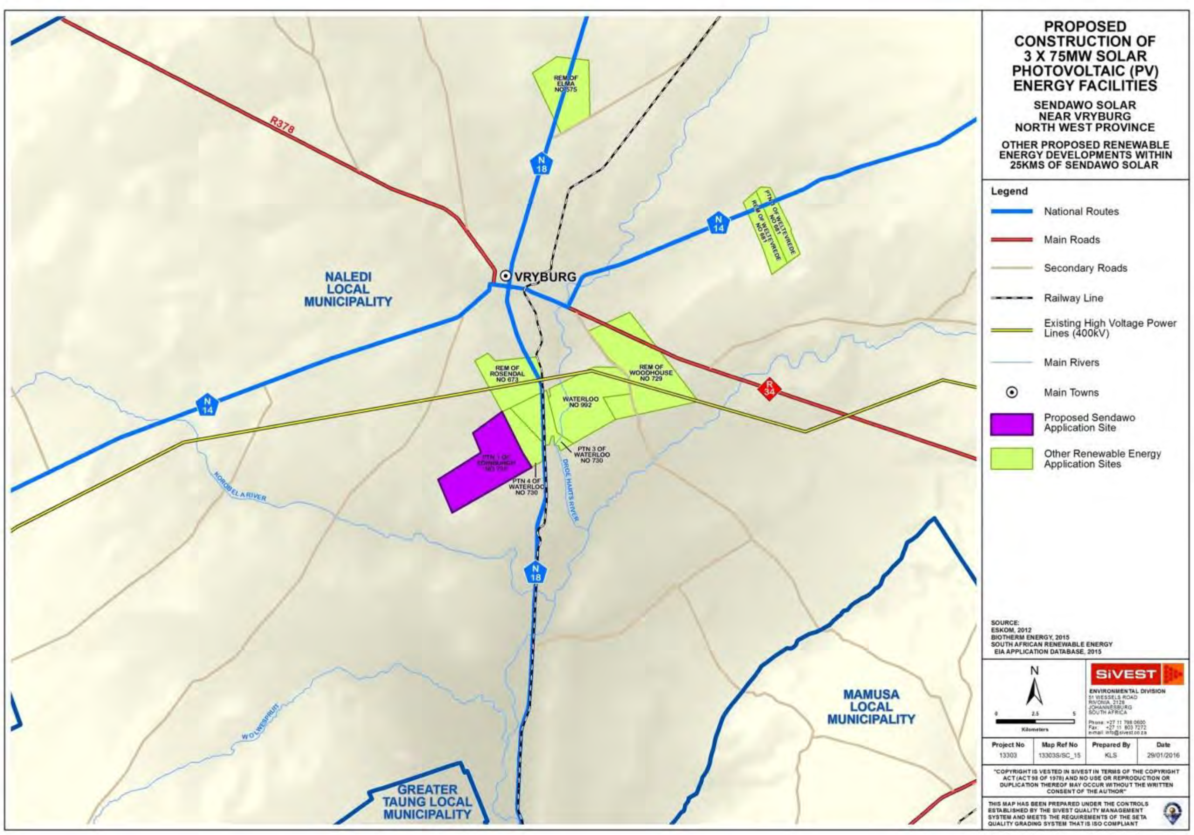


Figure 6: Renewable energy developments proposed within a 25km radius from the proposed Sendawo PV application site

The total surface area in a 25km radius around the proposed development amounts to approximately 194 874ha. The combined area taken up by the proposed renewable energy developments, including the Sendawo PV 1, 2 and 3 projects, amounts to approximately 9 797ha. This is approximately 5% of the total amount of habitat available within the 25km radius. The potential cumulative impact of the Sendawo PV 1, 2 and 3 projects on priority species is therefore rated as low.

9. SENSITIVITY MAP

The core study area is located in the endemic region with the fourth highest number of endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring in the study area, the application site and immediate surroundings should be regarded as moderately sensitive from an avifaunal perspective. There are no potential high sensitivity areas in the core study area itself. Within the immediate surroundings, potential high sensitive areas are the natural spring which is a source of surface water, a borehole and an ephemeral river with seasonal pools of water, as these micro-habitats are a potential focal point of bird activity. It is important to note that the sensitivity of the study area could be influenced by the development itself, in that the construction of the solar panels at the adjacent PV 1 facility will result in the relocation of surface water (in this instance the small concrete impoundment at the natural spring). The sensitivity map in Figure 8 should be interpreted from that perspective.

10. CONCLUSIONS

The proposed BioTherm PV 2 facility is located in the endemic region with the fourth highest number of endemics in southern Africa. With 20% of all southern African endemics or near endemics potentially occurring at the core study area and immediate surroundings, the application site and immediate surroundings as a whole should be regarded as moderately sensitive from an avifaunal perspective.

No potentially high sensitive, no-go areas were identified in the core study area. A small concrete impoundment at a natural spring, a borehole and the Dry Harts River were identified as potential high sensitive areas in the immediate surroundings, as these micro-habitats are potential focal points of bird activity. It is important to note that the sensitivity of the study area could be influenced by the development itself, in that the construction of the solar panels at the adjacent PV 1 facility will result in the relocation of the impoundment, currently located at the natural spring, which means that the 250m zone currently classified as high sensitive around the impoundment could fall away. The potential impact of displacement of priority species due to disturbance associated with construction of the PV 2 plant and associated infrastructure are rated as high, and will remain so after mitigation. The potential impact of displacement of priority species due to habitat transformation associated with construction of the PV 2 plant and associated infrastructure, is also rated as high and will remain so after mitigation. The impact of mortality of priority species due to collisions with solar panels is rated as low and could be further reduced through mitigation. The impact of displacement of priority species due to disturbance associated with de-commissioning of the PV 2 plant and associated infrastructure is likewise rated as low and could be further reduced through mitigation.

In view of the very dry conditions which prevailed at the site during the pre-construction monitoring which was implemented from November 2015 to February 2016, the low number of birds recorded should not necessarily be taken as an absolutely representative snapshot of the typical avifaunal dynamics at the core study area under all conditions.

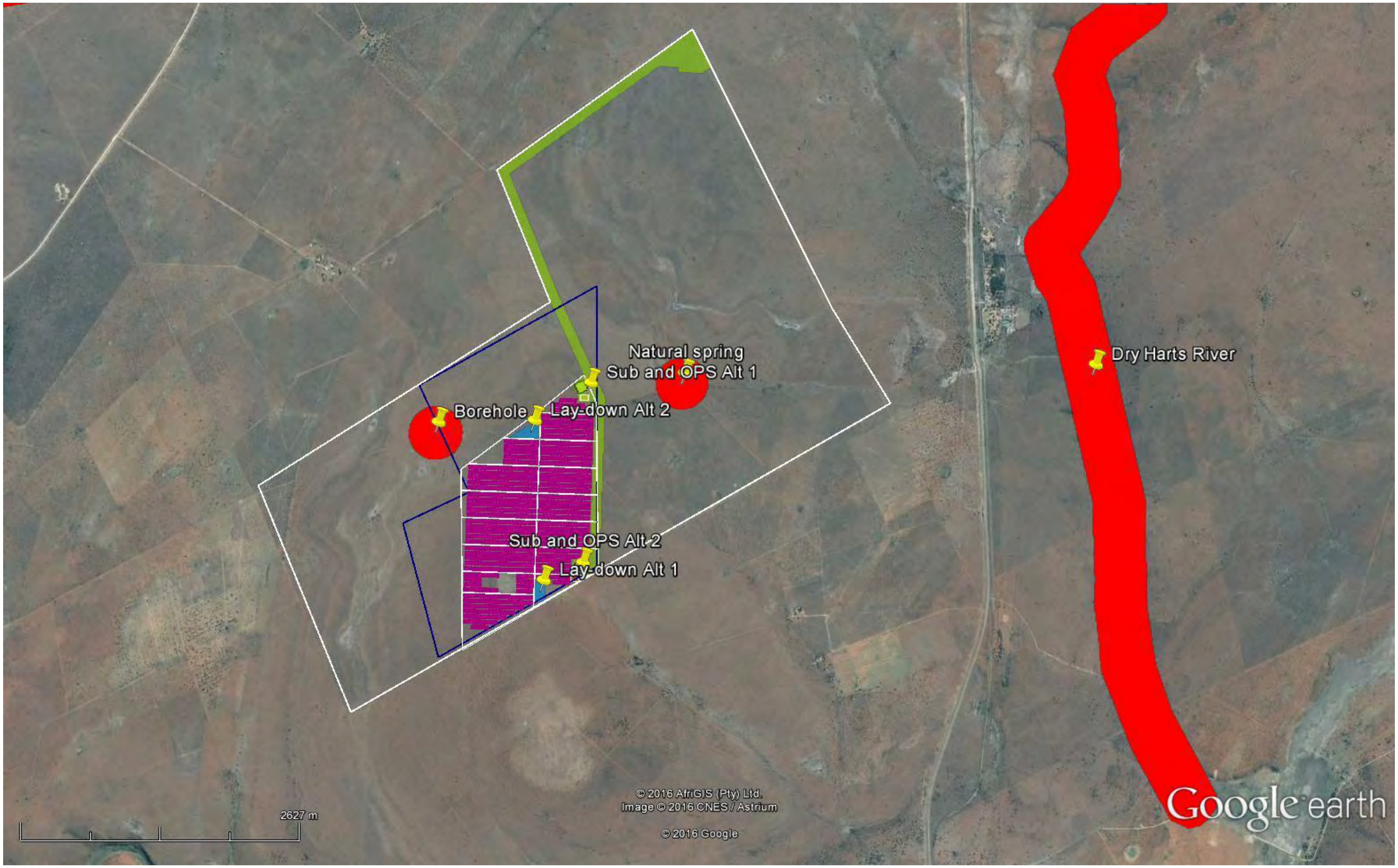


Figure 8: Sensitivity map of the study area. Red areas indicate high sensitivity.

11. RECOMMENDATIONS

See Section 7: IMPACTS TABLES above.

12. REFERENCES

- ANIMAL DEMOGRAPHY UNIT. The southern African Bird Atlas Project 2. University of Cape Town. http://sabap2.adu.org.za. Accessed 9 May 2016.
- BARNES, K.N. (ed.) 1998. The Important Bird Areas of southern Africa. BirdLife South Africa: Johannesburg.
- COUNTY OF MERCED. 2014. Draft Environmental Impact Report for the Wright Solar Park Conditional Use Permit Application CUP12-017. Public Draft. July. (ICF 00552.13.) Merced, CA. Prepared by ICF International, Sacramento, CA.
- H. T. HARVEY & ASSOCIATES. 2014a. California Valley Solar Ranch Project Avian and Bat Protection Plan Sixth Quarterly Post construction Fatality Report 16 November 2013 - 15 February 2014.
- H. T. HARVEY & ASSOCIATES. 2014b. California Valley Solar Ranch Project Avian and Bat Protection Plan Sixth Quarterly Post construction Fatality Report 16 February 2014 - 15 May 2014.
- H. T. HARVEY & ASSOCIATES. 2015. Ivanpah Solar Electric Generating System Avian & Bat Monitoring Plan 2013-2014 Annual Report.
- HARRISON, J.A., ALLAN, D.G., UNDERHILL, L.G., HERREMANS, M., TREE, A.J., PARKER, V & BROWN, C.J. (eds). 1997. The atlas of southern African birds. Vol 1 & 2. BirdLife South Africa, Johannesburg.
- HERNANDEZ, R.R., et al., 2014, "Environmental Impacts of Utility-Scale Solar Energy," Renewable and Sustainable Energy Reviews 29: 766–779.
- HOCKEY P.A.R., DEAN W.R.J., AND RYAN P.G. 2005. Robert's Birds of Southern Africa, seventh edition. Trustees of the John Voelcker Bird Book Fund, Cape Town.
- HUSO, M. 2010. An estimator of wildlife fatality from observed carcasses. Environmetrics 22(3):318–329. Doi: 10.1002/env.1052
- IVANPAH SOLAR ELECTRIC GENERATING SYSTEM. 2014a. ISEGS Monthly Compliance Report 43 April_2014.
- IVANPAH SOLAR ELECTRIC GENERATING SYSTEM. 2014b. ISEGS Monthly Compliance Report 44 May_2014.
- JENKINS, A., DE GOEDE, J.H. & VAN ROOYEN, C.S. 2006. Improving the products of the Eskom Electric Eagle Project. Unpublished report to Eskom. Endangered Wildlife Trust.
- KAGAN, R. A., T. C. VINER, P. W. TRAIL, AND E. O. ESPINOZA. 2014. Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis. National Fish and Wildlife Forensics Laboratory.
- MACLEAN, G.L. 1999. Southern African endemic birds: their distribution and conservation. An invited evening public lecture. http://www.int-ornith-union.org/files/proceedings/durban/South%20African%20Papers/SApaper1.htm.
- MARNEWICK, M.D., RETIEF E.F., THERON N.T., WRIGHT D.R., ANDERSON T.A. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: Birdlife South Africa.
- MCCRARY, M. D., R. L. MCKERNAN, R. W. SCHREIBER, W. D. WAGNER, AND T. C. SCIARROTTA. 1986. Avian mortality at a solar energy plant. J. Field Ornithology 57:135-141.

- MUCINA. L. & RUTHERFORD, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- PHIPPS WL, WOLTER K, MICHAEL MD, MACTAVISH LM, YARNELL RW. 2013. Do Power Lines and Protected Areas Present a Catch-22 Situation for Cape Vultures (*Gyps coprotheres*)? PLoS ONE 8(10): e76794. doi:10.1371/journal.pone.0076794.
- SMALLWOOD, K.S. 2014. Docket Number: 09-AFC-07C. Project Title: Palen Solar Power Project - Compliance. Exhibit 3128. Testimony of K. Shawn Smallwood, Ph.D. California Energy Commission.

APPENDIX 1 PRE-CONSTRUCTION MONITORING

BIRD MONITORING AT SENDAWO SOLAR ENERGY FACILITIES

1. Objectives

The objective of the pre-construction monitoring at the proposed Sendawo Solar Facilities was to gather baseline data over a period of six months on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the solar farm sites to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the solar farm sites to measure the potential impact on flight activity of the solar farm.

2. Methods

The monitoring protocol for the site is designed according to the draft version (November 2015) of Birdlife South Africa *Best Practice Guidelines for assessing and monitoring the impact of solar energy facilities on birds in southern Africa (Jenkins et.al).*

Monitoring surveys were conducted at the proposed PV sites by one field monitor during November 2015, January 2016 and February 2016.

Monitoring was conducted in the following manner:

- Two walk transects of 1km each were identified at the PV sites and counted 8 times per sampling session. All birds were recorded during walk transects.
- The following variables were recorded:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Distance from transect (0-50 m, 50-100 m, >100 m);
    - Wind direction;
    - Wind strength (calm; moderate; strong);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);

  - Temperature (cold; mild; warm; hot);
  - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
  - Co-ordinates (priority species only).

- One vantage point (VP) was identified to record the flight altitude and patterns of priority species. A total of 12 hours per sampling session was spent doing vantage point watches. The following variables were recorded for each flight:
  - Species;
  - Number of birds;
  - Date;
  - Start time and end time;
  - Wind direction;
  - Wind strength (estimated Beaufort scale 1-7);
  - Weather (sunny; cloudy; partly cloudy; rain; mist);
  - Temperature (cold; mild; warm; hot);
  - Flight altitude (high i.e. >200m; medium i.e. 20m – 200m; low i.e. <20m);
  - Flight mode (soar; flap; glide; kite; hover); and
  - Flight time (in 15 second-intervals).

The objective of the transect monitoring was to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind farm activities. The objective of vantage point counts was to measure the potential collision risk with the PV arrays, and to see how flight behaviour is influenced by the PV arrays. Waterbirds, raptors, South African Red Data species and Southern African endemics and near-endemics were classified as priority species.

A potential focal point (FP) of bird activity was identified at the proposed site itself, namely a natural spring with open water (a small concrete impoundment). The impoundment was monitored for the presence of priority species during each of the three surveys.

All incidental sightings of priority species at the core study area and immediate surroundings were also recorded.

Figure 1 below indicates the area where monitoring was performed. Appendix 3 indicates all avifaunal species recorded during the pre-construction monitoring.

Figure 1: Area where monitoring was performed, with position of VP (yellow placemark), focal point (FP1 - blue placemark), walk transects (yellow lines) and land parcel boundaries (white polygon).

APPENDIX 2 BIRD HABITATS

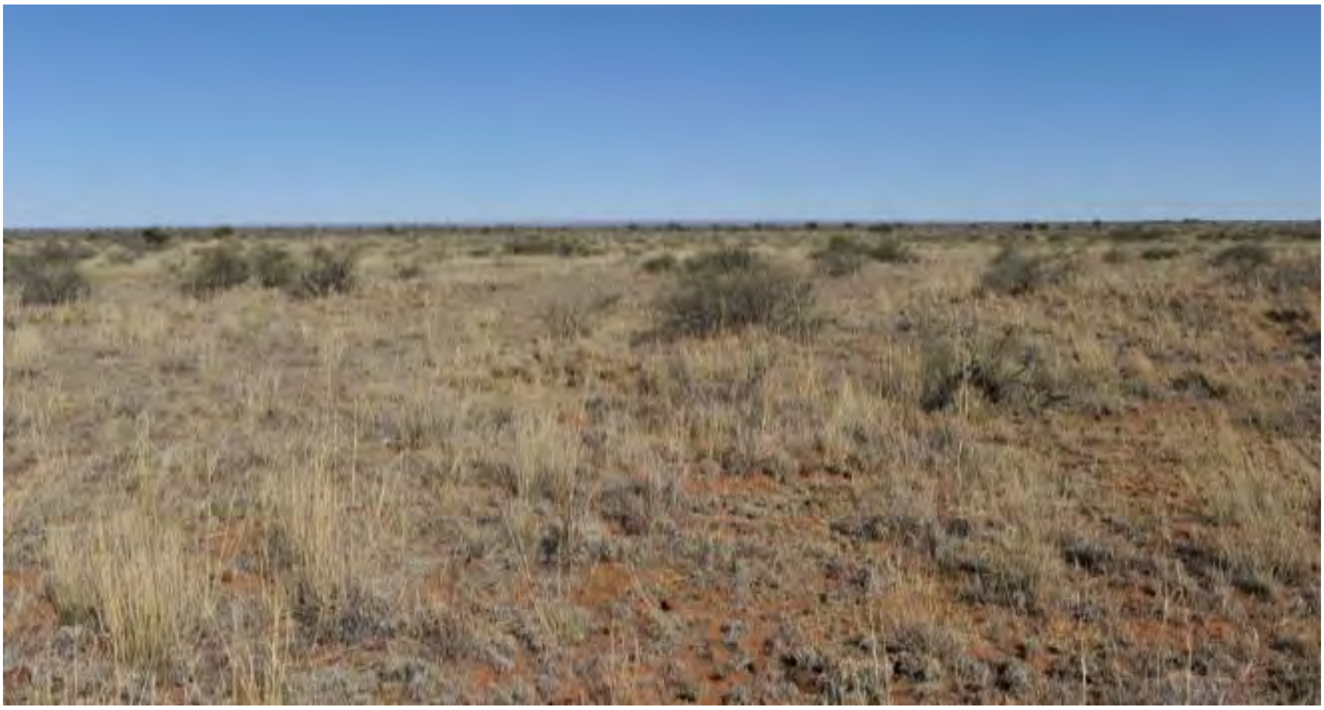


Figure 1: Typical Ghaap Plateau Vaalbosveld in the study area

Figure 2: The ephemeral Dry Harts River

Figure 3: The small concrete impoundment at a natural spring at the adjacent PV 1 facility which was monitored as a focal point.

Figure 4: A reservoir at a borehole situated approximately 400m from the PV 2 core study area.

APPENDIX 3: SPECIES THAT COULD POTENTIALLY OCCUR AT THE CORE STUDY AREA AND IMMEDIATE SURROUNDINGS

Priority species are highlighted

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Abdim's Stork	*Ciconia abdimii*	0	NT	LC	
Acacia Pied Barbet	*Tricholaema leucomelas*	67.5	Near-endemic		
African Black Duck	*Anas sparsa*	0			
African Black Swift	*Apus barbatus*	2.5			
African Darter	*Anhinga rufa*	0			
African Fish-Eagle	*Haliaeetus vocifer*	2.5			
African Grey Hornbill	*Tockus nasutus*	30			
African Harrier-Hawk	*Polyboroides typus*	5			
African Hoopoe	*Upupa africana*	85			
African Palm-Swift	*Cypsiurus parvus*	60			
African Paradise-Flycatcher	*Terpsiphone viridis*	2.5			
African Pipit	*Anthus cinnamomeus*	17.5			
African Purple Swamphen	*Porphyrio madagascariensis*	2.5			
African Quailfinch	*Ortygospiza atricollis*	25			
African Red-eyed Bulbul	*Pycnonotus nigricans*	87.5			
African Sacred Ibis	*Threskiornis aethiopicus*	7.5			
African Snipe	*Gallinago nigripennis*	0			
African Spoonbill	*Platalea alba*	0			
African Stonechat	*Saxicola torquatus*	5			

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Amur Falcon	*Falco amurensis*	7.5			
Ant-eating Chat	*Myrmecocichla formicivora*	2.5	Endemic		x
Ashy Tit	*Parus cinerascens*	10	Near-endemic		
Barn Owl	*Tyto alba*	32.5			
Barn Swallow	*Hirundo rustica*	40			x
Barred Wren-Warbler	*Calamonastes fasciolatus*	0	Near-endemic		
Black Crake	*Amaurornis flavirostris*	2.5			
Black Stork	*Ciconia nigra*	2.5	VU	LC	
Black-chested Prinia	*Prinia flavicans*	55	Near-endemic		x
Black-chested Snake-Eagle	*Circaetus pectoralis*	0			
Black-collared Barbet	*Lybius torquatus*	62.5			
Black-crowned Night-Heron	*Nycticorax nycticorax*	0			
Black-faced Waxbill	*Estrilda erythronotos*	17.5			
Black-headed Heron	*Ardea melanocephala*	17.5			
Black-shouldered Kite	*Elanus caeruleus*	20			
Blacksmith Lapwing	*Vanellus armatus*	70			
Black-throated Canary	*Crithagra atrogularis*	40			
Black-winged Stilt	*Himantopus himantopus*	0			
Blue Waxbill	*Uraeginthus angolensis*	2.5			
Bokmakierie	*Telophorus zeylonus*	10	Near-endemic		x

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Bradfield's Swift	*Apus bradfieldi*	0			
Bronze Mannikin	*Spermestes cucullatus*	15			
Brown Snake-Eagle	*Circaetus cinereus*	0			
Brown-crowned Tchagra	*Tchagra australis*	20			
Brown-hooded Kingfisher	*Halcyon albiventris*	22.5			
Brown-throated Martin	*Riparia paludicola*	2.5			
Brubru	*Nilaus afer*	2.5			
Buffy Pipit	*Anthus vaalensis*	0			
Burchell's Coucal	*Centropus burchellii*	25			
Burchell's Courser	*Cursorius rufus*	0	VU, Near-endemic	LC	
Burchell's Sandgrouse	*Pterocles burchelli*	0	Near-endemic		
Burchell's Starling	*Lamprotornis australis*	0			
Cape Glossy Starling	*Lamprotornis nitens*	65			x
Cape Longclaw	*Macronyx capensis*	0			
Cape Penduline-Tit	*Anthoscopus minutus*	15	Near-endemic		
Cape Robin-Chat	*Cossypha caffra*	62.5			
Cape Sparrow	*Passer melanurus*	95	Near-endemic		x
Cape Teal	*Anas capensis*	0			
Cape Turtle-Dove	*Streptopelia capicola*	47.5			x
Cape Vulture	*Gyps coprotheres*	0	EN	EN	
Cape Wagtail	*Motacilla capensis*	80			
Cape White-eye	*Zosterops virens*	5	Endemic		
Capped Wheatear	*Oenanthe pileata*	0			x

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Cardinal Woodpecker	*Dendropicos fuscescens*	5			
Cattle Egret	*Bubulcus ibis*	25			
Chat Flycatcher	*Bradornis infuscatus*	5	Near-endemic		
Chestnut-backed Sparrowlark	*Eremopterix leucotis*	0			
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*	32.5	Near-endemic		
Cinnamon-breasted Bunting	*Emberiza tahapisi*	7.5			
Comb Duck	*Sarkidiornis melanotos*	0			
Common Fiscal	*Lanius collaris*	40			
Common Moorhen	*Gallinula chloropus*	5			
Common Myna	*Acridotheres tristis*	77.5			
Common Ostrich	*Struthio camelus*	12.5			
Common Quail	*Coturnix coturnix*	0			
Common Sandpiper	*Actitis hypoleucos*	2.5			
Common Scimitarbill	*Rhinopomastus cyanomelas*	0			x
Common Waxbill	*Estrilda astrild*	7.5			
Crested Barbet	*Trachyphonus vaillantii*	75			
Crimson-breasted Shrike	*Laniarius atrococcineus*	17.5	Near-endemic		x
Crowned Lapwing	*Vanellus coronatus*	80			x
Curlew Sandpiper	*Calidris ferruginea*	0			
Desert Cisticola	*Cisticola aridulus*	15			x
Diderick Cuckoo	*Chrysococcyx caprius*	45			
Double-banded Courser	*Rhinoptilus africanus*	0	NT	LC	

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Eastern Clapper Lark	*Mirafra fasciolata*	10	Near-endemic		x
Egyptian Goose	*Alopochen aegyptiacus*	5			
European Bee-eater	*Merops apiaster*	55			x
European Roller	*Coracias garrulus*	2.5	NT	NT	
Fairy Flycatcher	*Stenostira scita*	0	Endemic		
Familiar Chat	*Cercomela familiaris*	12.5			
Fawn-coloured Lark	*Calendulauda africanoides*	10			x
Fiscal Flycatcher	*Sigelus silens*	80	Endemic		
Fork-tailed Drongo	*Dicrurus adsimilis*	30			
Gabar Goshawk	*Melierax gabar*	7.5			
Giant Kingfisher	*Megaceryle maximus*	0			
Glossy Ibis	*Plegadis falcinellus*	0			
Golden-breasted Bunting	*Emberiza flaviventris*	7.5			
Golden-tailed Woodpecker	*Campethera abingoni*	2.5			
Great Crested Grebe	*Podiceps cristatus*	0			
Great Egret	*Egretta alba*	0			
Great Reed-Warbler	*Acrocephalus arundinaceus*	0			
Great Sparrow	*Passer motitensis*	0			
Greater Honeyguide	*Indicator indicator*	0			
Greater Kestrel	*Falco rupicoloides*	12.5			
Greater Striped Swallow	*Hirundo cucullata*	67.5			

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Green Wood-Hoopoe	*Phoeniculus purpureus*	7.5			
Green-backed Heron	*Butorides striata*	2.5			
Green-winged Pytilia	*Pytilia melba*	10			
Grey Heron	*Ardea cinerea*	17.5			
Grey-backed Sparrowlark	*Eremopterix verticalis*	0	Near-endemic		
Groundscraper Thrush	*Psophocichla litsipsirupa*	52.5			
Hadeda Ibis	*Bostrychia hagedash*	77.5			x
Hamerkop	*Scopus umbretta*	0			x
Helmeted Guineafowl	*Numida meleagris*	52.5			x
House Sparrow	*Passer domesticus*	75			
Jacobin Cuckoo	*Clamator jacobinus*	5			
Kalahari Scrub-Robin	*Cercotrichas paena*	67.5	Near-endemic		x
Karoo Thrush	*Turdus smithi*	80	Endemic		
Kittlitz's Plover	*Charadrius pecuarius*	0			
Klaas's Cuckoo	*Chrysococcyx klaas*	12.5			
Kori Bustard	*Ardeotis kori*	0	NT	NT	x
Lanner Falcon	Falco biarmicus	0	VU	LC	x
Lark-like Bunting	*Emberiza impetuani*	2.5	Near-endemic		x
Laughing Dove	*Streptopelia senegalensis*	97.5			x
Lesser Grey Shrike	*Lanius minor*	22.5			x
Lesser Honeyguide	*Indicator minor*	2.5			
Lesser Kestrel	*Falco naumanni*	12.5			
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	5			

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Levaillant's Cisticola	*Cisticola tinniens*	12.5			
Lilac-breasted Roller	*Coracias caudatus*	20			
Little Bee-eater	*Merops pusillus*	7.5			
Little Egret	*Egretta garzetta*	5			
Little Grebe	*Tachybaptus ruficollis*	2.5			
Little Stint	*Calidris minuta*	0			
Little Swift	*Apus affinis*	57.5			x
Long-billed Crombec	*Sylvietta rufescens*	2.5			
Long-tailed Paradise-Whydah	*Vidua paradisaea*	27.5			
Long-tailed Widowbird	*Euplectes progne*	2.5			
Maccoa Duck	*Oxyura maccoa*	2.5	NT	NT	
Malachite Kingfisher	*Alcedo cristata*	0			
Mallard Duck	*Anas platyrhynchos*	0			
Marico Flycatcher	*Bradornis mariquensis*	2.5			x
Marico Sunbird	*Cinnyris mariquensis*	25			
Marsh Owl	*Asio capensis*	0			
Marsh Sandpiper	*Tringa stagnatilis*	2.5			
Martial Eagle	*Polemaetus bellicosus*	0	EN	VU	x
Namaqua Dove	*Oena capensis*	40			x
Namaqua Sandgrouse	*Pterocles namaqua*	2.5	Near-endemic		
Neddicky	*Cisticola fulvicapilla*	42.5			x
Northern Black Korhaan	*Afrotis afraoides*	65	Endemic		x
Olive Thrush	*Turdus olivaceus*	0			

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Orange River Francolin	*Scleroptila levaillantoides*	17.5			
Orange River White-eye	*Zosterops pallidus*	65	Endemic		
Pearl-spotted Owlet	*Glaucidium perlatum*	35			
Pied Crow	*Corvus albus*	77.5			x
Pied Kingfisher	*Ceryle rudis*	2.5			
Pin-tailed Whydah	*Vidua macroura*	42.5			
Plain-backed Pipit	*Anthus leucophrys*	2.5			
Pririt Batis	*Batis pririt*	7.5	Near-endemic		
Purple Heron	*Ardea purpurea*	0			
Purple Roller	*Coracias naevius*	2.5			
Rattling Cisticola	*Cisticola chiniana*	12.5			
Red-backed Shrike	*Lanius collurio*	15			
Red-billed Firefinch	*Lagonosticta senegala*	52.5			
Red-billed Quelea	*Quelea quelea*	30			x
Red-billed Teal	*Anas erythrorhyncha*	10			
Red-breasted Swallow	*Hirundo semirufa*	20			
Red-capped Lark	*Calandrella cinerea*	7.5			
Red-crested Korhaan	*Lophotis ruficrista*	7.5			
Red-eyed Dove	*Streptopelia semitorquata*	87.5			x
Red-faced Mousebird	*Urocolius indicus*	80			
Red-headed Finch	*Amadina erythrocephala*	57.5	Near-endemic		
Red-knobbed Coot	*Fulica cristata*	10			

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Reed Cormorant	*Phalacrocorax africanus*	2.5			
Rock Dove	*Columba livia*	42.5			
Rock Kestrel	*Falco rupicolus*	0			
Rock Martin	*Hirundo fuligula*	17.5			
Ruff	*Philomachus pugnax*	0			
Rufous-naped Lark	*Mirafra africana*	30			x
Sabota Lark	*Calendulauda sabota*	17.5	Near-endemic		x
Scaly-feathered Finch	*Sporopipes squamifrons*	80	Near-endemic		x
Secretarybird	*Sagittarius serpentarius*	0	VU	VU	
Shaft-tailed Whydah	*Vidua regia*	10			x
Sociable Weaver	*Philetairus socius*	0	Endemic		
South African Cliff-Swallow	*Hirundo spilodera*	17.5	Endemic		x
South African Shelduck	*Tadorna cana*	0	Endemic		
Southern Grey-headed Sparrow	*Passer diffusus*	30			
Southern Pale Chanting Goshawk	*Melierax canorus*	7.5	Near-endemic		
Southern Pied Babbler	*Turdoides bicolor*	0	Endemic		
Southern Pochard	*Netta erythrophthalma*	2.5			
Southern Red Bishop	*Euplectes orix*	30			
Southern Yellow-billed Hornbill	*Tockus leucomelas*	2.5			
Speckled Pigeon	*Columba guinea*	95			

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
Spike-heeled Lark	*Chersomanes albofasciata*	0	Near-endemic		x
Spotted Eagle-Owl	*Bubo africanus*	7.5			
Spotted Flycatcher	*Muscicapa striata*	12.5			
Spotted Thick-knee	*Burhinus capensis*	45			
Spur-winged Goose	*Plectropterus gambensis*	5			
Steppe Buzzard	*Buteo vulpinus*	12.5			x
Swainson's Spurfowl	*Pternistis swainsonii*	47.5			
Swallow-tailed Bee-eater	*Merops hirundineus*	10			
Three-banded Plover	*Charadrius tricollaris*	0			
Village Indigobird	*Vidua chalybeata*	5			
Violet-eared Waxbill	*Granatina granatina*	27.5			
Wattled Starling	*Creatophora cinerea*	10			x
White-backed Mousebird	*Colius colius*	40	Endemic		x
White-backed Vulture	*Gyps africanus*	0	CR	CR	
White-bellied Sunbird	*Cinnyris talatala*	17.5			
White-breasted Cormorant	*Phalacrocorax carbo*	0			
White-browed Sparrow-Weaver	*Plocepasser mahali*	30			x
White-faced Duck	*Dendrocygna viduata*	15			
White-rumped Swift	*Apus caffer*	55			x

Species	Scientific name	SABAP2 reporting rate	Red Data status	Global status	Recorded during pre-construction monitoring
White-throated Swallow	*Hirundo albigularis*	10			
Willow Warbler	*Phylloscopus trochilus*	5			
Wood Sandpiper	*Tringa glareola*	0			
Yellow Canary	*Crithagra flaviventris*	75	Near-endemic		
Yellow-bellied Eremomela	*Eremomela icteropygialis*	7.5			x
Yellow-billed Duck	*Anas undulata*	12.5			
Yellow-billed Egret	*Egretta intermedia*	0			
Yellow-billed Kite	*Milvus aegyptius*	0			
Yellow-crowned Bishop	*Euplectes afer*	5			
Zitting Cisticola	*Cisticola juncidis*	12.5			x

Appendix 6C:
Surface Water Assessment

BIOTHERM ENERGY (PTY) LTD

Proposed Construction of the 75MW Sendawo 2 Solar Photovoltaic (PV) Energy Facility near Vryburg, North West Province

Surface Water Impact Assessment Report

Issue Date: 27th May 2016
Revision No.: 1
Project No.: 13303

Date:	27th May 2016
Document Title:	Proposed Construction of the 75MW Sendawo 2 Solar Photovoltaic (PV) Energy Facility near Vryburg, North West Province - Surface Water Impact Assessment Report
Author:	Shaun Taylor
Revision Number:	1
Checked by:	Lynsey Rimbault
Approved:	Rebecca Thomas
Signature:	Thomas
For:	SiVEST Environmental Division

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Proposed Construction of the 75MW Sendawo 2 Solar Photovoltaic (PV) Energy Facility near Vryburg, North West Province - Surface Water Impact Assessment Report

Specialist:	SiVEST South Africa (Pty) Ltd		
Contact person:	Shaun Taylor		
Postal address:	P O Box 2921, Rivonia		
Postal code:	2128	Cell:	072 779 4899
Telephone:	011 798 0600	Fax:	011 803 7272
E-mail:	shaunt@sivest.co.za		
Professional affiliation(s) (if any)	South African Wetland Society (SAWS)		

Project Consultant:	SiVEST South Africa (Pty) Ltd		
Contact person:	Rebecca Thomas		
Postal address:	P O Box 2921, Rivonia		
Postal code:	2128	Cell:	082 302 9010
Telephone:	011 798 0600	Fax:	011 803 7272
E-mail:	Rebeccat@sivest.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Shaun Taylor ______________________, declare that -- General

declaration:

I act as the independent specialist in this application;

I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

I declare that there are no circumstances that may compromise my objectivity in performing such work;

I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;

I will comply with the Act, Regulations and all other applicable legislation;

I have no, and will not engage in, conflicting interests in the undertaking of the activity;

I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;

All the particulars furnished by me in this form are true and correct; and

I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SiVEST South Africa (Pty) Ltd

Name of company (if applicable):

27th May 2016

Date:

BIOTHERM ENERGY (PTY) LTD

PROPOSED CONSTRUCTION OF THE 75MW SENDAWO 2 SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR VRYBURG, NORTH WEST PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

Contents **Page**

LIST OF TABLES

LIST OF FIGURES

BIOTHERM ENERGY (PTY) LTD

PROPOSED CONSTRUCTION OF THE 75MW SENDAWO 2 SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR VRYBURG, NORTH WEST PROVINCE

SURFACE WATER IMPACT ASSESSMENT REPORT

1 INTRODUCTION

BioTherm Energy (Pty) Ltd (hereafter referred to as "BioTherm") are proposing to construct a Solar Photovoltaic (PV) development, including an associated substation and a 400kV power line, located near Vryburg, in the North West Province (hereafter referred to as the "proposed development"). Sendawo Solar will consist of three (3) 75MW solar PV facilities, namely Sendawo Solar 1, Sendawo Solar 2 and Sendawo Solar 3. In addition, a substation and a 400 kV power line will connect the PV facilities to the proposed Sendawo substation.

In terms of the Environmental Impact Assessment (EIA) Regulations (08 December 2014) promulgated under Sections 24 and 24D of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), various aspects of the proposed development are considered to fall within the ambit of listed activities which may have an impact on the environment, and therefore require environmental authorisation from the National Department of Environmental Affairs (DEA) prior to the commencement of such activities.

It has been identified that an EIA process is to be followed which will require scoping and impact phase assessments for the proposed Sendawo PV and 400kV power line and substation developments. It must be noted that each respective PV facility will be treated separately for the purpose of this EIA process. The same will be done for the associated substation and 400kV power line. Four (4) EIAs will therefore be undertaken with regards to the proposed PV development (3 for the PV facilities and 1 for the substation and 400kV power line).

Having completed the scoping phase assessment, the second phase of the environmental authorisation process will be the impact assessment phase. This will provide detailed information obtained as a result of on-site fieldwork undertaken to verify and groundtruth desktop findings in the scoping phase. The fieldwork information will also include any additional findings that were not identified in the desktop assessment. This report will furthermore provide details on the project type (technology considered, output capacity, layout alternatives etc.), the anticipated legislative requirements, comparative assessment of the alternatives to be considered, and finally the potential environmental and cumulative impacts that could be associated with the proposed development and other surrounding developments respectively from a surface water perspective.

SiVEST Environmental Division has been appointed as the independent surface water specialist consultant to undertake the surface water assessment for all the Sendawo Solar PV facilities as well as the 400kV power line and substation proposed near Vryburg. Note, however, that this report will only include findings on the 75MW Sendawo 2 Solar Facility. Associated studies for the remaining components have been compiled in separate reports for each separate impact assessment.

1.1 Legislative Context

1.1.1 National Water Act, 1998 (Act No. 36 of 1998)

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) was created in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. The NWA recognises that the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users. Bearing these principles in mind, there are a number of stipulations within the NWA that are relevant to the potential impacts on rivers, streams and wetlands that may be associated with the proposed development. These stipulations are explored below and are discussed in the context of the proposed development.

Firstly, it is important to discuss the type of water resources protected under the NWA. Under the NWA, a 'water resource' includes a watercourse, surface water, estuary, or aquifer. Specifically, a watercourse is defined as (*inter alia*):

- A river or spring;
- A natural channel in which water flows regularly or intermittently; and
- A wetland, lake or dam into which, or from which, water flows.

In this context, it is important to note that reference to a watercourse includes, where relevant, its bed and banks. Furthermore, it is important to note that water resources, including wetlands, are protected under the NWA. 'Protection' of a water resource, as defined in the NWA entails the:

- Maintenance of the quality and the quantity of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource; and
- Rehabilitation of the water resource.

In the context of the proposed development and implications towards surface water resources potentially occurring on the study site, the definition of pollution and pollution prevention contained within the NWA is relevant. 'Pollution', as described by the NWA, is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (*inter alia*):

- Less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- Harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

The inclusion of physical properties of a water resource within the definition of pollution entails that any physical alterations to a water body (for example, the excavation of a wetland or changes to the morphology of a water body) can be considered to be pollution. Activities which cause alteration of the biological properties of a watercourse, i.e. the fauna and flora contained within that watercourse are also considered pollution.

In terms of **Section 19** of the NWA, owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to (*inter alia*):

- Cease, modify, or control any act or process causing the pollution;
- Comply with any prescribed waste standard or management practice;
- Contain or prevent the movement of pollutants;
- Remedy the effects of the pollution; and
- Remedy the effects of any disturbance to the bed and banks of a watercourse.

1.1.2 National Environmental Management Act, 1998 (Act No. 107 of 1998)

The National Environmental Management, 1998 (Act No. 107 of 1998) (NEMA) was created essentially to established:

- Principles for decision-making on matters affecting the environment;
- Institutions that will promote co-operative governance; and
- Procedures for co-ordinating environmental functions exercised by organs of the state to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment.

It is stipulated in NEMA *inter alia* that everyone has the right to an environment that is not harmful to his or her health or well-being. Moreover, everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Accordingly, several of the principles of NEMA contained in **Chapter 1 Section 2**, as applicable to wetlands, stipulate that:

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
  - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
  - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied.

- That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.

- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

In line with the above, **Chapter 7** further elaborates on the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities. In other words, this chapter of NEMA addresses the tools that must be utilised for effective environmental management and practice. Under these auspices, the Environmental Impact Regulations (2006, 2010 and 2014 as amended) were promulgated in order to give effect to the objectives set out in NEMA. Subsequently, activities were defined in a series of listing notices for various development activities. Should any of these activities be triggered, an application for Environmental Authorisation subject to a Basic Assessment (BA) or Environmental Impact Assessment (EIA) process is to be applied for. Fundamentally, applications are to be applied for so that any potential impacts on the environment in terms of the listed activities are considered, investigated, assessed and reported on to the competent authority charged with granting the relevant environmental authorisation.

The above stipulations of the NWA and NEMA have implications for the proposed development in the context of surface water resources. Accordingly, implications and potential impacts / issues of the proposed development on potentially affected surface water resources are addressed later in this report (**Section 8 & 9**).

1.2 Definition of Surface Water Resources as Assessed in this Study

Using the definition of a surface water resource under the NWA, this study will include a river, a spring, a natural channel in which water flows regularly or intermittently, a wetland, lake or dam into which, or from which, water flows.

1.2.1 Wetlands

For wetlands specifically, the lawfully accepted definition of a wetland in South Africa is that within the NWA. Accordingly, the NWA defines a wetland as, “land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

Moreover, wetlands are accepted as land on which the period of soil saturation is sufficient to allow for the development of hydric soils, which in normal circumstances would support hydrophytic vegetation (i.e. vegetation adapted to grow in saturated and anaerobic conditions).

Inland wetlands can be categorised into hydrogeomorphic units (HGM units). **Ollis *et al.* (2013)** have described a number of different wetland hydrogeomorphic forms which include the following:

- Channel (river, including the banks): a linear landform with clearly discernable bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit.
- Channelled valley-bottom wetland: a valley-bottom wetland with a river channel running through it. Channelled valley-bottom wetlands must be considered as wetland ecosystems that are distinct from, but sometimes associated with, the adjacent river channel itself, which must be classified as a "river".
- Unchannelled valley-bottom wetland: a valley-bottom wetland without a river channel running through it.
- Floodplain wetland: a wetland area on the mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank. Floodplain wetlands must be considered as wetland ecosystems that are distinct from but associated with the adjacent river channel itself, which must be classified as a "river".
- Depression: a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.
- Flat: a Level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench, closed elevation contours are not evident around the edge of a wetland flat.
- Hillslope seep: a wetland are located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope.

1.2.2 Riparian Habitat

Riparian habitats may potentially occur in the study area. Riparian habitats (also known as riparian areas or zones) include plant communities usually adjacent to or along natural channels that are affected by surface and subsurface flows (**DWAF, 2005**). Riparian habitats can be found on the edges of lakes, or drainage lines, but are more commonly associated with channelled flowing systems like streams and rivers. Riparian habitats can also be associated with wetlands that are similarly associated with streams and rivers. These are defined as riparian wetlands.

1.2.3 Watercourses

According to the NWA, a watercourse falls within the ambit of a 'water resource'. For watercourses however, the following is relevant:

- A river or spring; and
- A natural channel in which water flows regularly or intermittently.

Watercourses may be perennial or non-perennial in nature. Moreover, non-perennial watercourses can encompass seasonal or ephemeral watercourses (including drainage lines) depending on the climate and other environmental constraints.

Any of the above mentioned wetland forms, riparian habitats or watercourses may occur within the study area. The types of surface water resources identified are addressed later in the report (**Section 6**).

1.3 Assumptions and Limitations

This study has only focused on the findings of the proposed 75MW Sendawo PV 1 Solar Facility. Associated studies for the remaining components have been compiled in separate reports for each separate impact assessment.

The identification and in-field delineation of surface water resources were only undertaken within the proposed development area. Delineation of surface water resources in the wider areas were not undertaken.

Aquatic studies of fish, invertebrates, amphibians etc. have not been included in this report. Nor has a hydrological or groundwater study been included.

Wetland or river health, ecosystem services and the ecological importance/sensitivity have also not been assessed for identified surface water resources.

As an avifaunal assessment is being carried out for this project, impacts as related to waterfowl are not included in this report. It is assumed that potential impacts to waterfowl as included in the avi-faunal assessment.

2 PROJECT NEED AND DESIRABILITY

The negative environmental impacts of using fossil fuels are well documented. In addition to depleting fossil fuels, the processes often result in large pollution risks. The Government of South Africa has committed to contributing to the global effort to mitigate greenhouse emissions.

According to the White Paper on the Promotion of Renewable Energy and Clean Energy Development (2002), the Government has committed to develop the framework within which the renewable energy industry can operate, grow, and contribute positively to the South African economy and to the global environment.

Government's long-term goal is the establishment of a renewable energy industry producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels.

In response to this goal, BioTherm are proposing to establish a Solar PV development, including the associated substation and 400kV power line, near Vryburg, in the North West Province.

The overall objective of the project is to generate electricity to feed into Eskom's national electricity grid by means of renewable energy technologies.

3 PROJECT TECHNICAL DESCRIPTION: SENDAWO 2 SOLAR

3.1 Project Location

The Sendawo Solar PV facility will be located approximately 10km south of Vryburg, within the Dr Ruth Segomotsi Mompati District Municipality of the North West Province. The larger application site is approximately 1709 hectares (ha). However, the buildable area will be significantly smaller than this and will be determined by sensitive areas identified during the Scoping Phase of the EIA. Sendawo Solar will consist of three (3) 75MW solar PV facilities, namely Sendawo Solar 1, Sendawo Solar 2 and Sendawo Solar 3. In addition, 132kV power lines will connect thee PV facilities to the proposed Sendawo substation (substations and power line assessments are dealt with in a separate report – not included herein). The proposed development of the three (3) Sendawo Solar PV facilities will be on the following farm:

- Farm Edinburgh 735, portion number 1.

The project site, with regards to the three (3) Sendawo Solar PV facilities located near Vryburg, has been identified through pre-feasibility studies conducted by BioTherm based on an estimation of the solar energy resource as well as weather, dust, dirt, snow and surface albedo. Grid connection and land availability were also important initial considerations. The application site and proposed grid connections with regards to the three (3) Sendawo Solar PV facilities located near Vryburg are shown in the locality map (Figure 1).

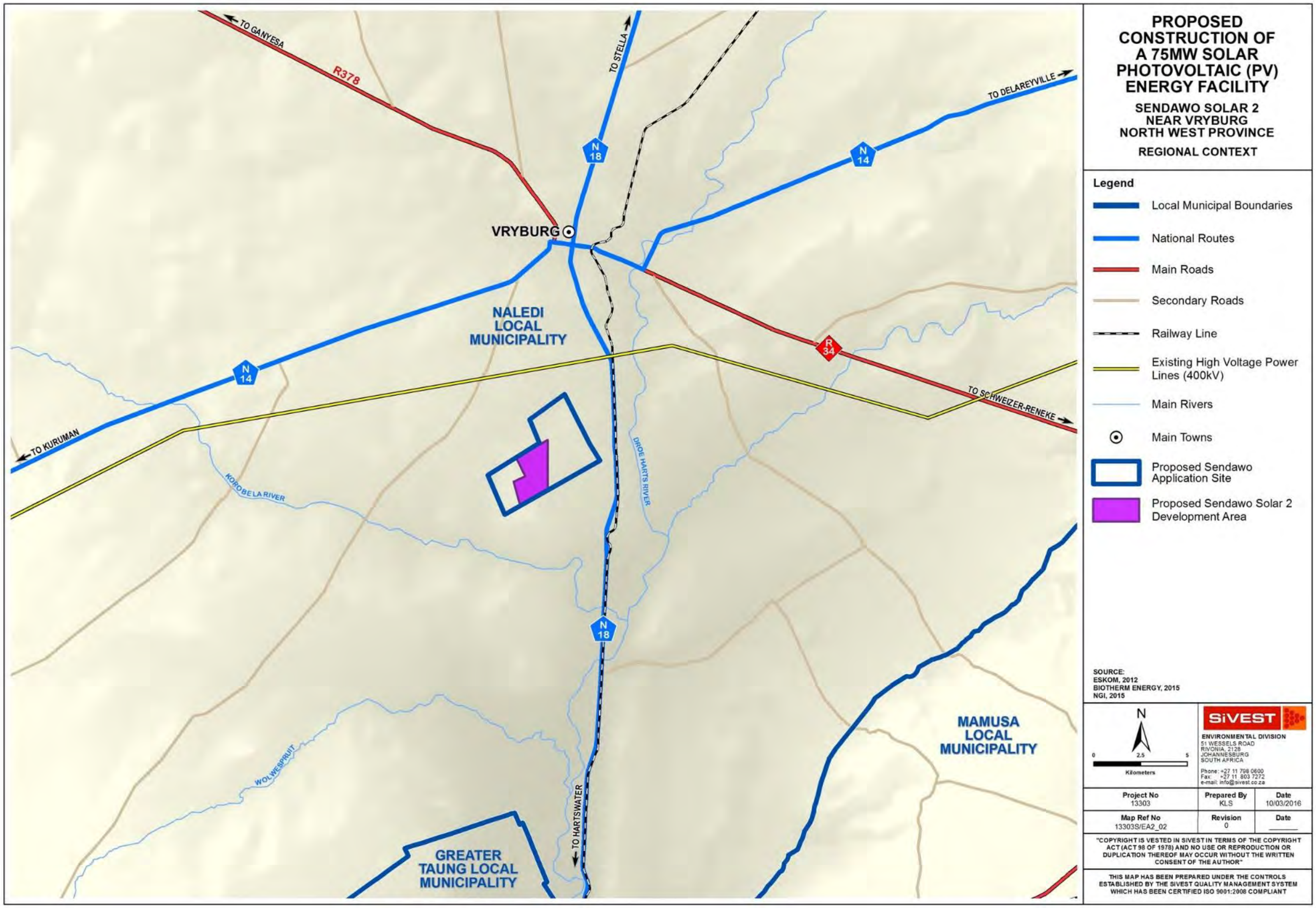


Figure 1. Proposed 75MW Sendawo 2 Solar PV Facility Regional Study Area

3.2 Sendawo Solar PV Facility Technical Details

In addition to the PV panels, it is proposed that each Sendawo Solar PV energy facility will consist of the following components:

- An onsite switching station, with the transformers for voltage step up from medium voltage to high voltage;
- The PV panels (**Figure 2**) will be connected in strings to inverters and inverter stations will be required throughout the site. Inverter stations will house 2 x 1MW inverters and 1 x 2MVA transformers;
- DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to 22-33kV (medium voltage) in the transformers (**Figure 4**).
- The 22-33kV cables will be run underground in the facility to a common point before being fed to the onsite switching station where the voltage will be stepped up to 132kV.
- Grid connections will be to the proposed Sendawo substation. The Sendawo substation will be connected to the existing Mookodi Main Transmission substation by a proposed 400kV power line. The distance will be approximately 3km (Note that the substation and power line component forms part of a separate scoping study. Therefore, these component are not assessed herein).
- A internal power line routing with a voltage of 132kV to the proposed Sendawo substation;
- A laydown area for the temporary storage of materials during the construction activities;
- Access roads and internal roads;
- A car park and fencing; and
- Administration, control and warehouse buildings.

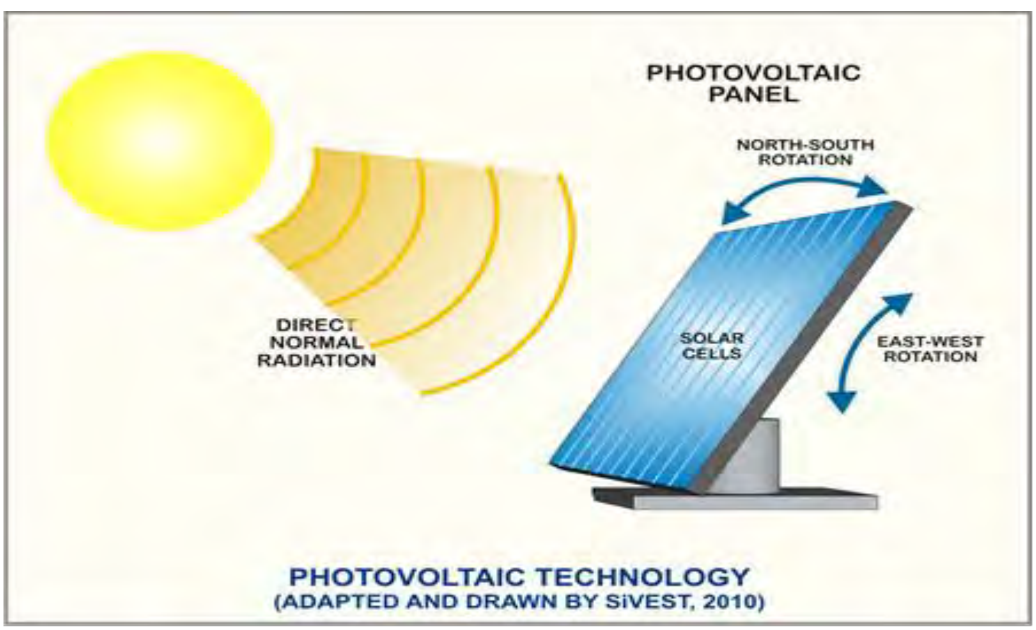


Figure 2. Typical Solar PV Panel

The solar panels are generally configured in banks of arrays or sub-arrays depending on the number of PV panels used and the size of the arrays. The rows of PV panels are spaced both to allow access to vehicles during maintenance and to ensure that one array or one sub-array does not cast a shadow over the one behind. The electricity is cabled to inverters, which convert DC power to AC and synchronised to the electricity grid. The output is connected through various switchgear, protection devices and meters to local users and the grid. The inverters, switchgear and other electrical equipment are standard items as used for a wide range of industrial applications. The other major operating component of the system is the inverter, which converts the DC power produced by the solar modules into AC power before being sent to the grid.

The smallest unit of a PV installation is a cell. A number of cells form a module, and finally a number of modules form the arrays (**Figure 3**). Modules are arranged into strings that form the solar field. Modules are arranged in sections called tables and are installed on racks which are made of aluminium or steel.

All the arrays are wired to inverters that convert direct current (DC) into alternating current (AC) that can be stepped up and fed into the national grid system.

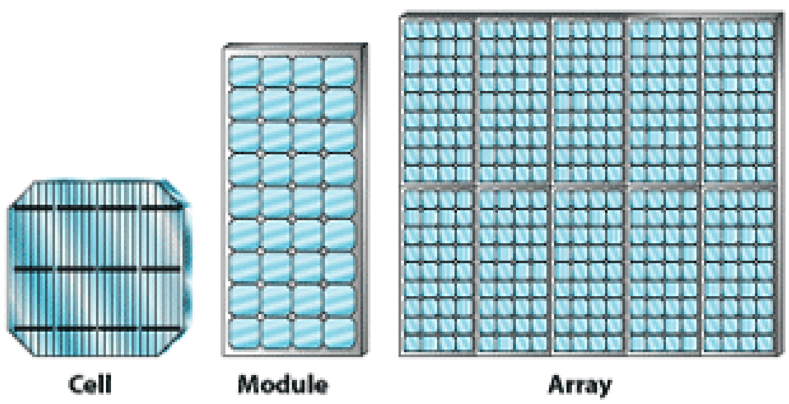


Figure 3. Illustration of a PV installation

The PV arrays are typically connected to each other in strings, and the strings are connected to DC to AC inverters (**Figure 4**). The DC to AC inverters may be mounted on the back of the panels support substructures / frames or alternatively in a central inverter station. The strings are connected to the inverters by low voltage DC cables. Power from the inverters is collected in medium voltage transformers through AC cables. Cables may be buried or pole mounted depending on voltage level and site conditions.

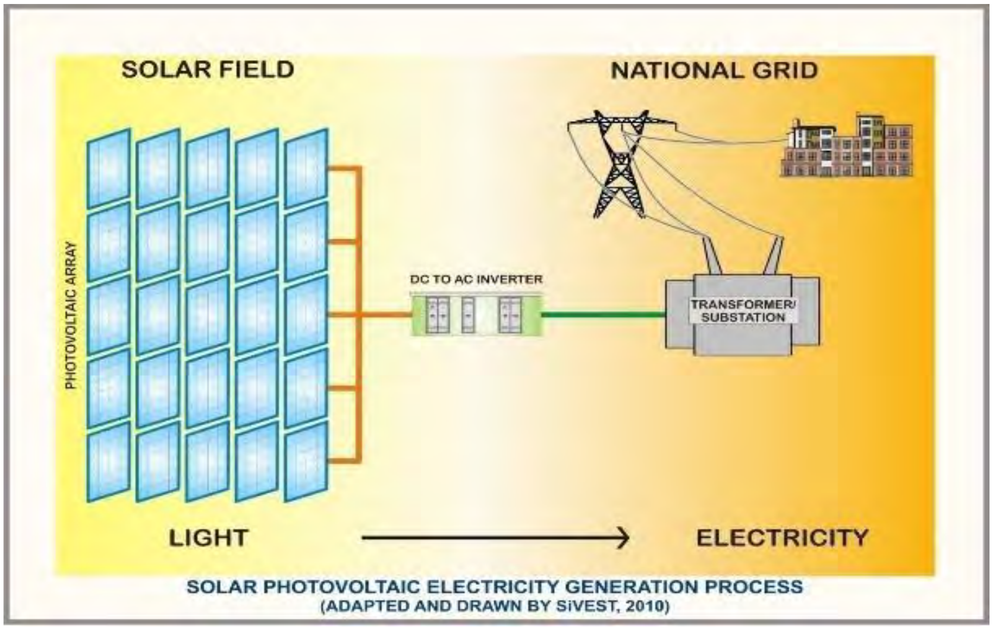


Figure 4. Conceptual PV Electricity Generation and Conversion Process

3.3 Alternatives

In terms of the NEMA and the EIA Regulations, feasible alternatives are required to be considered during the EIA Process. All identified, feasible alternatives are required to be evaluated in terms of social, biophysical, economic and technical factors. The following alternatives will be considered as part of this Impact Report:

- Site Layout Alternatives for the 75MW Sendawo 2 PV facility which will consider two (2) different location alternatives for the following components:
  - Substation;
  - Operations Building; and
  - Lay-down area
- No-go Alternatives for the 75MW Sendawo 2 PV facility.

4 METHODOLOGY

4.1 Revisit Scoping Desktop Delineations of Surface Water Resources

The first step in the impact level surface water assessment was to revisit the initial scoping level desktop findings of the surface water features. This was undertaken using Geographic Information System (GIS) software. The software ArcView developed by ESRI was used. The collection of data source information encompassed (but is not limited to) the National Freshwater Ecosystem Priority Areas **(NFEPA, 2011)** database, the North West and National Environmental Potential Atlas **(ENPAT, 2000 & 2002)** database as well as the National Biodiversity Assessment **(SANBI, 2012)** database. The use of Google Earth™ imagery supplemented these data sources.

Utilising these resources, the wetlands and any other surface water resources that were identified in the scoping phase were mapped and highlighted for the in-field phase of the assessment. The supplementary use of satellite imagery (**Google Earth™**) allowed for other potentially overlooked surface water resources, not contained within the above mentioned databases, to be identified and ground-truthed in the field work phase.

4.2 Field-based Surface Water Resources Delineation Techniques

4.2.1 Wetlands

Wetland delineations are based primarily on soil wetness indicators. For an area to be considered a wetland, redoximorphic features must be present within the top 50cm of the soil profile **(Collins, 2005)**. Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils alternate between aerobic (oxygenated) and anaerobic (oxygen depleted) conditions. Only once soils within 50cm of the surface display these redoximorphic features, can the soils be considered 'hydric soils'. Redoximorphic features typically occur in three types **(Collins, 2005)**:

- A reduced matrix - i.e. an in situ low chroma (soil colour), resulting from the absence of Fe^{3+} ions which are characterised by "grey" colours of the soil matrix;
- Redox depletions - the "grey" (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur;
- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles). These can occur as:
  - Concretions - harder, regular shaped bodies;
  - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours;
  - Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

The potential occurrence / non-occurrence of wetlands and wetland (hydric) soils on the study site were assessed according to the **DWAF (2005)** guidelines, "A practical field procedure for the identification and delineation of wetlands and riparian areas". According to the **DWAF (2005)** guidelines, soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence. This is mainly due to the fact that soil wetness indicators remain in wetland soils, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 50cm of the soil profile alone is sufficient to identify the soil as being hydric or non-hydric (non-wetland soil) **(Collins, 2005)**. Three other indicators (vegetation, soil form and terrain unit) are typically used in combination with soil wetness indicators to supplement findings. Where soil wetness and/or soil form could not be identified, information and personal professional judgment was exercised using the other indicators to determine what area would represent the outer edge of the wetland.

It must be recognised that there are normally three zones to every wetland including the permanent zone, seasonal zone and the temporary zone. Each zone is differentiated based on the degree and duration of soil saturation. The permanent zone usually reflects soils that indicate inundation cycles that last more or less throughout the year, whilst the seasonal zone may only reflect soils that indicate inundation cycles for a significant period during the rainy season. Lastly, the temporary zone reflects soils that indicate the shortest period(s) of inundation that are long enough, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation **(DWAF, 2005)**.

Vegetation identification was based on identifying general plant species within the wetland boundaries focusing on the occurrence of hydrophytic (water loving) wetland vegetation. In identifying hydrophytic vegetation, it is important to distinguish between plant species that are **(DWAF, 2005)**:

- Obligate wetland species (ow): always grows in wetland - >99% chance of occurrence;
- Facultative wetland species (fw): usually grow in wetlands – 67-99% chance of occurrence;
- Facultative species (f): are equally likely to grow in wetlands and non-wetland areas – 34-66% chance of occurrence;
- Facultative dry-land species (fd): usually grow in non-wetland areas but sometimes grow in wetland = 1-34% chance of occurrence.

The actual delineation process essentially entailed drawing soil samples, at depths between 0-50 cm in the soil profile, using a soil augur. This is done in order to determine the location of the outer edge of the temporary zone for wetlands. The outer edge of the temporary zone will usually constitute the full extent of the wetland, thereby encompassing any other inner lying zones that are saturated for longer periods. Where the appropriate wetland soil form is of interest, soil samples are drawn up to a depth of 1.2 metres (where possible).

Where a wetland was identified, a conventional handheld Global Positioning System (GPS) was used to record the points taken in the field. The GPS points were then imported into a GIS system for mapping purposes. The GPS is expected to be accurate from 5 up to 15 metres depending on meteorological conditions. A GIS shapefile was created to represent the boundaries of the delineated wetlands or other surface water resources.

4.2.2 Riparian Habitat

In terms of watercourses and riparian habitats, the **DWAF (2005)**, the assessment for riparian habitats requires the following aspects to be taken into account:

- topography associated with the watercourse;
- vegetation; and
- alluvial soils and deposited material.

The topography associated with a watercourse can (but not always limited to) comprise the macro channel bank. This is a rough indicator of the outer edge of the riparian habitat.

The riparian habitat relies primarily on vegetation indicators. The outer edge of the riparian habitat can be delineated where there is a distinctive change in the species composition to the adjacent terrestrial area or where there is a difference in the physical structure (robustness or growth forms – size, structure, health, compactness, crowding, number of individual plants) of the species from the adjacent terrestrial area (**DWAF, 2005**).

Riparian habitats are usually associated with alluvial soils (relatively recent deposits of sand, mud or any type of soil sediment) (**DWAF, 2005**). This indicator is not commonly viewed as the primary indicator but rather as a supplementary indicator to confirm either topographical or vegetation indicators, or both.

Where riparian habitats occur, the above mentioned indicators were used to identify the outer edge. A GPS was used to record the points taken in the field.

4.2.3 Drainage Pathways

In terms of drainage lines or pathways, there are no official methodologies or guidelines for delineating drainage lines in the country. As such, the environmental indicators used to identify riparian habitats (such as topography associated with a watercourse, alluvial soils and deposited materials, and vegetation), which also form integral biophysical components of drainage lines were used to identify these temporary conduits for surface water run-off.

4.2.4 Natural Springs

In terms of natural springs, as there are also no official methodologies for delineating springs in the country, selected environmental indicators used to identify wetland habitats (such as vegetation, soil form and terrain unit indicators) which also form integral biophysical components of springs, were used to identify and delineate this environmental feature.

4.3 Surface Water Buffer Zones

The compilation of preliminary guidelines for the determination of wetland and watercourse buffer zones has been developed by **Macfarlane *et al* (2014)**. This method of buffer determination is the most current applicable methodology. The current method according to **Macfarlane *et al* (2014)** proposes highly conservative buffer widths based on generic relationships for broad-scale assessments, but also allows buffers to be modified based on more detailed site-level information. The conceptual framework utilises the following keys decisions in the design criteria **Macfarlane *et al* (2014)**:

- Levels of user expertise;
- Precautionary principle;
- Predictability and administration;
- Data collection and assessment; and
- Buffer widths tailored according to risk.

The assessment procedure is an eight step process which is shown in **Figure 5** below.

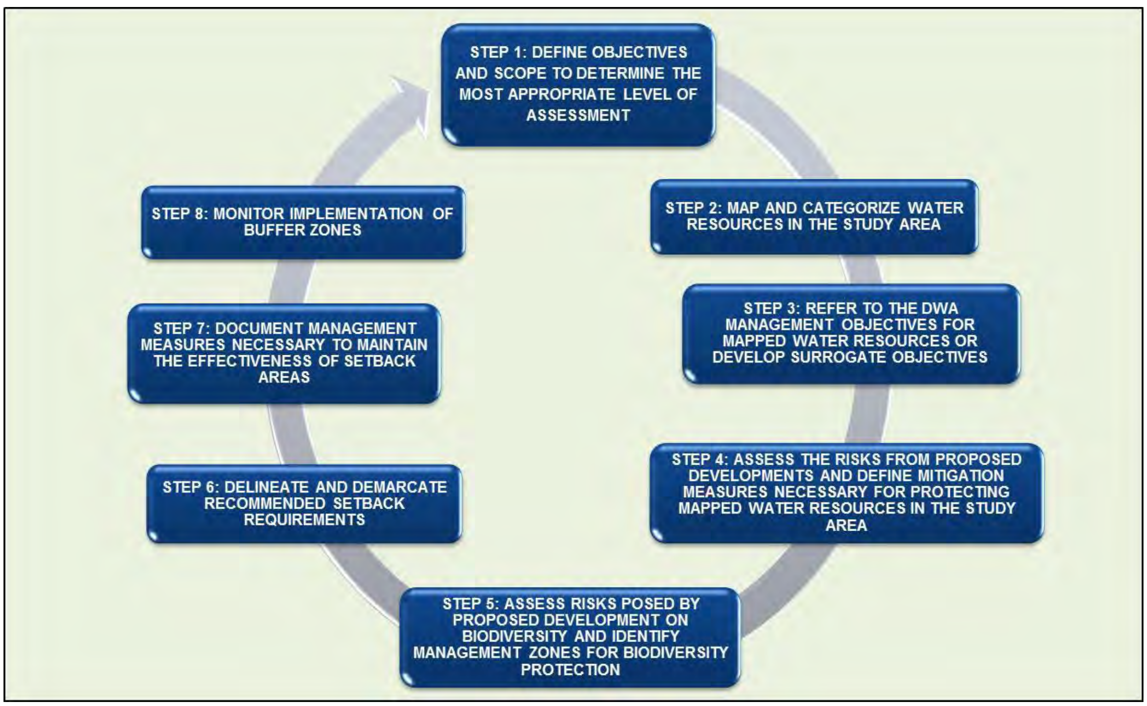


Figure 5. Buffer determination assessment procedure according to Macfarlane et al (2014).

The use of this method can be used at a site specific level for impact assessments. Furthermore, it is based on grounded scientific principles. This method is accordingly applied herein.

4.4 Impact Assessment Method

Current and potential impacts will be identified based on the proposed development and potential impacts that may result for the construction, operation and decommissioning of the proposed development. The identified potential impacts will be evaluated using an impact rating method **(Appendix A)**. This is addressed in **Section 9**.

5 GENERAL STUDY AREA

The proposed application site for the 75MW Sendawo 2 Solar PV facility will be located approximately 10km south of Vryburg, within the Dr Ruth Segomotsi Mompati District Municipality of the North West Province. The application site has an extent of approximately 1700ha. The buildable area will, however, be significantly smaller than this and was reduced as a result of environmental sensitive areas as far as possible that were identified during the Scoping Phase of the EIA. The proposed development of the three (3) Sendawo PV facilities are on the following farm:

- Farm Edinburgh 735, portion number 1.

The Sendawo 2 Solar PV development site can be accessed via the N18. The surrounding land use within the direct proximity of the development site comprises predominantly of vacant land, existing cultivation (agriculture), mining and residential.

A map indicating the land use of the area surrounding the site proposed for the Sendawo 2 Solar PV facility has been provided in **Figure 6** below.

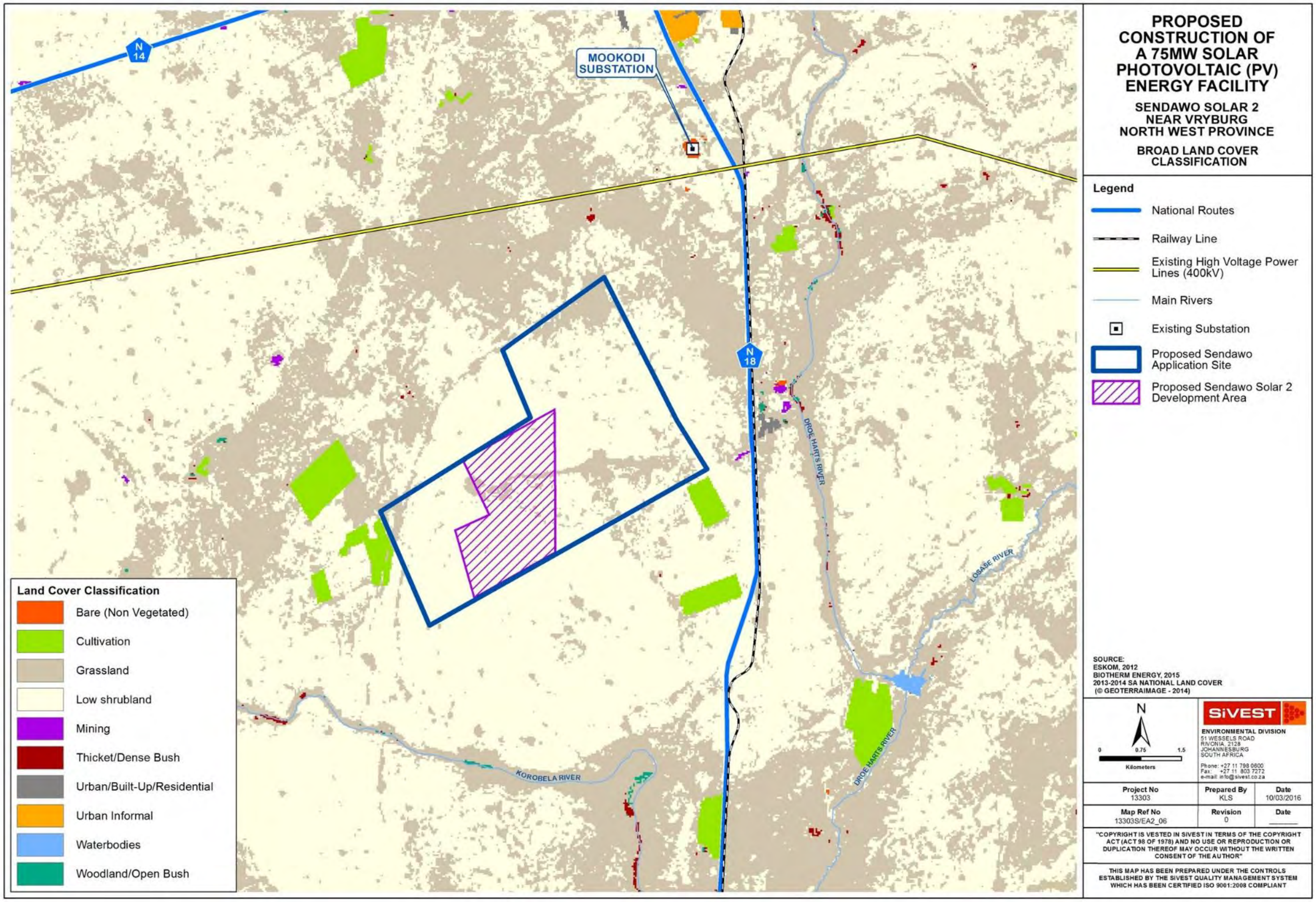


Figure 6. Sendawo 2 Solar PV Facility Landuse Map

According to **Mucina and Rutherford (2006)**, the proposed site for the Sendawo 2 Solar PV facility falls within the Savanna Biome. Within a biome, smaller groupings referred to as bioregions can be found which provide more specific but general details as to the biophysical characteristics of smaller areas. The development site can be found within the Eastern Kalahari Bushveld bioregion. Going into even finer detail, vegetation units are classified which contain a set of general but more local biophysical characteristics as opposed to the entire bioregion. The proposed Sendawo 2 Solar PV development site can therefore be found within the Ghaap Plateau Vaalbosveld vegetation unit (**Figure 7**). The description of Vegetation and Landscape Features, Geology and Soils, Climate and Conservation as contained in **Mucina and Rutherford (2006)** are provided below for this vegetation unit.

5.1 Ghaap Plateau Vaalbosveld

The vegetation and landscape features of the Ghaap Plateau Vaalbosveld vegetation unit is characterised by a flat plateau with a well-developed shrub layer consisting of *tarchonanthus camphoratus* and *Acacia karoo* species. The open tree layer consists of the *Olea europaea* subsp. *africana*, *Acacia tortilis*, *Ziziphus mucronanta* and *Rhus lancea*. The *Olea* species is considered to be more important in the southern parts of this vegetation unit, while the *Acacia tortilis*, *Acacia hebeclada* and *Acacia mellifera* species are more important in the north and part of the west of the vegetation unit. Much of the south-central part of this vegetation unit has remarkably low cover of *Acacia* species for an arid savanna and is dominated by the non-thorny *T. camphoratus, R. lancea* and O. *europaea* subsp. *africana*.

The geology and soils of this vegetation unit are characterised by surface limestone of Tertiary to Recent age. In addition, dolomite and chert of the Campbell Group (Griqualand West Supergroup, Vaalian Erathem) support shallow soils (0.1 – 0.25m) of the Mispah and Hutton soil forms. The land types found within this vegetation unit consist mainly of Fc with some Ae and Ag soil types.

The climate is characterised by summer and autumn rainfall with very dry winters. The Mean Annual Precipitation (MAP) of this vegetation unit ranges from about 300mm in the southwest to about 500mm in the northeast. Frost is frequent to very frequent in winter. The mean monthly maximum and minimum temperatures recorded for the town of Koopmansfontein were 36.3°C and -7.5°C for January and July respectively. Corresponding values for Armoedsvlakte (near Vryburg) were 36.6°C and -5.5°C for December and July, respectively.

The conservation status of this vegetation unit is described as least threatened. No areas within this vegetation unit are conserved in statutory conservation areas. In addition, only about 1% is already transformed and erosion is considered to be very low.

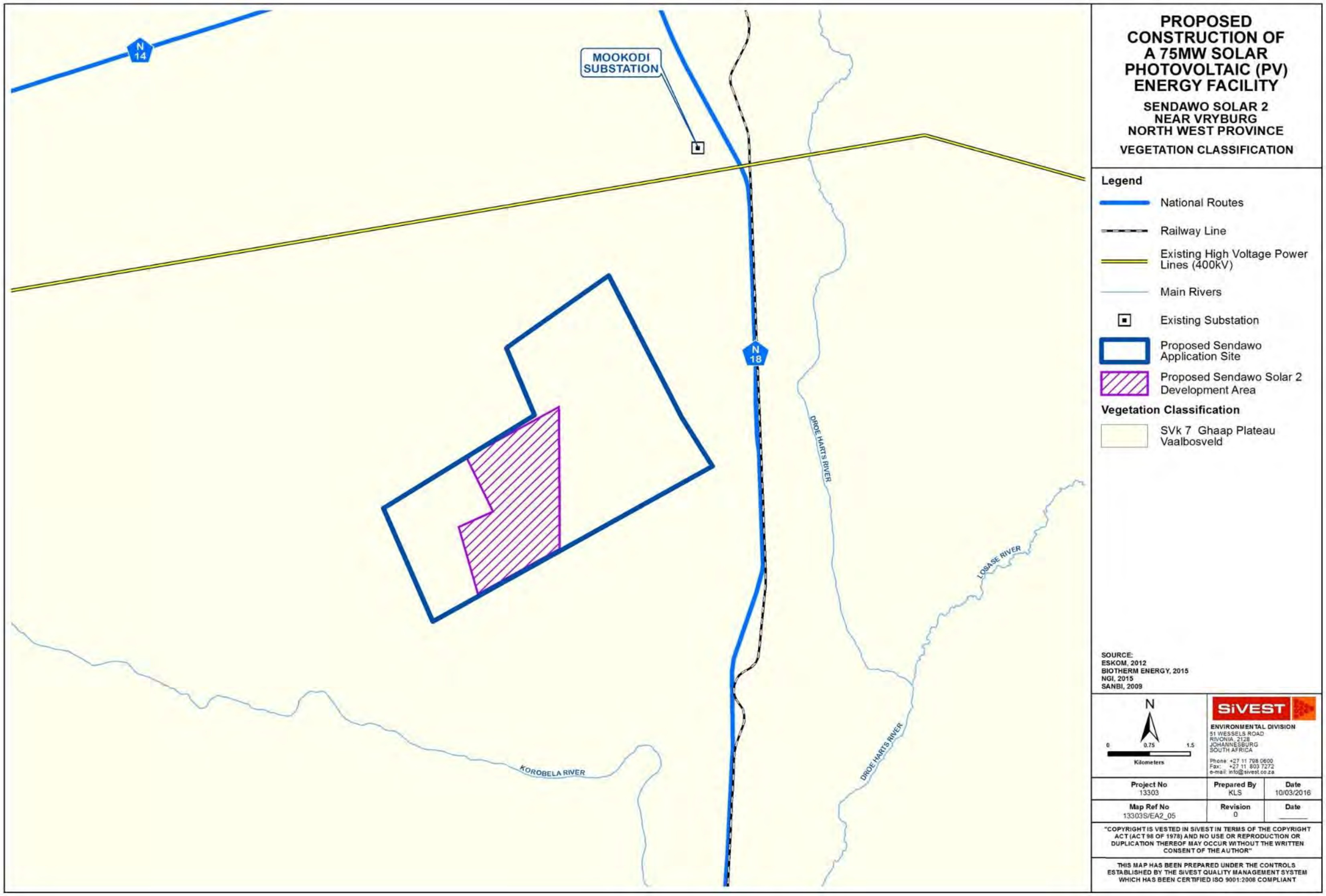


Figure 7. Sendawo Solar PV Facility Vegetation Unit Map

6 FINDINGS OF ASSESSMENT

6.1 Refinement of Scoping Phase Desktop Findings Based on Detailed In-field Investigations and Delineations for the Application Site

The in-field wetland delineation assessment took place from the 3rd to 4th December 2016. The fieldwork verification, ground-truthing and delineation assessment was undertaken to scrutinise the results of the desktop identified features as well as to identify any potentially overlooked wetlands or other surface water resources in the field for the greater application site. The results are displayed in **Figure 8**.

Ultimately, it was found that there are fifteen (15) pan wetlands, one (1) natural spring and one (1) drainage line on the greater application site. The field identified pan wetlands correlated with the wetlands identified at a desktop level for the application site, with the exception of three wetlands which were not verified based on lack of any physical evidence of wetland indicators in the field. Additionally, however, a number of the wetlands were also incorrectly classified as valley bottom wetlands. These were re-classified as pan wetlands and the one wetland re-classified as a natural spring based on the characteristics identified in the field. The boundaries were refined based on in-field delineations.

Aside from these surface water features, as per the desktop assessment, no rivers were identified on site. Although, a drainage line was identified in-field. This drainage line is substantially shorter than that delineated at the desktop level however, which was also refined based on findings in the field.

The physical characteristics of the various indicators for the pan and spring wetlands as well as the drainage lines are provided in more detail below.

6.1.1 Pan Wetlands

6.1.1.1 Terrain and Wetland Soil Characteristics

The general terrain is mostly flat. There is a very low central ridge line however which runs diagonally from the north west to the south east, bisecting the greater application site. Shallowed out basins within the flatter landscape areas form a suitable physical template for endorheic (closed systems that are in-ward draining) pan/depression wetlands.

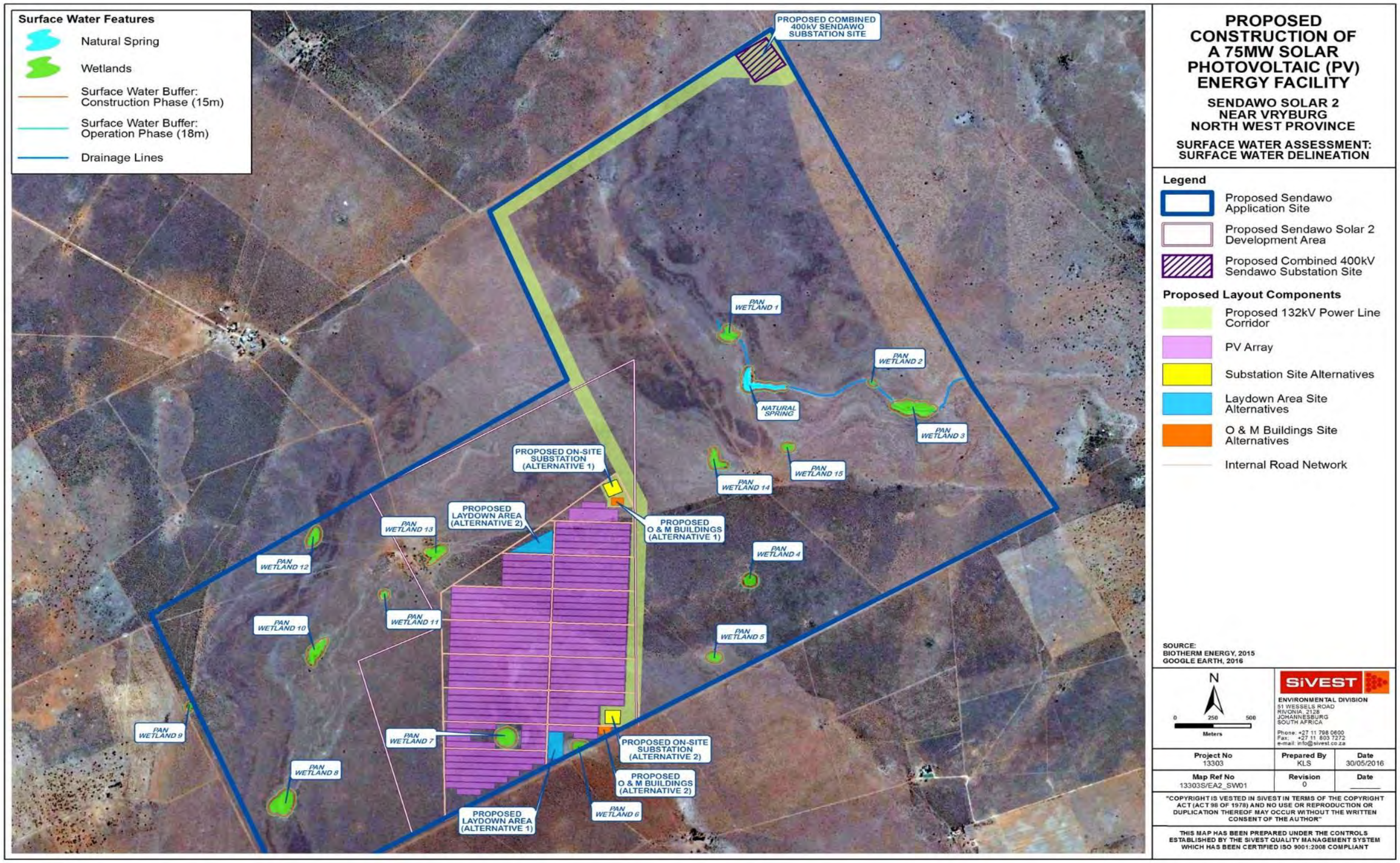


Figure 8. 75MW Sendawo 2 Solar PV Plant Surface Water Delineation Map

The word 'pan', in ecological wetland studies, is a generic term used in South Africa used to describe a wetland type that has a shallow depression or basin and that is usually a closed-system. Overall, pans are principally viewed as ephemeral and sporadic **(Meintjies *et al*., 1994)**. Pans are also regularly restricted to lowlands or plains and can become very turbid after rainfall events and saline throughout time **(Masing *et al*. 1990)**. In terms of pan wetland formation in South Africa, several conditions contribute to pan formation. Allan *et al*. (1995) stresses the role of wind action whereas **Goudie and Wells (1995)** state the following predisposing conditions:

- Areas must be arid;
- An area should not be one where fluvial processes are fully integrated; and lastly,
- An area should not be one where aeolian accumulation does not result in the infill of any irregularities in the land surface.

The pan wetlands within the greater application site are good examples of typical pan wetlands in arid areas.

Figure 9. Pan Wetland identified near the Western Boundary of the Greater Application Site

In terms of pan wetland geomorphology, the influx of silt and clay due to inward depositional processes results in the accumulation of sediment. This sediment forms a layer that is relatively impermeable and is found near the surface in the subsoil of a pan basin. However, soil composition (for example, degree of sand, silt and clay) varies between pans. In general however, three types of soil forms were identified within the pan wetlands. The first type of soils within the wetlands were predominantly found to contain clays up to the point that the soils were almost vertic in characteristics. Soils were dark in colour with a vertic structure deeper beneath the Orthic A horizon. Soil depth was however limited (up to 60cm) due to the presence of calcrete or bedrock. Small calcretions were evident in the soil samples drawn, before reaching calcrete

(**Figure 10**). These types of soils were mainly found in the proposed Sendawo 1 and 2 PV plant sites located near the southern and western boundaries of the greater application site. The soil form that could be attributed to these wetlands include that of the Arcadia Soil Form. This soil form is not typically associated with wetlands. However, mottling at the surface revealed hydric soils thereby indicating wetland conditions.

Figure 10. Dark Clay Soils with Calcretions (left) with Mottling at the Surface (right)

Further north, soils within the pan wetlands were found to be more plinthic (loose, friable or slightly firm consistence, (**MacVicar et al., 1991**)) in character. Soil particles were a yellow / brown colour. Typical mottling in the form of iron sesquioxide concentrations were observed. Additionally, Iron redox depletions were also noticed (**Figure 11**). The Soft Plinthic B horizon could be attributed to the sub-soils within these wetlands. A shallow Orthic A horizon was found to overlie the Soft Plinthic sub-soils. Overall, where an Orthic A horizon overlay a Soft Plinthic B horizon, the Westleigh Soil Form could be attributed to the pan wetlands.

Figure 11. Iron Concentrations and Depleted Soils within the Pan Wetlands with the Soft Plinthic Soil Horizon

The third soil form identified could be attributed to the Mispah Soil Form. The soil profile over some of the pans were relatively thin before being interrupted by bedrock (**Figure 12**). The soils were of an Orthic character and some red iron oxide mottling was observed at the surface in the sandier soils whereas other pans expressed higher clay content with small lime nodules.

Figure 12. Thin Soil Profile of a Pan Wetland with Bedrock Extrusions

Given the characteristics of the soils and the attributed soil forms, the pan wetlands can be considered to be temporary in nature.

6.1.1.2 Wetland Vegetation

The pan wetlands were somewhat sparsely vegetated to almost completely devoid of vegetation towards the core of the wetlands. Many of the wetlands associated with the vertic soils were however found to contain mainly higher order tree (*Acacia* sp.) species. The pan wetlands associated with the Soft Plinthic soils were more inclined to be vegetated with graminoid species (*Aristida junciformus*, *Cymbopogon caesius*, *Cynodon dactylon*, and *Sporobolus iocladus (*fw)). For the pan wetlands with both soils types, aquatic species in the form of *Persicaria* sp. (**Figure 13**) and other herb like vegetation species were noticed.

Figure 13. *Persicaria* sp. observed in one of the Pan Wetlands

6.1.2 Spring

6.1.2.1 Terrain and Soil Characteristics

A natural spring occurs when the water table intercepts the earth's surface as a natural flow of water **(Tarbuck & Lutgens, 1987)**. A natural spring was identified on the greater application site located centrally on the property. The spring (**Figure 14**) is located on flat landscape which slopes very slightly to the south east whereby flow from the spring leads in this direction and forms a drainage line (described separately in the **Section 6.1.3** below) up to a pan wetland. Connectivity between these three features is considered important in terms of ecological connectivity from a hydrological and habitat perspective.

In terms of soil characteristics, beneath the Orthic A horizon, the sub-soils at the source and nearby the seepage point of the spring were highly bleached (**Figure 14**) representing an E horizon. However, moving gradually away from the source, the presence of bedrock was found to increase from deep closer to the surface until extruding some distance away into the drainage line area. The Wasbank Soil Form could be attributed to the soils at the spring.

Figure 14. Seepage Point of the Natural Spring (left) and Bleached Soils of the Spring (right)

6.1.2.2 Vegetation

At the source of the spring, little vegetation was present. However, with increasing distance from the seepage point, graminoid and rush species were identified. Graminoid species included mainly *C. dactylon* whilst the rush species noted included *Facinia nodosa* and *Scirpoides* sp.

Figure 15. *Facinia nodosa* and *Scirpoides* sp. within the Spring

Given the characteristics of the soils and the attributed soil forms, the spring can be considered to be seasonal to temporary (for drier years) in nature.

6.1.3 Drainage Line

6.1.3.1 Topography associated with a Watercourse

As explained above, when in flow, the drainage line acts to connect the spring with a pan wetland located to the south west of the spring. The topography is flat but slopes very slightly to the south east in which the direction of the drainage line flows. The soil profile of the drainage line is very shallow with bedrock extruding for stretches where a soil profile is extremely thin (+-5cm) (**Figure 16**). The soil type varies from the transition zone of the spring where bleached sandy soils change further into the drainage line where the bedrock influence becomes a factor with limited soil profile.

Figure 16. Bedrock Extruding at the Surface within the Drainage Line

6.1.3.2 Vegetation

Over the areas where the soil profile is deeper closer to the spring, graminoid species and rushes can be found including that described for the spring above such as *C. dactylon*, *F. nodosa* and *Scirpoides* sp. Within the course of the drainage line, over the areas of thin soil profile underlain by shallow bedrock, only graminoid species were observed presumably as a consequence of reduced soil depth and moisture.

Figure 17. Close to the Transition Zone of Soil Types where Vegetation Communities change from Graminoid to Herbaceous cover within the Drainage Line

Given the characteristics of the soils and the vegetation present, the drainage line can be considered to be reliant on flows from the spring to the north west, with this feature being one of the main sources of water input. It is therefore presumed to be temporary in nature flowing only when receiving significant flows from the spring or after heavy rainfall.

6.1.3.3 Alluvial Soils and Deposited Materials

No deposited material was evidenced. It is presumed that when flows do occur, run-off is limited to surface run-off in which limited materials (in the form of sediment and vegetation deposits). Given the temporal nature of the drainage line, deposits may well be trampled or blown away by wind. Alluvial deposits from flows associated with the spring are anticipated however.

6.2 Surface Water Buffer Zones

Construction and operation buffer zones were determined for the identified wetlands since it is only these features that may be potentially directly affected by the proposed development.

For the wetlands, the primary threat related to PV developments during the construction phase, is increased run-off and sediment inputs (USEPA, 2005 & 2006), as well as turbidity. This is presumably during vegetation clearing for the PV arrays and excavation of pits for the foundations of the individual PV panels. These areas are left vulnerable to surface run-off, consequent erosion and sedimentation. Given the relatively flat terrain, the size and proximity of the proposed PV field, this is a distinct possibility. However, the aridity of the study area will be a factor in whether there is any run-off at all. Timing of construction is therefore important outside of the rainy season as far as practically possible in order to limit impacts arising from run-off. Nonetheless, the potential impacts can be easily mitigated with simple management measures in place. Therefore, the buffer zones can be of limited size in order to address potential impacts.

For the operation phase, run-off from the PV field and adjacent services roads (SANRAL, 2009b; DNREA, 2006; Walker et al., 2000 & Cummings, 1999) can contribute to increased run-off and sediment inputs, as well as turbidity in the wetlands. Again, the terrain and climate factors will have a bearing on potential impacts. However, with the implementation of mitigation measures, potential impacts can be avoided.

Based on the above as well as the suggested mitigation measures stipulated in **Section 9**, construction and operation buffer zones were determined for the identified wetlands. As such, the wetland buffer zones that were determined and are applicable include the following:

- Construction Phase Buffer: 15m
- Operation Phase Buffer: 18m

6.3 Sendawo 2 Solar PV Facility Surface Water Delineation Results

At a site specific level, the surface water resources delineated on the proposed Sendawo 2 PV Plant site includes only three (3) pan wetlands (pan wetlands 6, 7 and 13) that could potentially be affected. The surrounding pan wetlands, drainage line and spring have a small chance of being affected from an indirect perspective.

7 ALTERNATIVES COMPARATIVE ASSESSMENT

On-site substation, operation building and lay-down area alternatives have been investigated for the proposed solar PV development (**Table 1**). These alternatives have been comparatively assessed in order to determine the preferred alternatives from a surface water perspective.

The following factors were taken into account when comparatively evaluating the proposed alternatives:

- Size and number of potentially impacted surface water resource(s) in the proposed alternative;
- Proximity to the nearest surface water resource(s);

- The location of any surface water resources present and the ability of the proposed development to be constructed out of, around or away from any nearby surface water resources; and
- Existing impact factors (such as existing infrastructure, roads and impacted land).

In terms of the first criteria, the size and number of surface water resources within an alternative area was relevant. The more surface water resources that are present and the greater the area each occupies, it is likely that the impact of the proposed development will be greater.

The second criteria to consider is proximity of the proposed development positioning to any nearby surface water resources. The type of surface water resource and the distance of the proposed development to it will have a bearing on whether there may be direct or indirect impacts that could affect it.

The third criteria focuses on whether the proposed development may be able to be constructed with surface water resources present. It may be possible for the proposed development to be constructed if there are few surface water resources present and the facility component or infrastructure is repositioned to avoid the surface water feature. In this instance, maneuverability of the site layout may only also be possible should any surface water resources be located on the boundary of the proposed development area under consideration.

The final criteria of significance, when selecting the most suitable alternative, is existing infrastructure (power lines, roads, railway etc.) and impacted land (agricultural fields, urban areas etc.). Disturbance to an existing impacted area will be less than if undisturbed, or where less impacted land is affected.

The logic for each criteria was applied in the assessment below.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 1. Surface Water Comparative Assessment Table

Alternative	Preference	Reasons
OPERATIONS BUILDING AND SUBSTATION		
Sendawo PV 2 Operations Building and Substation Alternative 1	Preferred	There are no wetlands within a 500m radius of Sendawo PV 2 Operations Building and Substation Alternative 2. This option is viewed as preferred.
Sendawo PV 2 Operations Building and Substation Alternative 2	Not preferred	The proposed location for the Sendawo PV 2 Operations Building and Substation Alternative 1 is located approximately 100m north east of pan wetland 6. The next nearest surface water resource is pan wetland 7 located west approximately 550m away. This proposed alternative is viewed as not preferred given the closer proximity to surface to the two above mentioned pan wetlands which may result in higher potential run-off and sedimentation impacts.
LAYDOWN AREA		
Sendawo PV 2 Laydown Area Alternative 1	Not preferred	The proposed location for the Sendawo PV 2 Laydown Area Alternative 1 is located approximately 60m west of pan wetland 6. The next nearest surface water resource is pan wetland 7 located west approximately 200m away. This proposed alternative is viewed as not preferred given the closer proximity to surface to the two above mentioned pan wetlands which may result in potential run-off and sedimentation impacts.
Sendawo PV 2 Laydown Area Alternative 2	Preferred	There are no wetlands within a 400m radius of Sendawo PV 2 Laydown Area Alternative 2. This option is viewed as preferred.

From the above, the preferred location options include Sendawo PV 2 Operations Building and Substation Alternative 1 and Sendawo PV 2 Laydown Area Alternative 2.

8 LEGISLATIVE IMPLICATIONS

In the context of the proposed development impacting on surface water resources, the following environmental and water legislation is applicable.

8.1 National Environmental Management Act, 1998 (No. 107 of 1998) & Environmental Impact Assessment Regulations (2014)

- Environmental Impact Assessment regulations 2014, Listing Notice 1, GN. 983, Activity 12:

The development of-

(xii) *infrastructure or structures with a physical footprint of 100 m2 or more;*

where such development occurs-

(a) within a watercourse;

(c) if no development setback exists, within 32 m of a watercourse, measured from the edge of a watercourse; -

The only component of the proposed development that will trigger the above activity are the internal roads which route along the southern boundary of pan wetland 6 being within the 32m proximity threshold.

- Environmental Impact Assessment regulations 2014, Listing Notice 1, GN. 983, Activity 19:

The infilling or depositing of any material of more than 5 m³ into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 m³ from-

(i) a watercourse;

The internal access road which routes along the southern boundary of pan wetland 6 may require infilling of sand or alternatively removal or soil or sand of more than 5m³ from the wetland for the shoulder of the road which will therefore trigger this activity.

8.2 National Water Act, 1998 (Act No. 36 of 1998)

According to the NWA, the following are considered “water uses” and will require licensing in the form of a water use license application:

a) Taking water from a water resource;
b) Storing water;
c) Impeding or diverting the flow of water in a watercourse;
d) Engaging in stream flow reduction activity contemplated in Section 36 of the NWA;
e) Engaging in a controlled activity identified as such in Section 37 (1) or declared under Section 38(1) of the NWA;
f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;
i) Altering the bed, banks, course or characteristics of a watercourse;
j) Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

As the internal access road routes along the southern boundary of pan wetland 6, the following water uses will need to be applied for:

- (c) Impeding or diverting the flow of water in a watercourse;
- (i) Altering the bed, banks, course or characteristics of a watercourse;

9 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED DEVELOPMENT

From a surface water resource perspective, potential impacts are anticipated to take place as a result of the proposed development affecting pan wetlands 6. This section will identify and contextualise each of the potential impacts within the context of the proposed development and the identified surface water resources. This section will rate these impacts according to an impact rating system (see **Appendix A** for a full methodology and description of the impact rating system), determine the effect of the environmental impact and provide recommendations towards mitigating the anticipated impact. The identification and rating of impacts will be undertaken for the pre-construction, construction, operation and de-commissioning phase of the proposed development.

9.1 Pre-construction Phase Potential Impacts

9.1.1 Impacts associated with the Construction Lay-down Area Alternatives

A construction lay-down area will be required for the proposed development. The location of the construction lay-down area alternative is important, as it is proposed that Alternative 2 is to be placed near to two pan wetlands (approx. 280m away), and is likely to result in indirect negative impacts. Indirectly, potential downstream contamination and pollution impacts from stored oils, fuels, and other hazardous substances or materials being transported via run-off are a possibility. Where site clearing for the lay-down area may be required near the wetlands, clearance/removal of vegetation at the surface can leave the downstream wetland vulnerable to erosion and sedimentation impacts from associated run-off.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 2** below.

Table 2. Impact rating for pre-construction impacts related to the construction lay-down area and the wetland

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Impacts associated with the construction lay-down area near to wetlands	
Extent	*Site*	
Probability	*Possible*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be further reduced.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	1
Irreplaceable loss	2	1

Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	- 22 (low negative)	- 7 (low negative)
Mitigation measures	**Preventing Indirect Erosion, Sedimentation and Run-off Impacts** – In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian "sausage" nets can be used to around the lay-down area to prevent run-off from the cleared proposed construction lay-down area flowing into the surrounding area and possibly, any nearby wetlands. This will additionally assist with preventing consequent erosion and sedimentation in susceptible surrounding areas.	

9.2 Construction Phase Potential Impacts

9.2.1 Vehicle and Machinery Degradation Impacts

Construction vehicles (heavy and light) will require access to the proposed PV arrays. Potential negative impacts can include the need to travel around pan wetland 6, thereby resulting in physical degradation. Physical degradation in the form of compaction of soils, potential erosion, consequent sedimentation and general disturbance from vehicle movement can result. Additionally, inward drainage into the wetlands directly or from run-off containing oils, fluids and/or fuels either leaking or spilling from vehicles and machinery in general or during re-fuelling or servicing in or near the wetland is a probability. Should any leakage or spillage occur in and/or near the wetland, potential soil/water contamination/toxication of amphibians, avi-fauna or other organisms frequenting the wetlands can result. Fuels and oils also pose a fire risk not only to the wetlands but also neighbouring grazing lands or nearby settlement areas.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 3** below.

Table 3. Impact rating for construction vehicle and machinery degradation impacts to wetlands

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Vehicle and machinery degradation to the wetland	
Extent	*Site*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Low cumulative Impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be reduced.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	- 28 (low negative)	- 13 (low negative)
Mitigation measures	**Preventing Physical Degradation of the Wetland** – A water use license will be required before construction takes place alongside the wetland. All stipulated mitigation measures and conditions of the WUL are to be implemented accordingly. Where a WUL permit has been issued as well as environmental authorization for construction of the access roads around pan wetland 6, construction workers will only be allowed in the designated roads around the wetlands. Outside of the established roads, the wetland area is to be clearly demarcated as highly sensitive, and no access into these areas is to be allowed.	

	All wetlands in the proposed development site are to be designated as highly sensitive and will need to be clearly demarcated at all times. Access into the remaining wetlands not affected by the roads is also prohibited. **Preventing Soil Contamination** – No vehicles are to be allowed in the highly sensitive areas unless authorised. Should vehicles be authorised in highly sensitive areas, all vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the required construction areas. All vehicles and machinery must be regularly serviced and maintained before being allowed to enter the construction areas. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place in the highly sensitive areas. The study site is to contain sufficient spill contingency measures throughout the construction process. These include, but are not limited to, oil spill kits to be available, fire extinguishers, fuel, oil or hazardous substances storage areas must be bunded to prevent oil or fuel contamination of the ground and/or nearby wetland or the associated buffer zone.

9.2.2 Human Degradation of Flora and Fauna associated with the Wetlands

The possibility of human degradation to the wetlands is likely to occur during the construction phase, since construction activities will take place in relative close proximity to wetlands. Human degradation can take the form of physical / direct degradation such as lighting fires (purposefully or accidentally) in or near to the wetlands. Usage of the wetlands for sanitation purposes may take place when inundated, resulting in pollution of the wetland. The wetland may also be utilised as a source of water for domestic use, building and general cleaning purposes.

Fauna and avi-fauna associated with wetlands are often hunted, trapped, killed or eaten. This impact must be prevented. Finally, flora associated with wetlands may need to be cleared or removed for building storage purposes which can result in a loss of resources.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 4** below.

Table 4. Impact rating for construction phase human degradation of flora and fauna associated with the wetland

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Human degradation to fauna and flora associated with the wetlands	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*Low*	
Significance Rating	*Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact can be further reduced.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	1	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	- 11 (low negative)	- 6 (low negative)
Mitigation measures	**Minimising Human Physical Degradation of Sensitive Areas** – Construction workers are only allowed in designated construction areas and not into the wetlands designated as highly sensitive, unless the environmental authorisation and respective water use license authorize them to do so. No animals on the construction site or surrounding areas are to be hunted, captured, trapped, removed, injured, killed or eaten. Should any party be found guilty of such an offence, stringent penalties should be imposed. The appointed environmental control	

	officer (ECO) is to be contacted should removal of any fauna be required during the construction phase. No “long drop” toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the wetland where these are required. Temporary chemical sanitation facilities must be placed over a bunded or a sealed surface area and adequately maintained to prevent pollution impacts. No water is to be extracted unless a water use license is granted for specific quantities for a specific water resource. No hazardous or building materials are to be stored or brought into the highly sensitive areas. Should a designated storage area be required, the storage area must be placed at the furthest location from the highly sensitive area. Appropriate safety measures as stipulated above must be implemented. No cement mixing is to take place in the wetland. In general, any cement mixing should take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Importantly, no mixing of cement directly on the surface is allowed in the highly sensitive area.

9.2.3 Degradation and Removal of Soils and Vegetation associated with the Wetlands

The proposed access road is to be located along the boundary of pan wetland 6 within the associated buffer zones. Removal or infill of wetland soils can therefore be expected to take place. Functionality will be affected in terms of hydrological functionality as well as pedological functionality for the respective wetlands.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 5** below.

Table 5. Impact rating for construction phase degradation and removal of vegetation and soils associated with the wetlands and the associated buffer zones

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Degradation and removal of soils and vegetation associated with the wetlands	
Extent	*Site*	
Probability	*Definite*	
Reversibility	*Barely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced slightly.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	- 32 (medium negative)	- 30 (medium negative)
Mitigation measures	**Avoiding Direct Impacts to the Wetland** – Roads established on the boundary of pan wetland 6 mentioned above will need to have specific erosion and sedimentation mitigation measures to prevent unnecessary potential impacts affecting the wetlands. Adequate structures must therefore be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian “sausage” nets can be used to along the boundaries of the access roads to prevent sediment flowing into the wetland.	

	This will additionally assist with preventing consequent erosion.

9.2.4 Increased Run-off, Erosion and Sedimentation Impacts

Vegetation clearing will need to take place for the construction process. Excessive or complete vegetation clearance in the highly sensitive and nearby surrounding areas is likely to result in exposing the soil and leaving the ground susceptible to wind and water erosion, particularly during and after rainfall events. Due to the climate of the study area and sudden sporadic rainfall, general soil erosion, as a consequence of the proposed development, is a distinct possibility. A further impact due to erosion and storm water run-off impacts is increased sedimentation to the wetland. Deposited sediments can smother vegetation and change flow paths and dynamics making affected areas susceptible to alien plant invasion leading to further degradation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 6** below.

Table 6. Impact rating for construction phase increased storm water run-off, erosion and sedimentation impacts

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Increased storm water run-off, erosion and increased sedimentation impacting on the wetlands	
Extent	*Site*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Significant loss of resources*	
Duration	*Short term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low negative impact.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1

Irreplaceable loss	3	2
Duration	1	1
Cumulative effect	3	1
Intensity/magnitude	3	1
Significance rating	- 39 (medium negative)	- 8 (low negative)
Mitigation measures	**Preventing Increased Run-off and Sedimentation Impacts** – Vegetation clearing should take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation clearing must not take place in areas where construction will only take place in the distant future. An appropriate storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off in the designated construction areas. In general, adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and sediment volumes. The use of silt fencing and potentially sandbags or hessian "sausage" nets can be used to prevent erosion in susceptible construction areas. All impacted areas are to be adequately sloped to prevent the onset of erosion. Importantly, special attention must be given and implemented at the recommendation of the ECO for site specific erosion, sedimentation and run-off mitigation measures at the edge of the buffer zones of the wetlands.	

9.3 Operation Phase Potential Impacts

9.3.1 Vehicle Damage to the Wetlands

Access roads to the proposed PV field during the operation and maintenance phase can physically affect the nearby identified wetlands. Therefore, it is important that roads are not planned and constructed within any of the wetlands and/or associated buffer zones. However, where it is not possible to avoid this, the wetland will be susceptible to compaction and erosion impacts for the lifecycle of the proposed development leading to long term impacts. Regular vehicle movement in the affected wetlands can compact the soil affecting the hydrology of the system. Similarly, regular movement from vehicles can smooth the ground surface making it a preferential pathway for surface flows, susceptible to accelerated run-off which can induce erosion.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 7** below.

Table 7. Impact rating for operation phase vehicle damage

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Vehicle damage to the wetland	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Barely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be further reduced slightly.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2

Intensity/magnitude	3	3
Significance rating	- 48 (medium negative)	- 39 (medium negative)
Mitigation measures	**Minimising Vehicle Damage to the Wetland** – It is recommended that any road plan and associated structures be submitted to the relevant environmental and water departments for approval prior to implementation. The access roads that are environmentally authorised and have been permitted in terms of water use licensing alongside pan wetland 6 will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month in the rainy season (October to March). Additionally, after short or long periods of heavy rainfall or after long periods of sustained rainfall, the roads will need to be checked on an *ad hoc* basis for erosion. Rehabilitation measures will need to be employed should erosion be identified. Where erosion begins to take place, this must be dealt with immediately to prevent significant erosion damage to the wetland. Should large scale erosion occur, a rehabilitation plan will be required. Input, reporting and recommendations from a suitably qualified wetland/surface water specialist must be obtained in this respect.	

9.4 Decommissioning Phase Potential Impacts

9.4.1 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar potential impacts are therefore expected to occur and the stipulated mitigation measures (where relevant) must be employed as appropriate to minimise impacts.

9.5 Cumulative impacts

Although it is important to assess the site specific surface water impacts of the proposed solar facility and the associated components, it is equally important to assess the potential cumulative surface water impact that could materialise in the area should other renewable energy facilities be granted environmental authorisation and be constructed. Cumulative impacts are the impacts, which combine from different developments / facilities and result in significant impacts that may be larger than the sum of all the impacts combined.

The renewable energy developments that are being proposed within a 25km radius from the study site are indicated in **Table 8** and **Figure 18** below.

Table 8. Renewable energy developments proposed within the vicinity of the proposed development

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Scoping and EIA processes underway.	Kabi Solar (Pty) Ltd	75MW	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390	Environmental authorisation received	Sediba Power Plant (Pty) Ltd	75MW	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308	Environmental authorisation received and preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75MW	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	Environmental authorisation received	Cronos Energy (Pty) Ltd	75MW	Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	Environmental authorisation received 29 June 2013. Amended to 75MW on 4 April 2014.	Carocraft (Pty) Ltd	75MW	Portion 1 and the Remainder of the Farm Weltevrede 681
Expansion of the Carocraft Solar Park	14/12/16/3/3/2/699	Scoping and EIA processes underway.	Carocraft (Pty) Ltd	75MW	Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 1 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 1 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729
Woodhouse Solar 2 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 2 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729

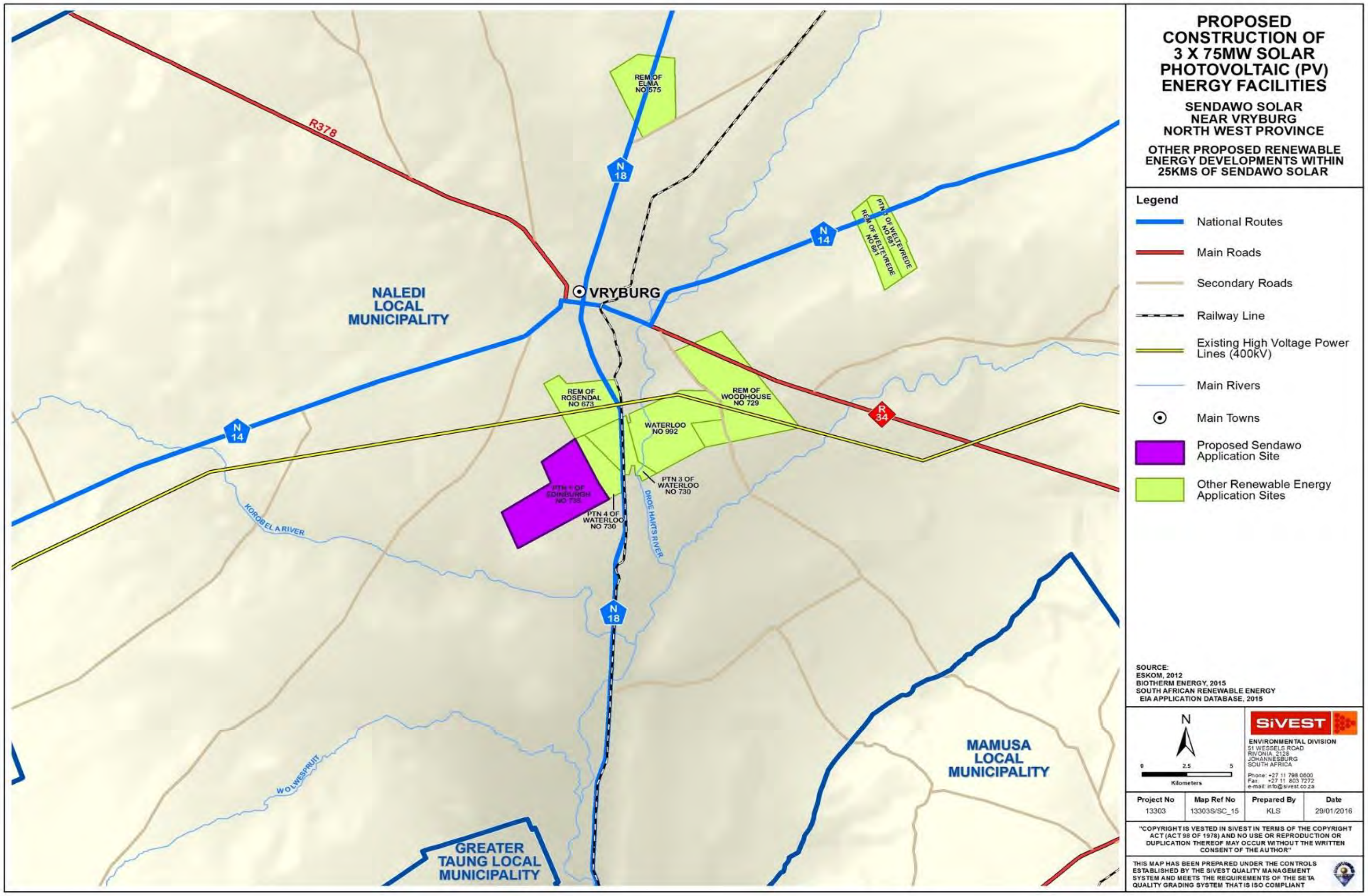


Figure 18: Renewable energy facilities proposed within the vicinity of the proposed development site

The key factor to consider when evaluating surface water impacts from a cumulative perspective is downstream impacts. Where a development takes place upstream, should impacts occur these are likely to have an effect downstream to some extent.

In the context of the proposed development, similar developments (solar facilities) are located directly to the north and north east. Several more are located much further (over 10kms away) to the north and north east which will not have any effect on the proposed development, nor will the proposed development have an effect on these developments.

Importantly, there is a drainage system that stems from the Sediba Power Plant 75MW PV Solar Facility on the Remainder of the Farm Rosendal 673 that is located to the north of the proposed development site. The drainage systems flows in a southerly direction and hence any upstream increase in storm water flows or sedimentation volumes can have an adverse impact on the greater proposed PV application sites (Sendawo PV 1, 2 and 3). Consequent erosion can also ensue as a result of increased surface run-off. Conversely, the same downstream impacts can be associated with the construction of Sendawo 1, 2 and 3 to the adjacent property to the east (Tiger Kloof Solar PV Facility on Portion 4 & 3 of the Farm Waterloo 730).

However, should the mitigation measures stipulated in this report be strictly adhered to, downstream impacts can be limited. Overall, cumulative impacts are not expected to be significant several kilometres downstream of any linear hydrological system and will be fairly localized within the particular catchment. With the implementation of mitigation measures (generic and specific), downstream impacts can be significantly reduced.

10 SPECIALIST RECOMMENDATIONS

The relevant water use license and environmental authorisations are to be applied for before construction is allowed to commence. In this instance, where any structures or roads are within the wetlands and/or the associated buffer zones of the wetlands, adequate run-off mitigation measures need to be accounted for as stipulated in **Section 9** above to prevent/minimize accelerated run-off, erosion and sedimentation impacts.

All the identified triggered activities and water uses identified in **Section 8** should be confirmed with the relevant government authoritative departments.

11 CONCLUSIONS

A surface water delineation and impact assessment is provided in this report for the proposed development. Findings were based on a method for delineating wetlands and riparian habitat as per the **DWAF 2005** guidelines. Ultimately, it was found that there are three pan wetlands (pan wetlands 6, 7 and 13) on the Sendawo PV 2 study site. A 15m construction buffer zone and 18m operation buffer zone is to be applied to the wetlands based on the type and condition of the wetland, as well as the potential impacts expected and mitigations measures to be implemented.

A comparative assessment was undertaken to determine which of the proposed lay-down, substation and operations building alternative sites would be most suitable from a surface water perspective. Accordingly, the preferred location options include Sendawo PV 2 Operations Building and Substation Alternative 1 and Sendawo PV 2 Laydown Area Alternative 2.

In terms of potentially applicable environmental and water related legislature, several listed activities and water uses have been identified that will be applicable to the proposed development based on the current layout. In terms of NEMA (1998) and the EIA Regulations (2014), Activities 12 and 19 of Government Notice 983 have been identified as being applicable as a result of an access road being placed along the southern boundary of pan wetland 6. With respect to the NWA (1998), water uses (c) and (i) will also be applicable where the proposed access road will be along the boundary of pan wetland 6. The above identified activities and water uses should however be confirmed with the relevant government departments.

Foreseen potential negative impacts in terms of the pre-construction, construction, operation and decommissioning phases of the proposed development were identified and assessed. Mitigation measures have been stipulated and must be included and implemented as part of the Environmental Management Programme (EMPr) for the proposed development. The impacts for each phase of the proposed development are summarised as follows:

PRE-CONSTRUCTION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Construction Lay-down Area at Construction Lay-down Area Alternative 2	- 22 (low negative)	- 7 (low negative)
CONSTRUCTION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Vehicle and Machinery Degradation	- 28 (low negative)	- 13 (low negative)
Human Degradation of Flora and Fauna associated with the Wetland	- 11 (low negative)	- 6 (low negative)

Degradation and Removal of Soils and Vegetation associated with the Wetland	- 32 (medium negative)	- 30 (medium negative)
Increased Run-off and Sedimentation	- 30 (medium negative)	- 8 (low negative)
OPERATION PHASE		
	Pre-mitigation Rating	**Post-mitigation Rating**
Vehicle Damage to the Wetland	- 48 (medium negative)	- 39 (medium negative)

It is not anticipated that the proposed development will need to be decommissioned. However, should this need to take place, all relevant identified potential construction impacts will be applicable and the relevant mitigation measures must be implemented where applicable.

For cumulative potential impacts, the primary impact of concern relates to increased surface run-off and consequent potential erosion and sedimentation primarily as a result of construction activities. The degree of impact can be expected to be compounded with construction activities taking place at the same time should construction of the solar facilities in the adjacent properties also commence simultaneously, and where sudden and heavy rainfall is experienced. However, where mitigation measures are strictly adhered to, potential impacts radiating outwards as a result of the proposed development can be minimized significantly. The cumulative impact is therefore expected to be low.

In terms of final specialist recommendations, the relevant water use license and environmental authorisations are to be applied for before construction is allowed to commence. In this instance, where any structures or roads are within the wetlands and/or the associated buffer zones of the wetlands, adequate run-off mitigation measures need to be accounted for as stipulated in **Section 9** above to prevent/minimize accelerated run-off, erosion and sedimentation impacts.

All the identified triggered activities and water uses identified in **Section 8** should be confirmed with the relevant government authoritative departments.

12 REFERENCES

1. Collins, N.B., 2005: Wetlands: *The basics and some more*. Free State Department of Tourism, Environmental and Economic Affairs.
2. Cummings, 1999: Tracks and Roads. In Landcare Notes. State of Victoria, Department of Natural Resources and Environment.
3. Department of Natural Resources, Environment and the Arts (DNREA), 2006: Road Drainage, Land Note ASLN-01. Vegetation and Land Management Natural Resource Management Division. Alice Springs.
4. Department of Water Affairs and Forestry (DWAF), 2005: *A practical field procedure for identification and delineation of wetlands and riparian areas* (edition 1). DWAF, Pretoria.
5. Goudie, A.S & Wells, G. L., 1995: The nature, distribution and formation of pans in arid zones, *Earth-Science Reviews*, 38, 1-69.
6. Macfarlane, D. M., Bredin, I. P., Adams, J. B., Zungu, M. M., Bate, G. C & Dickens, C. W. S., 2014: *Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries*. Final Consolidated Report. WRC Report No TT 610/14, Water Research Commission, Pretoria.
7. Masing, V., Svirezhev, Y. M., Loffler, H & Patten, B. C., 1990: Wetlands in the Biosphere, in Patten, B. C. (ed), *Wetlands and shallow continental water bodies*, Volume 1: Natural and Human Relationships, SPB Academic Publishing, The Netherlands.
8. Meintjies, S., Seaman, M. T & Kok, D. J., 1994: Duration of inundation and change in physical and chemical characteristics of small temporary pan in South Africa, *Hydrobiologia*, 281, 79-90.
9. Mucina, L & Rutherford, M. C., 2006: The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
10. Ollis, D. J., Snaddon, C. D., Job, N. M & Mbona, M., 2013: *Classification System for Wetlands and other Aquatic Ecosystems in South Africa*, User Manual: Inland Systems.
11. SANRAL, 2009b: Drainage. *In Routine Road Maintenance Manual (2nd ed.)*. Pretoria: South African National Roads Agency Ltd. Chapter 10.
12. Tarbuck, E. J & Lutgens, F. K. (Eds), 1987: *The Earth: an Introduction to Physical Geology*. Columbus, OH: Merrell Publishing, Co.
13. USEPA, 2005: National Management Measures to Control Nonpoint Source Pollution from Urban Areas (Online). Available: http://www.epa.gov/nps/urbanmm/
14. USEPA, 2006: Construction Site Stormwater Runoff Control (Online). Available http://wwwcfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure=id4
15. Walker, D., Entine, L and Kummer, S., 2000: Local Road Assessment and Drainage Manual. Transportation and Information Centre, Wisconsin-Madison University.

Appendix A:

Impact Rating Methodology

The determination of the effect of an environmental impact on an environmental parameter (in this instance, wetlands) is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in **Table 9**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is usually assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

In this case, a unique situation is present whereby various scenarios have been posed and evaluated accordingly. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 9. Example of the significance impact rating table.

NATURE		
Includes a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		

1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		

This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:		

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

SiVEST Environmental Division
51 Wessels Road, Rivonia. 2128. South Africa
PO Box 2921, Rivonia. 2128. South Africa

Tel + 27 11 798 0600
Fax +27 11 803 7272
Email info@sivest.co.za
www.sivest.co.za

Contact Person:	Shaun Taylor
Cell No.:	+27 72 779 4899
Email:	shaunt@sivest.co.za

Appendix 6D:

Soils and Agricultural Potential Assessment

EIA REPORT

On contract research for

SiVEST

SOIL INFORMATION FOR SITE 2 OF THE PROPOSED SENDAWO SOLAR ENERGY PLANT, NEAR VRYBURG, NORTH WEST PROVINCE

By

D.G. Paterson (Pr. Sci. Nat. 400463/04)

Report No. GW/A/2016/xx

February 2016

ARC-Institute for Soil, Climate and Water,
Private Bag X79, Pretoria 0001, South Africa

Tel (012) 310 2500 Fax (012) 323 1157

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
February 2016

CONTENTS **Page**

1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by SiVEST to undertake a soil investigation near Vryburg, in the North West Province, where a solar power (PV) project is proposed. The objectives of the study are;

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

- To assess broad agricultural potential and the impacts thereon.

2. SITE CHARACTERISTICS

2.1 Location

An area was investigated lying approximately 10 km to the south of the town of Vryburg. The area lies between 27° 02′ and 27° 06′ S and between 24° 41′ and 24° 45′ E. Within this area, three separate possible sites for the establishment of the solar power project have been identified.

This report deals with ***Site 2***, which is identified in pink on the locality map (Figure 1). The other two sites are also shown, but not coloured in.

2.2 Terrain

The area lies at a height of approximately 1 200 to 1 220 metres above sea level. The area slopes very gently (<2%) to the south-west). No permanent drainageways are present in the vicinity.

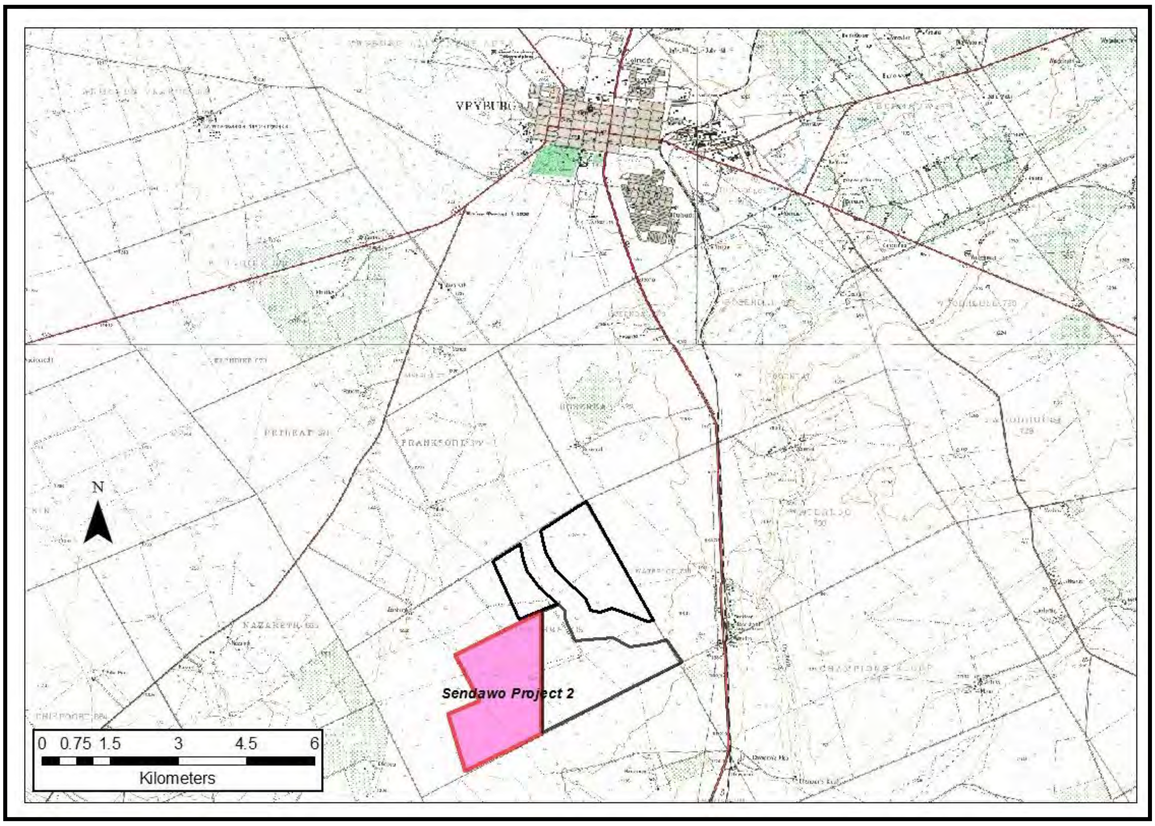


Figure 1 Locality map

2.3 Climate

The climate of the study area (Kotze & Lonergan, 1984) can be regarded as warm to hot with moderate rain in summer and dry winters. The long-term average annual rainfall in this region of North West is only 445 mm, of which 357 mm, or 79.5%, falls from November to April. Rainfall is erratic, both locally and seasonally and therefore cannot be completely relied on for agricultural practices. The average evaporation is over 2 600 mm per year, peaking at over 10.5 mm per day in December.

Temperatures vary from an average monthly maximum and minimum of 32.1°C and 16.7°C for January to 19.0°C and -0.6°C for July respectively. The extreme high temperature that has been recorded is over 42°C and the extreme low −10.0°C. Frost occurs most years on 30-40 days on average between early June and mid-September.

2.4 Parent Material

The geology of the area comprises dolomite of the Schmidtsdrift Formation, with a small area of Kalahari sand in the north-east (Geological Survey, 1984).

The distribution of the geological units in the area is shown in Figure 2.

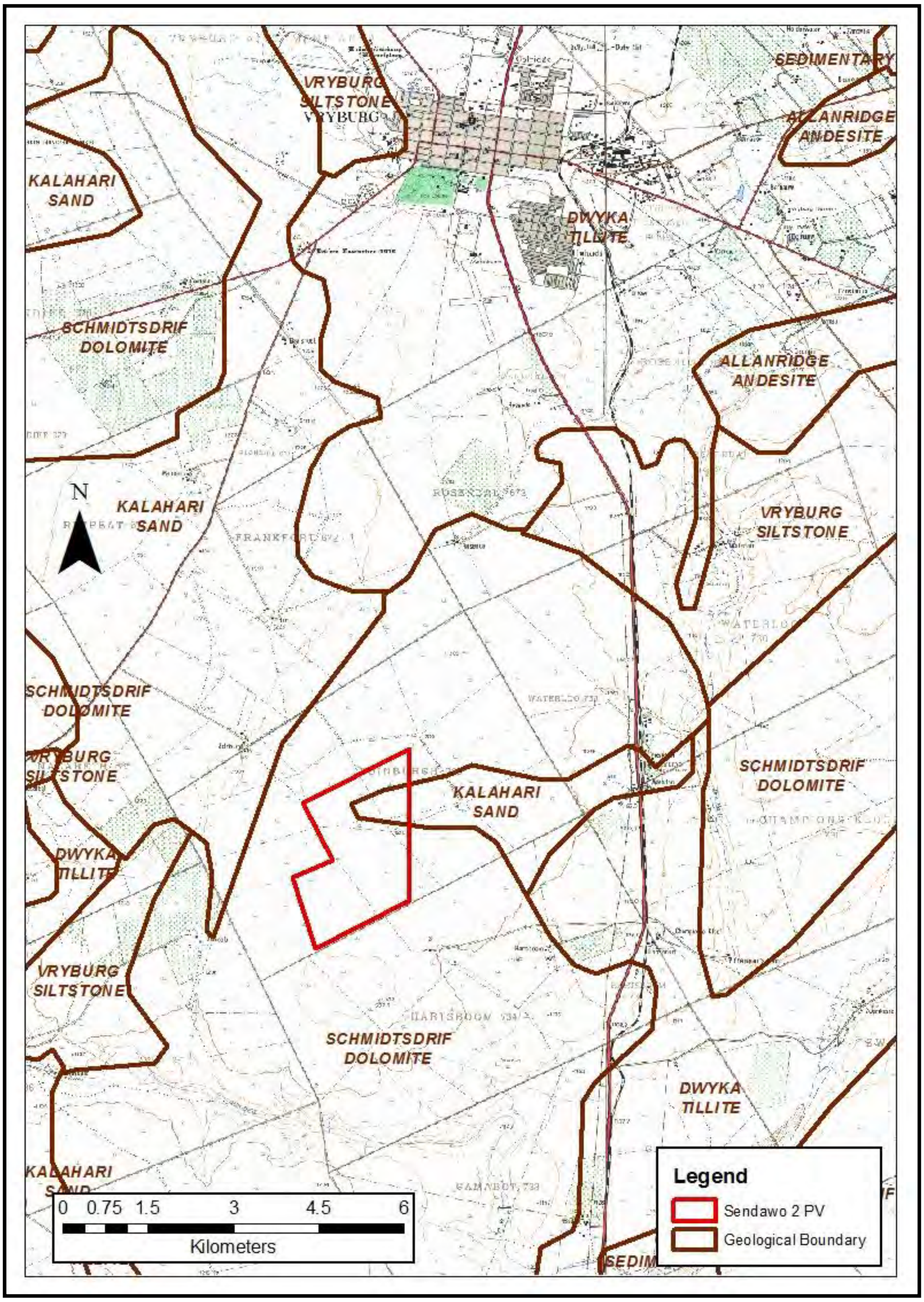


Figure 2 Geology

3. METHODOLOGY - SOILS

For the original scoping study for this project, existing soil information was obtained from the map sheet 2624 Vryburg (Eloff *et al.,* 1978) from the national Land Type Survey, published at 1:250 000 scale.

For this second (EIA) phase of the study, a field trip (in conjunction with other specialists) was carried out whereby the soils at various localities within the area were investigated using a hand-held soil auger, in order to carry out a ground-truthing exercise. A reference grid of 250 x 250 m was established, using a GPS to locate points in the field, and selected points were visited to carry out a soil observation. This involved describing the main soil characteristics at each point, as well as classifying the soil according to the South African soil classification system (Soil Classification Working Group, 1991).

4. SOIL PATTERN

The desk-top study indicated that the soils in the vicinity of the project were all shallow to very shallow (<500 mm), usually sandy and calcareous, overlying either rock or cemented hardpan calcrete. Some rock outcrops occur in places in the landscape.

The soil investigation confirmed this, with virtually all of the soils observed being less than 450 mm onto hard or weathering rock. The soils are reddish-brown to brown, structureless to weakly structured and belong to the Mispah, Glenrosa and Hutton soil forms (Soil Classification Working Group, 1991).

The location of the points in and around Site 2 that were visited during the field trip is shown in Figure 3.

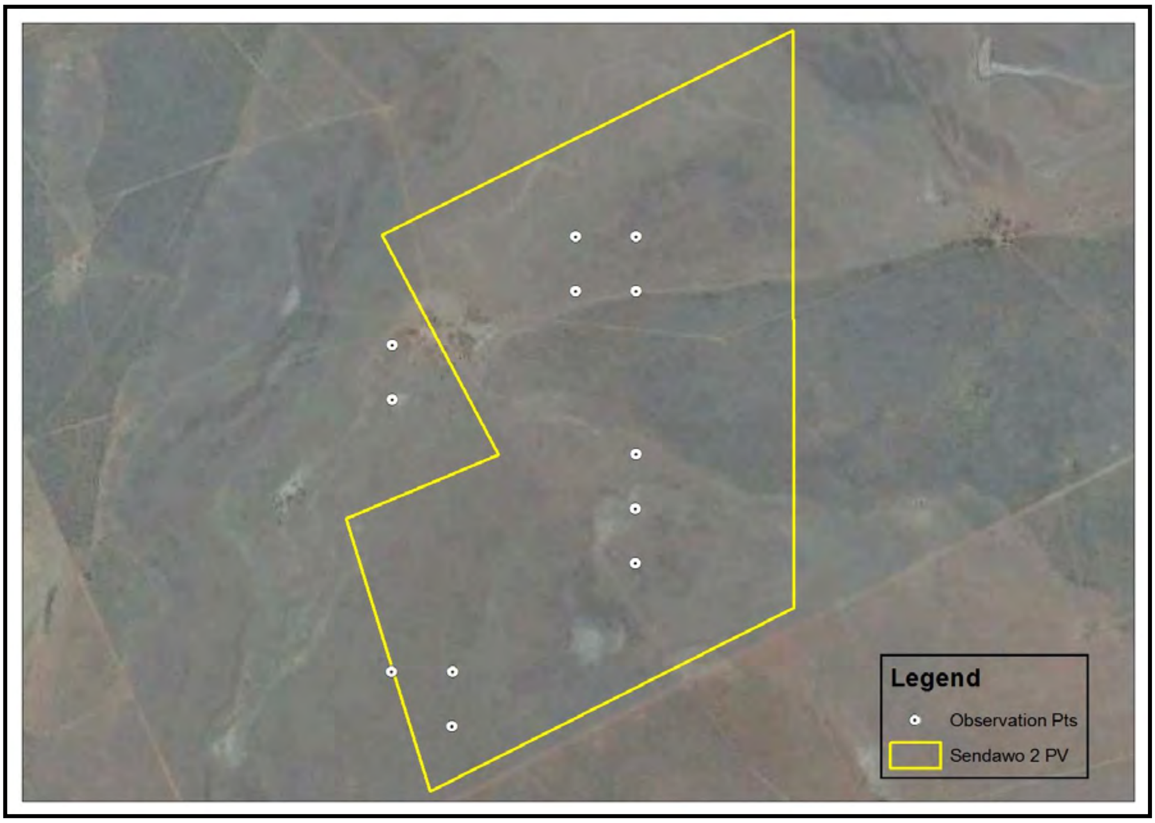


Figure 3 Soil observation points

5. AGRICULTURAL POTENTIAL

The shallow soils in the area, coupled with the low rainfall (Section 2.3) means that the only means of reliable cultivation would be by irrigation and the Google Earth image of the area (Figure 3) shows absolutely no signs of any agricultural infrastructure and certainly none of irrigation.

The climatic parameters (Section 2.3) mean that this part of North West is well suited for grazing but here the grazing capacity is relatively low, around 12 ha/large stock unit (ARC-ISCW, 2004).

5.1 Land Use

The land use in the area is dominantly "shrubland and low fynbos" with some small areas of "bare rock and soil (natural)" as classified by the National Land Cover (Thompson, 1999). As previously mentioned, there are no areas of cultivation that were identified, only a few small, isolated areas of "Improved grassland".

6. IMPACTS

The Impact Assessment Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

6.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 1.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

6.2 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Description of terms

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.

IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects

INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
Significance		

SIGNIFICANCE

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.

51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The impact can be summarized as follows:

Table 2 Rating of impacts (loss of potential)

IMPACT TABLE FORMAT		
Environmental Parameter	***Soil resources and associated agricultural potential***	
Issue/Impact/Environmental Effect/Nature	***The loss of agriculturally productive soil due to the establishment of the infrastructure of the PV project***	
Extent	*Confined to the* ***site only***	
Probability	*It is* ***probable*** *that impacts will occur*	
Reversibility	*The impact will in all probability be* ***partly*** *to* ***completely reversible*** *if the infrastructure is removed.*	
Irreplaceable loss of resources	***No loss*** *of irreplaceable resources.*	
Duration	***Long term****, for the operational life of the project*	
Cumulative effect	***Negligible to no*** *cumulative effects*	
Intensity/magnitude	***Low*** *to* ***medium*** *– not to any significant degree.*	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	3
Reversibility	2	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	**-22 (negative low)**	**-10 (negative low)**

IMPACT TABLE FORMAT	
Mitigation measures	Due to the prevailing low potential agricultural environment, little or no mitigation measures are required. The footprint of the development should be kept to a minimum, so that at least the effect on grazing land for livestock is reduced.

Table 3 Rating of impacts (erosion hazard)

IMPACT TABLE FORMAT		
Environmental Parameter	***Increased hazard of soil erosion***	
Issue/Impact/Environmental Effect/Nature	***The loss of topsoil by being exposed to wind action due to construction processes***	
Extent	*Confined to the **site only**, but possibly in the broader vicinity, if not mitigated*	
Probability	*It is **probable** that impacts will occur*	
Reversibility	*The impact will in all probability be **partly** to **completely reversible** if the infrastructure is removed.*	
Irreplaceable loss of resources	***No loss** of irreplaceable resources.*	
Duration	***Long term**, for the operational life of the project*	
Cumulative effect	***Possible medium** cumulative effects*	
Intensity/magnitude	***Medium** – not to any significant degree, though some modification is possible*	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	3	1
Intensity/magnitude	3	1
Significance rating	**-42 (negative medium)**	**-9 (negative low)**
Mitigation measures	The main mitigation would be to ensure that physical disturbance caused by soil removal and/or re-distribution is kept to a minimum. In such an area of low rainfall and hot conditions, vegetation is fragile and often difficult to re-establish. The relatively sandy nature of the soils means	

IMPACT TABLE FORMAT	
	that if exposed, there is a real hazard of soil removal by wind erosion, especially in the drier winter months. To combat this, any bare soil should be re-vegetated as soon as possible and preventative measures, such as soil covering and windbreaks, may also be required.

6.3 Cumulative Impacts

The main cumulative impact would be as a result of the fact that several solar power generation projects are planned in the vicinity of Vryburg (eight projects within an approximate 20 km radius). The ***soils*** on each site would not have an impact on any other site, but there would be a potential of increased dust production as a result of construction activities, especially in the drier months, when wind can cause soil particles to become detached from the bare soil surface. The main mitigation measures would include ensuring that the topsoil remains moist if possible, and that the construction footprint is as small as possible, with minimum soil surface disturbance due to construction activities.

6.4 Comparison of Alternatives

When looking at the two proposed alternatives, from a soils viewpoint there is little or no difference between them.

Table 4. Comparative Assessment of Alternatives – Sendawo 2 PV

Alternative	Preference	Reasons
OPERATIONS BUILDING AND SUBSTATION		
Sendawo PV 2 Operations Building and Substation Alternative 1	No Preference	Relatively uniform shallow soils, low rainfall, limited impacts
Sendawo PV 2 Operations Building and Substation Alternative 2	No Preference	Relatively uniform shallow soils, low rainfall, limited impacts
LAYDOWN AREA		
Sendawo PV 2 Laydown Area Alternative 1	No Preference	Relatively uniform shallow soils, low rainfall, limited impacts
Sendawo PV 2 Laydown Area Alternative 2	No Preference	Relatively uniform shallow soils, low rainfall, limited impacts

REFERENCES

ARC-ISCW, 2004. Overview of the status of the agricultural natural resources of South Africa (First Edition). ARC-Institute for Soil, Climate and Water, Pretoria

Geological Survey, 1984. 1:1 million scale geological map of South Africa. Department of Mineral and Energy Affairs, Pretoria.

Kotze, A.V. & Lonergan, A.T., 1984. Climate data. In: Land types of the maps 2522 Bray, 2622 Morokweng, 2524 Mafeking and 2624 Vryburg. *Mem. Agric. nat. Res. S. Afr*. No. 1. ARC-Institute for Soil, Climate and Water, Pretoria.

Thompson, M.W., 1999. South African National Land-cover Database Project. CSIR Environmentek, ENV/P/C 98136, Pretoria.

Soil Classification Working Group, 1991. Soil Classification. A Taxonomic System for South Africa. ARC-Institute for Soil, Climate & Water, Pretoria.

Appendix 6E:
Visual Assessment

BIOTHERM ENERGY PTY (LTD)

Proposed Construction of the 75MW Sendawo Solar 2 Photovoltaic (PV) Energy Facility near Vryburg, North West Province

Visual Impact Assessment Report – Impact Phase

Issue Date: 01 June 2016
Revision No.: 1
Project No.: 13303

Date:	01 June 2016
Document Title:	Proposed Construction of the 75MW Sendawo Solar 2 Photovoltaic (PV) Energy Facility near Vryburg, North West Province: Visual Impact Assessment Report – Impact Phase
Author:	Stephan Jacobs B.Sc. (Hons) Environmental Management & Analysis (UP) BSc Environmental Sciences (UP)
Revision Number:	#1
Checked by:	Andrea Gibb (internal review) B.Sc. (Hons) Environmental Management (UNISA) BSc Landscape Architecture *Cum Laude* (UP) *Report to be peer reviewed*
Approved:	Kelly Tucker
Signature:	
For:	SiVEST Environmental Division

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	**14/12/16/3/3/2/892**
NEAS Reference Number:	
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Proposed Construction of the 75MW Sendawo Solar 2 Photovoltaic (PV) Energy Facility near Vrybug, North West Province

Specialist:	**SiVEST SA (Pty) Ltd**		
Contact person:	Stephan Jacobs		
Postal address:	P O Box 2921, Rivonia		
Postal code:	2128	Cell:	072 737 2114
Telephone:	011 798 0677	Fax:	011 803 7272
E-mail:	stephanj@sivest.co.za		
Professional affiliation(s) (if any)	None		

Project Consultant:	**SiVEST SA (Pty) Ltd**		
Contact person:	Rebecca Thomas		
Postal address:	P O Box 2921, Rivonia		
Postal code:	2128	Cell:	082 302 9010
Telephone:	011 798 0600	Fax:	011 803 7272
E-mail:	rebeccat@sivest.co.za		

The specialist appointed in terms of the Regulations

I, ___________**Andrea Gibb**_________________, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist

SiVEST SA (Pty) Ltd

Name of company (if applicable)

28 April 2016

Date

The specialist appointed in terms of the Regulations

I, **Stephan Jacobs**, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist

SiVEST SA (Pty) Ltd

Name of company (if applicable)

29 February 2016

Date

BIOTHERM ENERGY PTY (LTD)

PROPOSED CONSTRUCTION OF THE 75MW SENDAWO SOLAR 2 PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR VRYBURG, NORTH WEST PROVINCE

VISUAL IMPACT ASSESSMENT REPORT – IMPACT PHASE

Contents Page

List of Figures

List of Tables

Appendices

GLOSSARY OF TERMS

ABBREVIATIONS

DM	District Municipality
EIA	Environmental Impact Assessment
Ha	Hectares
I&AP	Interested and/or Affected Party
kV	Kilovolt
LM	Local Municipality
NGI	National geo-spatial information
O&M	Operations and Maintenance
SANBI	South African National Biodiversity Institute
VIA	Visual Impact Assessment

DEFINITIONS

Anthropogenic feature: An unnatural feature as a result of human activity.

Aspect: Direction in which a hill or mountain slope faces.

Cultural landscape: A representation of the combined worlds of nature and of man illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal (World Heritage Committee, 1992).

Sense of place: The unique quality or character of a place, whether natural, rural or urban. It relates to uniqueness, distinctiveness or strong identity.

Scenic route: A linear movement route, usually in the form of a scenic drive, but which could also be a railway, hiking trail, horse-riding trail or 4x4 trail.

Sensitive visual receptors: An individual, group or community that is subject to the visual influence of the proposed development and is adversely impacted by it. They will typically include locations of human habitation and tourism activities.

Study area: The study area is assumed to encompass a zone of 5km from the outer boundary of the PV energy development area. This is also referred to as the visual assessment zone.

Viewshed: The geographical area, based entirely on topography, from where an object / structure would be visible, i.e. the zone of visual influence. The viewshed defines the outer boundary of a visual envelope, usually along crests and ridgelines.

Visual character: The physical elements and forms and land use related characteristics that make up a landscape and elicit a specific visual quality or nature. Visual character can be defined based on the level of change or transformation from a completely natural setting.

Visual contrast: The degree to which the development would be congruent with the surrounding environment. It is based on whether or not the development would conform with the land use, settlement density, forms and patterns of elements that define the structure of the surrounding landscape.

Visual envelope: A geographic area, usually defined by topography, within which a particular project or other feature would generally be visible.

Visual exposure: The relative visibility of a project or feature in the landscape.

Visual impact: The effect of an aspect of the proposed development on a specified component of the visual, aesthetic or scenic environment within a defined time and space.

Visual receptors: An individual, group or community that is subject to the visual influence of the proposed development but is not necessarily adversely impacted by it. They will typically include commercial activities and motorists travelling along routes that are not regarded as scenic.

Visual sensitivity: The inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (visual character), spatial distribution of potential receptors, and the likely value judgements of these receptors towards the new development, which are usually based on the perceived aesthetic appeal of the area.

BIOTHERM ENERGY PTY (LTD)

PROPOSED CONSTRUCTION OF THE 75MW SENDAWO SOLAR 2 PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR VRYBURG, NORTH WEST PROVINCE

VISUAL IMPACT ASSESSMENT REPORT – SCOPING PHASE

1 INTRODUCTION

BioTherm Energy (Pty) Ltd (hereafter referred to as BioTherm) are proposing to construct a solar photovoltaic (PV) energy facility, near Vryburg in the North West Province (hereafter referred to as the 'proposed development'). The proposed development will therefore consist of a 75MW export capacity solar PV facility, referred to as Sendawo Solar 2, which is aimed at generating electricity that is to be fed into the Eskom grid. SiVEST South Africa (Pty) Ltd (hereafter referred to as SiVEST) have been appointed by BioTherm to undertake the Environmental Impact Assessment (EIA) for proposed construction of the solar PV energy facility. As part of the EIA studies conducted for the proposed development, the need to undertake a visual impact assessment (VIA) has been identified. During the Scoping Phase of the EIA, a desktop assessment of the visual environment within the study area was undertaken in order to characterise the area and broadly identify all the potential visual impacts and issues relating to the proposed development. This visual assessment undertaken during the EIA phase focuses on the potential sensitive receptor locations, and provides an assessment of the magnitude and significance of the visual impacts associated with the proposed solar PV energy facility. The main deliverable of this study is the generation of maps indicating visual receptors within the various distance bands and this report indicating the findings of the study.

1.1 Project Description

At this stage, it is understood that the 75MW export capacity Sendawo Solar 2 PV energy facility will consist of the following components:

- Approximately 274 00 to 281 000 solar PV panels with a total export capacity of 75MW;
- Panels will be either fixed axis mounting or single axis tracking solutions (**Figure 1**), and will be either crystalline silicon or thin film technology;

- On-site switching substation, with the transformers for voltage step up from medium voltage to high voltage;
- The PV panels (**Figure 2**) will be connected in strings to inverters and inverter stations will be required throughout the site. Inverter stations will house 2 x 1MW inverters and 1 x 2MVA transformers;
- DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to 22-33kV (medium voltage) in the transformers (**Figure 3**);
- The 22-33kV cables will be run underground in the facility to a common point before being fed to the on-site switching substation where the voltage will typically be stepped up to 132kV;
- Grid connections will be to the proposed Sendawo substation. The Sendawo substation will be connected to the existing Mookodi Main Transmission Substation (MTS) by a proposed 400kV power line. The distance will be approximately 3km (Note that the substation and power line component forms part of a separate on-going EIA process. Therefore, these component are not assessed herein).
- A 132kV power line to the proposed Sendawo Substation (part of a separate on-going EIA process);
- A lay-down area for the temporary storage of materials during the construction activities;
- Access roads and internal roads;
- Construction of a car park and fencing around the project; and
- Administration, control and warehouse buildings.

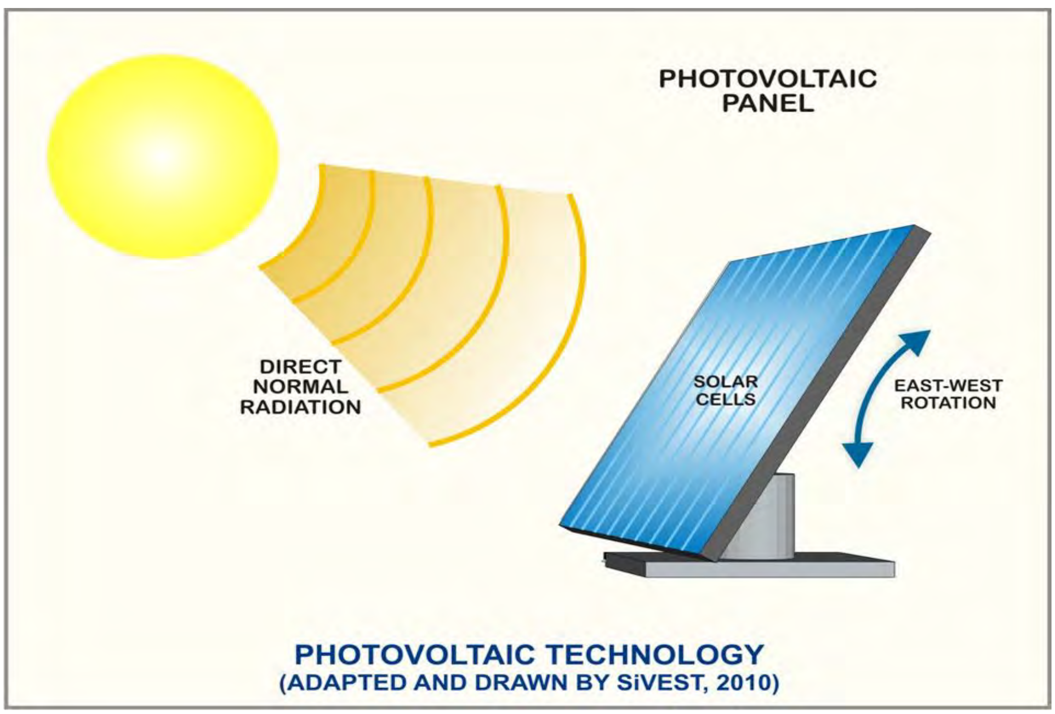


Figure 1: Typical Solar PV Panel

The solar panels are generally configured in banks of arrays or sub-arrays depending on the number of PV panels used and the size of the arrays. The rows of PV panels are spaced both to allow access to vehicles during maintenance and to ensure that one array or one sub-array does not cast a shadow over the one behind. The electricity is cabled to inverters, which convert DC power to AC and synchronised to the electricity grid. The output is connected through various switchgear, protection devices and meters to local users and the grid. The inverters, switchgear and other electrical equipment are standard items as used for a wide range of industrial applications. The other major operating component of the system is the inverter, which converts the DC power produced by the solar modules into AC power before being sent to the grid.

The smallest unit of a PV installation is a cell. A number of cells form a module, and finally a number of modules form the arrays (**Figure 2**). Modules are arranged into strings that form the solar field. Modules are arranged in sections called tables and are installed on racks which are made of aluminium or steel.

All the arrays are wired to inverters that convert direct current (DC) into alternating current (AC) that can be stepped up and fed into the national grid system.

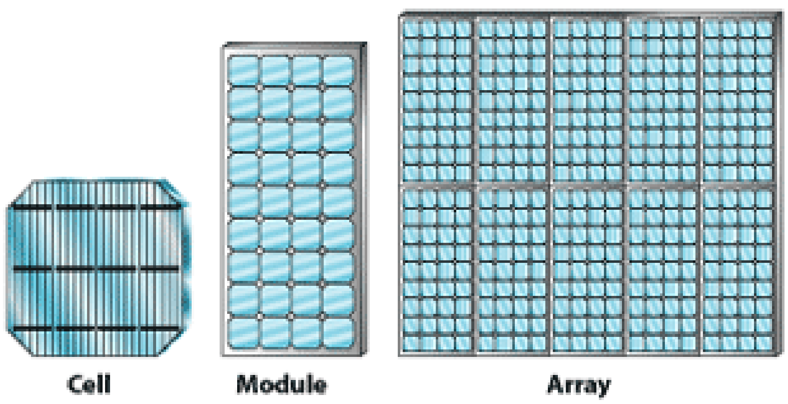


Figure 2: Illustration of a PV installation

The PV arrays are typically connected to each other in strings, and the strings are connected to DC to AC inverters (**Figure 3**). The DC to AC inverters may be mounted on the back of the panels support substructures / frames or alternatively in a central inverter station. The strings are connected to the inverters by low voltage DC cables. Power from the inverters is collected in medium voltage transformers through AC cables. Cables may be buried or pole mounted depending on voltage level and site conditions.

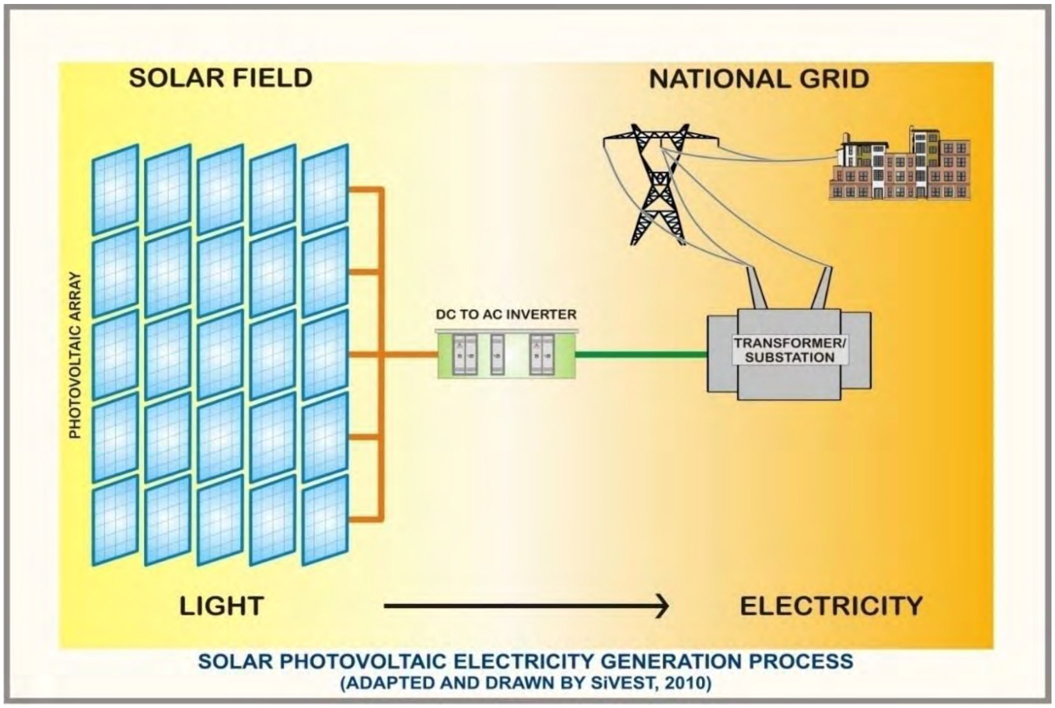


Figure 3: PV electricity generation and conversion process

1.2 Alternatives

Due to the limited space available as well as the constraints of the sensitive areas, no alternative PV panel layouts were identified. Other design or layout alternatives have however been identified, which include two (2) alternative site locations for the on-site 132kV substation as well as two (2) site alternatives for the operation and maintenance (O&M) buildings. Additionally, two (2) laydown area site alternatives were also identified (**Figure 4**). Should the other two (2) proposed PV projects located on the same farm (namely Sendawo Solar 1 and Sendawo Solar 3) also be granted Environmental Authorisations (EAs) and be awarded preferred bidder status by the DoE the possibility of sharing the substation site to reduce the environmental impact will be considered.

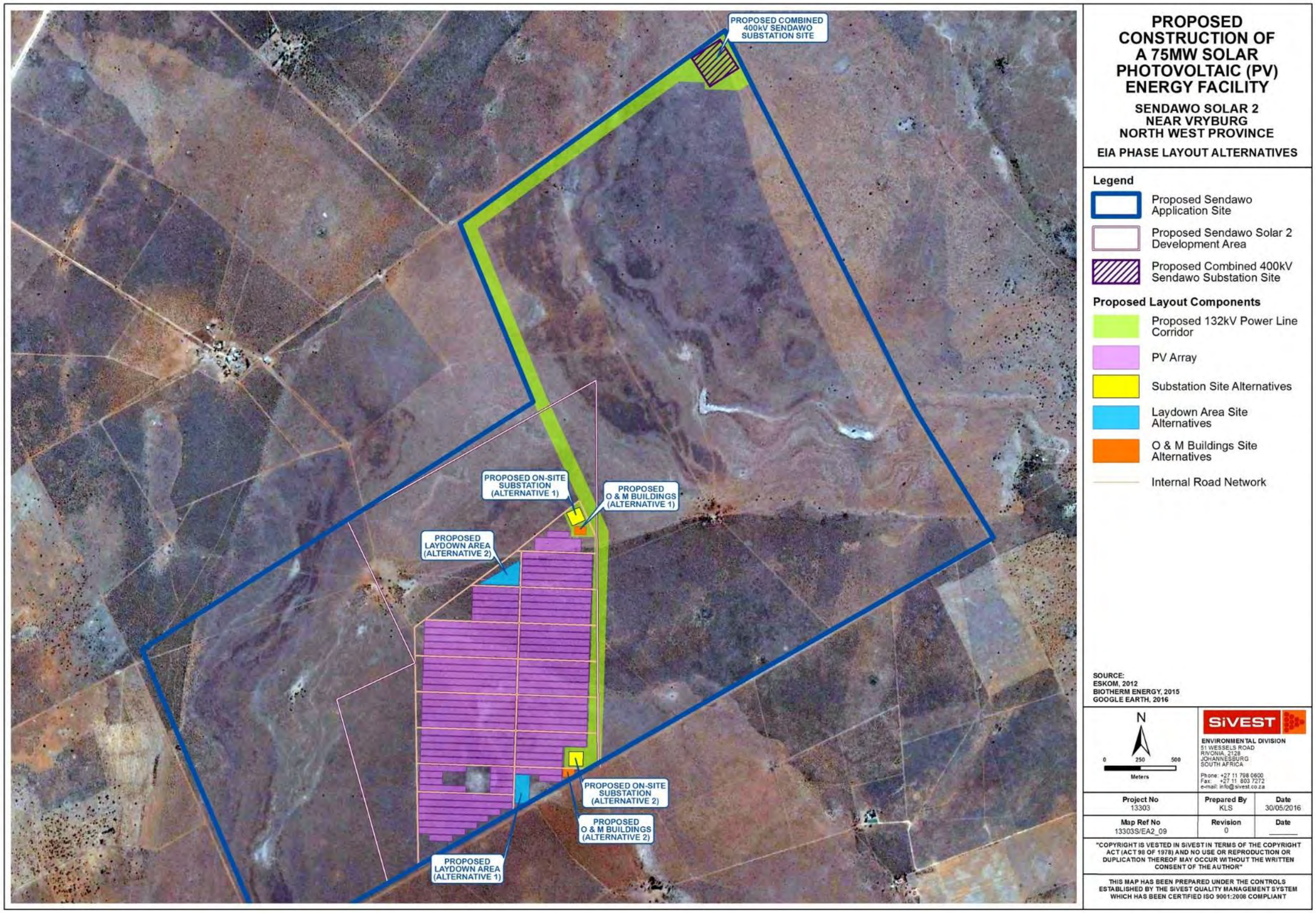


Figure 4: Proposed Site Layout Alternatives

1.3 Site Location

The proposed development site for the 75MW Sendawo Solar 2 PV energy facility will be located within the North West Province, approximately 11km south-west of Vryburg. It falls within the Naledi Local Municipality that forms part of the Dr Ruth Segomotsi Mompati District Municipality (**Figure 5**). The application site as shown on the locality map below (**Figure 6**) comprises of Portion 1 of the Farm Edinburgh No. 735. The proposed development area is expected to occupy a footprint area of approximately 416 hectares (ha). The proposed solar PV energy facility will be accessed by the N18 which is located directly east of the application site.

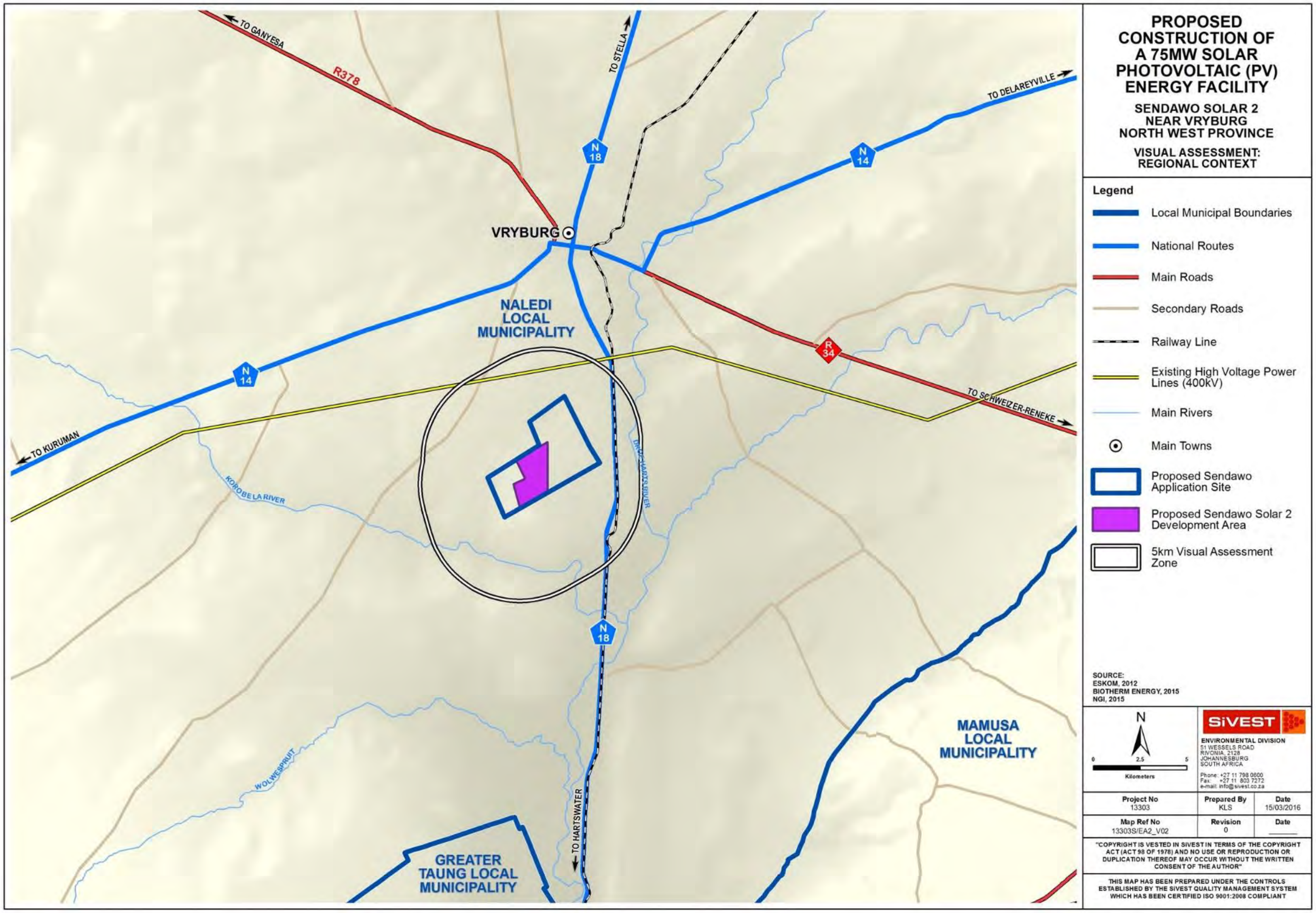


Figure 5: Regional Context Map

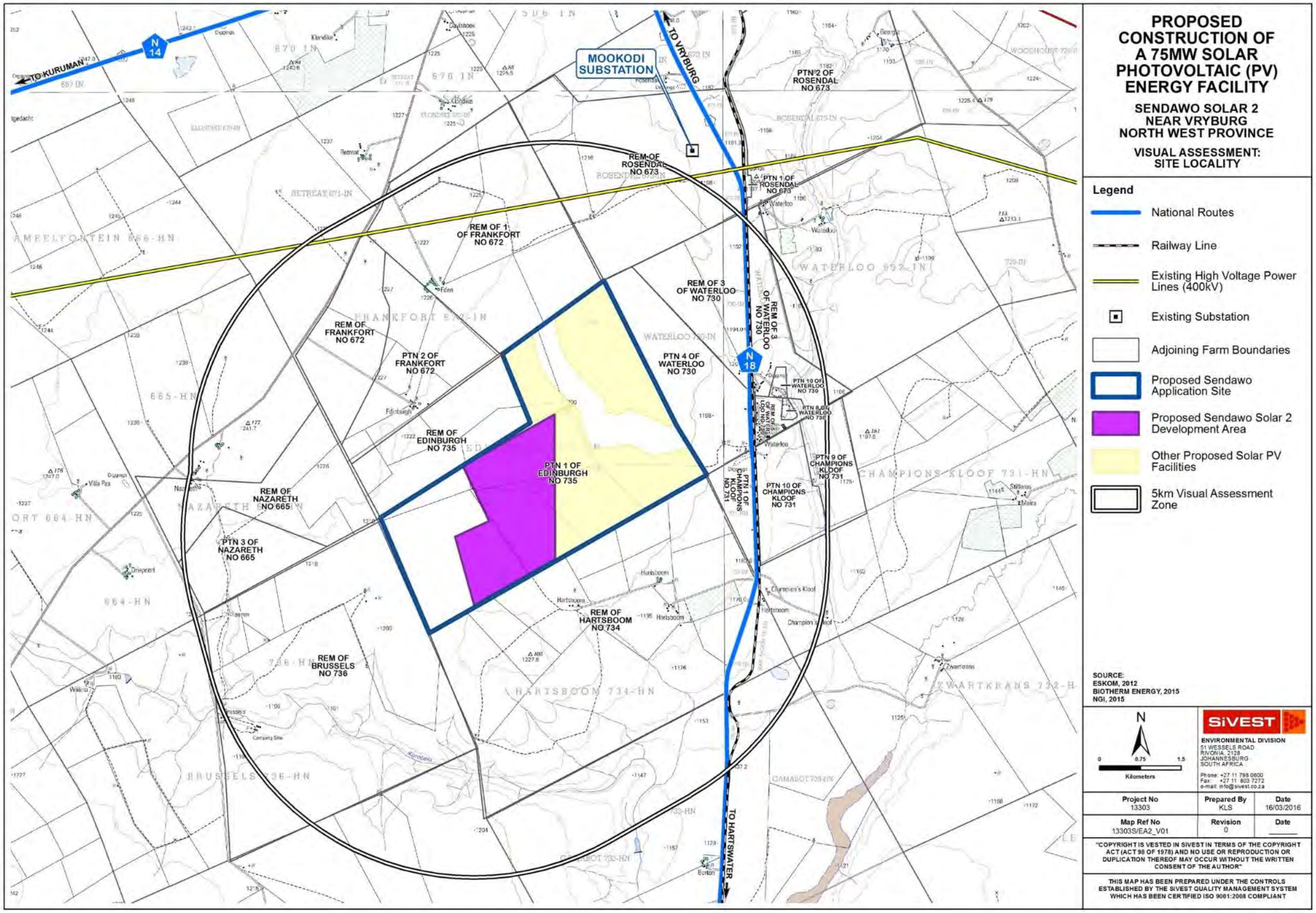


Figure 6: Locality Map

1.4 Assumptions and Limitations

- Given the nature of the receiving environment and the height of the proposed PV panels, the study area or visual assessment zone is assumed to encompass a zone of 5km from the proposed PV energy facility – i.e. all areas within a 5km radius of the application site. The 5km radius was assigned as distance is a critical factor when assessing visual impacts and although the proposed development may still be visible from areas outside the 5km radius, the degree of visual impact would diminish considerably. Thus the need to assess the impact on potential receptors outside the visual assessment zone would not be warranted.

- Due to the extensive number of farmsteads and residential dwellings located within 5km of the application site, which could potentially be sensitive to the proposed development, the identification and impact assessment rating on potentially sensitive visual receptor locations was based on a combination of desktop assessment as well as field-based observation. Initially Google Earth imagery was used to identify potentially sensitive receptor locations within the study area. Thereafter a site visit was undertaken to assist with rating the impact of the proposed development from each potentially sensitive visual receptor location and to eliminate receptors that are unlikely to be influenced by the proposed development. This involves establishing the visual character and level of transformation within the study area, classifying the study area into zones of visual contrast and identifying screening factors within the study area.

- It should be noted that the 'experiencing' of visual impacts is subjective and largely based on the perception of the viewer or receptor. A number of broad assumptions were made in terms of the sensitivity of the receptors to the proposed development. This is usually dependent on the use of the facility and the economic dependency on the natural / untransformed quality of views from the facility. Sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed development. They include; tourism facilities and residential dwellings within natural / rural settings. Therefore, not all receptor locations would necessarily perceive the proposed development in a negative way.

- No viewsheds were generated during this visual study, as the topography within the study area is relatively flat. Within this context, minor topographical features, vegetative screening, or man-made structures would be important factors which would influence the degree of visibility and which would not be factored in by the viewsheds.

- A matrix has been developed to assist in the assessment of the potential visual impact at each receptor location. The limitations of quantitatively assessing a largely subjective or qualitative type of impact should be noted. The matrix is relatively simplistic in considering three main parameters relating to visual impact, but provides a reasonably accurate indicative assessment of the degree of visual impact likely to be exerted on each receptor location by the proposed solar energy facility. The matrix should therefore be seen as a representation of the likely visual impact at a receptor location.

- The assessment of receptor-based impacts has been based on the solar energy facility layout and alternatives provided by the proponent. It is recognised however that this layout is a preliminary one, and is subject to changes based on a number of potential factors, including the findings of the EIA studies. The PV panel area and associated infrastructure may thus move, which may result in greater or lesser visual impacts on receptor locations.

- A cumulative impact assessment has been undertaken to provide a representation of the number of proposed renewable energy facilities likely to be visible from each potentially sensitive receptor location, if they were all constructed. Factors affecting visibility, such as localised screening from trees or topographical undulations have not been factored into the cumulative impact assessment.

- Visualisation modelling has not been undertaken for the proposed development due to budget limitations. Should the need for visualisation modelling be proven by stakeholder / I&AP feedback, then this will be able to be incorporated into this assessment.

- No feedback regarding the visual environment has been received from the public participation process to date. Any feedback relevant to the visual environment received will be incorporated into further drafts of this report.

- Operational and security lighting will be required for the PV facility and on-site substation proposed within the development footprint. At the time of undertaking the visual study no information was available regarding the type and intensity of lighting required and therefore the potential impact of lighting at night has not been assessed at a detailed level. General measures to mitigate the impact of additional light sources on the ambiance of the nightscape have been provided.

- Most rainfall within the area occurs from November to April during the summer months. Therefore as the fieldwork was undertaken in December during the summer season the surrounding vegetation can be expected to provide the maximum potential screening. During winter months the visual impact of the proposed development may therefore be greater, particularly from farmhouses surrounded by tall deciduous trees.

1.5 Assessment Methodology

1.5.1 Field work and photographic review

From the 3rd to the 4th of December 2015 (summer), the study area was visited in order to;

- verify the landscape characteristics identified during the scoping phase visual study;
- classify the study area into zones of visual contrast;
- capture photos of the proposed study area;
- verify the potentially sensitive visual receptor locations previously identified during the scoping phase;
- eliminate receptors that are unlikely to be influenced by the proposed development; and
- identify any additional visually sensitive receptor locations within the study area.

1.5.2 Physical landscape characteristics

A site visit and digital information from spatial databases such as the National Geo-spatial Information (NGI), the South African National Biodiversity Institute (SANBI) and the South African National Land Cover (Geoterraimage – 2014) were sourced to provide baseline information on the topography, vegetation and land use in the study area. These physical landscape characteristics are important factors which influence the visual character and visual sensitivity of the study area.

1.5.3 Identification of sensitive receptors

During the field investigation, potentially sensitive visual receptor locations within the study area, such as residences, were identified and assessed as they may be potentially sensitive to the visual impacts associated with the proposed development. It must be noted that Google Earth imagery was used to assist with identifying and assessing these potentially sensitive receptor locations.

1.5.4 Impact Assessment

A rating matrix was used to objectively evaluate the significance of the visual impacts associated with the proposed development, both before and after implementing mitigation measures. Mitigation measures were identified (where possible) in an attempt to minimise the potential visual impact of the proposed development. The rating matrix made use of a number of different factors including geographical extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect and intensity, in order to assign a level of significance to the visual impact of the project. A separate rating matrix was used to assess the visual impact of the proposed development on the sensitive receptor locations, as identified. This matrix is based on the distance of a receptor from the proposed development, the presence of screening factors and the degree to which the proposed development would contrast with the surrounding environment from a particular location. Thereafter, the layout alternatives were comparatively assessed, in order to ascertain the preferred alternative from a visual perspective.

1.5.5 Consultation with I&APs

Continuous consultation with Interested and Affected Parties (I&APs) undertaken during the public participation process (PPP) will be used to help establish how the proposed PV energy facility will be perceived by the various receptor locations and the degree to which the impact will be regarded as negative. Although I&APs have not as yet provided any feedback in this regard, the report will be updated to include relevant information as and when it becomes available.

2 VISUAL BASELINE ASSESSMENT

The physical and land use related characteristics are outlined below as they are important factors contributing to the visibility of a development and visual character of the study area. Defining the visual character is an important part of assessing visual impacts as it establishes the visual baseline or existing visual environment in which the development would be constructed. The visual impact of a development is measured according to this visual baseline by establishing the degree to which the development would contrast or conform with the visual character of the surrounding area. The inherent sensitivity of the area to visual impacts or visual sensitivity is thereafter determined, based on the visual character, economic importance of the scenic quality of the area, inherent cultural value of the area and presence of visual receptors.

2.1 Topography

The topography within and in the immediate vicinity of the proposed application site is characterised by a flat to gently undulating landscape sloping down in a south-easterly direction towards the Droe Harts Rivier.

A representation of the typical views from the application site has been provided in **Figure 7** below.

Figure 7: View from the Sendawo PV application site showing the typically flat to gently undulating terrain within the study area

The topography in the wider study area is largely characterised by level plains with little noticeable relief and very gradual slopes (**Figure 8**). The valleys of the Droe Harts and Korobela rivers in the eastern and southern sectors of the study area tend to comprise of more irregular plains and more pronounced slopes.

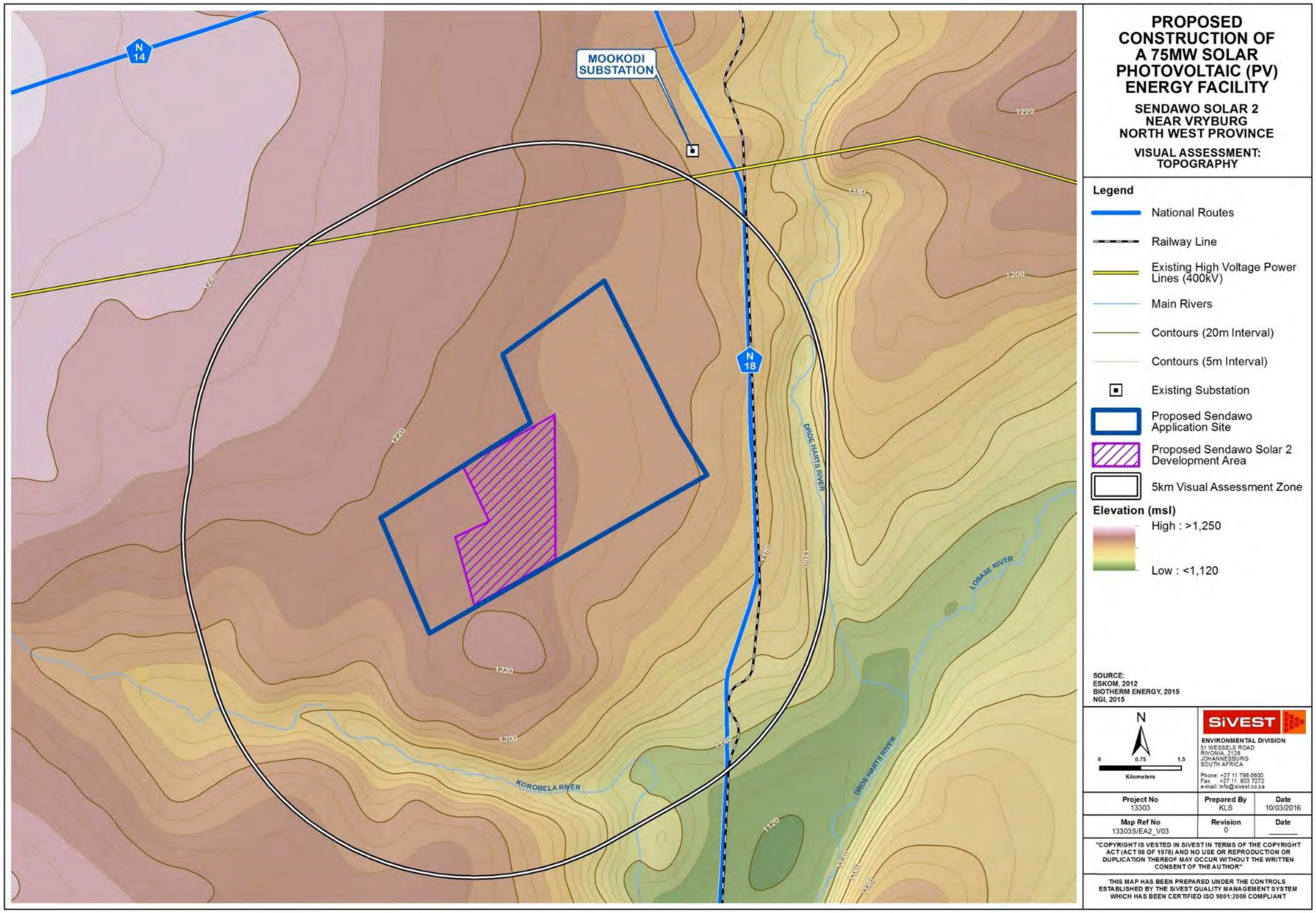


Figure 8: Topography within the study area

2.1.1 *Visual Implications*

The very flat nature of the topography is a strong factor influencing the types of vistas typically present in the study area, as there are few areas of rising ground to block views and limit viewsheds. Views are only likely to be partially restricted in the river valleys in the eastern and southern sectors of the study area. As a result, typically wide-ranging vistas are experienced within the study area, especially from locally higher elevations.

2.2 Vegetation and Land Cover

The entire study area is covered by the Ghaap Plateau Vaalbosveld vegetation type (**Figure 10**), which is characterised by a well-developed shrub layer and an open tree layer. In certain areas, man has had an impact on the natural vegetation, especially around farmsteads, where over many years tall exotic trees and other typical garden vegetation have been established. Much of the study area however is still characterised by natural low shrubland (**Figure 9**) with transformation limited to a few isolated areas of cultivation.

Figure 9: Typical vegetation cover within the study area

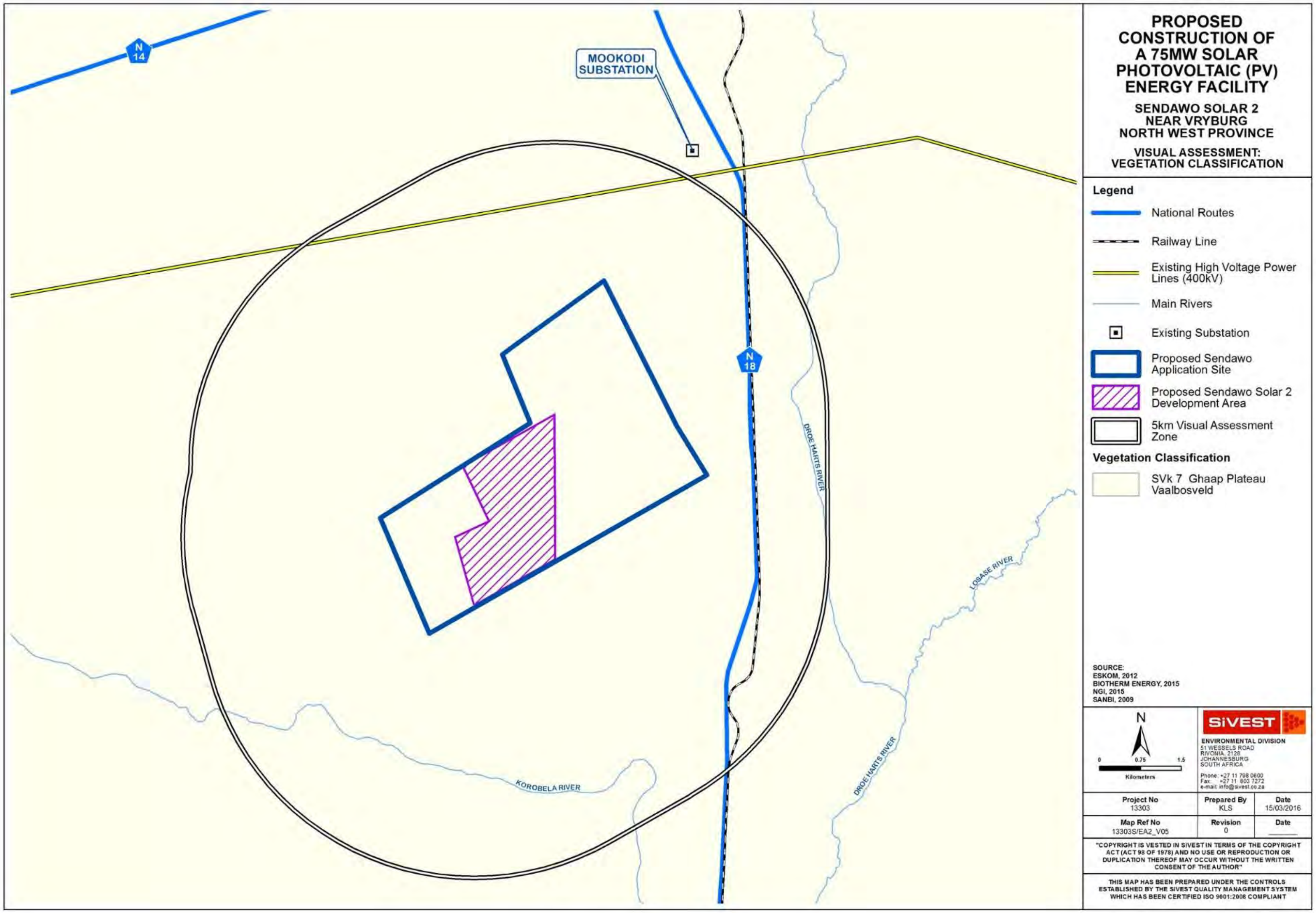


Figure 10: Vegetation within the study area

Much of the assessment area is characterised by natural unimproved vegetation, which is used as grazing land for game, cattle, sheep and goats (**Figure 14**). Cultivation is restricted to relatively small areas scattered throughout the study area.

Built form, in areas where livestock rearing occurs, is limited to isolated farmsteads, gravel access roads, ancillary farm buildings, telephone lines, windmills, fences and the remnants of old workers' dwellings.

Figure 11: Typical built form present within the study area

It must also be noted that a high voltage 400kV power line bisects the northern section of visual assessment zone and is visible from within the application site. In addition, the Mookodi Main Transmission Substation (MTS) can be found to the north-east of the application site. However, the tall steel structures that make up the Mookodi MTS are only visible from certain areas of the application site.

Figure 12: View from within the application site showing the Mookodi MTS which is located north-east of the application site as well as the 400kV power line that bisects the northern section of the visual assessment zone.

The closest built-up areas are the agricultural town of Vryburg, which is located some 3km north of the visual assessment zone and the Huhudi informal/semi-formal settlement which is located in the northern sector of the study area adjacent to the N18. Within this part of the study area, human influence is also visible in the form of the N18 national route and a railway line which both traverse the study area in a north-south direction as well as electricity transmission infrastructure comprising a 400kV power line and the newly constructed Mookodi MTS (**Figure 13**). In addition, there are some small quarries in the study area as well as the Arthington Memorial Church and the Tiger Kloof Educational Institution along the N18.

Figure 13: Eskom's newly constructed Mookodi Main Transmission Substation (MTS) which is located to the north-east of the application site, on the boundary of the visual assessment zone.

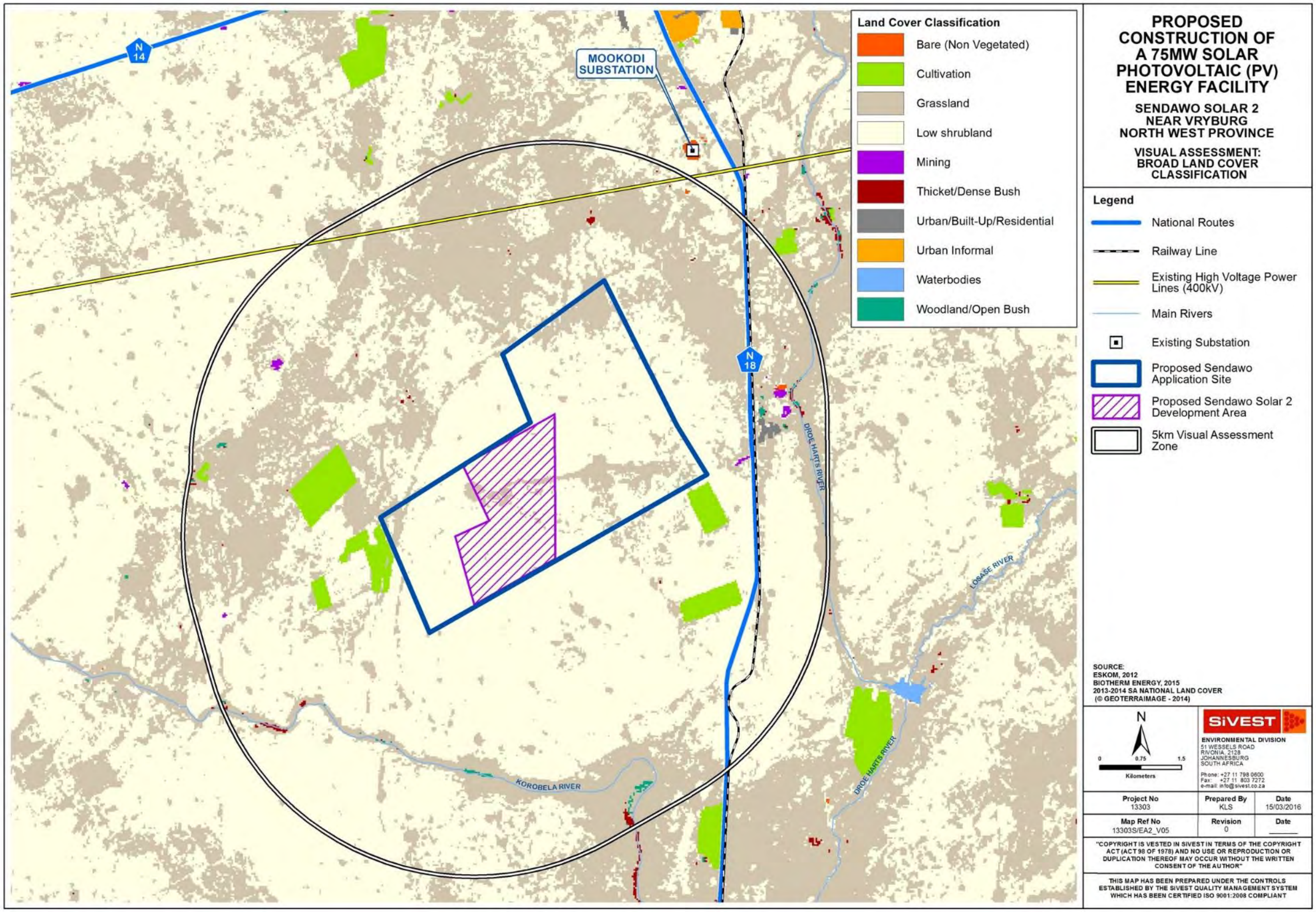


Figure 14: Land cover within the study area

2.2.1 Visual Implications

The predominant very low shrub layer and open areas of cultivated fields results in wide-open vistas across most of the study area. Only in areas where tall trees (sometimes exotic) have been established around farmhouses, would the vegetation provide visual screening (**Figure 15**). The relatively low density human habitation and natural vegetation cover across large portions of the study area would give the viewer the general impression of a largely natural rural setting (**Figure 16**). As previously mentioned, sparse human habitation and the predominance of natural vegetation cover across large portions of the study area would give the viewer the general impression of a largely natural rural setting. High levels of human transformation and visual degradation only become evident in the northern sector of the study area where the N18 approaches Huhudi and the outskirts of Vryburg.

The influence of the level of human transformation on the visual character of the area is described in more detail below.

Figure 15: Example of tall trees that have been established around a farmhouse

Figure 16: Typical natural rural visual character found within larger portions of the study area

2.3 Visual Character

Visual character can be defined based on the level of change or transformation from a completely natural setting, which would represent a natural baseline in which there is little evidence of human transformation of the landscape. Varying degrees of human transformation of a landscape would engender differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being at the opposite end of the scale to a largely natural undisturbed landscape. Visual character is also influenced by the presence of built infrastructure such as buildings, roads and other objects such as electrical infrastructure.

As previously mentioned, much of the study area is characterised by rural areas with low densities of human settlement. Agriculture in the form of livestock grazing is the dominant land use, which has transformed the natural vegetation in some areas. However, a large portion of the study area has retained a natural appearance due to the presence of the low shrubs and taller trees dominated by camel thorn (*Acacia erioloba*). The most prominent anthropogenic elements in these areas include the N18 national route, power lines, a new transmission substation and other linear elements, such as telephone poles, communication poles and farm boundary fences. The presence of this infrastructure is an important factor in this context, as the introduction of the proposed PV energy facility would result in less visual contrast where other anthropogenic elements are already present. Other human infrastructure in this setting occurs at a low density, and includes several gravel access roads and one north-south aligned railway line running parallel to the N18. Overall, the study area has a natural visual character, with certain areas displaying a rural or pastoral component where maize cultivation and farmsteads occur.

The relatively low density of human transformation throughout the surrounding area is an important component contributing to the largely natural visual character of the study area. This is important in the context of potential visual impacts associated with the proposed development of a PV energy facility as introducing this type of development could be considered to be a degrading factor in this context.

It should however be noted that other solar energy facilities are proposed in relatively close proximity to the proposed development. These facilities and their associated infrastructure, typically consist of very large structures which are highly visible. As such, these facilities will significantly alter the visual character and baseline in the study area if constructed and make it appear to have a more industrial-type visual character.

2.4 Cultural, Historical and Scenic Value

Cultural landscapes are becoming increasingly important concepts in terms of the preservation and management of rural and urban settings across the world. The concept of 'cultural landscape' is a way of looking at a place that focuses on the relationship between human activity and the biophysical environment (Breedlove, 2002). The cultural landscape concept is relatively new in the heritage conservation movement across the world. In 1992 the World Heritage Committee adopted the following definition for cultural landscapes:

Cultural landscapes represent the combined worlds of nature and of man illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.

According to the Committee's Operational Guidelines Cultural Landscapes can fall into three (3) categories

i) *"a landscape designed and created intentionally by man";*
ii) *an "organically evolved landscape" which may be a "relict (or fossil) landscape" or a "continuing landscape";*

iii) an "associative cultural landscape" which may be valued because of the "religious, artistic or cultural associations of the natural element"

The greater area surrounding the proposed development site is an important component when assessing visual character and scenic value. The surrounding area can be considered to be typical of a rural farming landscape that consists of relatively flat areas of natural low savannah shrubland interspersed with farmsteads, windmills, livestock holding pens and agricultural land. It is estimated that approximately 19% of the population of the Naledi Local Municipality (LM) reside on farms. Livestock farming and other forms of agriculture are also evident within the surrounding area. This can be attributed to the fact that the nearby town of Vryburg is considered to be the economic heartbeat of the region due to its agricultural activities. Vryburg is also considered to be South Africa's largest beef producing district, with some of the largest cattle herds in the world found at the town of Stella. Other important agricultural activities in the area include the production of maize and peanuts. The town of Vryburg is therefore considered to be the agricultural and industrial centre of the Dr. Ruth Segomotsi Mompati District Municipality (DM) as it is the district's biggest employment generator and GDP contributor. The importance of the agricultural sector in the town is further highlighted by the fact that Vryburg is host to one of the largest cattle sales in the Southern hemisphere as well as South Africa's third largest agricultural show (http://vryburg.com/about-vryburg/).

Vryburg is situated in the Bophirima (Western) region of the North West Province of South Africa and was founded in 1882 when the Republic of Stellaland was also founded (http://www.north-west-info.co.za/provinces/town/690). Today Vryburg is the industrial and agricultural capital of the Bophirima region. In 1904 the London Missionary Society established the Tiger Kloof Native Institute south of Vryburg, which has been classified as a provincial heritage site and is now known as the Tiger Kloof Educational Institution. In addition, the stone church on the premises, namely the Arthington Memorial Church, was built in 1925 by Tiger Kloof's masonry instructor and has subsequently been classified as a national monument. Vryburg is rich in cultural history, with the Theiler Museum located 8km west of the town. The museum houses a collection of the equipment used by Sir Arnold Theiler, the veterinarian who established the Onderstepoort veterinary research institute near Pretoria. Furthermore, the location of Vryburg presents significant income opportunities from tourism. The town is located on the N14, which eventually links Gauteng to Namibia. This in itself represents a possibility for entrepreneurs to earn income from passing tourists. Additionally, the town's rich cultural heritage could be better marketed as a tourism attraction, (as previously mentioned, it houses the Thiel Museum and the Arthington Memorial Church that was declared a national monument). It should also be noted that the western part of Vryburg is utilised as a nature reserve, a factor that could attract additional tourists.

The nearest known heritage site within the surrounding area is the Taung Skull World Heritage Site which is situated approximately 55km south of the study area. This heritage site marks a location of significant scientific importance as it was here, in 1924, where Professor Raymond Dart identified the 2.5 million year old fossilised skull of an infant gracile australopithecine from a limestone quarry near Taung. While numerous fossils have been recovered from the same quarry, the skull of the Taung Child is the only hominin remains recovered from this site. The finding of the Taung skull was thus noted to be one of the most significant archaeological accomplishments of time. The Taung skull discovery site is therefore officially part of the UNESCO Cradle of Humankind World Heritage Site and a monument has been erected to mark the location (http://www.southafrica.net/za/en/articles/entry/article-southafrica.net-taung-skull-heritage-route). Besides for the archaeological significant sites, the Taung Heritage site and the village of Taung present numerous alternative spots that regularly attract tourists..

Based on the above, the study area can be regarded as a type 'ii' organically evolving cultural landscape. It can be considered both a relict landscape, due to rich history dating back to 1882 and a continuing landscape as the typical rural farming landscape represent how the environment has shaped the predominant land use and economic activity practiced in the area, as well as the patterns of human habitation and interaction. The presence of small towns, such as Vryburg, engulfed by an otherwise rural environment, form an integral part of the wider landscape. In addition, the rich history could attract tourists into the area. This is important in the context of potential visual impacts associated with the proposed development of a PV energy facility as introducing this type of development could be considered to be a degrading factor within this context.

2.5 Visual Sensitivity

Visual Sensitivity can be defined as the inherent sensitivity of an area to potential visual impacts associated with a proposed development. It is based on the physical characteristics of the area (i.e. topography, landform and land cover), spatial distribution of potential receptors, and the likely value judgements of these receptors towards a new development (Oberholzer, 2005). A viewer's perception is usually based on the perceived aesthetic appeal of an area and on the presence of economic activities (such as recreational tourism) which may be based on this aesthetic appeal.

In order to assess the visual sensitivity of the area SiVEST has developed a matrix based on the characteristics of the receiving environment which, according to the Guidelines for Involving Visual and Aesthetic Specialists in the EIA Processes, indicate that visibility and aesthetics are likely to be 'key issues' (Oberholzer, 2005).

Based on the criteria in the matrix (**Table 1**), the visual sensitivity of the area is broken up into a number of categories, as described below:

i) **High** - The introduction of a new development such as the erection of a PV facility or power line would be likely to be perceived negatively by receptors in this area; it would be considered to be a visual intrusion and may elicit opposition from these receptors

ii) **Moderate** - Presence of receptors, but due to the nature of the existing visual character of the area and likely value judgements of receptors, there would be limited negative perception towards the new development as a source of visual impact.

iii) **Low** - The introduction of a new development would not be perceived to be negative, there would be little opposition or negative perception towards it.

The table below outlines the factors used to rate the visual sensitivity of the study area. The ratings are specific to the visual context of the receiving environment within the study area.

Table 1: Environmental factors used to define visual sensitivity of the study area

FACTORS	**RATING**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pristine / natural character of the environment										
Presence of sensitive visual receptors										
Aesthetic sense of place / scenic visual character										
Value to individuals / society										
Irreplaceability / uniqueness / scarcity value										
Cultural or symbolic meaning										
Scenic resources present in the study area										
Protected / conservation areas in the study area										
Sites of special interest present in the study area										
Economic dependency on scenic quality										
Local jobs created by scenic quality of the area										
International status of the environment										
Provincial / regional status of the environment										
Local status of the environment										
**Scenic quality under threat / at risk of change										

**A rating above '5' for this factor will trigger the need to undertake an assessment of cumulative visual impacts.

Low							**Moderate**							**High**
10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**

Based on the above factors, the study area is rated as having a low visual sensitivity. This is mainly owing to the relatively uninhabited character of the area and the presence of road, rail and electricity transmission infrastructure which would likely reduce the scenic quality of the area. An important factor contributing to the visual sensitivity of an area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape and depend on it to produce revenue and create jobs. As described below, a number of potentially sensitive receptors are present in the study area.

Several solar energy facilities are proposed within relatively close proximity to the proposed project. As such, an assessment of the cumulative impact that will be experience from each potentially sensitive receptor is included in **Section 0**.

2.6 Sensitive Visual Receptor Locations

A sensitive receptor location is defined as a location, from where receptors would potentially be adversely impacted by a proposed development. This takes into account a subjective factor on behalf of the viewer – i.e. whether the viewer would consider the impact as a negative impact. As described above, the adverse impact is often associated with the alteration of the visual character of the area in terms of the intrusion of the PV energy facility into a 'view', which may affect the 'sense of place'. The identification of sensitive receptors is typically undertaken based on a number of factors which include:

- the visual character of the area, especially taking into account visually scenic areas and areas of visual sensitivity;
- the presence of leisure-based (esp. nature-based) tourism or sites with historical and cultural value in an area;
- the presence of sites / routes that are valued for their scenic quality and sense of place;
- the presence of homesteads / farmsteads in a largely natural settings where the development may influence the typical character of their views; and
- feedback from interested and affected parties, as raised during the public participation process conducted as part of the EIA study.

A distinction must be made between a receptor location and a sensitive receptor location. Receptor locations are sites from where the proposed PV energy facility may be visible, but the receptor may not necessarily be adversely affected by any visual intrusion associated with the development. Receptor locations include locations of commercial activities and certain movement corridors, such as roads that are not tourism routes. Sensitive receptor locations typically include sites that are likely to be adversely affected by the visual intrusion of the proposed development. They include; tourism facilities, scenic sites and residential dwellings in natural settings.

Generally, the visibility of the development would diminish exponentially over distance. In order to account for this distance bands were used to assign zones of visual impact from the proposed development site. As such, the proposed development would be more visible to receptors located within a short distance and these would experience a higher adverse visual impact than those located at a moderate or long distance from the proposed development. The distance of a sensitive receptor location from the proposed development site was taken into account when rating the visual impact of the proposed development on these potential receptors.

Based on the height and scale of the project, as well as the investigations undertaken during the fieldwork, the radii chosen to assign these zones of visual impact are as follows:

- 0 < 500m (high impact zone);
- 500m < 2km (moderate impact zone); and
- 2km < 5km (low impact zone)

During the EIA phase VIA, a number of potentially sensitive visual receptors were identified. These are indicated in **Figure 19** below and each receptor is identified by a specific number (e.g. VR 1 = Visual Receptor 1). Of the potentially sensitive visual receptors identified, two (2) receptor locations were identified as being sensitive within the study area due to their cultural and historical value, namely the Arthington Memorial Church and Tiger Kloof Educational Institution (VR 7 and VR 9 respectively).

The Tiger Kloof Educational Institution was established in 1904 and has subsequently been declared a provincial heritage site. Today Tiger Kloof is regarded as a flourishing educational institute which provides primary as well as secondary school education. Some of the stone buildings and structures which were built as part of the original school can also still be found on the property today (**Figure 17**). The Arthington Memorial Church was built in 1925 by Tiger Kloof's masonry instructor and forms part of the facilities within the Tiger Kloof Educational Institution (**Figure 18**). It must be noted that the Arthington Memorial Church has been proclaimed a national monument and will be regarded as a visually sensitive receptor location for this reason. As previously mentioned, the Tiger Kloof Educational Institution and the Arthington Memorial Church have been declared a provincial heritage site and national monument respectively and are therefore are regarded as visually sensitive due to their historical significance.

Figure 17: One of the original stone structures which can still be found at the Tiger Kloof Educational Institution

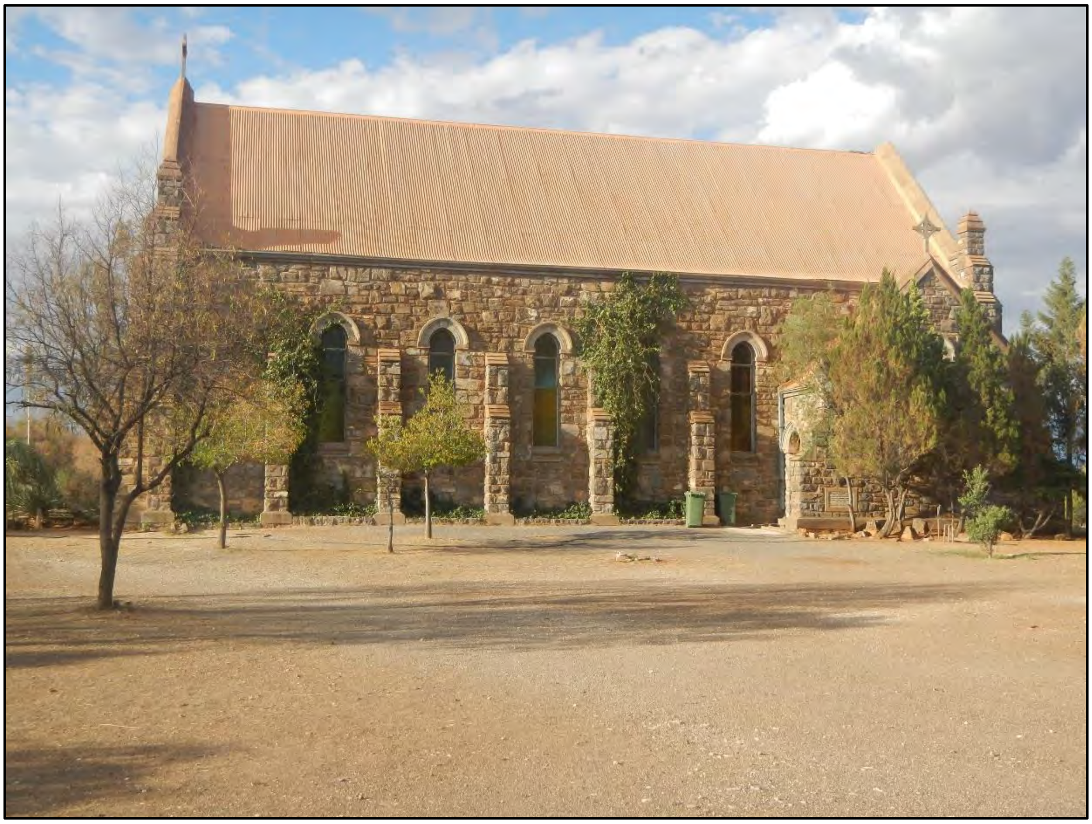


Figure 18: The Arthington Memorial Church which was built in 1925 by Tiger Kloof's masonry instructor. Today the church is a national monument.

During the EIA Phase site visit, several scattered farmsteads / homesteads which are used to house the local farmers as well as their farm workers were identified within the study area. These dwellings are located within a mostly rural setting and the proposed development will likely alter the natural vistas experienced from these dwellings. It is important to note that these visual receptor locations are regarded as potentially sensitive to the proposed development as the degree of visual impact experienced from these locations will vary from one inhabitant to another, as it is largely based on the viewer's perception and sentiments toward the development. Factors influencing the degree of visual impact experienced by viewers at these locations include the following:

- Value placed by the viewer on the rural characteristics of the area.
- The viewer's sentiments toward the proposed structures. These may be positive (a symbol of progression) or negative (foreign objects degrading the natural landscape).
- Degree to which the viewer will accept a change in the typical pastoral character of the surrounding area.

As mentioned above, only two (2) sensitive visual receptor locations with historical significance were identified within the rural parts of the study area. This is mainly due to low levels of leisure-based or nature based tourism activities in the assessment area. In addition, the main concentration of human habitation in the study area is the Huhudi informal/semi-formal settlement on the northern boundary of the assessment area. Although there is a relatively high concentration of receptors in this area, they are not regarded as sensitive to the visual impact of the proposed development due to the existing visual degradation within these areas.

A list of the visually sensitive and potentially sensitive receptor locations (including coordinates) that were identified during the EIA phase investigation are provided in **Appendix B**.

In many cases, roads, along which people travel, are considered to be sensitive receptor locations. The N18 highway which traverses the study area is considered to be a visually sensitive road as it is the main access road between Vryburg and Kimberley. In addition, this road may be used to access the Taung Skull World Heritage Site, located approximately 15km south-west of Taung. This site forms part of a UNESCO World Heritage Site as a skull of an early hominid child dating back 2.5 million years was unearthed at this site in 1924 (http://www.taungresort.co.za). The site also has extensive tourism potential as other natural wonders are present here, which include limestone cliffs and a collection of rock pools (the Blue Pools). The area is often frequented for a number of recreational activities such as hiking and abseiling and it is a popular picnic site (http://www.tourismnorthwest.co.za).

The relatively high volumes of motorists travelling along this road would be visually exposed to the proposed PV facility which lies just west of the N18.

Table 2 below provides details of the sensitive visual receptor locations that were identified within the study area.

Table 2: Visual receptor locations sensitive to the proposed Sendawo Solar 2 PV energy facility

Name	Distance from the proposed PV development area or associated infrastructure	Visual Impact Zone
VR 7 - Arthington Memorial Church	Approximately 3.7km	Low
VR 9 - Tiger Kloof Educational Institution	Approximately 3.8km	Low
N18 National Road	Varies (approximately 3.5km at the closest point)	Low

Other thoroughfares in the study area are primarily used by local farmers travelling to and from Vryburg. They are therefore not regarded as visually sensitive as they do not form part of any scenic tourist routes, and are not specifically valued or utilised for their scenic or tourism potential.

The potentially sensitive visual receptor locations in relation to the zones of visual impact are indicted in **Figure 19** below.

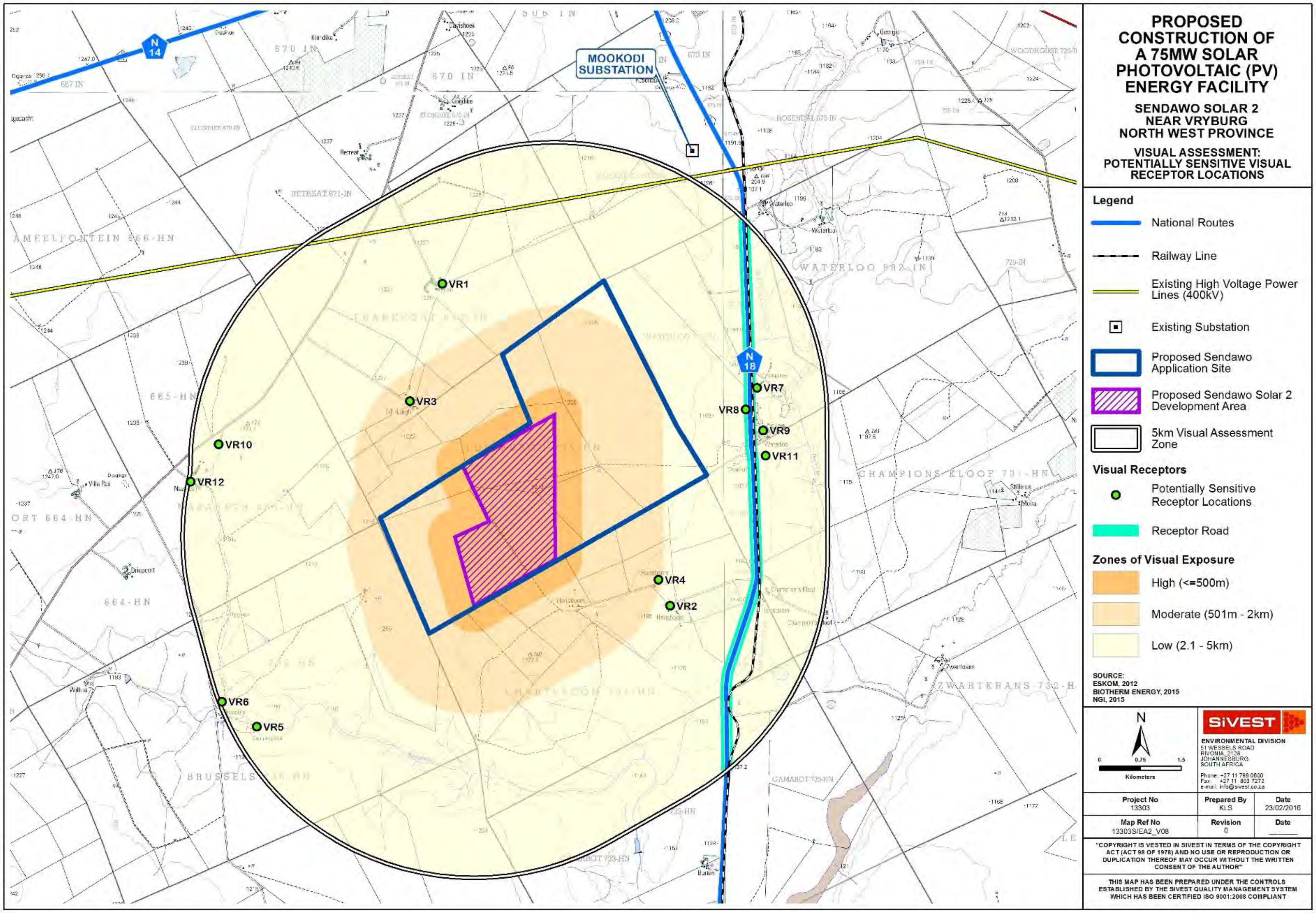


Figure 19: Visually sensitive receptors within the study area

3 TYPICAL VISUAL IMPACTS ASSOCIATED WITH PV ENERGY FACILITIES

In this section, the typical visual issues / impacts related to the establishment of a PV energy facility as proposed are discussed.

The solar power component of the proposed energy generation facility consists of photovoltaic (PV) panels, which grouped together form a ‘solar field’. Each PV panel is a large structure that is typically up to 10m high (equivalent in height to a building of approximately three storeys). The height of these objects will make them visible, especially in the context of a relatively flat landscape (**Figure 20**).

Figure 20: Photovoltaic Panels being erected near De Aar in the Northern Cape Province

More importantly, the concentration of these panels will make them highly visible, which will depend on the number of panels in each solar field, known as its spatial extent or footprint. Solar fields with a large spatial extent will become a distinctly visible dark grey / black feature that contrasts with the landscape, especially if the landscape is natural in character or undeveloped (**Figure 21**). As most solar power energy facilities tend to be located in vacant or uninhabited areas due to space availability, the landscape context is often natural or undeveloped and in this context the solar field could be considered to be a visual intrusion that possibly acts to alter the visual environment.

Figure 21: Photovoltaic Panels being erected near Lime Acres in the Northern Cape Province

In the case of PV energy facilities, taller vegetation such as trees and shrubs will need to be cleared. This practice of clearing vegetation will intensify the visual prominence of the solar energy facility, particularly in natural locations where woody vegetation still exists, but to a lesser degree if the proposed facility is located on land that has already been cleared or where the natural vegetation cover is short.

3.1.1 Associated Infrastructure

The infrastructure typically associated with a PV energy facility development will include the following:

- Pole mounted / buried cables to collect the power from the inverter stations; and
- A solar resource measuring station (typically 100m² and 5m high).
- An on-site substation to supply electricity the Eskom grid;
- Cables connecting the PV panels, which will be buried where possible;
- Buried (where possible) cabling to connect the PV panels to each other;
- Gravel access roads;
- Single storey administration buildings; and

- Temporary lay down areas required during construction.

On-site switching substations and overhead power lines by their nature are large objects and will typically be visible for great distances. Power lines consist of a series of tall towers thus making them highly visible. Like solar panels, power lines and substations are not features of the natural environment, but are representative of human (anthropogenic) alteration. Thus when placed in largely natural landscapes, they will be perceived to be highly incongruous in this setting. Conversely, the presence of other anthropogenic objects associated with the built environment, especially other power lines or substations, may result in the visual environment being considered to be ‘degraded’ and thus the introduction of a new power line into this setting may be less of a visual impact than if there was no existing built infrastructure visible.

Other proposed infrastructure may also be associated with visual impacts. The solar PV panel arrays are connected to each other in strings, which are likely to be buried, but which also may take the form of above-ground power lines. These cables may become a visual intrusion if placed in areas of the site that are visible to the surrounding areas, especially if located on higher lying areas. A trench dug for the cable (both during construction and post-construction once the trench has become back-filled) may become prominent if it creates a linear feature that contrasts with the surrounding vegetation. A similar principle exists with respect to any access roads constructed in these parts of the site. Roads are likely to be wider than cable trenches and thus could be even more greatly visible than the cable servitude. Cutting a ‘terrace’ into a slope would increase the visibility and contrast the road against the surrounding vegetation.

Lastly, buildings placed in prominent positions such as on ridge tops may also break the natural skyline, drawing the attention of the viewer.

The visual impact of the other associated infrastructure is however generally not regarded to be a significant factor when compared to the visual impact associated with a PV energy facility. They would however, magnify the visual prominence of the development if located on ridge tops or flat sites in natural settings where there is limited tall wooded vegetation present to conceal the impact.

4 IMPACT ASSESSMENT

4.1 Visual Compatibility / Contrast

The visual compatibility of the proposed development refers to the degree to which the development would be congruent with the surrounding environment. It is based on whether or not the development would conform with the land use, settlement density, structural scale, form and pattern of elements that define the structure of the surrounding landscape. The visual compatibility is an important factor to be considered when assessing the impact of the development within a specific context. A development that is incongruent with the surrounding area may change the character of the landscape, which could have a significant visual impact from key scenic views within the study area. Where a development corresponds with the surrounding environment the development would be easily absorbed by the surrounding environment and would result in little to no change in the visual character of the area.

As previously mentioned, the proposed development includes the construction of a 75MW export capacity solar PV facility which is aimed at feeding electricity back into Eskom's national grid. In general, the development would not be consistent with the prevailing residential and pastoral land use within the surrounding area. However, the anthropogenic elements and built-up areas present within parts of the study area are expected to partially alter the visual character and baseline and make certain areas appear to have a more industrial-type visual character. As such, the proposed development would increase the urban footprint and current level of visual transformation within the study area, but the existing unnatural forms will lessen the degree to which the proposed development would be considered incongruent with the surrounding landscape. As a whole the proposed development would contrast with the natural earthly tones of the prevailing shrubland vegetation and create a dark grey / black mass within the relatively uniform flat landscape. However, if some or all of the other solar energy facilities that are proposed within relatively close proximity to the proposed project are also constructed, the visual contrast would be significantly less as the proposed development would conform with the scale and form of these facilities.

4.2 Receptor Impact Rating

In order to assess the potential visual impact of the proposed development on the sensitive / potentially sensitive receptor locations identified during the field investigation, a matrix that takes into account a number of factors has been developed (**Table 3**), and is applied to each receptor location.

The matrix has been based on a number of factors as listed below:

- Distance of receptor away from the proposed development (distance banding)
- Presence of potential screening factors (topography, vegetation etc.)
- Location of the receptor in terms of zones of visual contrast

These factors are considered to be the most important factors when assessing the visual impact of a proposed development on a potentially sensitive visual receptor within this context. It must be remembered that the experiencing of visual impacts is a complex and qualitative phenomenon, and thus difficult to accurately quantify; thus the matrix should be seen as a representation of the likely visual impact at a receptor location. This rating matrix is a relatively simplified way to assign a likely representative visual impact, which allows a number of factors to be considered. Part of its limitation lies in the quantitative assessment of what is largely a qualitative or subjective impact.

Table 3: Visual assessment matrix used to rate the impact of the proposed development on potentially sensitive visual receptors

	VISUAL IMPACT RATING			
VISUAL FACTOR	**HIGH**	**MEDIUM**	**LOW**	**OVERRIDING FACTOR: NIL**
Distance of receptor away from proposed development	0 < 500m **Score: 3**	500m < 2km **Score: 2**	2km < 5km **Score: 1**	5km <
Presence of screening factors	Limited or no screening factors – development highly visible **Score: 3**	Screening factors likely to partially obscure the development **Score: 2**	Screening factors likely to obscure most of the development **Score: 1**	Screening factors completely block any views towards the development, i.e. the development is not within the viewshed
Zone of Visual Contrast	**High:** The development would contrast highly with the typical land use and/or pattern and form of human elements (infrastructural form). Typically a natural / pastoral environment with low-density rural infrastructure present (low voltage power lines and farm boundary fences). **Score: 3**	**Moderate:** The development would contrast moderately with the typical land use and/or pattern and form of human elements (infrastructural form) and existing level of visual transformation. Typically areas within close proximity to other prominent infrastructure (high voltage power lines and railway lines) and within intensive agricultural lands / cultivated fields. **Score: 2**	**Low:** The development would correspond with the typical land use and/or pattern and form of human elements (infrastructural form) and existing level of visual transformation. Presence of urban form and industrial-type infrastructure. The area is not highly valued or sensitive to change (e.g. the outskirts of urban and built-up areas). **Score: 1**	

4.2.1 Distance

As described above, distance of the viewer / receptor location away from the development is an important factor in the context of experiencing of visual impacts. A high impact rating has thus been assigned to receptor locations that are located within 0<500m of the proposed development. Beyond 5km, the visual impact would be virtually nil, as the development would appear to merge with the elements on the horizon. Any receptor location beyond this distance has therefore been assigned an overriding nil impact rating. As such, despite the impact rating assigned to the other visual factors, the overall impact rating would remain nil, as the proposed development would not visually influence any receptors located more than 5km from the development. Where a receptor is located within more than one distance band, such as a receptor road, it is assigned the score according to the closest distance it will get from the proposed development i.e. the highest visual impact experienced.

4.2.2 Screening factors

The presence of screening factors is equally important in this context as the distance away from the development. Screening factors can be vegetation, buildings, as well as topography. For example, a grove of trees located between a receptor location and an object could completely shield the object from the receptor location. Topography (relative elevation and aspect) plays a similar role as a receptor location in a deep or incised valley will have a very limited viewshed and may not be able to view an object that is in close proximity, but not in its viewshed. As such, the complete screening of the development has also been assigned an overriding nil impact rating, as the development would not impose any impact on the receptor.

4.2.3 Zones of visual contrast

The degree to which the proposed development would appear to contrast with the surrounding land use, settlement density, forms and patterns of elements that define the structure of the surrounding landscape is also considered in the matrix. The visual contrast is an important factor to be considered when assessing the impact of the proposed development from a specific location, as a development that appears contrasts with the visual backdrop may change the visual character of that landscape. This could have a significant visual impact on potentially sensitive visual receptors within the study area.

Based on the land use and visual character in the surrounding landscape, the area was assessed to determine the level of transformation and degree to which the proposed development would appear to be visually compatible with the surrounding environment when viewed from a particular location. In the context of this proposed development, the presence or absence of existing electrical infrastructure, dense settlement or other urban built-up form is an important factor influencing the level of visual contrast. For example, if the development was located adjacent to an existing solar PV energy facility it would result in significantly less visual contrast. The development site was therefore classified into the following zones of visual contrast:

- **High** – undeveloped / natural / rural areas;
- **Moderate** – Intensive agricultural lands / cultivated fields or areas within 500m of existing power line, road or rail infrastructure in undeveloped / natural / rural area; and
- **Low** – within 1 km from visually transformed urban / built-up areas.

The outcome of the visual contrast classification in relation to the potentially sensitive visual receptor locations is provided in **Figure 22** below.

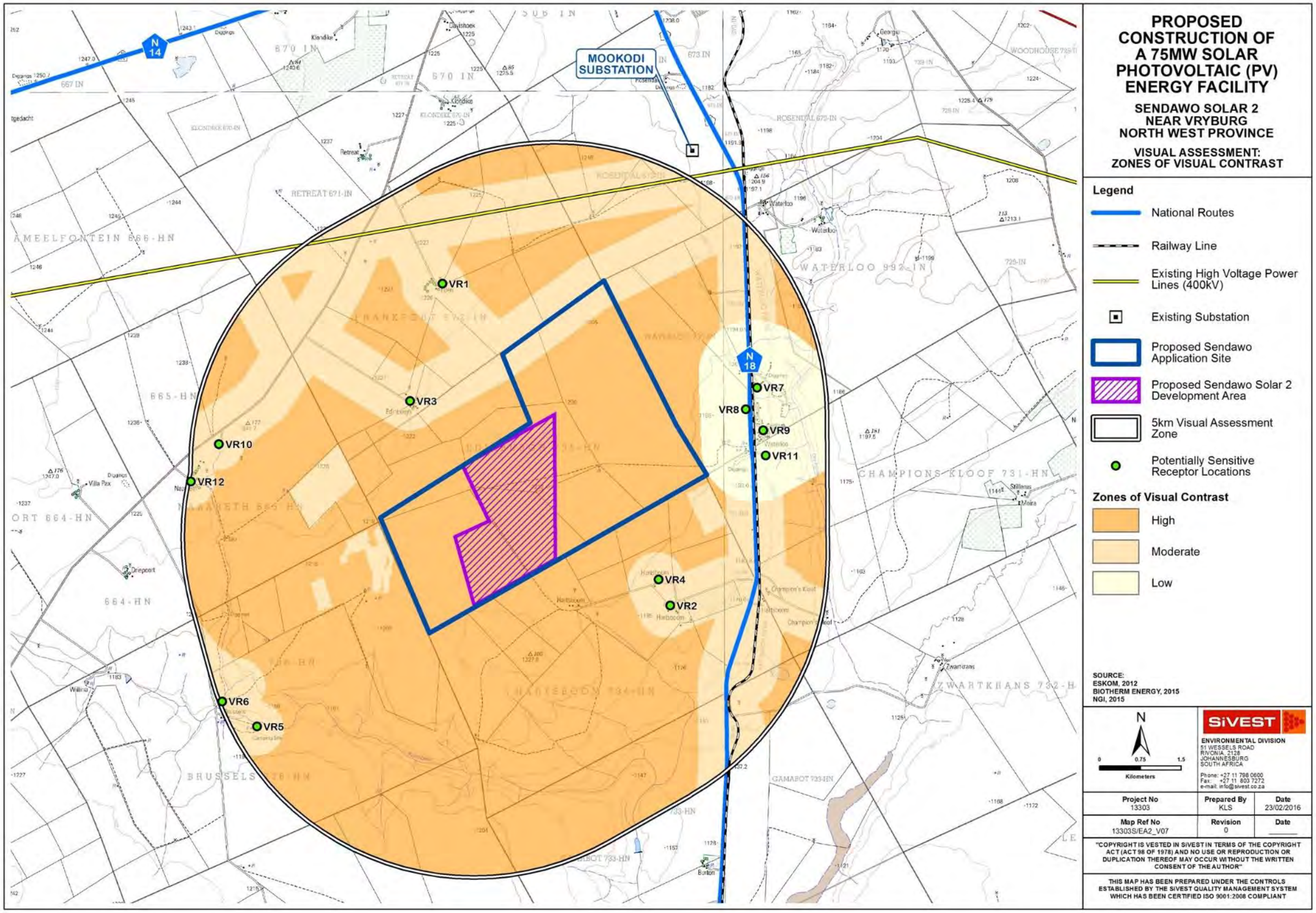


Figure 22: Zones of visual contrast

Table 4 below presents the results of the visual impact matrix

Categories of impact:

Rating	Overall Score
High Visual Impact	8-9
Moderate Visual Impact	5-7
Low Visual Impact	3-4
Negligible Visual Impact	(overriding factor)

Table 4: Visual impact of the proposed development on potentially sensitive visual receptors within the study area

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
VR 1	Low (1)	Moderate (2)	Moderate (2)	MODERATE
VR 2	Low (1)	Moderate (2)	Moderate (2)	MODERATE
VR 3	Moderate (2)	Moderate (2)	Moderate (2)	MODERATE
VR 4	Moderate (2)	Moderate (2)	Moderate (2)	MODERATE
VR 5	Low (1)	Negligible	Moderate (2)	LOW
VR 6	Low (1)	Negligible	Moderate (2)	LOW
VR 7 – Arthington Memorial Church	Low (1)	Moderate (2)	Low (1)	LOW
VR 8	Low (1)	High (3)	Low (1)	MODERATE
VR 9 – Tiger Kloof Educational Institution	Low (1)	Moderate (2)	Low (1)	LOW
VR 10	Low (1)	Moderate (2)	Moderate (2)	MODERATE
VR 11	Low (1)	High (3)	Low (1)	MODERATE
VR 12	Low (1)	Low (1)	Moderate (2)	LOW

As indicated above, the proposed development would result in a moderate visual impact on most of the potentially sensitive visual receptor locations with the study area (7 in total). It is important to note that the proposed development would have a low visual impact on both of the sensitive visual receptor locations, namely VR 7- The Arthington Memorial Church and VR 9 – Tiger Kloof Educational Institution. Although he development would be visible (to a degree) from all of the potentially sensitive visual receptor locations, it would not have a high impact on any and would exert a low impact on three (3) of the potentially sensitive visual receptor locations.

4.3 Night-time Impacts

The visual impact of lighting on the nightscape is largely dependent on the existing lighting present in the surrounding area at night. The night scene in areas where there are numerous light sources will be visually degraded by the existing light pollution and therefore additional light sources are unlikely have a significant impact on the nightscape. In contrast, introducing light sources into a relatively dark night sky will impact on the visual quality of the area at night. It is thus important to identify a night-time visual baseline before exploring the potential visual impact of the proposed PV energy facility at night.

The area surrounding the proposed development site is mostly uninhabited and as a result, relatively few light sources are present. The town of Vryurg and the informal/semi-formal settlement of Huhudi are the main source of light within the surrounding area, however they are located more than 7km away and are therefore expected to have a limited impact on the night scene. It must however be noted that the Tiger Kloof Educational Institution and the Arthington Memorial Church can be found within very close proximity to the application site and are expected to require some lighting for security reasons. In addition, another prominent light source within the study area at night is the security lighting at the Eskom Mookodi MTS which, according to local farmers, can be seen at night from relatively far away. Other sources of light are limited to, isolated lighting from the surrounding farmsteads. In general, the study area is characterised by a picturesque dark starry sky at night and the visual character of the night environment is considered to be generally 'unpolluted' and relatively pristine.

Security lighting at night will be required for the proposed PV energy facility. The type and intensity of lighting required was unknown at the time of writing this report and therefore the potential impact of the development at night has been discussed based on the general effect that additional light sources will have on the ambiance of the nightscape.

Although the area is not generally renowned as a tourist destination, the relatively natural dark character of the nightscape will be sensitive to the impact of additional lighting at night, particularly from nearby farmhouses. The security lighting required for the proposed project is likely to intrude on the nightscape and create glare, which will contrast with the dark backdrop of the surrounding area. Existing night time views toward the proposed site from potentially sensitive receptors are characteristic of a relatively dark night scene with some light sources visible in the distance as well as those from the nearby Mookodi MTS and Tiger Kloof Educational Institution, as a result lighting impacts from the proposed solar energy facility will increase the existing light pollution in the surrounding area.

4.4 Visual Impacts of Associated Infrastructure

4.4.1 Internal Roads

As mentioned above, a network of gravel access roads will also be constructed to provide access to the PV panels. Roads are typically only associated with significant visual impact if they traverse sloping ground on an aspect that is visible to the surrounding area. Considering the flat nature of the terrain on the site, it is likely that the visual impact associated with these roads would be limited to the impact of clearing the vegetation. However, if these roads are not maintained correctly during the construction phase, construction vehicles travelling along the gravel access roads could expose surrounding farmstead to dust plumes.

4.4.2 Underground cabling

The visual impact of the underground cabling would be very similar to roads in that the 'scar' associated with the cable could create a visual contrast with the largely natural vegetation on the site. However, as the PV panels are to be placed on flat terrain and there are no high ridges / high points on the proposed site, the visual impact of the cabling would be minimal. In spite of this it is recommended that all reinstated cable trenches should be re-vegetated with indigenous vegetation with shallow root systems, in order to reduce the potential for creating unnatural linear features in the environment.

4.4.3 On-site Switching Substation

A new on-site switching substation is being proposed as part of the PV energy facility development and will house transformers for voltage step up from medium voltage to high voltage. In isolation, the substations may be considered to be visually intrusive; however, it must be assumed that the on-site switching substation would be built to serve the needs of the power generated from the PV energy facility. Thus the substation would only be constructed if the PV energy facility was developed as well. The substation would likely form part of the PV complex, as viewed from the surrounding farmsteads. Views of the substation would therefore be dwarfed by the large number of PV panels that would be visible. As such, the substation is not expected to be associated with a significant visual impact, or even a measurable cumulative impact.

4.5 Cumulative Impacts

Although it is important to assess the visual impacts of the proposed PV energy facility on its own, it is equally important to assess the cumulative visual impact that could materialise in the area should other renewable energy facilities (both wind and PV plants) be granted authorisation to proceed. Cumulative impacts are the impacts, which combine from different developments / facilities and result in significant impacts that may be larger than sum of all the impacts.

These renewable energy facilities and their potential for large scale visual impacts could significantly alter the sense of place and visual character in the study area, if constructed. It must be noted that for the purpose of this study, renewable energy developments which are proposed within a 25km radius from the Sendawo Solar 2 PV energy facility were identified and mapped. Despite this, the cumulative visual impact experienced by each visual receptor will depend on the number of proposed developments within a 5km radius from the receptor location, as beyond 5km the visual impact of the development would diminish to an insignificant level.

The renewable energy developments that are being proposed within a 25km radius from the Sendawo Solar 2 PV application site are indicated in **Table 5** and **Figure 23** below.

Table 5: Renewable energy developments proposed within a 25km radius from the Sendawo Solar 2 PV application site

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Scoping and EIA processes underway.	Kabi Solar (Pty) Ltd	75MW	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390	Environmental authorisation received	Sediba Power Plant (Pty) Ltd	75MW	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308	Environmental authorisation received and preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75MW	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	Environmental authorisation received	Cronos Energy (Pty) Ltd	75MW	Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	Environmental authorisation received 29 June 2013. Amended to 75MW on 4 April 2014.	Carocraft (Pty) Ltd	75MW	Portion 1 and the Remainder of the Farm Weltevrede 681
Expansion of the Carocraft Solar Park	14/12/16/3/3/2/699	Scoping and EIA processes underway.	Carocraft (Pty) Ltd	75MW	Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 1 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 1 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729
Woodhouse Solar 2 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 2 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729
Sendawo Solar 1 PV Energy Facility	14/12/16/3/3/2/891	EIA process underway	BioTherm Energy (Pty) Ltd	75MW	Portion 1 of the Farm Edinburgh No 735.
Sendawo Solar 3 PV Energy Facility	14/12/16/3/3/2/893	EIA process underway	BioTherm (Pty) Ltd	75MW	Portion 1 of the Farm Edinburgh No 735.

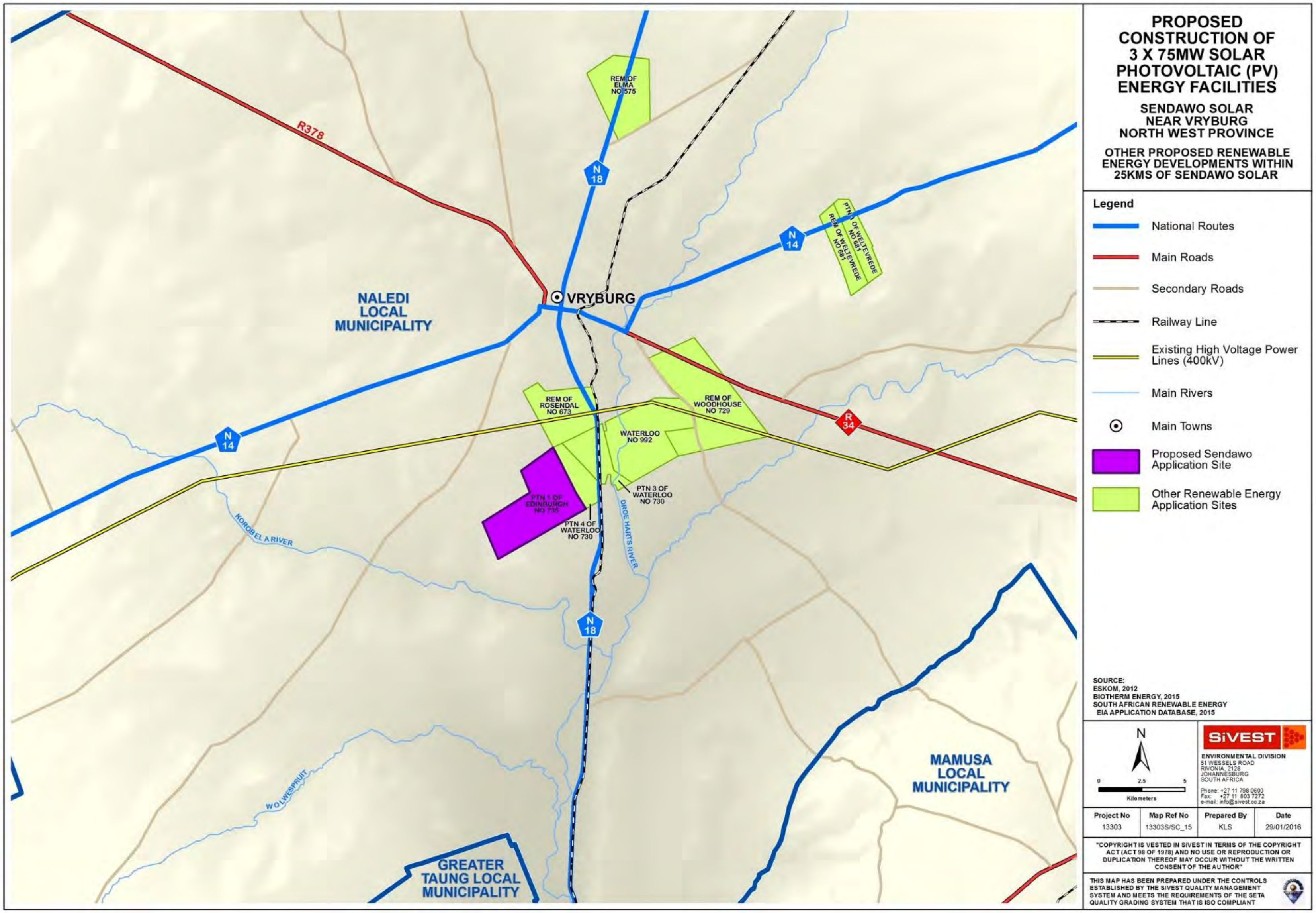


Figure 23: Renewable energy developments proposed within a 25km radius from the Sendawo Solar 2 PV application site

As previously mentioned, a 5km radius was used when determining the cumulative visual impact experienced by each sensitive receptor location. The cumulative impact assessment therefore investigated the number of proposed developments within a 5km radius from each respective sensitive receptor location. The number of proposed developments that each visually sensitive receptor would be visually exposed to (i.e. the cumulative impact experienced at each location) is indicated in **Table 6** below. It should be noted that the impact on each receptor location is indicative of the 'worst case' scenario which assumes that all of the proposed facilities would be developed.

Key

Likely to be visually exposed to the proposed development (within viewing distance)
Limited visual exposure to the proposed development (not within viewing distance)

Table 6: Cumulative visual impact on sensitive visual receptors

Sensitive Visual Receptors	Tiger Kloof Solar PV energy facility	Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	Waterloo Solar Park	Sendawo Solar 1 PV Energy Facility	Sendawo Solar 3 PV Energy Facility	Cronos Energy Renewable Energy Generation Project	75MW Carocraft PV Solar Park and associated infrastructure	Expansion of the Carocraft Solar Park	Woodhouse Solar 1 PV Facility	Woodhouse Solar 2 PV Facility
VR 7 – Arthington Memorial Church	√	√	√	√	√				√	√
VR 9 – Tiger Kloof Educational Institution	√	√	√	√	√				√	√
N18 National Road	√	√	√	√	√				√	√

As indicated in the table above, the cumulative impact on the N18, the Tiger Kloof Educational Institution and the Arthington Memorial Church was assessed as these were identified as sensitive visual receptor locations. These sensitive receptors could therefore be visually exposed to seven (7) additional proposed PV energy facilities should they all be constructed. It is also important to note that the Tiger Kloof Educational Institution and Arthington Memorial Church have been declared a provincial heritage site and national monument respectively. In addition, the N18 highway is considered to be a visually sensitive road as it is the main access road between Vryburg and Kimberley and may also be used to access tourism venues such as the Taung Skull World Heritage Site. The relatively high volumes of motorists travelling along this road could therefore be visually exposed to the seven (7) additional proposed PV energy facilities should they all be constructed.

Several scattered farmsteads / homesteads, which are used to house the local farmers as well as their farm workers, were identified within the study area and are regarded as potentially sensitive visual receptor locations. It was noted that a number of these dwellings are also located within a 5km radius from some of the additional renewable energy developments and are therefore expected to experience some visual impacts if some or all of the additional proposed PV energy facilities are constructed. These farmsteads / homesteads have however not been included as part of the cumulative assessment as the sensitivity of these visual receptors is largely subjective.

4.6 Overall Visual Impact Rating

The EIA requires that an overall rating for visual impact be provided to allow the visual impact to be assessed alongside other environmental parameters. SiVEST has developed an impact rating matrix for this purpose. The tables below present the impact matrix for visual impacts associated with the proposed construction and operation of the PV energy facility and the associated infrastructure.

Please refer to **Appendix A** below for an explanation of the impact rating methodology.

4.6.1 Planning

No visual impacts are expected during planning.

4.6.2 Construction

Table 7: Rating of visual impacts of the proposed Sendawo Solar 2 PV energy facility (including associated infrastructure) during construction

IMPACT TABLE	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	Large construction vehicles and equipment during the construction phase will alter the natural character of the study area and expose visual receptors to visual impacts associated with the construction phase. The construction activities may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. In addition, vehicles and trucks travelling to and from the proposed site on gravel access roads would increase dust emissions. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. The visual intrusion of the construction activities could adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the N18 and visitors at the Arthington Memorial Church or Tiger Kloof Educational Institution. Surface disturbance during construction would also expose bare soil which could visually contrast with the surrounding environment. Additionally, temporarily stockpiling soil during construction may alter the generally flat landscape. Wind blowing over these disturbed areas could therefore result in dust which would have a visual impact. The clearing of vegetation will be required for the installation of the PV panels. This is also expected to result in the generation of dust, alter the natural character of the surrounding area and therefore create a visual impact.
Extent	Local / District (2)
Probability	Probable (3)
Reversibility	Completely reversible (1)
Irreplaceable loss of resources	Marginal loss (2)
Duration	Short term (1)

Cumulative effect	Medium cumulative effects (3)	
Intensity/magnitude	Medium (2)	
Significance Rating	**Prior to mitigation measures:** Low negative impact **After mitigation measures:** Low negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	1	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-24 (negative low)	-20 (negative low)
Mitigation measures	▪ Carefully plan to reduce the construction period. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. ▪ Vegetation clearing should take place in a phased manner. ▪ Maintain a neat construction site by removing rubble and waste materials regularly. ▪ Make use of existing gravel access roads where possible. ▪ Limit the number of vehicles and trucks travelling to and from the proposed site. ▪ Ensure that dust suppression techniques are implemented on all gravel access roads. ▪ Ensure that dust suppression is implemented in all areas where vegetation clearing has taken place. ▪ Ensure that dust suppression techniques are implemented on all soil stockpiles. ▪ Re-vegetate all reinstated cable trenches with the same vegetation that existed prior to the cable being laid. ▪ Temporarily fence-off the construction site (for the duration of the construction period).	

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

4.6.3 Operation

Table 8: Rating of visual impacts of the proposed Sendawo Solar 2 PV energy facility during operation

IMPACT TABLE		
Environmental Parameter	Visual Impact	
Issue/Impact/Environmental Effect/Nature	The proposed Sendawo Solar 2 PV energy facility could exert a visual impact by altering the visual character of the surrounding area and exposing sensitive visual receptor locations to visual impacts. The development may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Maintenance vehicles may need to access the PV energy facility via gravel access roads and are expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Security and operational lighting at the proposed PV energy facility could result in light pollution and glare, which could be an annoyance to surrounding viewers. The visual intrusion of the proposed PV energy facility could adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the N18 and visitors at the Arthington Memorial Church or Tiger Kloof Educational Institution.	
Extent	Local/district (2)	
Probability	Definite (4)	
Reversibility	Irreversible (4)	
Irreplaceable loss of resources	Marginal (2)	
Duration	Long term (3)	
Cumulative effect	Medium cumulative effects (3)	
Intensity/magnitude	Medium (2)	
Significance Rating	**Prior to mitigation measures:** Medium negative impact **After mitigation measures:** Medium negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating

Extent	2	2
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-36 (medium negative)	-36 (medium negative)
Mitigation measures	▪ Light fittings for security at night should reflect the light toward the ground and prevent light spill. ▪ As far as possible limit the amount of security and operational lighting present on site. ▪ As far as possible limit the number of maintenance vehicles which are allowed to access the site. ▪ Ensure that dust suppression techniques are implemented on all gravel access roads.	

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

Table 9: Rating of visual impacts of the infrastructure associated with the Sendawo Solar 2 PV energy facility during operation

IMPACT TABLE	
Environmental Parameter	Visual Impact
Issue/Impact/Environmental Effect/Nature	The infrastructure associated with the proposed Sendawo Solar 2 PV energy facility could exert a visual impact by further altering the visual character of the surrounding area and exposing sensitive visual receptors to visual impacts. The development may be perceived as an unwelcome visual intrusion, particularly in more natural undisturbed settings. Maintenance vehicles may need to access the application site via gravel access roads in order to perform maintenance activities on the associated infrastructure and are expected to increase dust emissions in doing so. The increased traffic on the gravel roads and the dust plumes could create a visual impact and may evoke negative sentiments from surrounding viewers. Security and operational lighting at the infrastructure associated with the proposed PV energy facility could result in light pollution and glare, which could be an annoyance to surrounding viewers. The visual intrusion of the associated

	infrastructure could adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the N18 and visitors at the Arthington Memorial Church or Tiger Kloof Educational Institution.	
Extent	Local / District (2)	
Probability	Probable (3)	
Reversibility	Irreversible (4)	
Irreplaceable loss of resources	Marginal loss of resources (2)	
Duration	Long term (3)	
Cumulative effect	Medium cumulative impact (3)	
Intensity/magnitude	Low (1)	
Significance Rating	**Prior to mitigation measures:** Low negative impact **After mitigation measures:** Low negative impact	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	4	4
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	1
Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-14 (low negative)
Mitigation measures	▪ Light fittings for security at the proposed substation at night should reflect the light toward the ground and prevent light spill. ▪ The operations and maintenance (O&M) buildings should not be illuminated at night. ▪ Bury cables under the ground where possible. ▪ The O&M buildings should be painted with natural tones that fit with the surrounding environment. ▪ Select the alternatives that will have the least impact on visual receptors ▪ Limit the number of maintenance vehicles which are allowed to access the site. ▪ Ensure that dust suppression techniques are implemented on all gravel access roads.	

	▪ Non-reflective surfaces should be utilised where possible.

** Please note in the context of the visual environment 'resources' are defined as scenic / natural views that are almost impossible to replace.*

4.6.4 Decommissioning

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase.

5 COMPARATIVE ASSESSMENT OF ALTERNATIVES

As previously mentioned, only two (2) alternative site locations for the on-site 132kV substation, two (2) and O&M building and two (2) laydown area site alternatives are being investigated at this stage.

The preference rating for each alternative is provided in **Table 10** below. The alternatives are rated as being either preferred (the alternative will result in a low visual impact / reduce the visual impact), not-preferred (the alternative will result in a relatively high visual impact / increase the visual impact), favourable (the visual impact will be relatively insignificant) and no-preference (each alternative would result in an equal visual impact).

The degree of visual impact and rating is typically determined based on the following factors:

- The location of the alternative in relation to areas of high elevation, especially ridges, koppies or hills;
- The location of the alternative in relation to potentially sensitive and sensitive receptor locations; and
- The location of the alternative in relation to areas of natural bushveld vegetation (clearing site for the development worsens the visibility).

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact

NO PREFERENCE	The alternative will result in equal impacts

Table 10: Comparative Assessment of Alternatives – Sendawo 2 PV

Alternative	Preference	Reasons
O&M BUILDING AND SUBSTATION		
Sendawo PV 2 O&M Building and Substation Alternative 1	Preferred	No sensitive or potentially sensitive visual receptors can be found within 500m of the O&M Building and Substation Alternatives, within the high impact zone. In addition, no sensitive or potentially sensitive visual receptors can be found within 2km of these proposed alternatives, within the moderate impact zone. Both of the sensitive visual receptors identified within the study area, namely VR 9 – Tiger Kloof Educational Institution and VR 7 – Arthington Memorial Church, can be found further than 2km, within the low impact zone. Six (6) potentially sensitive visual receptors can also be found further than 2km from the proposed alternatives, within the low impact zone. It must be noted that four (4) potentially sensitive visual receptors are located further than 5km and the impact will therefore be negligible based on distance. As such, O&M Building and Substation Alternative 1 is marginally preferred as it is located slightly further from most of the potentially sensitive receptor locations. In addition, the O&M Building and Substation would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.
Sendawo PV 2 O&M Building and Substation Alternative 2	Favourable	No sensitive or potentially sensitive visual receptors can be found within 500m of the O&M Building and Substation Alternatives, within the

Alternative	Preference	Reasons
		high impact zone. One (1) potentially sensitive visual receptor, namely VR 4, can be found within 2km of these proposed alternatives, within the moderate impact zone. Both of the sensitive visual receptors identified within the study area, namely VR 9 – Tiger Kloof Educational Institution and VR 7 – Arthington Memorial Church, can be found further than 2km, within the low impact zone. Four (4) potentially sensitive visual receptors can also be found further than 2km from the proposed alternatives, within the low impact zone. It must be noted that five (5) potentially sensitive visual receptors are located further than 5km and the impact will therefore be negligible based on distance. Although these alternatives are located slightly closer to one (1) of the potentially sensitive receptor locations, it is still favourable as the O&M Building and Substation would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.
LAYDOWN AREA		
Sendawo PV 2 Laydown Area Alternative 1	Preferred	No sensitive or potentially sensitive visual receptors can be found within 500m of the Laydown Area Alternative, within the high impact zone. In addition, no sensitive or potentially sensitive visual receptors can be found within 2km of the proposed alternative, within the moderate impact zone. Five (5) potentially sensitive visual receptors can be found further than 2km, within the low impact zone. One (1) sensitive

Alternative	Preference	Reasons
		visual receptor identified within the study area, namely VR 9 – Tiger Kloof Educational Institution, can also be found further than 2km from the proposed alternative, within the low impact zone. It must be noted that five (5) potentially sensitive visual receptors are located further than 5km and the impact will therefore be negligible based on distance. In addition, one (1) sensitive visual receptor, namely VR 7 – Arthington Memorial Church, can also be found further than 5km form this alternative and the impact will therefore also be negligible based on distance. As such, Laydown Area Alternative 1 is marginally preferred as it is located slightly further from one (1) of the sensitive visual receptors, as well as one (1) of the potentially sensitive visual receptors. In addition, the laydown area would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.
Sendawo PV 2 Laydown Area Alternative 2	Favourable	No sensitive or potentially sensitive visual receptors can be found within 500m of the Laydown Area Alternative, within the high impact zone. In addition, no sensitive or potentially sensitive visual receptors can be found within 2km of the proposed alternative, within the moderate impact zone. Six (6) potentially sensitive visual receptors can be found further than 2km, within the low impact zone. Both sensitive visual receptors identified within the study area, namely VR 7 – Arthington

Alternative	Preference	Reasons
		Memorial Church and VR 9 – Tiger Kloof Educational Institution, can also be found further than 2km from the proposed alternative, within the low impact zone. It must be noted that four (4) potentially sensitive visual receptors are located further than 5km and the impact will therefore be negligible based on distance. Although this alternative is located slightly closer to one (1) of the sensitive visual receptors, as well as one (1) of the potentially sensitive visual receptors, it is still favourable as the laydown area would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.

6 CONCLUSIONS

The Visual Impact Assessment (VIA) conducted for the proposed Sendawo Solar 2 PV energy facility and associated infrastructure has demonstrated that much of the study area has a natural visual character, with certain areas displaying a distinctly rural or pastoral quality where maize cultivation and farmsteads occur. In addition, the study area is not valued for its tourism significance and is rated as having a low visual sensitivity. It was ascertained that due to the dominant farming practices and the relatively limited human habitation in the surrounding area, only two (2) sensitive receptor locations are present in the study area, namely the Arthington Memorial Church (VR 7) and Tiger Kloof Educational Institution (VR 9). These receptors were declared a national monument and provincial heritage site respectively and are therefore expected to experience the greatest visual impact as a result of the proposed development. Despite their significance with regards to heritage, the proposed development is expected to have a low visual impact on these two (2) sensitive receptors. It must also be noted that the N18 highway, which traverses the study area, is considered to be a visually sensitive road and the relatively high volumes of motorists travelling along this road would be visually exposed to the proposed PV facility. Several scattered farmsteads / homesteads which are used to house the local farmers as well as their farm workers were also identified within the study area and are regarded as potentially sensitive visual receptors. Upon further investigation, it was established that the proposed development would have a moderate visual impact on majority of these potentially sensitive visual receptors.

The overall significance of the visual impacts as a result of the proposed development during construction and operation was assessed according to SiVEST's impact rating matrix. The assessment revealed that overall the proposed Sendawo Solar 2 PV energy facility would have a low visual impact during construction and a medium visual impact during operation, with a number of mitigation measures available. The associated infrastructure would have a low visual impact during construction and operation.

As part of the VIA, the proposed on-site substation and O&M building site alternatives as well as the laydown area alternatives were comparatively assessed. The comparative assessment of alternatives revealed that Sendawo PV 2 O&M Building and Substation Alternative 1 was deemed to be the preferred option from a visual perspective, while Sendawo PV 2 O&M Building and Substation Alternative 2 would be a favourable option. With regards to the laydown area, Sendawo PV 2 Laydown Area Alternative 1 was deemed to be the preferred option from a visual perspective, while Sendawo PV 2 Laydown Area Alternative 2 would be a favourable option.

As part of the VIA, the cumulative visual impact that will be experienced by each sensitive visual receptor was also assessed. The cumulative visual impact was determined based on the number of proposed renewable energy developments within a 5km radius from a respective sensitive receptor location. Overall it was determined that the Tiger Kloof Educational Institution (VR 9), Arthington Memorial Church (VR 7) and the N18 would be visually exposed to seven (7) additional proposed PV energy facilities should they all be constructed.

Overall it can be concluded that although the visual impact of the proposed Sendawo Solar 2 PV energy facility would be reduced due to the lack of sensitive visual receptors present, the facility does not correspond with the current land use of the area and would visually contrast with the natural earthly tones of the prevailing vegetation by creating a dark grey mass within the relatively flat landscape. In addition, it is expected that cumulative visual impacts could materialise in the area should some or all of the other seven (7) nearby renewable energy facilities be granted environmental authorisation (EA) to proceed, receive a license and be constructed.

It is SiVEST's opinion that the visual impacts are not significant enough to prevent the project from proceeding and that an EA should be granted. From a visual impact perspective only three (3) sensitive visual receptors (two locations and one road) have been identified within the study area. In addition, the existing electrical infrastructure and other linear elements already present within the study area have already altered the natural character of the surrounding environment to a degree and are expected to lower the visual sensitivity of the area. It must also be noted that the visual impact of the proposed development on these three (3) sensitive visual receptors identified within the study area was rated as being low. SiVEST is therefore of the opinion that the impacts associated with the construction and operation phases can be mitigated to acceptable levels provided the recommended mitigation measures are implemented.

7 REFERENCES

- Barthwal, R. 2002. Environmental Impact Assessment. New Age International Publishes, New Delhi.
- Breedlove, G., 2002. A systematic for the South African Cultural Landscapes with a view to implementation. Thesis – University of Pretoria.
- Encounter South Africa Website: http://www.encounter.co.za/article/195.html
- Geoterraimage. 2015. 2013 – 2014 South African National Land-Cover Dataset: Data User Report and MetaData.
- Mitchell, P., 2002. The Archaeology of Southern Africa. Cambridge University Press, Cambridge.
- Mucina L., and Rutherford M.C., (eds) 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- North West Info Website: http://www.north-west-info.co.za/provinces/town/690
- North West Parks and Tourism Board Official Website: http://www.tourismnorthwest.co.za
- Oberholzer, B. 2005. Guideline for involving visual & aesthetic specialists in EIA processes: *Edition 1.* CSIR Report No ENV-S-C 2005 053 F. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.
- South African Tourism Website: http://www.southafrica.net/za/en/articles/entry/article-southafrica.net-taung-skull-heritage-route
- Taung Resort Website:http://www.taungresort.co.za
- UNESCO., 2005. Operational Guidelines for the Implementation of the World Heritage Convention. UNESCO World Heritage Centre. Paris.
- Vryburg.com Website: http://vryburg.com/about-vryburg/

Appendix A

IMPACT RATING METHODOLOGY

IMPACT RATING METHODOLOGY

The determination of the effect of an environmental impact on an environmental parameter (in this instance, wetlands) is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is usually assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

In this case, a unique situation is present whereby various scenarios have been posed and evaluated accordingly. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 1: Example of the significance impact rating table.

NATURE		
Includes a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.

3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		

1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Appendix B

LIST OF VISUALLY SENSITIVE AND POTENTIALLY SENSITIVE RECEPTOR LOCATIONS

Table i: Visually sensitive / potentially sensitive receptor locations within the study area

Name	Type	Coordinates	Zone of visual exposure
VR 1	Frankfort farmhouse	27° 1'54.56"S 24°41'52.46"E	Low
VR 2	Hartsboom farmhouse	27° 5'6.76"S 24°44'23.71"E	Low
*VR 3	Edinburgh farmhouse	27° 3'4.46"S 24°41'30.80"E	Moderate
VR 4	Hartsboom farmhouse	27° 4'51.28"S 24°44'16.04"E	Moderate
VR 5	Brussels farmhouse	27°6'18.33"S 24°39'48.20"E	Low
VR 6	Brussels "Jeugkamp"	27°6'3.37"S 24°39'25.15"E	Low
VR 7	Arthington Memorial Church	27° 2'56.92"S 24°45'21.97"E	Low
VR 8	Farmhouse to the north-west of the Tiger Kloof Educational Institution	27° 3'9.86"S 24°45'14.36"E	Low
VR 9	Tiger Kloof Educational Institution	27° 3'22.36"S 24°45'25.87"E	Low
VR 10	Nazareth farmhouse	27°3'29.95"S 24°39'23.44"E	Low
VR 11	Farmhouse to the south of the Tiger Kloof Educational Institution	27° 3'37.46"S 24°45'27.60"E	Low
VR 12	Nazareth farmhouse	27°3'52.16"S 24°39'4.75"E	Low

**Despite not being located within the proposed development site, the occupant of VR 3 supports the proposed development and is assumed to have a vested interest in the development. This is due to the fact that the development is proposed to be located on the property owned by this occupant. The occupant of this dwelling would therefore not perceive the proposed PV energy facility negatively.*

SiVEST Environmental Division
51 Wessels Road, Rivonia. 2128. South Africa
PO Box 2921, Rivonia. 2128. South Africa

Tel + 27 11 798 0600
Fax +27 11 803 7272
Email info@sivest.co.za
www.sivest.co.za

Contact Person: Stephan Jacobs
Tel No.: +27 11 798 0677
Email: stephanj@sivest.co.za

Appendix 6F:

Heritage and Palaeontology Assessment

BIOTHERM ENERGY (PTY) LTD

75MW SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY – SENDAWO SOLAR 2

Heritage Impact Assessment

Issue Date: 26 May 2016
Revision No.: 1
Project No.: 13303

Date:	26 May 2016
Document Title:	Heritage Impact Assessment
Author:	Jessica Angel/Wouter Fourie
Revision Number:	1
Checked by:	
For:	SiVEST Environmental Division

Executive Summary

PGS Heritage (Pty) Ltd (PGS) was appointed by SiVEST Environmental Division (SiVEST) to undertake a Heritage Impact Assessment that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of the Sendawo Solar 2, 75MW solar photovoltaic (PV) energy facility near Lichtenburg, North West Province.

Heritage resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

The Heritage Impact Assessment has shown that the proposed Sendawo Solar 2 project have heritage resources present on the property. This has been confirmed through a field survey, archival research and evaluation of aerial photography of the sites.

Archaeological Resources

During the fieldwork 2 archaeological resources were identified of which all were archaeological sites representing the Earlier, Middle and Later Stone Age. The sites are all rated as having local heritage significance. No mitigation is required for sites **V02** and **V03**.

Palaeontological Resources

Observations in the study are indicated deep windblown sand deposits with minor to no dolomite or breccia in the foot print area of the Solar 2 site. The possibility of the presence of cave breccia and stromatolites in the northern section of the powerline corridor at observation points 0592-0632 must be considered. Final identification of possible sites where significant cave breccia will occur will only be identified after completion of the geotechnical surveys.

Mitigation:

- It is essential that the results of the Geotechnical Surveys be provided to the HIA team and palaeontologist to assess the possible presence of sinkholes and cave breccia sites on all the proposed development areas;
- It is recommended that an palaeontologist be appointed to monitor geotechnical investigations as part of a watching brief.
- Field assessment indicated the presence of both significant stromatolite structures and possible cave breccia in the northern section of the power line corridor for Solar 2;
- If excavation of deeper than 1.5m is planned, the palaeontologist must assess the results of the geotechnical information and given the opportunity to comment on the likelihood of significant finds of fossils in all the planned development areas;
- If any excavation or collection of fossils is recommended, such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.

Due to the presence of significant stromatolites in a small area and the large number of boulders with stromatolites present on site it is recommended that a palaeontologist be appointed to monitor geotechnical investigations as part of a watching brief. The aim being the identification and mitigation of any newly discovered palaeontological sites, if recorded.

Impact Summary

Table 12 provides a summary of the projected impact rating for this project on heritage resources.

Table 1: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Heritage resources	Impact during construction	28		10	
			Negative medium Impact		Positive Low Impact
Palaeontological Resources	Impact during construction	52	Negative High impact	39	Positive High Impact

Assessment of Alternatives

An evaluation of the operations buildings, substation and lay down area alternatives have indicated that none of the proposed area impact directly on known heritage resources and thus no preference towards a specific alternative has been identified.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Comparative Assessment of Alternatives – Sendawo Solar 2

Alternative	Preference	Reasons
OPERATIONS BUILDING AND SUBSTATION		
Sendawo PV 2 Operations Building and Substation Alternative 1	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have

Alternative	Preference	Reasons
		been identified
Sendawo PV 2 Operations Building and Substation Alternative 2	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified
LAYDOWN AREA		
Sendawo PV 2 Laydown Area Alternative 1	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified
Sendawo PV 2 Laydown Area Alternative 2	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified

The overall impact on heritage resources is seen as acceptable and the proposed mitigation measures to be incorporated in the EMP will provided the necessary actions to address any impacts on heritage resources.

BIOTHERM ENERGY (PTY) LTD

HERITAGE REPORT

Contents **Page**

Appendices

1. INTRODUCTION

PGS Heritage (Pty) Ltd (PGS) was appointed by SiVEST Environmental Division (SiVEST) to undertake a Heritage Impact Assessment that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of the Sendawo Solar 2, 75MW solar photovoltaic (PV) energy facility near Lichtenburg, North West Province.

1.1. Scope of the Study

The aim of the study is to identify possible heritage sites, finds and sensitive areas that may occur in the study area for the EIA study. The Heritage Impact Assessment (HIA) aims to inform the Environmental Impact Assessment in the development of a comprehensive Environmental Management Plan to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2. Specialist Qualifications

PGS Heritage (PGS) compiled this Heritage Scoping Report.

The staff at PGS has a combined experience of nearly 70 years in the heritage consulting industry. PGS and its staff have extensive experience in managing the HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Jessica Angel, Archaeologist and author, holds a Masters degree in Archaeology and is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA).

Wouter Fourie, Project manager for this project, is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation, as well as being accredited as a Professional Heritage Practitioner with the Association of Professional Heritage Practitioners – Western Cape (APHP).

1.3. Assumptions and Limitations

Not detracting in any way from the fieldwork undertaken, it is necessary to realise that the heritage sites located during the fieldwork do not necessarily represent all the heritage sites present within the area. Should any heritage feature or objects not included in the inventory be located or observed, a heritage specialist must immediately be contacted. Such observed or located heritage features and/or objects may not be disturbed or removed in any way, until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well.

The survey was conducted over 2 days over the extent of the total footprint area. It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the heritage character of the area.

The fieldwork that covered the Sendawo solar PV application site is an area of 17.1 square kilometres.

A total of 2 sites, which can be considered archaeological were logged within the foot print area of PV2. All of these sites relate to the Stone Age.

1.4. Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

- National Environmental Management Act (NEMA), Act 107 of 1998
- National Heritage Resources Act (NHRA), Act 25 of 1999
- Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

- National Environmental Management Act (NEMA) Act 107 of 1998
    - Basic Environmental Assessment (BEA) – Section (23)(2)(d)
    - Environmental Scoping Report (ESR) – Section (29)(1)(d)
    - Environmental Impact Assessment (EIA) – Section (32)(2)(d)
    - Environmental Management Plan (EMP) – Section (34)(b)
- National Heritage Resources Act (NHRA) Act 25 of 1999
    - Protection of Heritage Resources – Sections 34 to 36; and
- Heritage Resources Management – Section 38
- Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002

Section 39(3)

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…" The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, and MPRDA legislation. In the latter cases, the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Sections of these Acts relevant to heritage (Fourie, 2008).

The NEMA 23(2)(b) states that an integrated environmental management plan should, "…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage".

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down in Section 33 of the regulations (Fourie, 2008).

Refer to **Appendix A** for further discussions on heritage management and legislative frameworks

Table 2: Terminology

Acronyms	***Description***
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
PSSA	Palaeontological Society of South Africa
ROD	Record of Decision

SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

Archaeological resources

This includes:

i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;

ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;

iii. wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;

iv. features, structures and artefacts associated with military history, which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;

ii. carrying out any works on or over or under a place;

iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;

iv. constructing or putting up for display signs or boards;

v. any change to the natural or existing condition or topography of land; and

vi. any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age, between 700 000 and 2500 000 years ago.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

Late Stone Age
The archaeology of the last 30 000 years, associated with fully modern people.

Palaeontology
Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Fossil
Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Holocene
The most recent geological time period which commenced 10 000 years ago.

Iron Age
The archaeology of the last 1000 years up to the 1800s, associated with people who carried out iron working and farming activities such as herding and agriculture.

Heritage
That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources
This means any place or object of cultural significance.
Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

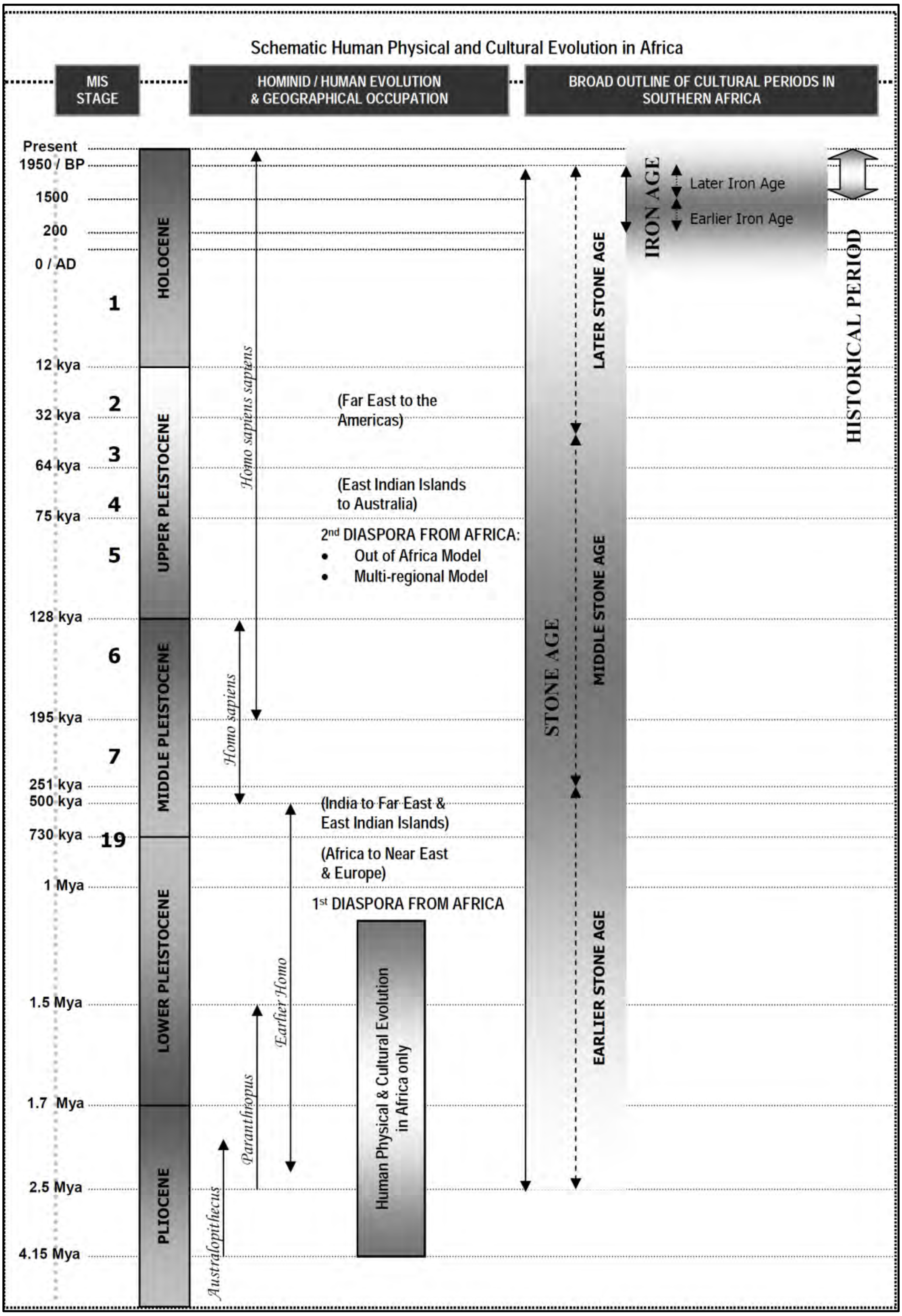


Figure 1 – Human and Cultural Timeline in Africa (Morris, 2008)

2. TECHNICAL DETAILS OF THE PROJECT

2.1. Site Location and Description

Sendawo Solar 2 will be located approximately 10km south of Vryburg, in the Dr Ruth Segomotsi Mompati District of the North West Province. (**Figure 2**).

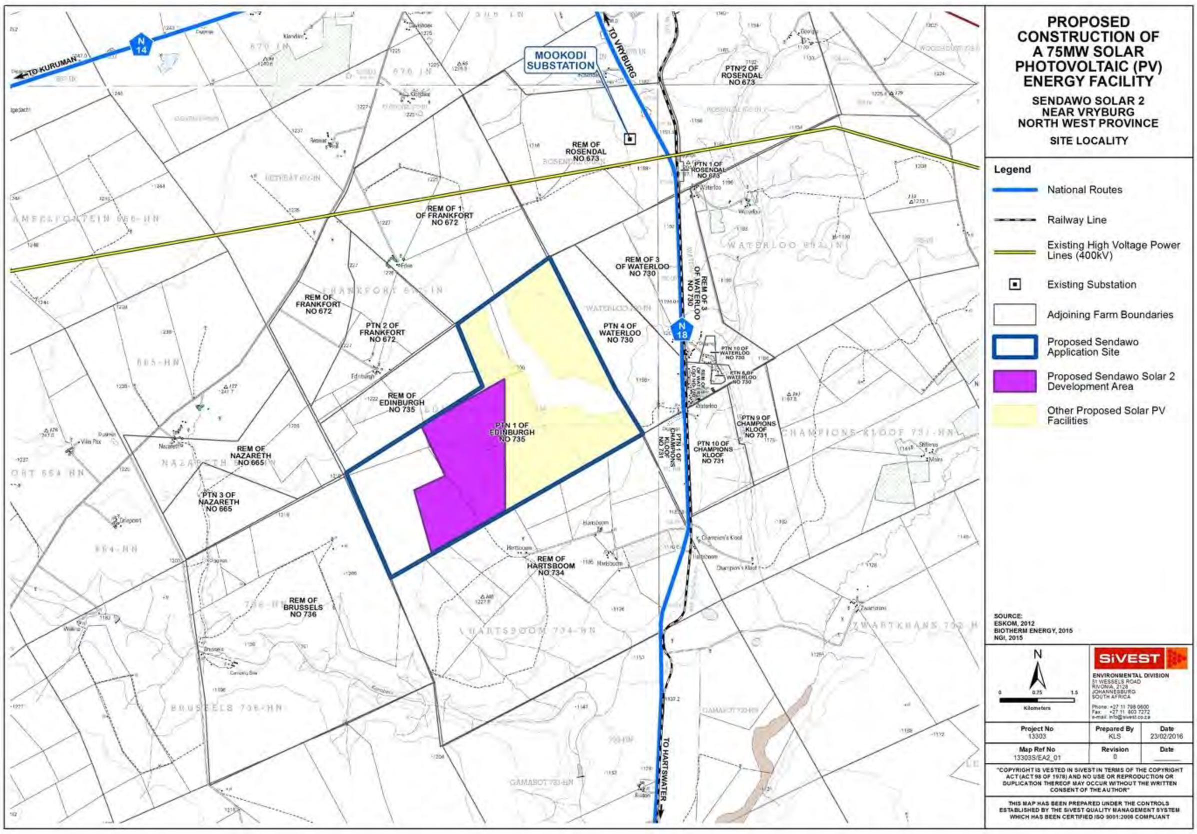


Figure 2 – Sendawo Solar 2 - Locality

The application site is approximately 1700ha however the buildable area will be significantly smaller than this and was determined by sensitive areas identified during the Scoping Phase of the EIA.

Panels will be either fixed axis mounting or single axis tracking solutions, and will be either crystalline silicon or thin film technology. In addition to the PV panels each project will consist of:

- An onsite switching station, with the transformers for voltage step up from medium voltage to high voltage;
- The panels will be connected in strings to inverters and inverter stations will be required throughout the site. Inverter stations will house 2 x 1MW inverters and 1 x 2MVA transformers;
- DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to 22-33kV (medium voltage) in the transformers.
- The 22-33kV cables will be run underground in the facility to a common point before being fed to the onsite switching station where the voltage will be stepped up to 132kV.

- A power line with a voltage of 132kV to the proposed Sendawo substation;
- A laydown area for the temporary storage of materials during the construction activities;
- Access roads and internal roads;
- A car park and fencing; and
- Administration, control and warehouse buildings.

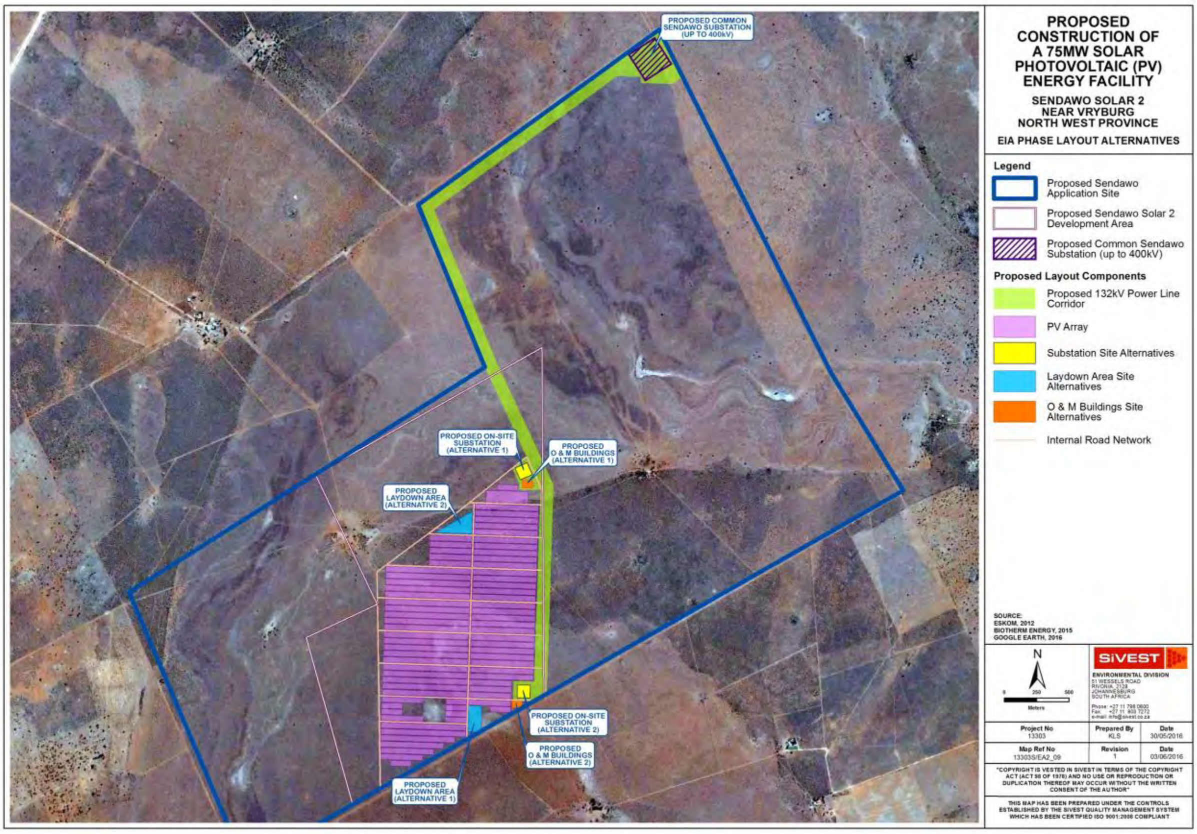


Figure 3 – Sendawo Solar 2 - Layout

3. ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1. Methodology for Assessing Heritage Site significance

PGS compiled this Heritage Assessment Document as part of the Heritage Impact Assessment (HIA) report for the proposed Sendawo Solar 2 Facility. The applicable maps, tables and figures, are included as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998). The HIA process consisted of three steps:

3.1.1. *Scoping Phase*

Step I – Literature Review: The background information to the field survey relies greatly on the Heritage Background Research.

3.1.2. *Impact Assessment Phase*

Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by a qualified archaeologist, which aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

Appendix B, outlines the Plan of study for the Heritage Impact Assessment process, while **Appendix C** provides the guidelines for the impact assessment evaluation that will be done during the EIA phase of the project.

4. BACKGROUND RESEARCH

The examination of heritage databases, historical data and cartographic resources represents a critical additional tool for locating and identifying heritage resources and in determining the historical and cultural context of the study area. Therefore, an Internet literature search was conducted and relevant archaeological and historical texts were also consulted. Relevant topographic maps and satellite imagery were studied.

4.1. Archival findings

4.1.1. *Overview of the archaeological fabric of the study area and surroundings*

A small number of archaeological and heritage contract projects have been undertaken in the general surroundings of the study area. Of the three heritage studies located in this area, two were undertaken for proposed photovoltaic solar farms and one for an extension to an existing base metal mine. No purely academic archaeological research appears to have taken place in the direct vicinity of the study area, with the nearest known research locality the Taung Skull World Heritage Site situated 18.4 km south-east of the present study area. It is important to note that the information listed here does not necessarily represent all the previous archaeological work undertaken in the vicinity of the study area. The second source is information from reports that were accessed from the SAHRA electronic database known as SAHRIS, and which for the most part came about due to the requirement for archaeological and heritage impact assessments to be undertaken for mining (and other development) activities.

4.1.2. Archaeological Sites as Revealed Through a Study of Published Literature

The following sites were identified by studying archaeological journals and books. The sites are grouped according to their respective farm names. At the end of each description the approximate distance between the site and the present study area is provided. No information could however be obtained with regard to any archaeological research that was undertaken in close proximity to the study area. In the surrounding landscape the following archaeological sites are known:

Taung

In 1924 Raymond Dart identified the skull of an infant gracile australopithecine from a limestone quarry near Taung. While numerous fossils have been recovered from the same quarry, the skull of the Taung Child is the only hominin remains recovered from this site. Taung is one of only three localities in South Africa where fossil evidence for early hominins were ever recovered, the other two being the Cradle of Humankind (with sites such as Sterkfontein and Kromdraai) and Makapansgat (Mitchell, 2002). The Taung Skull World Heritage Site is located 70 km south of the present study area.

Harts River Valley Survey Project

In 1989 the University of the Witwatersrand was commissioned to conduct an archaeological survey of a section of the Harts River valley that was scheduled to be flooded by the proposed construction of the Taung Dam. A total of 28 Stone Age and three pastoralist sites were identified during the survey. Of the 38 identified Stone Age sites, a total of 11 could be associated with the Early Stone Age.

The best-preserved sites identified during the survey were excavated in 1992, including two of the Early Stone Age sites namely 2724DB3 and 2724DB4. Incidentally, the research undertaken at these two sites has provided valuable insight into the Acheulian archaeology of South Africa. In the words of Prof. Kathleen Kuman (2001:20), the "...Harts Valley project provides further documentation for the South African part of this picture of technological continuity and the origins of prepared core technology within the Achuelian".

Seven rock art sites were also identified in the footprint area of the proposed Taung Dam. These seven sites comprise finger paintings of geometric patterns as well as one site which contains paintings of "...riders on horseback...riders on horseback chasing an elephant...and two geometric patterns" (Dowson et.al., 1992:28).

If any of these sites identified before the construction of the Taung Dam still exists, they would be located roughly 60 km south east of the present study area.

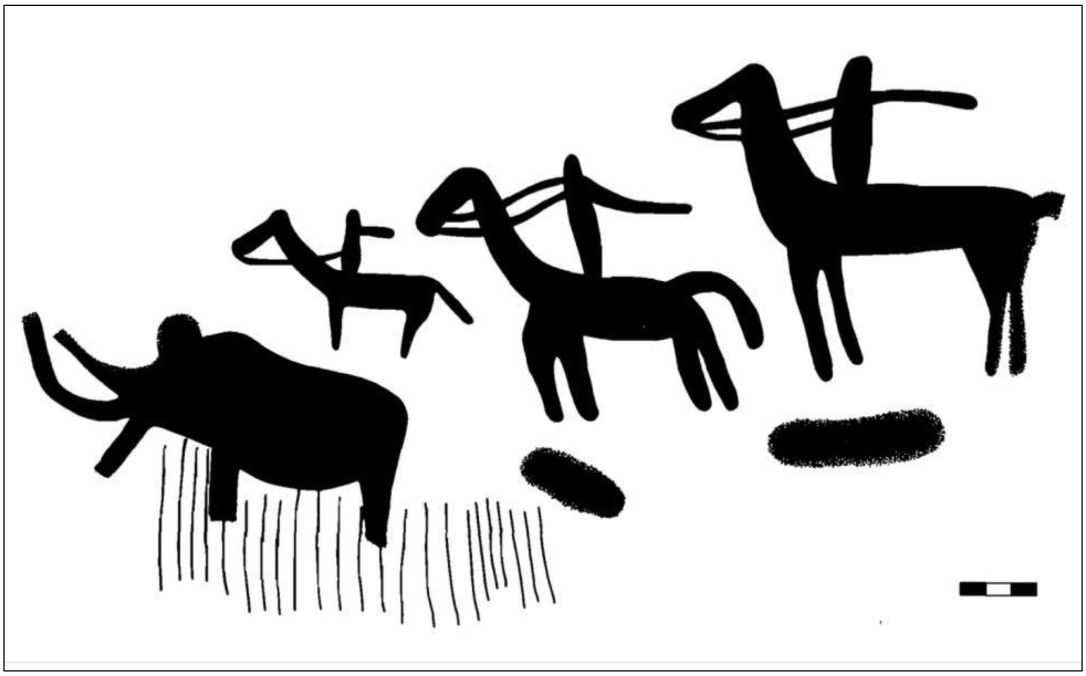


Figure 4 – Tracing of one of the rock art panels at a site located roughly 40 km east of the present study area (Dowson, et.al., 1992: 29).

The aim of the archival background research is to identify possible heritage resources that could be encountered during the field work, as summarised in **Table 3**.

Table 3: Summary of History of Vryburg Town and Surrounding Area

DATE	DESCRIPTION
2.5 million to 250,000 years ago	The Earlier Stone Age (ESA) is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these technological phases is known as Oldowan which is associated with crude flakes and hammer stones and dates to approximately 2 million years ago. The second technological phase in the Earlier Stone Age of Southern Africa is known as the Acheulean and comprises more refined and better made stone artefacts such as the cleaver and bifacial handaxe. The Acheulean phase dates back to approximately 1.5 million years ago. A total of 11 Early Stone Age sites with Acheulean lithics have been recorded in the Harts River valley, immediately east of the town of Taung and roughly 60 km east of the present study area (Kuman, 2001).
250,000 to 30,000 years ago	The Middle Stone Age is the second oldest phase identified in South Africa's archaeological history. It is associated with flakes, points and blades manufactured by means of the prepared core technique.
30,000 years ago to the	The Later Stone Age is the third phase in South Africa's Stone Age history. It is associated with an abundance of very small stone artefacts

historic past	(microliths). The Later Stone Age is also associated with rock engravings and rock paintings. Rock engravings are known from the wider vicinity of the study area (Bergh, 1998), with one known site located at Dinkweneng (roughly 43 km east of the study area). Furthermore, a Low Density Surface Scatter of Later Stone Age material was identified at the Pering Mine (approximately 60 km south-west of the study area) (Birkholtz, 2011).
Early 1600s	The Tswana groups known as the Thlaping and Thlaro moved southward into the area presently known as the Northern Cape. A century later they were settled in areas as far south as Majeng (Langeberg), Tsantsabane (Postmasburg) and Tlhaka le Tlou (Daniëlskuil) (Snyman, 1986).
c. 1770	The Kora moved into the area. Due to their superior firearms they applied increasing pressure on the Thlaping and Thlaro groups. In the end the Thlaping moved into a north-eastern direction to settle in the general vicinity of Dithakong, north-east of present-day Kuruman. The Thlaro settled in areas to the west and north-west of the Thlaping (Snyman, 1986).
c. 1795	Legassick (2010) confirms the presence of the Thlaping, Thlaro and Kora in the general vicinity of the study area during this time.
Early 1800s	After the threat of the Kora became less intensive the Thlaping moved to the vicinity of present-day Kuruman. The Thlaro returned to the Langeberg, establishing them on a permanent basis there during the 1820s (Snyman, 1986). During this time German-born deserter Jan Bloem and his followers established themselves at Lekatlong (Legassick, 2010).
1833	Hurutshe refugees established themselves at Taungs (Legassick, 2010). The present-day town of Taung is roughly 40 km due-south of the study area.
1834	Mahura and his Thlaping followers moved from the vicinity of Kuruman to Taungs. Apart from the 1,500 individuals that followed Mahura to Taungs, the settlement of Taungs at the time also included some 2,000 Hurutshe, the Kora leader Mosweu Taaibosch and his followers as well as some 1,500 Maidi (Legassick, 2010).
November 1840	Gasibonwe, the son of Mothibi, attacked Mahura's cattle posts at Taungs and further afield. His aim was to degenerate Mahura's rule and to achieve supremacy over all the Thlaping (Legassick, 2010).
22 April 1842	A treaty was signed between Griqua leader Andries Waterboer and Thlaping leader Mahura at Mahura's settlement near Taungs. The agreement included a definition of the boundary between the two groups. The section of the agreed upon boundary closest to the study area ran from Danielskuil to Boetsap, which meant that the study area was defined as part of this treaty as forming part of Thlaping land (Legassick, 2010). This boundary was very similar to an earlier one that was thought to have been agreed to during the 1820s as a boundary between the Griqua and the Thlaping (Legassick, 2010).

1867	Diamonds were discovered for the first time in South Africa near Hopetown. Alluvial diamonds were also discovered along both banks of the Orange River in the vicinity of the confluence of the Vaal and Harts Rivers (Van Staden, 1983). This resulted in large numbers of fortune seekers streaming into the area from overseas, which would have had a profound impact on the social-dynamics of the landscape.
27 October 1871	The area located in the triangle formed by the Orange and Vaal Rivers was proclaimed as British Territory and named Griqualand West. This proclamation came as a result of ownership disputes between the Griqua, the Boer Republic of the Orange Free State and the Boer Republic of the Zuid-Afrikaansche Republiek in terms of the newly discovered diamond diggings (www. wikipedia.com).
1879	After Barend Barends was defeated by the Khumalo Ndebele of Mzilikazi, Boetsap was occupied by two shopkeepers, Hunter and Tasker.
1882-1885	The Boer Republic of Stellaland existed during this time in the general area of the Vryburg district. Stellaland had its roots in the conflict between Mankurwane's Tlhaping and Mosweu's Kora over land. Both sides used white mercenaries who as part of their remuneration were to receive farms. Almost 300 Boers joined the side of Mosweu in this war and on 26 July 1882 Mankurwane sued for peace. As a result of the peace agreement a portion of land was set aside for the mercenaries. From September 1882 the capital of Stellaland was being laid out and named Vryburg. On 6 August 1883 the Republic of Stellaland was proclaimed. However, the republic seized to exist when Sir Charles Warren proclaimed the Bechuanaland Protectorate on 30 September 1885 (Bergh, 1999). The Taungs area, including the farm Brakfontein, was located just outside the southern boundary of Stellaland.
30 September 1885	Sir Charles Warren proclaims British Bechuanaland. This proclaimed area included the study area (www.wikipedia.com).
1895	British Bechuanaland was incorporated into the Cape of Good Hope (www.wikipedia.com). The study area now fell within the Cape of Good Hope. In the same year the Kaukwe Native Reserve was established in accordance with British Bechuanaland Proclamation No. 220 (Breutz, 1986). This reserve is located 60km south-west of the present study area
1904	Reverend William Charles Willoughby and his wife Bessie arrives in the vicinity of the current study area with the aim of assisting the Batswana to establish a school in Bechuanaland. After several attempts the Institution was finally established at Tiger Kloof. http://www.tigerkloof.com/index.php/about-us/history

4.1.3. *Findings of the background research*

The pre-history of the area is evident through the presence of numerous farms with rock engravings, including Verdwaal Vlakte, Bernauw, Schatkist, Wonderfontein and Kinderdam (Van Schalkwyk, 2012; Morris, 1998).

The numerous dry pans in the northern section of the study area also increase the probability of finding Stone Age Sites associated with hunter gatherer subsistence.

Heritage Resources associated with the South African War can be traced through the presence of blockhouse lines between Taung and Vryburg and onwards towards Madibogo, as well as the Vryburg concentration camp situated on the Vryburg Allotment area that is now part of the Leon Taljaard Nature Reserve to the north west of Vryburg.

Other areas of significance identified are the Devondale Mission (*circa* pre-1900), Tiger Kloof Institute (*circa* 1904) as well as the farmstead of the first and only president, Gerrit Jacobus van Niekerk, of the republic of Stellaland on the farm Niekerksrus. some 36 kilometres northwest of Vryburg.

4.1.4. *Themes identified during the research were*

- Palaeontology
- Pre-colonial archaeology and early inhabitants – especially associated with inland water in the arid regions of South Africa
- Early Colonial History and settlement
- Routes and transport
- Military history
- Town and village formation

4.2. Palaeontology

The following section is taken directly form the Palaeontological Impact Assessment completed for the project by Dr Gideon Groenewald (Groenewald, 2016).

The palaeontological resources in the Vryburg area have received very little scientific attention. To a great extent they can only be inferred from the rock units represented there on geological maps. Most of the potentially fossiliferous superficial deposits (e.g. Caenozoic alluvium) are not shown on the published geological maps, however.

Stromatolitic carbonate rocks (limestones, dolomites) of Early Precambrian (Archaean) age in outcrops of the Ventersdorp Group (Kameeldorns, Rietgat and Bothaville Formations) as well as the lower part of the Transvaal Supergroup (Ghaap Group, Vryburg Formation & Schmidtsdrift Subgroup, including the Boomplaas Formation). In the Vryburg area and further south towards

Taung these include some of the oldest (> 2.5 billion years) and best-preserved stromatolites (fossil microbial mounds) known from this period;

Stromatolites are recorded from the dolomite layers. Highly fossiliferous Caenozoic cave breccias are also known to occur within the dolomite layers, but are not mapped individually. These fossiliferous deposits often contain more recent mammal and hominid fossils, e.g. in the Cradle of Humankind."

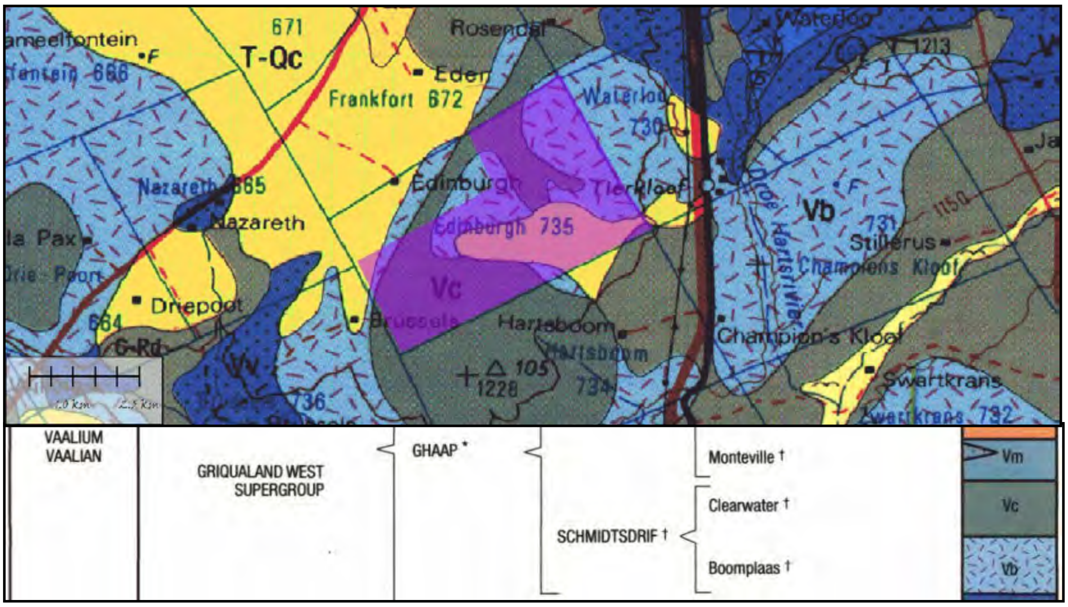


Figure 5 - The study area is underlain by rocks of the Boomplaas (Vb) and Clearwater (Vc) Formations of the Ghaap Group, and calcrete (T-Qc)

4.2.1. Findings from the studies

Through the analysis of the aerial photographs and available maps of the study area no obvious heritage sensitive areas were identified inside the study area. Some rocky outcrops that could possibly contain rock engravings and open air stone age sites have been identified as possible heritage sensitive areas. **Figure 6** Indicates the possible heritage sensitive areas.

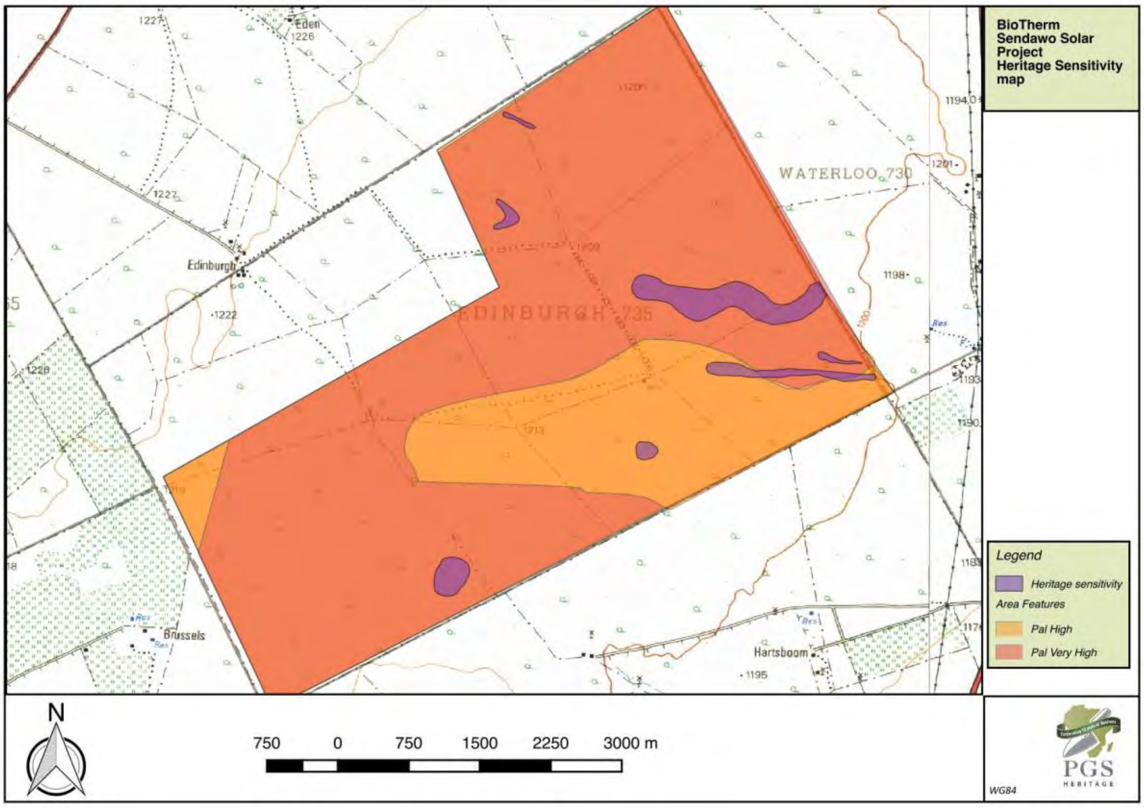


Figure 6 - Sendawo Solar Projects, projected heritage sensitivity map

4.3. Cumulative impacts

An evaluation of the possible cumulative impacts from the combined solar projects in the area (**Table 2** and **Figure 7**) on heritage resources has shown that the biggest envisaged impact could be on the palaeontological heritage of the area with the Rosendal and Wateroo solar facilities just east and north east of the of this proposed development increasing the possibility of impacts on the breccias that could occur in the area.

Though with the implementation of mitigation measures these impacts could be transformed into a positive impact through the discovery of previously unknown fossils and the subsequent study of such fossil finds adding to the academic knowledge of the palaeontological resources of the study area.

Table 4: Renewable energy developments proposed within a 25km radius from the Sendawo PV application site

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details

Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Scoping and EIA processes underway.	Kabi Solar (Pty) Ltd	75MW	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390	Environmental authorisation received	Sediba Power Plant (Pty) Ltd	75MW	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308	Environmental authorisation received and preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75MW	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	Environmental authorisation received	Cronos Energy (Pty) Ltd	75MW	Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	Environmental authorisation received 29 June 2013. Amended to 75MW on 4 April 2014.	Carocraft (Pty) Ltd	75MW	Portion 1 and the Remainder of the Farm Weltevrede 681
Expansion of the Carocraft Solar Park	14/12/16/3/3/2/699	Scoping and EIA processes underway.	Carocraft (Pty) Ltd	75MW	Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 2 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 2 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729
Woodhouse Solar 2 PV Facility	TBC	Scoping and EIA processes underway..	Genesis Woodhouse Solar 2 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729

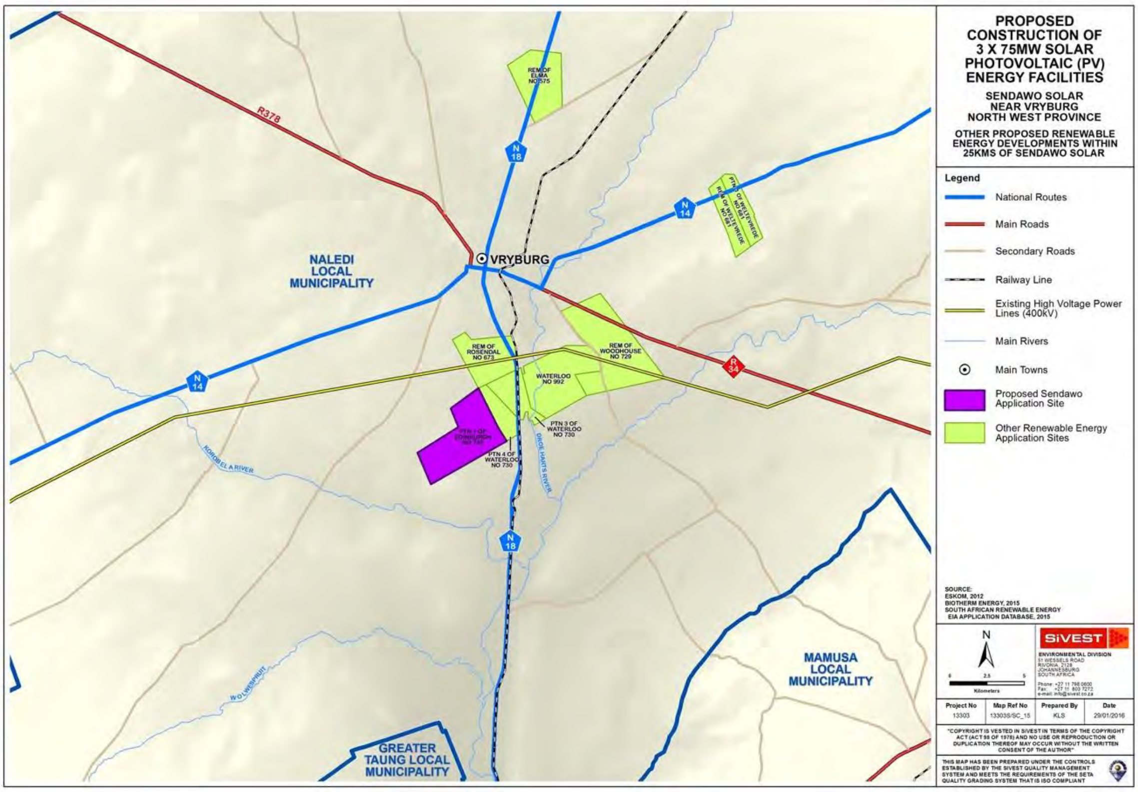


Figure 7 - Geographical position of renewable energy developments proposed within a 20km radius from the proposed Sendawo PV application site

5. IMPACT ASSESSMENT

5.1. Field work findings

5.1.1. Methodology

Fieldwork was conducted on the application site of the Sendawo Solar PV Projects from 3-4 December 2015. The methodology focused of a tracked selective walkthrough of the foot print areas of proposed PV project application area (**Figure 8**). An accredited professional archaeologist, Miss Jessica Angel, completed the fieldwork. The fieldwork was done on foot and by vehicle.

It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the heritage character of the area.

The field work that covered the Sendawo Solar PV application site is an area of 17.1 square kilometres.

A total of 2 sites, which can be considered archaeological were logged in the Solar 2, foot print area. All of these resources relate to the Stone Age.

A general background scatter of Stone Age artefacts (lithics) occurring over the extent of the area, required a refinement of the methodology and the defining of what constitutes an archaeological site as appose to a findspot.

It was decided to use the density of lithics present on the ground to be the guiding rule towards elaborating on a findspot and defining it as an archaeological site. A find spot was classified as and area containing a density of more than 10 lithics per square meter, while a density of or than 20 lithics per square meter was deemed to be the trigger mechanism for converting a find spot to an archaeological site.

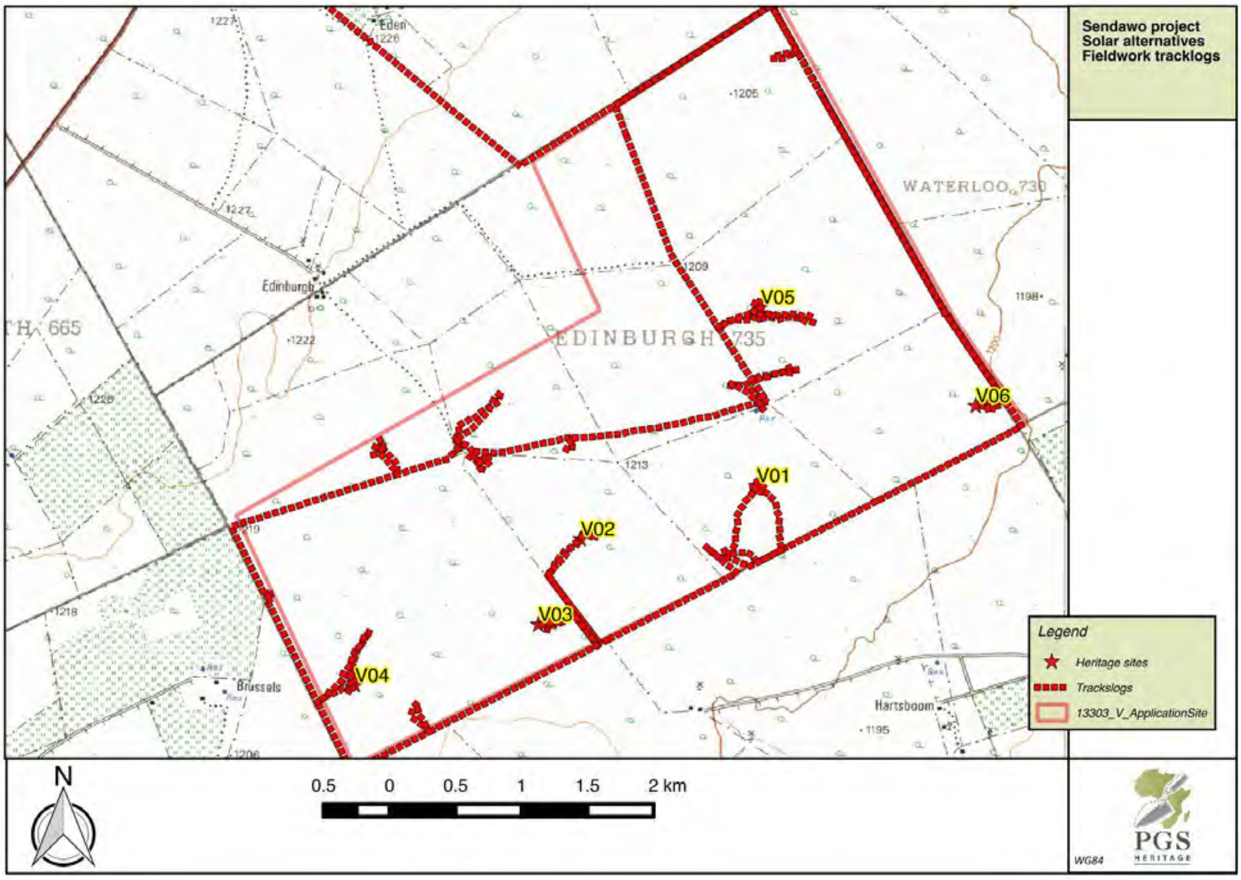


Figure 8 - Fieldwork tracklogs

5.1.2. Description of area

The study area and surrounds is characterised by low vegetation growth dispersed over fairly flat terrain. Dominating the surface area are vast exposed pebble layers usually associated with low rises in the landscape. Drainage lines and flat surface are characterised by red sand cover in between the exposed pebble layers.

Figure 9 – View of general area. This area is a pan than revealed archaeological materials

Figure 11 – General view of the area, dried pan with no archaeological finds

Figure 10 – View of general area

Figure 12 – Dried riverbed. At this location a substantial amount of LSA artefacts were located (V05)

5.1.3. Finds

The find spots varied from Later Stone Age (LSA) scatters consisting of flakes, chips and some cores manufactured from fine-grained quartzite, chalcedony, and cryptocrystalline (ccs) material; Middle Stones Age (MSA) lithics consisting of cores, chips and flakes with a low occurrence of formal tools. The majority of the material utilised were either lideanite that occur in the form of medium sized boulders or round washed pebbles in the area or coarse-grained quartzite that occur as sporadic outcrops.

Earlier Stone Age (ESA) lithics found at some of these finds spots consisted of a hand axe, cleavers and large flakes. Most of the lithics were either rolled or heavily weathered with patination evident on many of the lithics.

Find spots, **V02**, and **V03** have a low significance, however the possibility of subsurface deposits cannot be discounted and was kept in mind with the development of the mitigation recommendations.

Table 5 Sites – Application footprint

Site number	Type	Longitude	Latitude	Description	Heritage Significance
V02	MSA site	24.712619°	-27.072341°	Low density scatter of MSA material The site is open air and characterised by the typical Savanna Biome and more specifically in the Ghaap Plateau Vaalbosveld Group the size of the site is about 10 m$^{2.}$	Grade 4B
V03	MSA site	24.709388 °	-27.078875 °	Low-density scatter of MSA material The site is in a dry pan and characterized by the typical Savanna Biome and more specifically in the Ghaap Plateau Vaalbosveld Group. The size of the pan is about 50 m$^{2.}$	Grade 4B

Figure 13 – V02, MSA Acheulean artefact

Figure 14 – V03 weathered MSA artefacts

5.1.4. Palaeontological fieldwork

During the fieldwork period observations in the study are indicated deep windblown sand deposits with minor to no dolomite or breccia in the foot print area of the Solar 2 site **(Table 6**). The possibility of the presence of cave breccia and stromatolites in the northern section of the powerline corridor at observation points 0592-0632 must be considered. Confirmation of the significance of new sites will only be possible after completion of the geotechnical surveys.

Table 6: Photographic observations during fieldwork session

Photo	GPS station no (Figure 15) and coordinates	Description	Picture
1	(0402) -27° 05' 00.2" 24° 42' 29.6"	Deep windblown sand, no outcrop, no fossils observed	
2	(0412) -27° 04' 52.4" 24° 42' 44.8"	Deep sandy soils with Aardvark burrows No outcrop, no fossils observed	
3	(0422 -27° 04' 49.0" 24° 42' 51.4"	Deep red soil on windblown sand, no outcrop, no fossils observed	

4	(0612) -27° 01' 57.5" 24° 43' 31.9"	Shallow sandy soils on shale and quartzites with minor dolomite. No fossils observed.	
5	(0622) -27° 02' 19.2" 24° 42' 57.8"	Deeper sandy soils, windblown sand on shale and quartzites, minor dolomite and no significant fossils observed	
6	(0632) -27° 02' 23.8" 24° 42' 56.0"	Deep soil and Aardvark burrows in sandy zone. Geotechnical investigation might reveal cave breccia site	
7	(0682) -27° 03' 50.6" 24° 43' 00.1"	Deep windblown sand. No outcrops and no fossils observed	

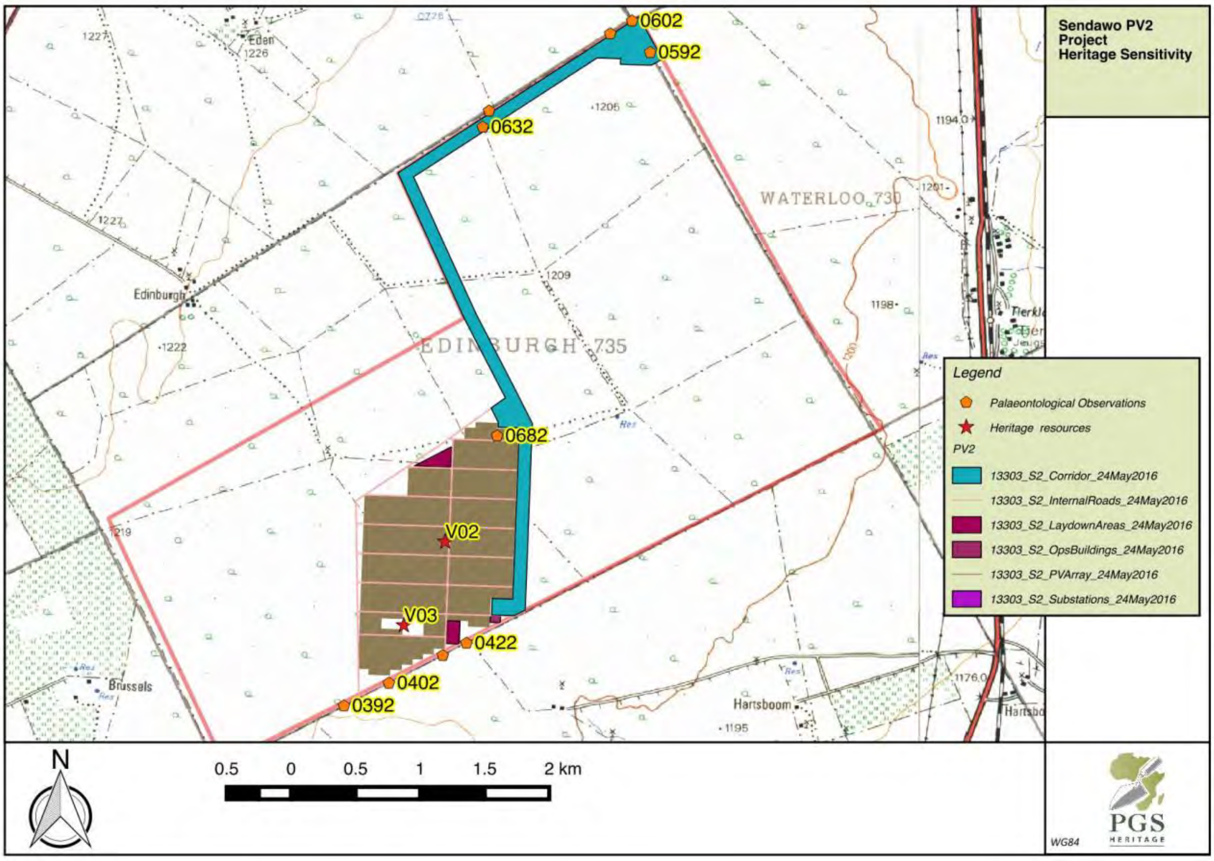


Figure 15 – Heritage resource finds and sensitivities

6. ASSESSMENT

The fieldwork findings have shown that the study area is characterised by a background scatter of Stone Age artefact. The methodology utilised in the identification and classification of finds between find spots and sites enable a clear distinction between groupings.

During the fieldwork period observations in the study are indicated deep windblown sand deposits with minor to no dolomite or breccia in the foot print. The possibility of the presence of cave breccia and stromatolites in the northern section of the powerline corridor at observation points 0592-0632 must be considered.

It must be kept in mind that the fieldwork could in no way identify all heritage resource within the development footprint and as such the fieldwork has shown that the possibility of encountering other Stone Age archaeological and palaeontological resources are extremely high.

The following set of tables provide an assessment of the impact on heritage resources within the development foot print

Table 7: Rating of Impacts – Chance finds

IMPACT TABLE

Environmental Parameter	Heritage Resources
Issue/Impact/Environmental Effect/Nature	The possibility of encountering previously unidentified heritage resources and specifically Stone Age archaeological sites. As well as the impact on the identified archaeological sites
Extent	Will impact on the footprint area of the development
Probability	The fieldwork has shown that such a predicted impact will definitely occur
Reversibility	Due to the nature of archaeological sites the impact is seen as irreversible, however mitigation could enable the collection of enough information to preserve the data from such a site
Irreplaceable loss of resources	The development could lead to significant losses in unidentified and unmitigated site
Duration	The impact on heritage resources such as archaeological sites will be permanent
Cumulative effect	As the type of development impact on a large area, and other similar development in the area will also impact on archaeological sites the cumulative impact is seen as having a medium negative impact.
Intensity/magnitude	The large scale impact on archaeological sites and will require mitigation work.
Significance Rating	The overall significance rating for the impact on heritage resources is seen as high pre-mitigation. This can be attributed to the very definite possibility of encountering more archaeological sites as shown through fieldwork. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a low impact rating.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	1

Intensity/magnitude	2	1
Significance rating	-28 (negative Medium Impact)	-10 (Positive low negative)
Mitigation measures	Monitoring during construction by an archaeologist Mitigation through archaeological excavations and collection where required	

Table 8: Rating of Impacts on palaeontological resources

IMPACT TABLE	
Environmental Parameter	Palaeontological Resources
Issue/Impact/Environmental Effect/Nature	The presence of previously unidentified Palaeontological heritage resources and specifically Palaeontological sites as well as the impact on the identified palaeontological sites
Extent	Will impact on the footprint area of the development but will have a significant impact on the National Heritage database
Probability	The fieldwork has shown that such a predicted impact will definitely occur
Reversibility	Due to the nature of palaeontological sites the impact is seen as irreversible, however mitigation could enable the exclusion of a small area to preserve the highly sensitive sites and collection of enough information to preserve the data from such a site
Irreplaceable loss of resources	The development could lead to significant losses in unidentified and unmitigated sites. Fossils can never be replaced
Duration	The impact on heritage resources such as palaeontological sites will be permanent unless mitigated by exclusion from this development
Cumulative effect	As the type of development impact on a large area, and other similar development in the area will also impact on palaeontological sites the cumulative impact is seen as having a major negative impact.
Intensity/magnitude	The large scale impact on palaeontological sites will require mitigation by exclusion of a small area from the proposed development
Significance Rating	The overall significance rating for the impact on heritage resources is seen as very high negative

	pre-mitigation. This can be attributed to the confirmed presence of significant stromatolites and the very high possibility of encountering more palaeontological sites during geotechnical investigations. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a low impact rating or even significant positive rating.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	2
Reversibility	3	2
Irreplaceable loss	3	2
Duration	4	4
Cumulative effect	2	2
Intensity/magnitude	3	3
Significance rating	-52 (high negative)	39 (high positive)
Mitigation measures	*Mitigation through palaeontological excavations and collection if Geotechnical Survey indicates necessity for mitigation* *Monitoring during construction by palaeontologist if fossils are exposed during excavation of more than 1.5m of soil cover*	

6.1. Cumulative impacts

An evaluation of the possible cumulative impacts from the combined solar projects in the area on heritage resources has shown that the biggest envisaged impact could be on the palaeontological heritage of the area of this proposed development increasing the possibility of impacts on the breccias that could occur in the area.

Though with the implementation of mitigation measures these impacts could be transformed into a positive impact through the discovery of previously unknown fossils and the subsequent study of such fossil finds adding to the academic knowledge of the palaeontological resources of the study area.

6.2. Impact Summary

Table 9 provides a summary of the projected impact rating for this project on heritage resources.

Table 9: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Heritage resources	Impact during construction	28		10	
			Negative medium Impact		Positive Low Impact
Palaeontological Resources	Impact during construction	52	Negative High impact	39	Positive High Impact

6.3. Assessment of Alternatives

An evaluation of the operations buildings, substation and lay down area alternatives have indicated that none of the proposed area impact directly on known heritage resources and thus no preference towards a specific alternative has been identified.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Comparative Assessment of Alternatives – Sendawo Solar 2

Alternative	**Preference**	**Reasons**
OPERATIONS BUILDING AND SUBSTATION		
Sendawo PV 2 Operations Building and Substation Alternative 1	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified
Sendawo PV 2 Operations Building and Substation Alternative 2	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified

Alternative	Preference	Reasons
LAYDOWN AREA		
Sendawo PV 2 Laydown Area Alternative 1	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified
Sendawo PV 2 Laydown Area Alternative 2	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified

7. MANAGEMENT GUIDELINE

7.1. Heritage Management Plan for EMP implementation

No.	Mitigation Measures	Phase	Timeframe	Responsible Party For Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)	Cost
A	Include section on possible heritage finds in induction prior to construction activities take place – Refer to Section 9 of this report	Planning /Pre-Construction	Prior to construction	Applicant ECO Heritage Specialist	ECO (Monthly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)	**R5 000**
B	Implement chance find procedures in case where possible heritage finds area made	Construction	During construction	Applicant ECO Heritage Specialist	ECO (weekly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 and 38 of NHRA	ECO Monthly Checklist/Report	**Possibly R10 000**
C	Implement mitigation for identified sites	Pre-construction	Pre-Construction	Applicant ECO Archaeologist	Once off	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 and 38 of NHRA	Completion of mitigation measures and obtain destruction permit	**Approximately R300 000**

Table 10: Palaeontological Mitigation measures proposed

No.	Mitigation Measures	Phase	Timeframe	Responsible Party For Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)	Cost
A	Include section on possible palaeontological heritage finds in induction prior to construction activities take place – Refer to Section 5 of this report referring to geotechnical reports	Planning /Pre-Construction	Prior to construction	Applicant ECO Heritage Specialist	ECO (Monthly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)	**R5 000**
B	Implement chance find procedures in case where possible new palaeontological heritage finds are made	Construction	During construction	Applicant ECO Heritage Specialist	ECO (weekly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35and 38 of NHRA	ECO Monthly Checklist/Report	**Possibly R10 000**
C	Monitoring of construction activities by palaeontologist if indicated after completion of geotechnical report	Construction	During construction	Applicant ECO Palaeontologist	Palaeontologist (Initial 5 day visit and then one day every 2 weeks)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 and 38 of NHRA	Palaeontologist Monthly Checklist/Report	**Monthly R40-50 000**

8. HERITAGE MANAGEMENT GUIDELINES

8.1. General Management Guidelines

1. The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-
   - (a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
   - (b) the construction of a bridge or similar structure exceeding 50m in length;
   - (c) any development or other activity which will change the character of a site-
     - (i) exceeding 5 000 m^2 in extent; or
     - (ii) involving three or more existing erven or subdivisions thereof; or
     - (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
     - (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
   - (d) the re-zoning of a site exceeding 10 000 m^2 in extent; or
   - (e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In the event that an area previously not included in an archaeological or cultural resources survey is to be disturbed, the SAHRA needs to be contacted. An enquiry must be lodged with them into the necessity for a Heritage Impact Assessment.

2. In the event that a further heritage assessment is required it is advisable to utilise a qualified heritage practitioner, preferably registered with the Cultural Resources Management Section (CRM) of the Association of Southern African Professional Archaeologists (ASAPA).

   This survey and evaluation must include:
   - (a) The identification and mapping of all heritage resources in the area affected;
   - (b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7 of the National Heritage Resources Act;
   - (c) An assessment of the impact of the development on such heritage resources;
   - (d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
   - (e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

(f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and

(g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

3. It is advisable that an information section on cultural resources be included in the SHEQ training given to contractors involved in surface earthmoving activities. These sections must include basic information on:

   a. Heritage;
   b. Graves;
   c. Archaeological finds; and
   d. Historical Structures.

   This module must be tailor made to include all possible finds that could be expected in that area of construction.

   Possible finds include:

   a. Open air Stone Age scatters, disturbed during vegetation clearing. This will include stone tools.
   b. Palaeontological deposits such as bone, and teeth in fluvial riverbank deposits.

4. In the event that a possible find is discovered during construction, all activities must be halted in the area of the discovery and a qualified archaeologist contacted.
5. The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures.
6. If mitigation is necessary, an application for a rescue permit must be lodged with SAHRA.
7. After mitigation, an application must be lodged with SAHRA for a destruction permit. This application must be supported by the mitigation report generated during the rescue excavation. Only after the permit is issued may such a site be destroyed.
8. If during the initial survey sites of cultural significance are discovered, it will be necessary to develop a management plan for the preservation, documentation or destruction of such a site. Such a program must include an archaeological/palaeontological monitoring programme, timeframe and agreed upon schedule of actions between the company and the archaeologist.
9. In the event that human remains are uncovered, or previously unknown graves are discovered, a qualified archaeologist needs to be contacted and an evaluation of the finds made.
10. If the remains are to be exhumed and relocated, the relocation procedures as accepted by SAHRA need to be followed. This includes an extensive social consultation process.

Table 11: Roles and responsibilities of archaeological and heritage management when heritage resources are discovered during operations

ROLE	RESPONSIBILITY	IMPLEMENTATION
A responsible specialist needs to be allocated and should attend all relevant meetings, especially when changes in design are discussed, and liaise with SAHRA.	The client	Archaeologist and a competent archaeology support team
If chance finds and/or graves or burial grounds are identified during construction or operational phases, a specialist must be contacted in due course for evaluation.	The client	Archaeologist and a competent archaeology support team
Comply with defined national and local cultural heritage regulations on management plans for identified sites.	The client	Environmental Consultancy and the Archaeologist
Consult the managers, local communities and other key stakeholders on mitigation of archaeological sites, when discovered.	The client	Environmental Consultancy and the Archaeologist
Implement additional programs, as appropriate, to promote the safeguarding of our cultural heritage. (i.e. integrate the archaeological components into the employee induction course).	The client	Environmental Consultancy and the Archaeologist,
If required, conservation or relocation of burial grounds and/or graves according to the applicable regulations and legislation.	The client	Archaeologist, and/or competent authority for relocation services
Ensure that recommendations made in the Heritage Report are adhered to.	The client	The client
Provision of services and activities related to the management and monitoring of significant archaeological sites (when discovered). The client with the specialist needs to agree on the scope and activities to be performed	The client	Environmental Consultancy and the Archaeologist
When a specialist/archaeologist has been appointed for mitigation work on discovered heritage resources, comprehensive feedback reports should be submitted to relevant authorities during each phase of development.	Client and Archaeologist	Archaeologist

8.2. All phases of the project

8.2.1. Archaeology

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area.

It is possible that cultural material will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure is often changed or added to during the subsequent history of the project. In general, these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction phase, it is important to recognise any significant material being unearthed, and to make the correct judgment on which actions should be taken. In the event that possible heritage resources are identified a qualified archaeologist/palaeontologist must be contacted to evaluate the finds and make recommendations on the mitigation required.

In addition, feedback reports can be submitted by the archaeologist to the client and SAHRA to ensure effective monitoring. This archaeological monitoring and feedback strategy should be incorporated into the Environmental Management Plan (EMP) of the project. Should an archaeological/palaeontological site or cultural material be discovered during construction (or operation), such as burials or grave sites, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery. SAHRA would need to be informed and may give advice on procedure. The developers therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have an archaeologist/palaeontologist available to do such work. This provision can be made in an archaeological monitoring programme.

In the case where archaeological material is identified during construction the following measures must be taken:

- Upon the accidental discovery of archaeological material, a buffer of at least 20 meters should be implemented.
- If archaeological material is accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the material permit must be applied for from SAHRA under Section 35 of the NHRA.

8.2.2. Graves

In the case where a grave is identified during construction the following measures must be taken:

- Upon the accidental discovery of graves, a buffer of at least 50 meters should be implemented.
- If graves are accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the remains a permit must be applied for from SAHRA (Section 36 of the NHRA) and other relevant authorities (National Health Act and its regulations). The local South African Police Services must immediately be notified of the find.
- Where it is recommended that the graves be relocated, a full grave relocation process that includes comprehensive social consultation must be followed.

The grave relocation process must include:

i. A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
ii. Site notices indicating the intent of the relocation;
iii. Newspaper notices indicating the intent of the relocation;
iv. A permit from the local authority;
v. A permit from the Provincial Department of Health;
vi. A permit from the South African Heritage Resources Agency, if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
vii. An exhumation process that keeps the dignity of the remains intact;
viii. The whole process must be done by a reputable company that is well versed in relocations;
ix. The exhumation process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the developing company.

9. CONCLUSIONS AND RECOMMENDATIONS

PGS Heritage (Pty) Ltd (PGS) was appointed by SiVEST Environmental Division (SiVEST) to undertake a Heritage Impact Assessment that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of the Sendawo Solar 2, 75MW solar photovoltaic (PV) energy facility near Lichtenburg, North West Province.

Heritage resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

The Heritage Impact Assessment has shown that the proposed Sendawo Solar 2 project have heritage resources present on the property. This has been confirmed through a field survey, archival research and evaluation of aerial photography of the sites.

9.1. Archaeological Resources

During the fieldwork 2 archaeological resources were identified of which all were archaeological sites representing the Earlier, Middle and Later Stone Age. The sites are all rated as having local heritage significance. No mitigation is required for sites **V02** and **V03**.

9.2. Palaeontological Resources

Observations in the study are indicated deep windblown sand deposits with minor to no dolomite or breccia in the foot print area of the Solar 2 site. The possibility of the presence of cave breccia and stromatolites in the northern section of the powerline corridor at observation points 0592-0632 must be considered. Final identification of possible sites where significant cave breccia will occur will only be identified after completion of the geotechnical surveys.

Mitigation:

- It is essential that the results of the Geotechnical Surveys be provided to the HIA team and palaeontologist to assess the possible presence of sinkholes and cave breccia sites on all the proposed development areas;
- It is recommended that an palaeontologist be appointed to monitor geotechnical investigations as part of a watching brief.
- Field assessment indicated the presence of both significant stromatolite structures and possible cave breccia in the northern section of the power line corridor for Solar 2;
- If excavation of deeper than 1.5m is planned, the palaeontologist must assess the results of the geotechnical information and given the opportunity to comment on the likelihood of significant finds of fossils in all the planned development areas;
- If any excavation or collection of fossils is recommended, such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.

Due to the presence of significant stromatolites in a small area and the large number of boulders with stromatolites present on site it is recommended that a palaeontologist be appointed to monitor geotechnical investigations as part of a watching brief. The aim being the identification and mitigation of any newly discovered palaeontological sites, if recorded.

9.3. Impact Summary

Table 12 provides a summary of the projected impact rating for this project on heritage resources.

Table 12: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Heritage resources	Impact during construction	28		10	
			Negative medium Impact		Positive Low Impact
Palaeontological Resources	Impact during construction	52	Negative High impact	39	Positive High Impact

9.4. Assessment of Alternatives

An evaluation of the operations buildings, substation and lay down area alternatives have indicated that none of the proposed area impact directly on known heritage resources and thus no preference towards a specific alternative has been identified.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Comparative Assessment of Alternatives – Sendawo Solar 2

Alternative	Preference	Reasons
OPERATIONS BUILDING AND SUBSTATION		
Sendawo PV 2 Operations Building and Substation Alternative 1	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified
Sendawo PV 2 Operations Building and Substation Alternative 2	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified
LAYDOWN AREA		
Sendawo PV 2 Laydown Area Alternative 1	NO PREFERENCE	The position of the foot print area impacts on no now heritage

Alternative	Preference	Reasons
		resources and no preference above the other alternatives have been identified
Sendawo PV 2 Laydown Area Alternative 2	NO PREFERENCE	The position of the foot print area impacts on no now heritage resources and no preference above the other alternatives have been identified

The overall impact on heritage resources is seen as acceptable and the proposed mitigation measures to be incorporated in the EMP will provided the necessary actions to address any impacts on heritage resources.

10. REFERENCES

10.1. Published References

Bergh, J.S. 1998. Geskiedenisatlas van die Vier Noordelike Provinsies. Van Schaik, Pretoria.

Bramford, M. & F. Thackeray. 2009. Continued Excavations at Wonderwerk Cave in The Digging Stick, Volume 26, No. 2.

Breutz, P.J. 1968. The Tribes of the Districts of Taung and Herbert. Department of Bantu Administration and Development, Ethnological Publication No. 51.

Dowson, T.A., Blundell, G. & Hall, S.L. 1992. Finger Paintings in the Harts River Valley, Northern Cape Province, South Africa in Southern African Field Archaeology, Volume 1, pp 27-32.

Humphreys, A.J.B. A Preliminary Report on Test Excavations at Dikbosch Shelter I, Herbert District, Northern Cape in The South African Archaeological Bulletin, Volume 29, No. 115 & 116

Kuman, K. 2001. An Acheulean Factory Site with Prepared Core Technology near Taung, South Africa. The South African Archaeological Bulletin, Vol. 56, No. 173/174 (Dec., 2001), pp. 8-22.

Legassick, M. 2010. The politics of a South African frontier: the Griqua, the Sotho-Tswana and the missionaries, 1780 – 1840. Basler Afrika Bibliographien, Basel.

Liebenberg, M.M.B. 1990. Schweizer-Reneke. HSRC, Pretoria.

Mitchell, P. 2002. The Archaeology of Southern Africa. Cambridge University Press, Cambridge.

Morris. D. 1988. Engraved in Place and Time: A Review of Variability in the Rock Art of the Northern Cape and Karoo. The South African Archaeological Bulletin Vol. 43, No. 148 (Dec., 1988), pp. 109-120

Republic of South Africa, 1999. National Heritage Resources Act, No. 25.

Snyman, P.H.R. 1986. Die Langeberg=Rebellie en die totstandkoming van Olifantshoek in Contree No. 20.

Raper, PE. 1983. Dictionary of Southern African Place Names. Head, Onomastic Research Centre, HSRC

Van Staden, A.J.C. 1983. Die Geskiedenis van die Nederduits Gereformeerde Gemeeente Reivilo 1883-1983. Church Council of the Reivilo Dutch Reformed Church, Reivilo.

10.2. Unpublished References

Birkholtz, P. 2011. Heritage Impact Assessment for the proposed Pering Mining Project, Located on the farm Pering Mine 1023 HN, North West Province. An unpublished report compiled by PGS Heritage and Grave Relocation Consultants for Marsh (Pty) Ltd.

Groenewald, G. 2016. Palaeontological Impact Assessment for the proposed Sendawo Solar Projects. For PGS Heritage (Pty) Ltd

Kruger, N. 2013. Archaeological Impact Assessment for a Photovoltaic Power Plant and Power Line Development on Portion 1 of the farm Kangkatjes 919 HN, North West Province. An unpublished report compiled by Ages for Vidigenix (Pty) Ltd.

Van Schalkwyk, J. 2011. Heritage Impact Assessment for the proposed development of Photovoltaic Power Plants on Five Different Locations in the North West and Northern Cape Provinces. An unpublished report compiled for Subsolar.

Van Schalkwyk, J.A. 2012. Heritage Impact Assessment for the proposed development of a photovoltaic power plant on a portion of the Farm Waterloo 992, Vryburg Region, North West Province.

Van Schalkwyk, J.A. 2013. Basic Heritage Assessment for the proposed Mookodi 132kv Phase 2 Power Lines Development, North West Province.

10.3. Internet References

www.info.gov.za
www.beeld.com
www.wikipedia.org
www.jstor.org

Anglo Boere Oorlog/Boer War (1899-1902) British Concentration Camp project. Anglo Boere Oorlog/Boer War (1899-1902) VRYBURG Camp/Kamp. http://www.geni.com/projects/Anglo-Boere-Oorlog-Boer-War-1899-1902-VRYBURG-Camp-Kamp/14136. Accessed 30 May 2014.

10.4. Historic Topographic Maps

One of the historic topographic maps used in this report was obtained from the National Archives and the other from the digital resources of the William Cullen Library, Historical Papers, Early Maps collection.

10.5. Google Earth

All the aerial depictions and overlays used in this report are from Google Earth.

Appendix A

LEGISLATIVE PRINCIPLES

LEGISLATIVE REQUIREMENTS – TERMINOLOGY AND ASSESSMENT CRITERIA

3.1 General principles

In areas where there has not yet been a systematic survey to identify conservation worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected.

Archaeological and palaeontological sites, materials, and meteorites are the source of our understanding of the evolution of the earth, life on earth and the history of people. In the new legislation, permits are required to damage, destroy, alter, or disturb them. People who already possess material are required to register it. The management of heritage resources are integrated with environmental resources and this means that before development takes place heritage resources are assessed and, if necessary, rescued.

In addition to the formal protection of culturally significant graves, all graves, which are older than 60 years and are not in a cemetery (such as ancestral graves in rural areas), are protected. The legislation protects the interests of communities that have interest in the graves: they may be consulted before any disturbance takes place. The graves of victims of conflict and those associated with the liberation struggle will be identified, cared for, protected and memorials erected in their honour.

Anyone who intends to undertake a development must notify the heritage resource authority and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the developer's cost. Thus, developers will be able to proceed without uncertainty about whether work will have to be stopped if an archaeological or heritage resource is discovered.

According to the National Heritage Act (Act 25 of 1999 section 32) it is stated that:

An object or collection of objects, or a type of object or a list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object, including –

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video 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), or in a provincial law pertaining to records or archives; and
- any other prescribed category.

Under the National Heritage Resources Act (Act No. 25 of 1999), provisions are made that deal with, and offer protection, to all historic and pre-historic cultural remains, including graves and human remains.

3.2 Graves and cemeteries

Graves younger than 60 years fall under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the Office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning, or in some cases the MEC for Housing and Welfare. Authorisation for exhumation and reinterment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. In order to handle and transport human remains the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the South African Heritage Resource Agency (SAHRA). The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

If the grave is not situated inside a formal cemetery but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws set by the cemetery authority must be adhered to.

Appendix B

Heritage Assessment Methodology

The section below outlines the assessment methodologies utilised in the study.

The Heritage Impact Assessment (HIA) report to be compiled by PGS Heritage (PGS) for the proposed Tlisitseng Solar projects will assess the heritage resources found on site. This report will contain the applicable maps, tables and figures as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998) and the Minerals and Petroleum Resources Development Act (MPRDA) (28 of 2002). The HIA process consists of three steps:

- Step I – Literature Review: The background information to the field survey leans greatly on the Heritage Scoping Report completed by PGS for this site.

- Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by qualified archaeologists, aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

- Step III – The final step involved the recording and documentation of relevant archaeological resources, as well as the assessment of resources in terms of the heritage impact assessment criteria and report writing, as well as mapping and constructive recommendations

The significance of heritage sites was based on four main criteria:

- **site integrity** (i.e. primary vs. secondary context),
- **amount of deposit, range of features** (e.g., stonewalling, stone tools and enclosures),
    - Density of scatter (dispersed scatter)
        - Low - <10/50m^2
        - Medium - 10-50/50m^2
        - High - >50/50m^2
- **uniqueness** and
- **potential** to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;
B - Mapping of the site and controlled sampling required;
C - No-go or relocate pylon position
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site

- Site Significance

Site significance classification standards prescribed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 13: Site significance classification standards as prescribed by SAHRA

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	Grade 4A	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	Grade 4C	Low Significance	Destruction

Appendix C

Impact Assessment Methodology to be utilised during EIA phase

1. Methodology for Impact Assessment

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

1.1. Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics, which include context, and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2. Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

1.2.1. Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 14: Description

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.

IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

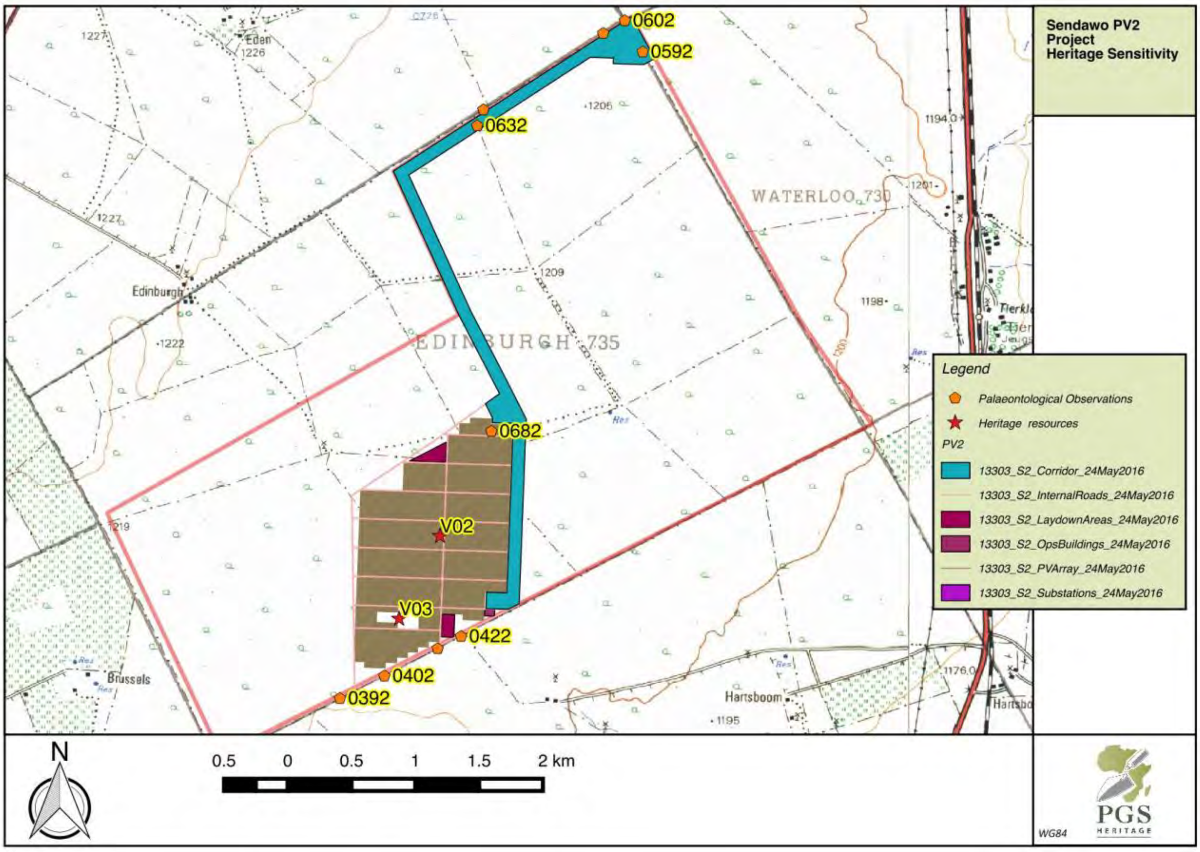
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect, which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY/ MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic, which can be measured and assigned a significance rating.		
Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The 2010 regulations also specify that alternatives must be compared in terms of impact assessment.

Appendix D

Heritage Maps



Appendix 6G:

Socio-economic Assessment

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE SENDAWO 2 75MW SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR VRYBURG, NORTH WEST PROVINCE

SOCIO-ECONOMIC IMPACT STUDY

FINAL REPORT

MAY 2016

URBAN-ECON
Development Economists

Celebrate Development Diversity

P.O. Box 13554, HATFIELD 0028
Tel: (012) 342-8686
Fax: (012) 342 8688
E-mail: pta@urban-econ.com

Celebrate Development Diversity.

Version:

Final version 1

25 May 2016

Project leader:

Elena Broughton

Cell: 082 463 2325

Email: elena@urban-econ.com

Report writer:

Mariette Steynberg

Cell: 079 029 5586

Email: mariette@urban-econ.com

SPECIALISTS DETAILS

Elena Broughton

Cell: 082 463 2325

E-mail: elena@urban-econ.com

Position: Manager/Senior Economist

Qualifications: MSc Technology Management, BSC (Hon) Technology Management, BCom (Hon) Economics

Experience: 11 years

Brief profile: Elena Broughton is a senior professional and the manager of the Innovation & Sustainable Development Unit at Urban-Econ. She has extensive knowledge in various fields of economic development that includes 11 years of experience in undertaking socio-economic impact assessment studies for a variety of private clients spanning the mining, manufacturing, energy, infrastructure, and retail sectors. She also acted as a peer reviewer in a number of socio-economic impact assessment studies and completed a few strategic socio-economic impact assessments. Her involvement in the field allowed her to develop a sound understanding of the South African environmental legislation and developmental policies and equipped her with a widespread knowledge of socio-economic implications and benefits of various new developments.

Mariette Steynberg

Cell: 079 029 5586

E-mail: mariette@urban-econ.com

Position: Development Economist

Qualifications: BComHons (International Trade and Development)

Experience: 3 years

Brief profile: Mariette Steynberg completed her BCom degree in 2008 at the University of Johannesburg with a double major in Economics and Econometrics. She went on to complete a BCom Honours degree in 2009 majoring in International Trade and Development Economics. To further her capabilities in the field she successfully completed a Post Graduate Diploma in Financial Planning in 2013 while working as a trainee planner before relocating to Pretoria to pursue a career in Economics.

DECLARATION OF INDEPENDENCE

I, Elena Konstantinovna Broughton, declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signed…………………………………. Date…………………………..

DECLARATION OF INDEPENDENCE

I, Mariette Steynberg, declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signed…………………………………. Date…………………………..

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

CAGR	Compounded Annual Growth Rate
CAPEX	Capital Expenditure
CBD	Central Business District
CSP	Concentrated Solar Power
DC	Direct Current
DoE	Department of Energy
DM	District Municipality
Dr.	Doctor
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ha	Hectare
GDP	Gross Domestic Product
IDP	Integrated Development Plan
IEA	International Energy Agency
IRP	Integrated Resource Plan
kV	kilovolts
LM	Local Municipality
m	Metre
m^2	Square metre
mm	Millimetre
Mr.	Mister
MTS	Main Transmission Substation
MW	Megawhatt
NDP	National Development Plan
NGPF	New Growth Path Framework

NSDP	National Spatial Development Perspective
OHL	Over Head Lines
OPEX	Operational Expenditure
PDP	Provincial Development Plan
PSDF	Provincial Spatial Development Framework
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
REIPPP	Renewable Energy Independent Power Producer Procurement
SDF	Spatial Development Framework
SETRM	Solar Energy Technology Roadmap
SMMEs	Small, Medium, and Micro Entreprises
Stats SA	Statistics South Africa
UCT	University of Cape Town

1 INTRODUCTION

This document is prepared by **Urban-Econ Development Economists** in request by **SiVEST Environmental Division** on behalf of **BioTherm Energy (Pty) Ltd** to undertake a Socio-Economic Impact Study for the development of the **Sendawo 2 Solar Photovoltaic (PV) energy facility and related infrastructure** near Vryburg in the North West Province. The socio-economic impact study is conducted as part of the Environmental Impact Assessment (EIA) process managed by SiVEST.

1.1 Brief Description of the Project

BioTherm proposes the development of the Sendawo 2 Solar PV energy facility near Vryburg in the North West Province. It is intended that the PV facility, with a 75 MW export capacity, and its associated infrastructure will be established on Portion 1 of Farm Edinburgh No. 735. In addition to Sendawo 2, BioTherm proposes to develop two more energy facilities with a 75 MW export capacity each, as well as the Sandawo Substation and 400 kV power line on Portion 1 of Farm Edinburgh No. 735. Each of these projects undergoes a separate environmental authorisation process. Should the proposed Sendawo Solar PV facility be approved, it will be connected to the proposed Sendawo Substation. Connection to the grid will be via the existing Eskom Mookodi Main Transmission Substation (MTS). environmental authorisation process.

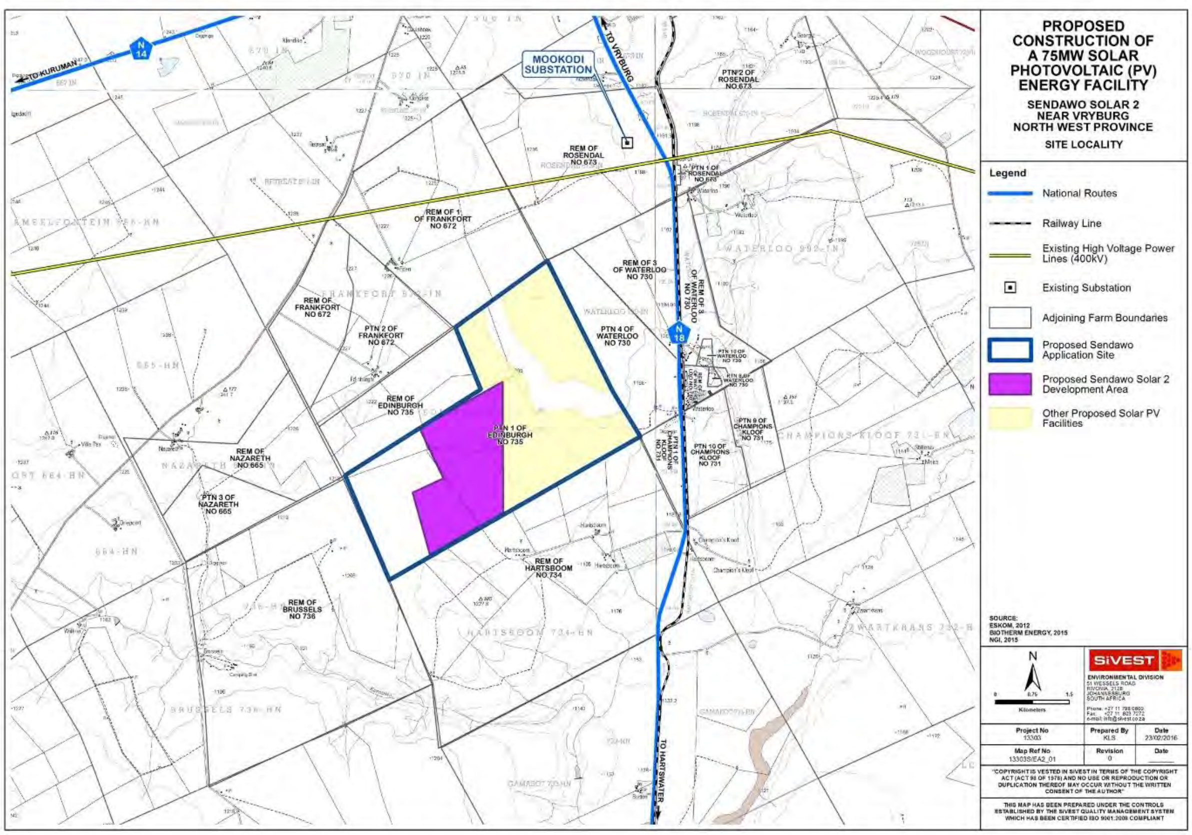


Figure 1-1: Proposed location of Sendawo 2 on Portion 1 of the Farm Edinburgh 735

The technical details and infrastructure requirements are:

- Approximately 275 000 solar PV panels with a total export capacity of 75 MW.
- The panels will either be fixed axis mounting, or single axis tracking solutions, and will be crystalline silicon or thin film technology.
- Onsite switching station with the transformers for voltage step up from medium voltage to high voltage.
- The panels will be connected in strings to the inverters. Inverter stations will house 2 inverters and 1 transformer.
- DC power from the panels will be converted to AC power in the inverters, and the voltage will be stepped up to 22 kV – 33 kV (medium voltage) in the transformers.
- The 22 kV – 33 kV cables will be run underground in the facility to a common point, before being fed to the onsite substation where the voltage will typically be stepped up to 132 kV.
- Grid connection is to the Mookodi MTS via the proposed Sendawo substation. The proposed Sendawo substation will have grid transformers for voltage step up to 400 kV. This enables the connection of multiple projects to the Mookodi MTS.
- A power line with a voltage of 132 kV is proposed and will run from the onsite substation to the proposed Sendawo substation. The proposed 400 kV power line which will connect the proposed Sendawo substation to the Mookodi MTS is part of a separate ongoing EIA process.
- A lay-down area of approximately 5 ha for the temporary storage of materials during the construction activities.
- Access roads and internal roads.
- Construction of a car park, and fencing around the project.
- Administration, control and warehouse buildings.

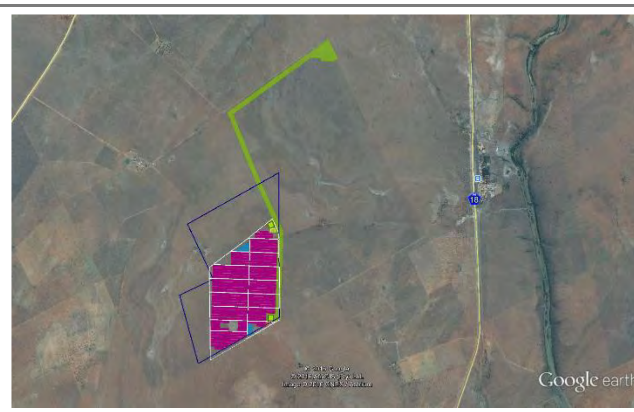
It is likely that the area required for the PV arrays will be entirely cleared or graded, with the removal of any tall vegetation that may be present. Due to advances in technology often impacting on the panels used, the actual sizes of the panels can only be determined during the final design stages of the project. However, at this stage it is likely that the dimensions of the solar panels will be 1956mm x 992mm x 40mm, the panels are mounted on aluminium frames, most likely with concrete or rammed pile foundations most commonly used for support.

Alternatives considered

The proposed project considered two alternatives for a substation, two alternatives for a laydown area, and two alternatives for operations building. These alternatives are illustrated on Map 1-1.

1.2 Scope and Purpose of the Study

The socio-economic impact assessment contains information that, together with other specialists, allows assessment of the project from a sustainable development perspective and assists in identifying



Map 1-1: Project component alternatives

"the most practicable environmental option" that provides the "most benefit and causes the least damage to the environment as a whole, at a cost acceptable to society", in the long-term and the short-term. In light of the above and in line with the Environmental Impact Assessment (EIA) Regulations of 2010, the purpose of the socio-economic impact assessment is to assess the need and desirability of the project. It specifically aims to ensure that the project, if approved, provides for justifiable social and economic development outcomes. As such, it aims to:

- identify, predict and evaluate geographical, social, economic and cultural aspects of the environment that may be affected by the project activities and associated infrastructure
- advise on the alternatives that best avoid negative impacts or allow to manage and minimise them to acceptable levels, while optimising positive effects

The specific objectives of the study include:

- Engage with the environmental practitioner, other specialists on the team, and the client to gain necessary background on the project.
- Delineate the zone of influence in consultation with other specialists on the team.
- Determine the affected communities and economies located in the zone of influence and identify sensitive receptors within the delineated study area, i.e. communities, land uses and economic activities that could be directly or indirectly negatively affected by the proposed project or benefit from it.
- Determine the data required to assess potential impacts, and respond to the questions outlined in the guidelines related to needs and desirability assessment.
- Review secondary data and assess data gaps.
- Conduct a site visit and collect primary social and economic data of the parties that may be directly or indirectly be affected (positively or negatively) by the proposed project in order to address data gaps.
- Create profiles for the communities and economies representing the study areas and the environmentally affected zone.
- Assess the need and desirability of the project and its alternatives in line with the specified guidelines.
- Identify, predict and evaluate the potential positive and negative impacts associated with the project following the environmental specialist's methodology.
- Advise on the most suitable alternative, inclusive of the "no-go" option.
- Develop a mitigation plan by proposing mitigation measures for negative effects and enhancement measures for positive impacts.

1.3 Methodology

The following methodology was followed in completing the study:

1. **Orientation:** The study started with gaining an understanding of the proposed project during various stages of its lifecycle and the potentially affected environment. Review of various data and maps provided for the project, as well as discussions with the project team, informed the delineation of the potential zone of influence associated with each component of the project. The delineated zone of influence defined the spatial boundaries of the area to be included in the assessment and assisted in identifying likely impacted and beneficiary communities and economic activities, as well as other stakeholders of the project.
2. **Policy alignment review:** Relevant government policies and other strategic documents were gathered and reviewed to determine the alignment of the proposed project with the strategic plans of various government spheres and highlight ay potential red flags, if such exist.
3. **Baseline profiling:** Following policy review, primary and secondary data were gathered to create the socio-economic profile of the delineated zone of influence. The baseline profile assisted in gaining an understanding of the communities and economic activities to be likely affected or benefit from the proposed project. This included a description of the study area's composition and locational factors, economic and labour profiles, way of life of communities located within the zone of influence, their demographic trends and cultural references, their health and wellbeing, and their living environment. Specific attention was paid to the socio-economic composition of the area affected by the project's footprint and its potential environmental effects, i.e. visual, noise, air pollution, etc.
4. **Impact analysis and evaluation**: Derived from the review of the project and the feedback received from various parties during data collection, the list of various negative and positive socio-economic impacts that can ensure as a result of the proposed activity during various stages of its life cycle was drawn and analysed. All identified socio-economic impacts were assessed and categorised in line with the rating provided by the environmental specialist (refer to Annexure A).
5. **Need and desirability assessment**: Given the knowledge of the project and the profile of the area where it is proposed to be located, the need and desirability thereof from a locational perspective was investigated. It involved the assessment of the project's alignment with the interests and needs of the broader public and the suitability and necessity of the project considering the chosen time and place.
6. **Formulation of mitigation and enhancement measures:** Following the analysis and ranking of impacts, recommendations to reduce or eliminate the potential negative effects on the affected parties and enhance positive impacts were provided.

1.4 Data gathering and consultation process

The project made use of both secondary and primary data.

Secondary data gathering

Secondary data was sourced from the following databases and documents:

- Stats SA Census, 2011

- Quantec Research Standardised Regional Data, 1995-2013
- Integrated Development Plans (IDP)
  - Dr. Ruth Segomotsi Mompati District Municipality (DM) Integrated Development Plan (IDP) (2015/2016)
  - Naledi Local Municipality (LM) Integrated Development Plan (2012 – 2017)
- Spatial Development Frameworks
  - National Spatial Development Perspective (2006)
  - North West Provincial Spatial Development Framework (PSDF) (2008)
- Provincial strategic documents
  - Renewable Energy Strategy for the North West Province (2012)
  - North West Provincial Development Plan (PDP) (2030)
  - North West Province Growth and Development Strategy (2004 – 2014)
- National strategic documents
  - National Energy Act (2008)
  - National White Paper on Renewable Energy (2003)
  - National Integrated Resource Plan for Electricity (2010 - 2030)
  - Overview of Renewable Energy Roadmap – the workshop on the Draft Integrated Energy Planning Report
  - Comment on the national Solar Energy Roadmap (in the process of being developed)
  - The National Development Plan (NDP) (2030)
  - New Growth Path Framework (NGPF) (2011)

Primary data gathering

The primary data gathering for this project was done by in-person interviews with the identified interested and affected individuals. Where in-person interviews were not possible, all effort was made to communicate with the specific individual or individuals either telephonically or via electronic correspondence.

The in-person interviews were undertaken during a site visit that took place between 2 December 2015 and 4 December 2015. During this time a total of nine interviews were completed. Seven of these interviews related to the owners and residents of directly and indirectly affected farm portions, one was with the library assistant in the nearby community of Huhudi and the final with a worker employed by the community work programme in Huhudi. The last two interviews were done to triangulate the information gathered from secondary data sources on the socio-economic status quo of the wider community, which may be affected by the proposed development.

Below is a list of all of the stakeholders that were consulted by means of in-person interviews during site visit which took place from 2 December to 4 December 2015:

- Owners and residents of directly or indirectly affected farm portions:
    - Mrs Adele Oberholzer – Trust beneficiary of Portion 1 of Farm Edinburgh 735
    - Mr Mark Boobbyer – Director at Tiger Kloof School
    - Mr Nico van Rooyen – Land owner of Remainder of Farm Hartsboom and lessee of Portion 4 of Farm Waterloo and Portion 1 of Farm Championskloof
    - Dr. Chris van Zyl – Land owner of Farm Waterloo 992
    - Mr Malcolm Blackwood – land occupier on the Farm Brussels and farming on the Farm Eden on behalf of his daughter, Linda Blackwood, who is the trust beneficiary of Farm Eden.
    - Ms Jill Blackwood – Trust beneficiary of the Farms Brussels and Frankfurt.
    - Mr Seeco – Lessee on Portion 3 of Remainder of the Farm Waterloo 730

- Members of the wider community:
    - Library assistant at Huhudi Public Library
    - Worker employed by the Huhudi Community Work Programme

Attempts were made to consult with the land owners of Portion 2 of the Farm Rosendal 673, Mrs. Anna van der Merwe. She was, however, unavailable resulting in her son answering the telephone call. The land owner's representative confirmed that she does not wish to take part in the process and does not want consultation.

1.5 Assumptions, limitations and gaps in knowledge

- The secondary data sources used to compile the socio-economic baseline (demographics, dynamics of the economy) although not exhaustive, can be viewed as being indicative of broad trends within the study area.

- The study was done with the information available to the specialist within the time frames and budget specified.

- Possible impacts and stakeholder responses to these impacts cannot be predicted with complete accuracy, even when circumstances are similar and these predictions are based on research and years of experience, taking the specific set of circumstance into account.

- It is assumed that the motivation, and ensuing planning and feasibility studies for the project were done with integrity and that all information provided to the specialist by the project proponent and its consultants to date is accurate.

- It is assumed that the project description and infrastructure components as discussed above are reasonably accurate. These details were used to assess the potential impacts.

- With regard to the in-person interviews undertaken the following assumptions are made:
    - Questions asked during the interviews were answered accurately.

  - The degree of the perceived possible significance of concerns raised by some of the respondents were rated by them truthfully.
  - That the attitudes of the respondents towards the project will remain reasonably stable over the short- to medium- terms.

- The land owner of Portion 2 of Farm Rosendal 673 refused consultation. The assumption is that no significant concern exists or it can be reasonably assumed that consultation would have been sought. Where applicable, Google Earth imagery was used to attempt to determine the current level of economic activity taking place on Portion 2 of Farm Rosendal 673 to aid in the assessment of any potential impact and its extent on the specific land owner.

- At the same time, it is assumed that the general concerns and opinions raised by all other land owners interviewed, such as security concerns, would also apply to the land owners not consulted with for whatever reason.

- Considering the information obtained through primary as well as secondary sources, as well as the fact that the location of Portion 2 of Farm Rosendal 673 is not directly adjacent to the site proposed for Sendawo 2, it can be concluded that the level of risk to the project associated with this knowledge gap is low.

2 POLICY REVIEW

A policy review plays an integral role in the early stages of a project. The review provides a high level indication of whether a project is aligned with the goals and aspirations of the developmental policy within a country and at local level. Furthermore, the analysis signposts any red-flag or developmental concerns that could jeopardise the development of the project and assist in amending it, preventing costly and unnecessary delays.

The following government strategic documents applicable to the delineated study areas were examined:

- National (South Africa) and provincial (North West) level Renewable Energy (RE) policy:
  - National Energy Act (2008),
  - National White Paper on Renewable Energy (2003),
  - National Integrated Resource Plan for Electricity (2010 – 2030),
  - Renewable Energy Strategy for the North West Province (2012)
  - Overview of RE Roadmap – the workshop on the Draft Integrated Energy Planning Report,
  - Comment on the National Solar Energy Roadmap, due for release in October 2016
- National, provincial, and local level spatial policy:
  - National Spatial Development Perspective (2006)
  - North West Provincial Spatial Development Framework (PSDF) (2008)
- National, provincial, and local level socio-economic development policy
  - National Development Plan (NDP) (2030)
  - New Growth Path Framework (NGPF) (2011)
  - North West Provincial Development Plan (PDP) (2030)
  - North West Province Growth and Development Strategy (2004 – 2014)
  - Dr. Ruth Segomotsi Mompati District Municipality Integrated Development Plan (IDP) 2015/16)
  - Naledi Local Municipality Integrated Development Plan (IDP) (2012 – 2017)

Renewable Energy (RE) policy

The **National Energy Act** (Act no, 34 of 2008), promulgated in 2008, has, as one of its key objectives, the promotion of diversity of the supply of energy and its sources. From this standpoint, the Act directly references the importance of the RE sector, with a mention of the solar energy sector included. The aim is to ensure that the South African economy is able to grow and develop, fast tracking poverty alleviation through the availability of a sustainable, diverse energy mix. Moreover, the goal is to provide for the increased generation and consumption of RE (Republic of South Africa, 2008).

The 2003 **White Paper on Renewable Energy** elaborates on the South African Government's policy principles, and strategic goals and objectives for promotion and implementation of the RE sector in the country. The White Paper, which acts as a supplement to the White Paper on Energy Policy, identifies the long- and medium-term potential of RE in South Africa.

As a signatory to the Kyoto Protocol, the country has made commitments to achieve greenhouse gas emission reduction targets. Considering the high reliance of South Africa on coal-fired power stations for electricity generation, the government's commitment to the development of a framework for the establishment and operation of a national RE framework is vital to the achievement of the emission reduction targets. Moreover, the development of a national RE framework will aid in increasing energy security in South Africa over time, through the diversification of supply. In this regard, the government's long-term goal is the establishment of a renewable energy industry, with RE energy carriers that are capable of offering a sustainable, non-subsidised alternative to fossil fuels (Department of Minerals and Energy, 2003).

The **Integrated Resource Plan (IRP), for Electricity** (2010 – 2030) final report provides for the disaggregation of RE technologies to differentiate and display solar photovoltaic (PV), concentrated solar power (CSP), and wind options clearly. The following policy considerations assisted in arriving at this version of the IRP:

- The installation of RE technologies brought forward in order to accelerate a local industry.
- To provide for the uncertainties associated with the cost of renewables and fuels, a nuclear fleet was included.
- The emissions constraint of 275 million tons of carbon dioxide per year after 2024 was maintained.
- Energy efficiency demand-side management measures were maintained.

The key conclusions from a review of the IRP, relevant to the RE sector, is that the accelerated roll out of RE technologies must be allowed and promoted in order to derive the benefits of localisation in these RE technologies. Moreover, it places emphasis on the establishment of a Solar PV programme (Republic of South Africa, 2011).

An overview of the **Renewable Energy Roadmap** states that the mandate of the Department of Energy (DoE) is the provision of secure and sustainable sources of electricity in order to stimulate economic development. The aim is to improve South Africa's energy mix by 2025, by having 30% clean energy generation. The Renewable Energy Roadmap elaborates by saying that four focus areas are key to achieving the Government's RE objectives; financial instruments, legal instruments, technology development, and awareness building, capacity building, and education (Modise, 2013).

The South African **Solar Energy Technology Roadmap** (SETRM) is being developed following collaboration between the DoE and the International Energy Agency (IEA), the GIZ, and the Department of Science and Technology (Modise, 2013). The objective of the SETRM is stated as "To develop a clear, comprehensive, and prioritised implementation plan (i.e. roadmap) for the development and diffusion of concentrated solar power; solar photovoltaic technology; solar heating and cooling technologies; and related R&D in South Africa toward reduced energy use, carbon emissions reduction; distributed electricity generation, expanded independent power production and electricity supply to the national grid, as well as the reduction of reliance on carbon fuels" on the DoE's website. The SETRM is set for release at the end of 2015.

According to the **Renewable Energy Policy for the North West Province**, the region is the fourth largest electricity consumer in the country (12%), with the bulk of this electricity requirement being supplied by coal-fired power stations in Mpumalanga. It furthermore states that roughly 63% of the electricity usage takes place in the mining sector, with the rural communities suffering from energy poverty in many cases. In communities, where electricity is not accessible, the households make use of wood for cooking and lighting; this is impacting negatively on the environment and the health of these communities. The RE Policy simultaneously recognises the potential for economic development and job creation that could ensue from the RE sector in the Province. Based on these aspects, the key objectives of the policy are set out as:

- Reduction of the Province's contribution to climate change.
- Alleviation of energy poverty.
- The promotion of economic development and job creation by developing a green economy.

With regard to solar energy generation, the Province's RE Policy notes that the North West Province has very good potential as a location for these projects – with average daily solar radiation rates of greater than 8 000 MJ/m^2; only the Northern Cape Province receives more solar radiation than the North West Province. The Dr. Ruth Segomotsi Mompati DM receives on average only 5% less solar radiation than Upington (an area that is considered a prime location for solar PV projects); the study area, therefore, shows high potential for solar energy application. The RE Policy subsequently proposes the following actions for the development of the Solar PV industry in the North West Province, and moreover, the areas identified as having a high potential:

- Identification of a suitable entity linked to the North West Province Government to drive the opportunities associated with Solar PV project under the Renewable Energy Independent Power Producer Procurement (REIPPP) Programme.
- The Province should initiate a project as part of the implementation plan to identify suitable areas with the following requirements:
    - Suitable and proven measured levels of solar radiation.
    - Possibility of a long-term lease or option on property.
    - Good grid infrastructure in close proximity.
    - Suitable connection point into the grid.
    - Low impact on agriculture and the environment.
    - Suitable access to and around the site to aid effective execution.
    - Close proximity to communities that could benefit from local economic development and job creation.
- The Province should also explore the likelihood of attracting PV project developers by packaging the most suitable and viable land areas for PV projects.
- The Province should focus on the development of local content for the manufacturing of components for the PV industry. As risk and uncertainty is associated with PV projects, long-term procurement programmes are needed to stimulate investment in local manufacturing, ensuring the future of the Solar PV industry (Department of Economic Development, Environment, Conservation, and Tourism, 2012).

Spatial planning policy

In the **National Spatial Development Perspective** (NSDP) (2006) a description of the country's spatial vision as per the earlier version of the NSDP is listed as follows (The Presidency of the Republic of South Africa, 2006):

- Focussing of economic growth stimulants and employment creation in areas where it is most effective and sustainable.
- The support of restricting, where feasible, to ensure greater economic competitiveness.
- Fostering development based on local potential.
- Ensuring that development institutions are able to provide basic needs throughout the country.

This vision is brought forward in the 2006 NSDP by ensuring that a systematic overview and framework for the understanding of the national spatial economy is provided, and aims to be used as a means for dialogue between the various spheres of government for deciding where to focus infrastructure investment and development spending for example. The 2006 NSDP furthermore states that certain opportunities exist for the local and district municipalities in order to ensure that coordinated government action is implemented. Actions with reference to the current project include (The Presidency of the Republic of South Africa, 2006):

- Decisively dealing with poverty, social and economic exclusion, and spatial fragmentation.
- Exploring and addressing the implication of natural resource potential and use for growing the economy and addressing poverty.
- Seeking out new areas of comparative advantage to identify and develop clusters of specialisation in collaboration with, especially, the provincial and national departments of trade and industry, labour, and economic affairs.

The **North West Provincial Spatial Development Framework and Environmental Management Plan** (PSDF – EMP) of 2008, is closely aligned to the NSDP, and as such places key importance on economic growth and poverty eradication. The spatial rationale is centred on the need to address issues related to spatial planning, socio-economic development, infrastructure, and the sustainable and conservative use of natural resources. The PSDF – EMP highlights the fact that the legacy of the Apartheid-era policy is the key issue, with parts of the Province being significantly underdeveloped.

Although the PSDF – EMP does not include any land use or bioregional mapping, it does provide information on the required natural resources and socio-economic issues that must be addressed. The most prominent natural resource problems include inter alia: inadequate water resources (impacting future development), bush encroachment and alien invasive species, land and soil degradation, and overgrazing. The most significant socio-economic issues highlighted in the PSDF – EMP are as follows (Department of Economic Development, Environment, Conservation, and Tourism, 2008):

- The creation of employment opportunities - including increased economic opportunities for the youth and women.
- The eradication of poverty.
- Attraction investment into the province.
- Achieving sustainable economic growth.
- The fight against, and prevention of HIV/Aids and other diseases.
- Achieving food security.
- Improved physical infrastructure, including the availability of industrial land.
- Decreasing the province’s illiteracy levels.
- Development of the province’s tourism potential.

- Managing population growth, urbanisation, and migration.

The DM's Spatial Development Framework was not available on the municipality's website; the IDP does, however, provide a summary of the district's SDF. Currently the Vryburg area (Naledi LM) is identified as a Priority 2 Investment Node. The IDP states that the district's SDF, Rural Development Strategy, and Environmental Management Plan sees the Vryburg region as a high priority intervention zone. The main issues being to ensure that the region is included in the next PSDF as an Intervention Zone 1, and to enhance Vryburg as a primary regional node (Dr. Ruth Segomotsi Mompati DM, 2015/16).

Socio-economic development policy

The **National Development Plan 2010 – 2030** (NDP 2030) aims to eliminate poverty and reduce inequality by 2030. At the same time, it is geared towards achieving economic growth by expanding opportunities, building capabilities, reducing poverty, and involving communities in their own development, all leading to an increase in living standards of these communities. The NDP 2030 recognises nine key challenges that need to be addressed. Although all challenges are seen to be important, the priority areas can be identified as job creation and improvement of the quality of national education. Managing the transition towards a low carbon economy is also one of the nine key national challenges; in line with this, the expansion and acceleration of a commercial RE sector is seen as a key intervention strategy. The NDP 2030 seeks to ensure that half of all electricity generation capacity is provided by renewable resources (National Planning Commission, 2011).

The **New Growth Path Framework** (NGPF) of 2011 states that the achievement of decent work creation, reducing inequality, and poverty eradication, can only take place if the South African economy is restructured. It is required that the economy improves its rate of labour absorption, as well as composition and rate of growth. To aid in this goal, five key job drivers were identified, and according to the NGPF, one of these job drivers is "Seizing the potential of new economies" (Department of Economic Development, 2010)

The NGPF states that technology innovation is capable of significant employment creation, with the potential to achieve a target of 300 000 jobs by 2020, and 400 000 jobs by 2030 that could be directly attributed to the Green Economy. One of the main strategies to achieve this job creation target is the comprehensive support required by the energy efficiency and RE sectors. Programmes aimed at encouraging the local production of inputs, (with solar water heaters as a starting point), and appropriate pricing policies will form a part of the strategy (Department of Economic Development, 2010).

The **North West Provincial Development Plan** (2030) is shaped from the NDP and attempts to align with the NDP's vision, objectives and priorities for a united South Africa in 2030. The key focus areas of the PDP are based on the main challenges hampering growth in the North West Province, and are similar to that of the NDP, with a focus on the rural economy, and the upgrading, provision, and maintenance of economic infrastructure in the Province. Furthermore, the Province is focused on the transformation of human settlements and the eradication of corruption. The PDP states that RE, especially solar, and waste/biomass initiatives, is seen as being increasingly important in the Province, as its contribution to provincial energy consumption is envisaged to increase over the next two decades (North West Planning Commission, 2013).

The North West **Provincial Growth and Development Strategy** (PGDS) (2004 – 2014) identifies an underdeveloped state of the small private sector as one of the key developmental challenges in the Province. Other challenges include low population densities, inadequate infrastructure and service delivery backlogs, a predominantly poor population with low literacy levels, substantial inequalities between rich and poor, as well as disparities between urban and rural communities, and the HIV/Aids pandemic. Considering this, the objectives of the PGDS are addressing poverty and unemployment, and simultaneously improving the low level of skills and expertise in the Province (North West Province: Office of the Premier, 2004).

The PGDS identifies the following pillars of economic development:

- Growth and Investment,
- Agricultural and Rural Development,
- Mining and Energy,
- Manufacturing,
- Tourism,
- Construction and Infrastructure,
- Small Medium and Micro Enterprises (SMMEs), and
- Training and Skills Development.

Importantly, RE and Solar technologies are not addressed within the Mining and Energy pillar, or in the PGDS. Focus is, however, on provision for a more diversified future economy.

The **Dr. Ruth Segomotsi Mompati DM Integrated Development Plan** (IDP) (2015/16) states the DM's mission as "To ensure optimal utilisation of available resources through effective, efficient, sustainable, integrated planning and corporate governance". The DM's development plan is aligned to the NDP and aimed at reducing poverty and inequality. The DM's IDP furthermore, states that government should shift investment towards projects and programmes that will assist individuals in improving their lives as well as the lives of their children and the communities they live in. The IDP identifies education and public transport as examples of opportunities that should be explored. Some of the key factors identified inter alia as drivers of the creation of equality and prosperity are job creation, bulk infrastructure expansion, and making the transition to a low carbon economy (Dr. Ruth Segomotsi Mompati DM, 2015/16).

To achieve the recognition of Vryburg as a primary regional node, as a part of the DM's spatial vision, the following IDP projects are proposed:

- Infrastructure provision and upgrades,
- Bypass road,
- CBD upgrades,
- Township regeneration projects in previously disadvantaged areas,
- Local economic development strategies.

In the **Naledi LM' Integrated Development Plan** (2012 – 2017) it is reiterated that the LM, and Vryburg in particular, has been identified as a priority two investment area due to the LM's regional growth needs, being the main trading centre in the DM, and the district's administrative centre. Some of the opportunities identified in the LM, with reference to the primary study area, include capitalisation on Vryburg's status as the secondary regional centre, and a beef beneficiation programme, with Vryburg envisioned as the institutional headquarters of the beneficiation programme (Naledi Local Municipality, 2013).

Threats or weaknesses applicable to the Vryburg region are also identified in the IDP and relevant problems include, the overcrowding and degradation of agricultural land in settlement areas, and a lack of development capital to provide and maintain bulk infrastructure in the LM. Moreover, the plan states that the LM is characterised by old and dilapidated electricity infrastructure, and that additional provision and strengthening of the network is required to meet the rising demand for electricity (Naledi Local Municipality, 2013).

The municipality is in need of additional generation capacity, and a solar farm has previously been approved for the LM (Broedersput area). From a national and provincial policy perspective, the proposed project is supported. Although no clear contravention of local policy was identified, it may even be argued that the project will advance the position of Vryburg as secondary regional centre and primary regional node, it should not interfere with other key development strategies, such as the beef beneficiation strategy planned for Vryburg.

The review of applicable key policy documents revealed that all spheres of government support the establishment of the proposed project at the envisaged location. No red flags could be identified that could impact the project from a policy perspective. Although care will have to be taken to ensure that the establishment and growth of activities identified as drivers of economic development in the study area is not unduly negatively impacted by the establishment of the project in the proposed region.

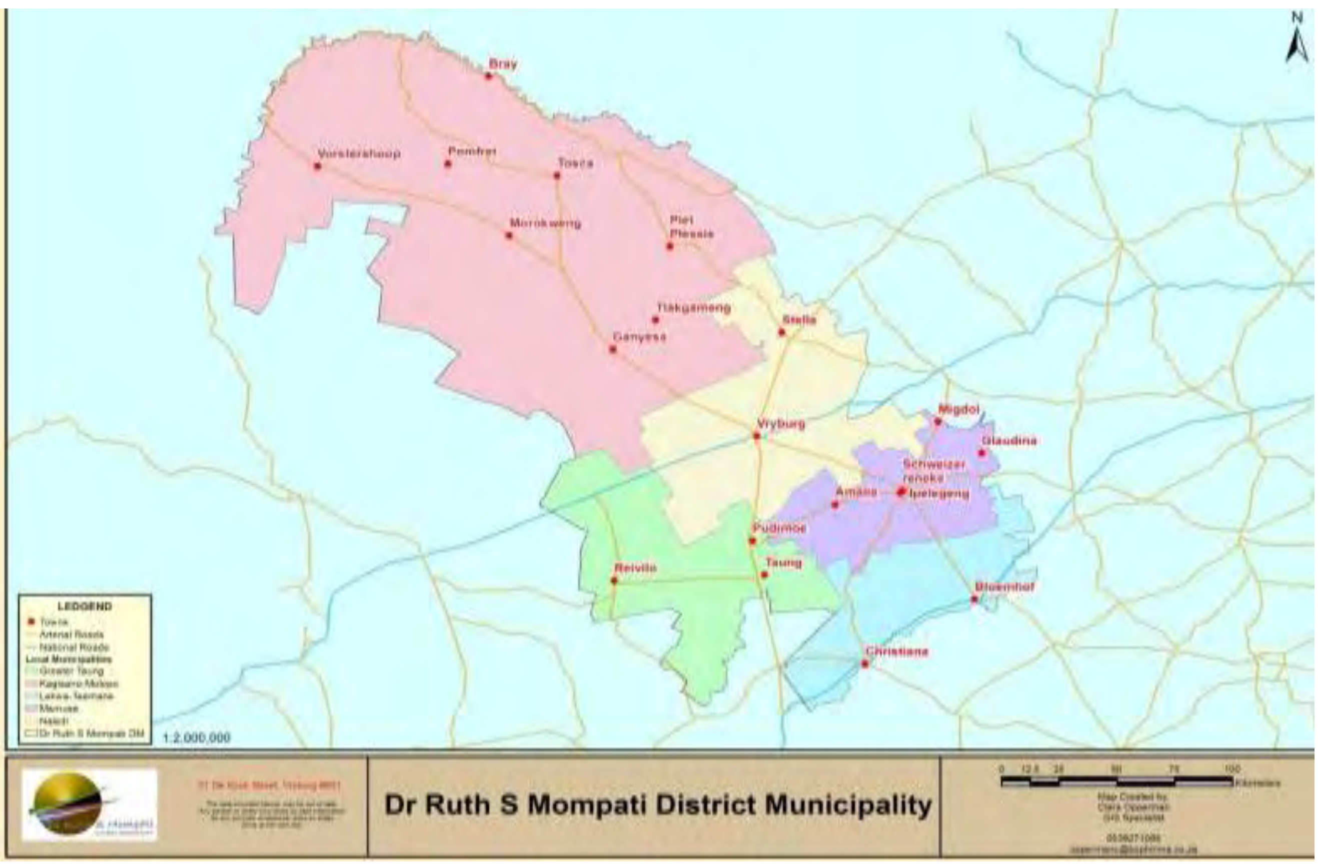
3 BASELINE INFORMATION

This chapter examines key socio-economic characteristics of the study area, as per delineation provided in the previous chapter. This is essential as it provides both qualitative and quantitative data related to the communities and economies under observation, creating a baseline against which the impacts can be assessed.

3.1 Study area's composition and locational factors

Spatial context and regional linkages

The proposed Sendawo Solar PV project is located south of Vryburg in the Naledi LM (see Map 3-1). Vryburg hosts Naledi LM's administrative centre, and is considered the agricultural and industrial centre of the Dr. Ruth S. Mompati DM. The Naledi LM comprises approximately 15% of the total land area of the DM, and is the most significant employment creator and GDP contributor in the district. This is chiefly due to the fact that the town hosts the third largest agricultural show in South Africa.



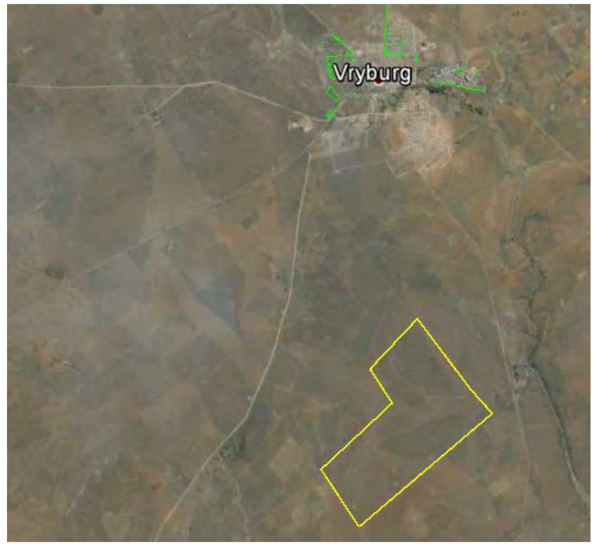
Map 3-1: Locality of the Naledi LM (Dr. Ruth Segomotsi Mompati DM, 2015/16)

The Naledi LM is one of five local municipalities in the Dr. Ruth S, Mompati DM. The DM borders with Botswana to the north, the Ngaka Modiri Molema DM to the north-east, Dr. Kenneth Kaunda DM to the south-east, the Free State Province to the south-east, and the Northern Cape Province to the south and west.

The town of Vryburg is situated on the N14 national road, running from the Gauteng Province through Vryburg, Kuruman, and Upington, and connecting Gauteng to the mining town Springbok in the Northern Cape. This regional linkage is further strengthened by the fact that the road also links Gauteng to Namibia. Vryburg is also located on main railway lines connecting Cape Town to Botswana and Zimbabwe.

Towns and settlements

The closest town to the proposed Sendawo project is the town of Vryburg. The town is situated halfway between Kimberley and Mafikeng and is the administrative centre of the DM. It is also considered the economic heartbeat of the region due to its agricultural activities.



Map 3-2: Location of the project site relative to Vryburg

Vryburg was founded on September 20th 1882, and by February of 1883 some 400 farms had been established. Stella is located north-east of Vryburg, while the township Huhudi is located just south of the town. In 1904 the London Missionary Society established the Tiger Kloof Native Institute south of Vryburg; the stone church on the premises is a national monument. The town is rich in cultural history, with the Theiler Museum located 8 km west of Vryburg. The museum houses a collection of the equipment used by Sir Arnold Theiler, the veterinarian who established the Onderstepoort veterinary research institute near Pretoria.

Other settlements in proximity to the proposed project side include:

- Pudimoe
- Huhudi
- Schweizer-Reneke
- Hartswater
- Bloemhof
- Wolmaranstad
- Christiana
- Hoopstad

Resources and land capability

Vryburg is South Africa’s largest beef producing district. Other important agricultural activities include the production of maize and peanuts. The town is considered the agricultural and industrial centre of the Dr. Ruth S. Mogomotsi DM, being the districts biggest employment generator and GDP contributor. The importance of the agricultural sector in the town is further highlighted by the fact that the town is host to South Africa’s third biggest agricultural show.

The town has been identified as a second priority investment location, and is ideally located on important regional linkage such as the N14 connecting Gauteng to the Northern Cape, as well as key railway lines. Based on its location, policy makers have identified Vryburg as ideal for establishing a primary regional node.

Furthermore, the location of Vryburg also presents significant income opportunities from tourism. The town is located on the N14, which eventually links Gauteng to Namibia. This in itself represents a possibility for entrepreneurs to earn income from passing tourists. Additionally, the town's rich cultural heritage could be better marketed as a tourism attraction, (it houses the Thiel Museum and a stone church that was declared a national monument). According to the Naledi LM IDP, the western part of Vryburg is also utilised as a nature reserve, a factor that could attract additional tourists.

3.2 Demographic Profile

The population of any geographical area is the cornerstone of the development process, as it affects the economic growth through the provision of labour and entrepreneurial skills, and determines the demand for the production output. Examining population dynamics is essential in gaining an accurate perspective of those who are likely to be affected by any prospective development or project.

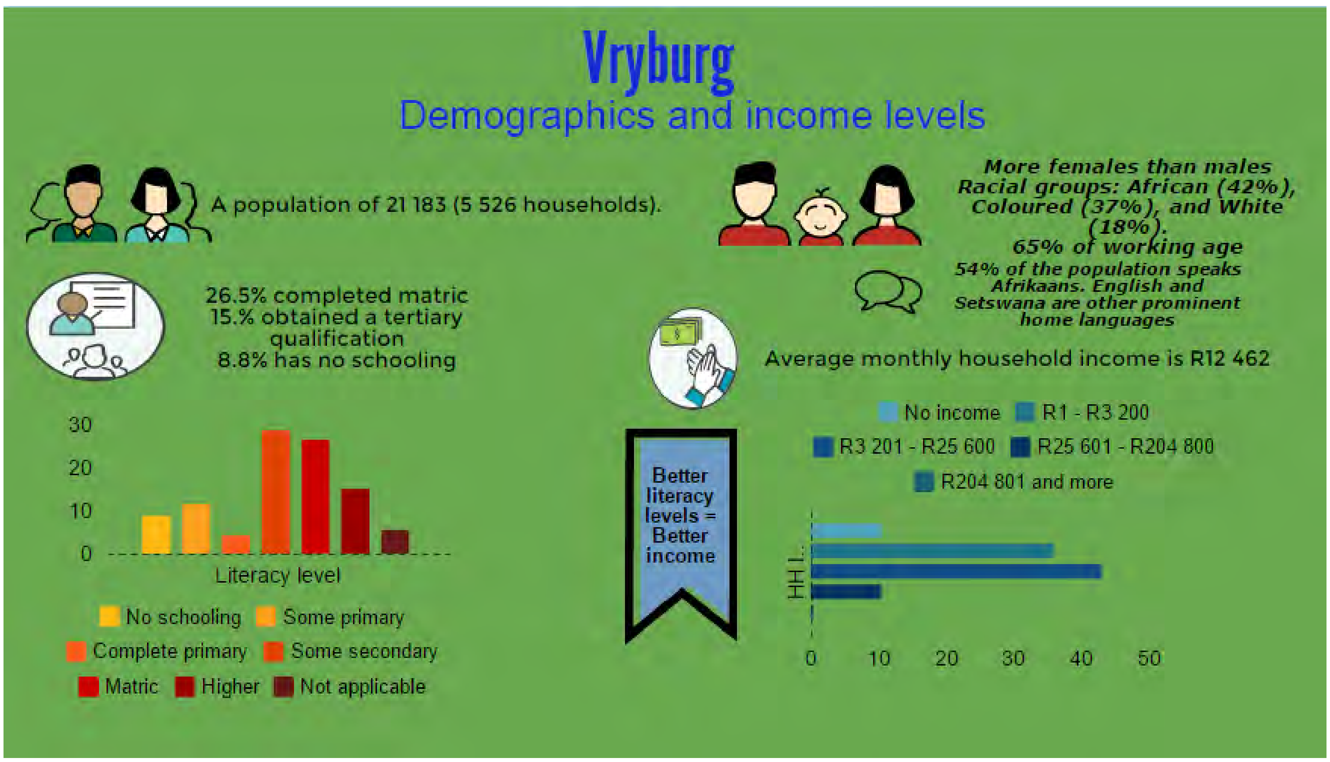


Figure 3-1: Infographic: Vryburg Demographics in 2011 (Stats SA, 2012)

It is estimated that approximately 19% of the population of the Naledi LM reside on farms. When compared to the 9.45% and 5.3% of the DM, and country's respective populations, the relative importance and size of the agricultural activities taking place in the Naledi LM is again highlighted. As identified in the policy documents reviewed, the Naledi LM and more specifically Vryburg is considered the biggest beef producer in the country. The fact that Vryburg is the administrative centre as well as industry hub of the DM is reflected in the fact that the Naledi LM has only 4.1% of its households living on tribal land or in rural regions, compared to the 55.6% of the households of the Dr. Ruth S. Mompati DM living in rural regions.

The racial mix in the DM follows that of the province more closely, while there is more similarities between the Naledi LM and the country. It is estimated that 79% of South Africa's population is African, while in the LM 74.5% of the population is African. In the DM and province, the demographic is distinctly different, with 91.5% and 90% of the respective populations classified as African. The next biggest population group in the municipalities being studied is Coloured, with 14.5% of the LM's population, and 3.9% of those living in the DM from this racial group. 9.4% Of the population of the LM is White while 3.9% of the DM's population is White. The population of Vryburg is slightly more diversified; here 41.7% is African, 37.2% is Coloured, and 17.6% is White. The town also has the biggest Indian/Asian population of all the study communities, and it is estimated that 2.8% of Vryburg's population is of Indian or Asian descent (Stats SA, 2012).

Based on Census 2011 data, more than half (54%) of the population of Vryburg is Afrikaans speaking, a further 31.8% speaks Setswana, and 6.28% speaks of Vryburg's population considers English to be their mother tongue. The dynamic changes slightly in the study municipalities; in the LM 67.7% of the population has Setswana as home language with even more in the DM (82.8%), speaking Setswana. Other prominent home languages in these municipalities are Afrikaans and English, although spoken on a much smaller scale than in Vryburg (Stats SA, 2012).

There are more females (51.9%), than males (48.1%) in the Vryburg population. This follows the pattern of the DM closely; here 48.5% of the population is male and 51.5% is female. In the LM the situation is different, although the ratio between male and female is more equal in the Naledi LM, there are still slightly more males than females (50.3% vs. 49.7%). A study area's dependency ratio can be defined as the proportion of the population who will be dependent on the economically active population, thus individuals aged 0 – 14 years and 65 and older. Based on these qualifications, it can be estimated that roughly 34.5% of South Africa's population can be classified as dependants. In Vryburg this ratio is fairly on par – 34.9% of the population is aged 0 – 14 years or older than 65 years. However, in the LM and DM, the working age population is considerably smaller, leading to a larger proportion of the respective populations who can be considered dependants; 36% in the LM, and 41.6% in the DM (Stats SA, 2012). This could be seen as a development constraint since the social needs would be higher in these communities.

In the Dr. Ruth S. Mompati DM literacy levels are worrisome; here 21% of the population aged 20 years and older has had no formal education, with 22.2% achieving only a slightly better level of literacy by completing some primary schooling. Moreover, only 16.8% of the population of the DM, aged 20 and older, has been able to successfully complete matric. The situation in the Naledi LM is less dire but still suggestive of a community with low literacy levels. In the LM, 21.5% of the population has achieved a matric qualification, while 16.5% of the population aged 20 years and older has had no formal education and 16.8% has had some primary schooling. Literacy levels in Vryburg are above the national average, it is estimated that 26.5% of the population aged 20 years and older successfully completed matric with a further 15% obtaining a tertiary education; however, there is still 8.8% of Vryburg's population, aged 20 and older, who has had no education (Stats SA, 2012).

In Vryburg the average monthly household income is R12 462, which is significantly more than the average national household income of R9 235 per month. The broader population of the study area is earning considerably less, with the average monthly income for the DM and LM at R4 320 and R7 168, respectively, per household (Stats SA, 2012). The lower than average national income levels could be indicative of a limited number of job opportunities available, which in turn is associated with a smaller than average economic base. At the same time, the high earnings in Vryburg are easily explainable when referring to the region's dominance in beef production.

The fact that opportunities in Vryburg are more readily available and of a better quality than the rest of the study areas, is evident when looking in greater detail at the average household income data. Nationally it is estimated that 14.9% of households do not have any regular income. In Vryburg this figure is at 10.5% with 46.4% of the households earning less than R3 200 per month. In the LM 12.9% of households have no access to income, while 66.6% survive on less than R3 200 per month. In the DM the situation is much direr; here 17% of the households do not have an income, with 78.5% of households earning less than R3 200 per month (Stats SA, 2012). The relatively low income levels can be seen as an indication of a small tax base, which presents service delivery challenges for the study municipalities.

3.3 Economy

The structure of the economy and the composition of its employment provide valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector are also important for the economic impact results' interpretation, as it allows the assessment of the extent to which the proposed activity would change the economy, its structure, and trends of specific sectors.

The structure of the economy and the composition of its employment provides valuable insight into the dependency of an area on specific sectors and its sensitivity to fluctuations of global and regional markets. Knowledge of the structure and the size of each sector is also important for the economic impact results' interpretation, as it allows for an assessment of the extent to which the proposed activity would change the economy, its structure, and trends of specific sectors.

The economy of the Naledi LM is valued at R2 857 million in current prices; that is a contribution of 27.3% to the economy of the Dr. Ruth S. Mompati DM, (valued at R10 457 million in current prices), or 1.4% contribution to the R199 551 million North West Province's economy (Quantec, 2014). Based on these estimates, it can be stated that the economy of the North West Province contributes approximately 6.5% to the national economy.

Based on constant prices it is estimated that the economy of Naledi LM grew by a Compounded Annual Growth Rate (CAGR), of 2.1% over the ten-year period between 2003 and 2013. This is below the average national CAGR for the same period of 3.3%, but on par with the Province's growth rate (2.2%). At the same time the growth rate in the DM was recorded as 1.5% (Quantec, 2014). In the LM the construction sector showed the most significant growth at 12%, while the transport sector grew at a CAGR of 5.4%. Over the same period the primary sector decreased by 5.2%, driven by a 5.1% decline in the agricultural sector and a 7.2% decline in the mining sector.

The economies of the primary study area's municipalities are predominantly service economies, with 85.6% and 78.2% of the LM and DM's respective economies' GDP in current prices generated by the tertiary sector. This is well above the national average, as 70.5% of South Africa's GDP at current prices is generated by the tertiary sector. As seen in Table 3-1, the importance of the general government sector in the study area's municipalities is substantially more than in the province and South Africa. In the Naledi LM 29.3% of the current GDP was generated by the government sector, while a quarter of the DM's GDP at current prices was generated by this sector. Vryburg, is the administrative seat of the district, which explains the higher than average contribution by the government sector to the GDP of the LM.

Table 3-1: Economic structure of the various delineated study areas

Economic Sector	Dr. Ruth S. Mompati DM		Naledi LM	
	GDP in current prices (R'm)	% of GDP	GDP in current prices (R'm)	% of GDP
Agriculture	R710	6.8%	R101	3.5%
Mining and quarrying	R543	5.2%	R10	0.4%
Manufacturing	R452	4.3%	R112	3.9%
Electricity, gas and water	R248	2.4%	R85	3.0%
Construction	R330	3.2%	R104	3.6%
Trade	R1 323	12.6%	R365	12.8%
Transport and communication	R896	8.6%	R364	12.7%
Finance and business services	R1 640	15.7%	R551	19.3%
Personal services	R1 688	16.1%	R327	11.5%
General government	R2 628	25.1%	R838	29.3%
TOTAL	**R10 457**	**100%**	**R2 857**	**100%**
Economic Sector	**South Africa**		**North West Province**	
	GDP in current prices (R'm)	% of GDP	GDP in current prices (R'm)	% of GDP
Agriculture	R72 202	2.3%	R4 815	2.4%
Mining and quarrying	R282 366	9.2%	R61 478	30.8%
Manufacturing	R349 066	11.3%	R9 580	4.8%
Electricity, gas and water	R91 201	3.0%	R2 642	1.3%
Construction	R114 754	3.7%	R5 065	2.5%
Trade	R510 666	16.6%	R24 937	12.5%
Transport and communication	R272 303	8.8%	R15 383	7.7%
Finance and business services	R680 443	22.1%	R30 209	15.1%
Personal services	R182 795	5.9%	R16 588	8.3%
General government	R524 716	17.0%	R28 855	14.5%
TOTAL	**R3 080 513**	**100%**	**R199 551**	**100%**

(Quantec, 2014)

3.4 Labour Force and Employment Structure

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs and improve their standard of living. As such, employment and unemployment rates are important indicators of socio-economic well-being.

Table 3-2: labour force of the delineated study areas

Indicator	South Africa	North West Province	Dr. Ruth S. Mompati DM	Naledi LM	Vryburg
Working age population	33 928 806	2 273 362	271 161	42 774	13 809

Indicator	South Africa	North West Province	Dr. Ruth S. Mompati DM	Naledi LM	Vryburg
Non-economically active population	13 238 633	907 948	132 786	16 198	4 911
Labour force	18 841 453	1 236 786	112 900	24 749	8 461
Employed	13 254 829	848 107	72 535	18 237	6 952
Unemployed	5 586 624	388 679	40 365	6 512	1 509
Unemployment rate	29.7%	31.4%	35.8%	26.3%	17.8%
Labour force participation rate	55.5%	54.4%	41.6%	57.9%	61.3%
Discouraged work seekers	5.4%	5.7%	9.4%	4.3%	3.2%

(Stats SA, 2012)

As stated previously, the proportion of the working age individuals in the LM and DM's respective total populations is relatively small when compared to the national average. It is estimated that 42 774 individuals in the Naledi LM are of working age (15 – 64 years of age). Proportionally, Vryburg has a bigger working age population, with 13 809 individuals out of 21 183 strong population being of working age.

Based on South Africa's official unemployment rate, only 17.8% of the labour force in Vryburg is unemployed. This is evidence of the comparatively good economic opportunities available in the town. An argument further strengthened by the fact that 64.6% of employment opportunities in the town are formal opportunities, compared to 56.7% and 57.4% in the DM and LM, respectively (Stats SA). In the Naledi LM the unemployment rate is higher (26.3%), but still lower than the national average of 29.7%. Unemployment in the province and DM is; however, much worse. In the province 31.4% of the labour force is unemployed, while more than a third (35.8%), of the labour force in the DM is unemployed. The fact that comparatively better economic opportunities are available in the LM is further reflected in the higher than average labour force participation rate of 61.3%. Furthermore, only 3.2% of the working age population is discouraged work seekers.

In the DM just about three quarters of all employment is created by the tertiary sector, with the community social and personal services sector, and the government sector generating 46% of the total employment creation in this economy. In the Naledi LM the portion of jobs created by the tertiary sector is even greater; here 78.5% of employment opportunities are generated by service industries (23.5% by the personal services sector, 20.4% by the trade sector, and 18.8% by the government sector). Other major employment creators in the LM are the construction industries (8.5%), and agriculture (7%) (Quantec, 2014).

3.5 Income

In the Dr. Ruth S. Mompati DM literacy levels are worrisome; here 21% of the population aged 20 years and older has had no formal education, with 22.2% achieving only a slightly better level of literacy by completing some primary schooling. Moreover, only 16.8% of the population of the DM, aged 20 and older, has been able to successfully complete matric. The situation in the Naledi LM is less dire but still suggestive of a community with low literacy levels. In the LM, 21.5% of the population has achieved a matric qualification, while 16.5% of the population aged 20 years and older has had no formal education and 16.8% has had some primary schooling. Literacy levels in Vryburg are above the national average, it is estimated that 26.5% of the population aged 20 years and older successfully completed matric with a further 15% obtaining a tertiary education; however, there is still 8.8% of Vryburg's population, aged 20 and older, who has had no education (Stats SA).

In Vryburg the average monthly household income is R12 462, which is significantly more than the average national household income of R9 235 per month. The broader population of the study area is earning considerably less, with the average monthly income for the DM and LM at R4 320 and R7 168, respectively, per household (Stats SA). The lower than average national income levels could be indicative of a limited number of job opportunities available, which in turn is associated with a smaller than average economic base. At the same time, the high earnings in Vryburg are easily explainable when referring to the region's dominance in beef production.

The fact that opportunities in Vryburg are more readily available and of a better quality than the rest of the study areas, is evident when looking in greater detail at the average household income data. Nationally it is estimated that 14.9% of households do not have any regular income. In Vryburg this figure is at 10.5% with 46.4% of the households earning less than R3 200 per month. In the LM 12.9% of households have no access to income, while 66.6% survive on less than R3 200 per month. In the DM the situation is much direr; here 17% of the households do not have an income, with 78.5% of households earning less than R3 200 per month (Stats SA). The relatively low income levels can be seen as an indication of a small tax base, which presents service delivery challenges for the study municipalities

3.6 Access to services and state of local built environment

Access to shelter, water, electricity, sanitation, and other services are indicators that assist to determine the standard of living of the people in the area under investigation. Infrastructure and the state of local infrastructure is another indicator to contemplate when considering living standards. The availability of social and economic infrastructure including roads, educational facilities, and health facilities further indicates the nature of the study area, which is valuable in developing a complete profile of the circumstances in which communities are living. These measurements create a baseline against, which the potential impacts of the proposed project can be assessed.

3.6.1 Access to Housing and Basic Services

Housing

According to the 2011 National Census, 81.1% of households in Vryburg were living in formal brick structures. In the LM 82.8% live in formal structures, while proportionally even more households in the DM live in formal structures (85.7%). It follows that Vryburg has the highest number of households living in informal structures – 18.3% of households, compared to the 16.3% in the LM and 10.3% in the DM. In the DM, 3.3% of households reside on tribal land, while 1.3% of households in the LM are living on tribal land. In Vryburg this is considerably less, with 0.1% of households living on informal land.

To address the housing backlog that is evident from the number of informal dwellings in Vryburg, the Naledi LM IDP contains the following housing projects with a total budget of R47.6 million:

- Vryburg – Colride: Renovation of RDP stock.
- Vryburg – Huhudi Southern Buffer: blocked project to be unblocked.
- Vryburg Extension 25: Informal settlement upgrading.

- Vryburg Extension 28: Informal settlement upgrading.
- Rural housing – communal land rights applications across the LM.

Access to water

The provision of piped water to households in the primary study area exceeds the provincial and national statistics significantly. In Vryburg 82% of households have access to piped water in their dwellings or inside their yards. A further 17.4% have to access piped water from a communal stand, while 0.2% of the households in Vryburg have no access to piped water. In the LM, slightly more households have to access piped water via a communal tap (20%), while 78% have access in their own home or yard. Furthermore, in the LM 2% of households have no access to piped water.

The national statistics indicate that 73.4% of households have piped water in their yard or dwelling, while 8.8% have no access to piped water. Service delivery within the DM is below national levels. It is estimated that 47.9% of households access piped water inside their home or dwelling, while 47.7% have access from a communal stand. The proportion of the DM's population with no access to piped water is; however, still fewer than that of the country at 4.4%.

According to the Naledi LM's IDP, the municipality is the water services provider and Sedibeng Water was appointed by the district as water services provider for Pudimoe, a settlement south of Vryburg. Huhudi (a settlement located between Pudimoe and Vryburg) needs approximately 2.5 mega litres (ml), per day and is dependent on Pudimoe for water. Currently Huhudi is receiving between .75 and 1.2 ml of water, the town's water need is therefore not met. The plant at Pudimoe is refurbished and operational but the bulk water pipeline is still under construction.

The IDP acknowledges that more water points need to be made available in informal areas to improve access, and that the water meters at existing pumps require replacement. The municipality receives water from the Pudimoe purification plant and 18 boreholes. It is estimated that, depending on the hours pumping, the Pudimoe plant provides between 1 ml and 3 ml per day, with no bulk metering available to measure the yield of boreholes. As mentioned, the challenge is that the water supply is inadequate from the purification plant and boreholes. The LM hopes that refurbishment of the second Pudimoe purification plant and sinking of three additional boreholes will address this.

Access to sanitation

If not managed and provided adequately, the basic need of sewerage and sanitation can pose serious health and safety risks to the communities not receiving these basic services. In Vryburg 82.7% of households had access to a flushing toilet, while 3.1% of the households had no access to toilet facilities. At the same time, 4.1% of the town's households were using pit latrines, while 9.4% were still reliant on the bucket system.

The situation is markedly worse in the municipalities being studied. In the DM only 35% of households had access to a flushing toilet, while 11.2% of the households had no access. The bulk of the households (49.9%) in the DM was using pit latrine systems, with 0.9% of households using the bucket system. More households had access to a flushing toilet in the LM (69.2%); however, 4.5% of the Naledi LM's households were still using the bucket system. A situation that is in stark contrast to the government's determination to eradicate all bucket toilet systems by 2007. 11.8% Of households in the LM were using pit latrines, while 12.6% had no access to toilet facilities.

As discussed, the Naledi LM IDP reveals that the municipality has been awarded as the water services provider. The following sanitation service provision challenges and backlogs are identified in the IDP:

- A new waste water treatment plant is needed at Stella.
- VIP toilets must be chemically treated to clean pits.
- Additional Honey Sucker is needed to improve efficiency at Stella, Dithakwaneng, and Devondale.
- Increased support from the DM is needed.
- Stella requires a new oxidation pond, with the current oxidation pond not up to standard.
- The bulk waste water treatment plant is under capacity, and the bulk sewer network has reached maximum capacity.
- The town of Stella is not connected to the sewer network.

Access to electricity

The indicator “electricity for lighting”, was used as a proxy for measuring households’ access to electricity. Nationally it is estimated that 84.8% of households have access to the grid for lighting. In the primary study area the percentage of households with access is less – 81.1% in Vryburg, 76.8% in the Naledi LM, and 82.3% in the Dr. Ruth S. Mompati DM.

The main alternative source for lighting in the study areas was candles; 17.7% of households in Vryburg used candles for lighting, while in the LM 21.3% relied on candles and 16% of households in the DM uses candles for lighting. In Vryburg 0.3% of households had no means of power to generate lighting, while 0.2% of households were using solar power for this purpose.

The Naledi LM IDP states that the electrical infrastructure in the LM is old and dilapidated. It goes on to state that the need exists for strengthening of the network and the creation of additional supply as the need for electricity increases in the LM. The in-migration in to LM further increases this need. Eskom is increasing supply to the LM as the system is already under pressure and a solar farm has been approved for Broedersput. The strategies identified by the LM in its IDP document to improve electricity supply include:

Supply electricity from the southern side of Vryburg in order to reduce the pressure on the main substation at the industrial area.

- Develop the second fidder line to assist the Delarey fidder line of Eskom.
- Strengthening the fidder line feeding Stella substation.
- Upgrade the internal bulk network and distribution lines.
- The introduction of energy saving appliances.
- The introduction of rebates on all housing plans with “more natural” lighting options.

Refuse removal service

It is estimated that 62% of households nationally have their refuse removed by a local authority on a weekly basis. In Vryburg the number of households with access to this service is substantially more (89.6%), while in the Naledi LM 66.4% of households have access to weekly refuse removal by a local authority. In the DM the main method of garbage disposal is an own refuse dump; 60.7% of households rely on this method, while only 27% has access to weekly garbage collection by a local authority.

The Naledi LM's IDP highlights the following service delivery constraints/problems related to adequate refuse disposal in the LM:

- No access to waste and refuse disposal at Dithakwaneng and Devondale.
- No licensed landfill site at Stella.
- Illegal dumping.
- Insufficient number of refuse bins in Naledi.
- Insufficient number of transfer stations.
- Unreliable transport for refuse removal.
- Mass containers are not being maintained.

Internet access

Internet access has become increasingly important in accessing economic opportunities. Although not a definitive measure, it could be argued that a lack of access to the knowledge readily available on the internet could negatively affect an individual's ability to access quality educational and economic opportunities. It is estimated that 64.5% of all South African households have no access to internet services. In Vryburg just more than half (55%), of households have no access. This effectively excludes 55% of households from the economic and social opportunities that could be accessed via the internet. In the LM and DM the rate of exclusion is even higher, with 67.1% and 79.4% of the respective populations not having access. For those with access, a cell phone is the most common method of access, followed by home internet access or access at work.

3.6.2 Social and Recreational Infrastructure

The Naledi LM's IDP (2012 – 2017) contains information on the social and recreation infrastructure available in the LM. The IDP furthermore, provides a brief description of the general state of the infrastructure available. This section will summarise these findings.

According to the IDP, **health facilities** in the LM are situated in close proximity to the communities they are intended for and are easily accessible. The communities are using private vehicles and taxis to access these facilities and no need for government transport exists. Table 3-3 provides information on the health facilities available in the Naledi LM. The only hospital in the LM is located in Vryburg. The town's population also has access to a mobile clinic and a community health centre. The IDP furthermore, suggests that there is a lack of HIV counselling facilities in the LM.

Table 3-3: Health facilities in the Naledi LM

Town	Hospital	Clinic	Mobile Clinic	Community health centre
Vryburg	1	-	1	1
Colridge	-	1	-	-
Huhudi	-	1	-	-
Stella	-	-	-	1

(Naledi Local Municipality, 2013)

The **sport facilities** available in the LM are depicted in Table 3-4. The municipalities realise the importance of the availability of these facilities in youth development, stating that measures should be implemented to increase the use of these facilities by the youth of the LM. It is evident from the data presented here that the LM is in need of rugby fields to ensure that grassroots development of the sport can take place here if the potential exists.

Table 3-4: Sport and recreational facilities in the Naledi LM

Town	Public swimming pool	Netball court	Soccer field	Tennis court	Rugby field	Gym
Vryburg	1	3	2	1	-	1
Huhudi	1	-	1	-	-	-
Colridge	1	-	1	1	-	-
Kismet	-	-	1	1	-	-

(Naledi Local Municipality, 2013)

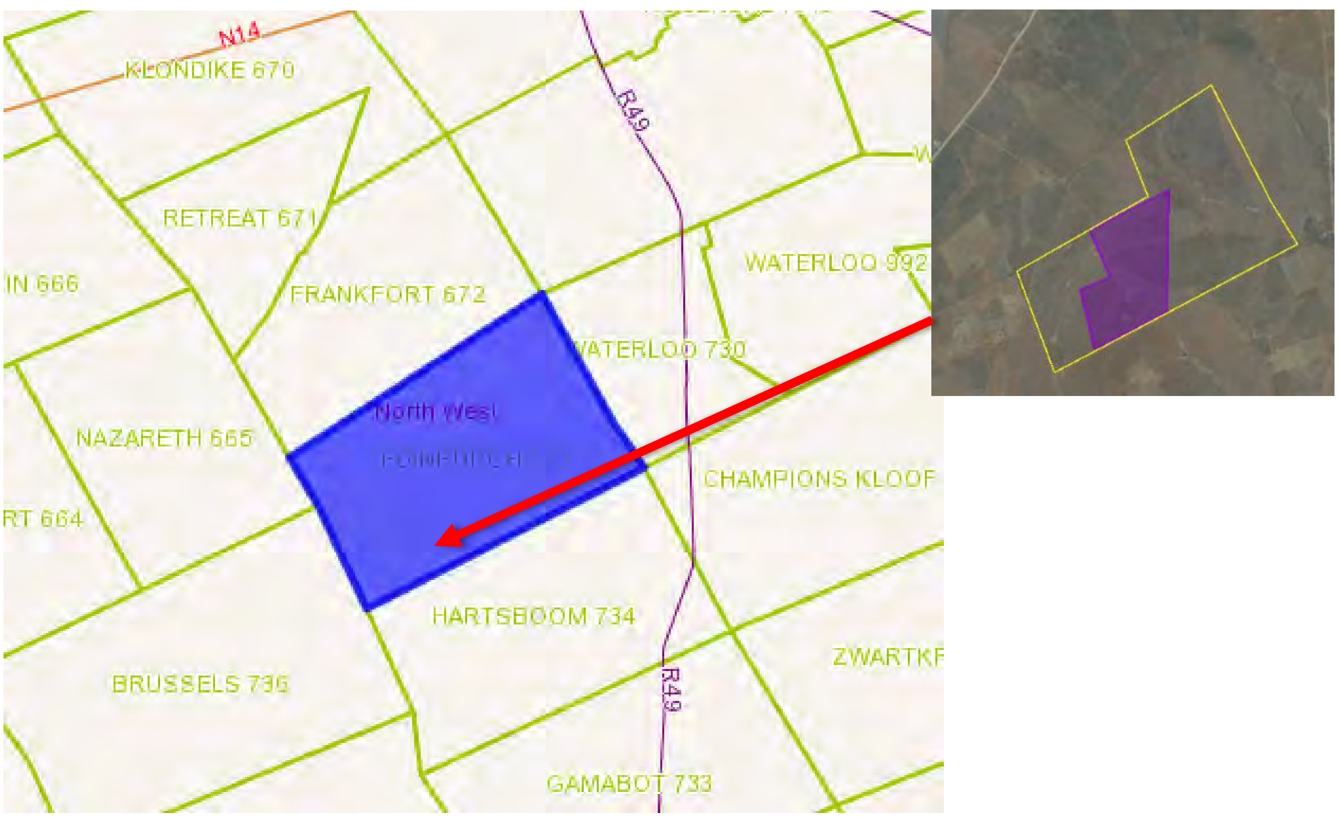
Also identified within the IDP are five **cemeteries**, four formal and one informal burial yard exists within the Naledi LM. Cemeteries play a vital cultural role in any community, and it is therefore, important to ensure that adequate provision is made for the communities' needs in this regard.

3.7 Site-related information

The following paragraphs provide the socio-economic profiles of the farm portions where the proposed project is planned to be constructed.

3.7.1 Land-use profile

Map 3-3 shows the farm portion earmarked for development of the proposed Sendawo PV facilities, with the Sendawo 2 array highlighted. The primary data were gathered from the site visit that took place between 2 December 2015 and 4 December 2015.



Map 3-3: Farms directly and indirectly impacted by the propsed Sendawo 2 PV facility project (Chief Surveyor-General, 2016)

Portion 1 and Remainder of Farm Edinburgh 735

Portion 1 and Remainder of Farm Edinburgh 735 is currently in the Edinburgh Trust together with various other family farms. Mrs Adele Oberholzer is the nominated beneficiary of Portion 1 of Farm Edinburgh 735; she manages and operates the agricultural activities taking place on the farm. The farms in the family trust have been in the family for four generations. The development is proposed to be located on Portion 1 of the Farm Edinburgh; the Remainder of the Farm Edinburgh does, however, belong to the same land owner with the economic activities taking place across the farm portions. No distinction can, therefore, be made between the two farm portions. The consultation with the land owner revealed the following.

- **Demographics and residence:** There is one residence on the farm, where the land owner's elderly mother stays. No workers reside on the farm.
- **Economic activities:** The land is primarily used for cattle and game breeding. Some hunting takes place during the winter months but this is an insignificant part of the business. The particulars of the commercial farming activity include:
    - Between 15 and 20 buffalos for breeding.
    - A breeding herd of Sable Antelope with 25 bulls.
    - Other game is uncounted, roaming freely.
    - Approximately 150 breeding cows for the weaner market.
    - The total operations employ two individuals from Huhudi on a permanent basis.
    - Casual labour is employed as required and varies; the average is five per day as needed.
    - All labour is paid well above the minimum wage requirement.
- **Services:** The farm uses borehole water; electricity is supplied by Eskom. Solar power is used for electric fences and security.
- **Concerns raised:** The following concerns were raised by the land owner during the consultation process:
    - During construction and operation, all access gates to the farm will have to be kept close to prevent game from escaping. This is a major concern.
    - The proposed PV farm would have to be carefully fenced according to the standard for game fences to ensure that the animals can graze on the rest of the Farm Edinburgh without causing damage to the Sendawo 2 development. The land owner has made it clear that no responsibility will be accepted from her for any damage of this kind.
    - Stock theft and personal security, especially as far as it applies to the elderly female residing on the farm.
    - Water currently extracted from the borehole cannot be used for the proposed project and alternative means to acquire access to water for the operations of the PV facility will need to be sought by the developer.
- **Community observations:** The land owner made the following observations about the broader community:
    - The biggest problem facing the surrounding community is the lack of proper education.
    - Initially, agricultural activities in the area attracted hopeful job seekers. Farmers are now employing less individuals or even laying off some. As a result, there are some individuals with no other experience but farming, who cannot find jobs in the agricultural sector and who do not possess any skills to be employed in other industries.

Farm Waterloo 730

Farm Waterloo 730 is a private property, on which a government school (i.e. the Tiger Kloof School) is located. It is an institution with a rich history.

The information gathered from the consultation with the Tiger Kloof School director, Mr Mark Boobbyer can be summarised as follows:

- In total, 800 ha of Farm Waterloo 730 is leased out, 50 ha is used for the school and related buildings, and the remaining 350 ha is used for the school farm and the adventure training and camp that started at the end of 2015.
  - Portion 4 of Farm Waterloo, the area directly adjacent to the proposed Sendawo application site, is leased to the land owner of Farm Hartsboom. The analysis of socio-economic activities of this portion is combined with that of Farm Hartsboom.
  - The Remainder 3 of Waterloo 730 is leased to a farmer, Mr Seeco. Mr Seeco farms only on this land in the area.
- The current school director's tenure is set to end in June 2016. Although he has done significant work at the school since 2012; it is not foreseen that his departure will negatively impact on the operations at the school.
- **School operations:**
  - The school has 680 learners, of whom 170 are boarders. The school plans to expand in the future.
  - The school employs 100 individuals including educators and auxiliary staff. Of these individuals, 20% are government employees. A significant portion of the educators are Zimbabwean.
  - The school's biggest source of financial support is from a Swiss Trust.
  - A fee is payable at the school, although a significant proportion of the pupils are disadvantaged, coming from Huhudi and surrounds.
- **The school farm operations:**
  - The church attracts a lot of tourists. The church, along with the Tiger Kloof School Hall, is rented out for weddings and other functions. Although this venture only started in 2015, it has proven to be very popular.
  - The adventure camp and training centre is a new venture too but is showing significant potential and attracting big interest. The maximum capacity at the camp is 60 beds.
  - The farming and tourism activities being operated by the school are not yet profitable.
- **Services:** The school uses borehole water and has a grid connection.
- **Concerns and issues raised:**
  - A negative impact on the supply of borehole water.
  - The school will not grant permission for any sort of access road without receiving compensation.
  - Although not raised by the stakeholder, the potential negative impact of the proposed PV facility on the tourism activities operated by the school should be considered.

The following information was gathered from consultation with Mr. Seeco during the site visit in December 2015:

- The total area leased is 500 ha. Only 250 ha is shown on the lease agreement signed with the school; the other 250 ha is being considered for the potential development of another RE project.
- The lessee is not aware of other available land should the current land become unavailable to him.
- **Demographics and residence:** No one resides on this portion of land.
- **Economic activity**:
  - The lessee is using the land for the grazing of cattle. Usually the land is utilised at its full carrying capacity; lower than usual cattle was grazing during December due to the drought.
  - The lessee is employing one full time worker and one-part time worker. These workers receive a minimum wage.
- **Concerns raised:**
  - The possibility of stock theft as the presence and movement of people in the area increases is the biggest concern.
  - Possible negative impact on the water supply since the animals are drinking the borehole water.

Portion 1 of Farm Championskloof 731

The portion 1 of Farm Championskloof 731 that could be impacted indirectly by the proposed Sendawo development is leased to the owner of Farm Hartsboom 731. This landowner, therefore, operates commercial agricultural activities across the Farms Hartsboom, Portion 1 of Championskloof and Portion 4 of Waterloo. Discussion of these operations is provided under Farm Hartsboom 734.

Remainder of Farm Hartsboom 734

As mentioned, the owner of Remainder of Farm Hartsboom 734, Mr Nico Van Rooyen, is also leasing Portion 4 of Farm Waterloo 730 and Portion 1 of Farm Championskloof 731. The following information was gathered from the consultation with the stakeholder during the site visit in December 2015.

- **Demographics and residence:**
  - The owner and his family reside on the farm.
  - Farm Hartsboom has been in his family for two generations.
- **Economic activity**:
  - The current lease contract is for three years with the option of extension. It has been in place for six years previously.
  - The leased land is used mainly for grazing of game, which mostly comprise of antelope family animals such as Kudus, Rooibokke, etc.
  - Farm Hartsboom is used for cattle breeding (i.e. 200 breeding cows).
  - The leased land hosts an additional 70 breeding cows.
  - The farming operations employ four permanent workers; they receive a minimum wage.
- **Services**: The farm uses borehole water. Eskom supplies electricity, but solar power is used for the electric gates.
- The **concerns** raised are:

- The most likely and most probable access road to Sendawo 2 is not ideal, it will split the grazing land on Portion 4 of Farm Waterloo 730 and Portion 1 of Farm Championskloof 731 in two.
- The impact of dust on the residence. This is a concern not only during the construction phase but also once the facility reaches operations, since vegetation will be removed for the solar PV facility to be established. He is concerned about wind blowing sand in the direction of the farm and the residence.
- Noise disturbances: any possible noises to be kept to office hours.
- Increased risk of theft and other social ills as the number of construction workers present in the area and on site increases.
- Concerned about water availability and sand erosion. According to the stakeholder it is especially significant as his farm is at an incline with the other farm.
- The land owner raised the issue that if vegetation on the proposed site is removed, firebreaks will need to be established. The project proponent must ensure that the correct measures are implemented since it could impact the entire community if not managed.

Remainder of Farm Brussels 736

Remainder of Farm Brussels 736 is a family-owned farm that belongs to the Kromkloof Trust. Ms Jill Blackwood, who is a sister of the nominated beneficiary of the farm where the proposed project is to be located, is a beneficiary of Remainder of Farm Brussels 736 and Farm Frankfort 665. As advised by the beneficiary of the farm, heir brother, Mr Malcolm Blackwood and his wife reside illegally on Remainder of Farm Brussels 736, which they also use for farming. Consultation with Ms Blackwood and Mrs Oberholzer revealed that they are in the process of evicting Mr Blackwood off the land.

The consultation with Mr Blackwood, which took place during the site visit in December 2015, revealed the following:

- Mr. Blackwood's daughter, Linda, is a beneficiary of the Edinburgh Trust, with the land portion known as Eden bequeathed to her. Eden is part of Remainder of 1 of Frankfort 672, which is directly adjacent to the proposed project site on the north-west side. He is thus farming on Eden and Remainder of Farm Brussels 736.
- Remainder of Farm Brussels 736 is approximately 2 000 ha, and Farm Eden 1 000 ha.
- **Demographics and residence:**
    - Mr Blackwood and his wife reside on the farm.
    - Six families of workers employed on the farm reside on the farm.
- **Economic activity**
    - In total, the farming operations include approximately 300 heads of cattle and 50 heads of game from the antelope family.
    - During the site visit, some small-scale farming with sheep, pigs, and chickens close to the residence was also observed. These are believed to be used primarily for subsistence.
    - The aim is eventually to offer hunting activities at the farm.
    - The total operations employ six individuals. They receive above minimum wages.
- **Concerns raised:**
    - Increased risk of livestock theft.

- Disturbance of peace. Currently their residence is fairly remote; they are concerned what may happen if the movement of people increases as a result of the construction activities.
- Water supply: the borehole water supply to the farm is already irregular.

The consultation with Ms Blackwood, the beneficiary of the farm, raised the concern over the security risk for both human and stock theft. She does not foresee the proposed project, and the potential need for the relocation of the game belong to Mrs. Oberholzer to the Middelkop Safaris grazing land, impacting negatively on the level of her current economic activities associated with Middelkop Safaris.

Remainder of Farm Nazareth 665

Remainder of Farm Nazareth 665 is not directly adjacent to the Sendawo proposed project site, but it shares boundaries with Remainder of Farm Edinburgh 735, which may host the proposed project on a portion of it. It forms part of the Edinburgh Trust., whose trustees include Mrs Adele Oberholzer, her mother, and their lawyer. A portion of Remainder of Farm Nazareth belongs to the lawyer, with his mother, Mrs Hanna Kruger, residing on Portion 3 of Nazareth 665. The farm is not used for any commercial economic activity.

Portion 2, Remainder, and Remainder of 1 of Farm Frankfort 672 (excluding Eden)

Farm Frankfort 672 is administered by the Kromkloof Trust. Ms Jill Blackwood and Mrs Adele Oberholzer have a joint venture called Middelkop Safaris, which is operated from Portion 2 and Remainder of Farm Frankfort 672. They each also operate their own farming operations as indicated previously. The land owner is not concerned that the proposed project would negatively impact on any of her current economic activities. The biggest concern raised applies to personal security and the risk of stock theft.

Summary and the zone of influence

In general, with respect to the current land use, it can be concluded that the immediate study area is mainly used as grazing land. The proposed development is thus, slightly in conflict with the current land use, as it may result in sterilisation of the agricultural land from its current potential. The concern would be to ensure that the development of the PV facility does not unduly negatively impact on the level of agricultural activity currently taking place in the area.

Some low-intensity tourism activities are in the early stages of operation at the Tiger Kloof School. The installation of the proposed PV facility may negatively impact on the tourism potential at this site. However, it should be noted that the rural natural characteristic of the area is already partially degraded by visible railway lines, a road, and bulk electrical infrastructure.

Although all of the land owners and lessees discussed above are adjacent and potentially indirectly affected properties; the location of the proposed Sendawo 2 PV array means that the impact will most likely be limited to only a few of the farms and farm portions. These include:

- Farm Hartsboom 734, and due to the nature of operations on this farm also Portion 4 of Farm Waterloo 730 and Portion 1 of Farm Championskloof 731
- Remainder of Farm Brussels 736
- Remainder of Farm Nazareth 665

It should also be highlighted that should the Sendawo 2 development be approved, it will have an impact on the existing land uses taking place on the rest of the Farm Edinburgh 735. For the purpose of the study, it is assumed that only Sendawo 2 is implemented. The discussion on the possibility and level of the impacts that may ensue should all three Sendawo developments be approved will be discussed in length under the section that will deal with cumulative impacts of the development of the solar PV industry in the broader study area.

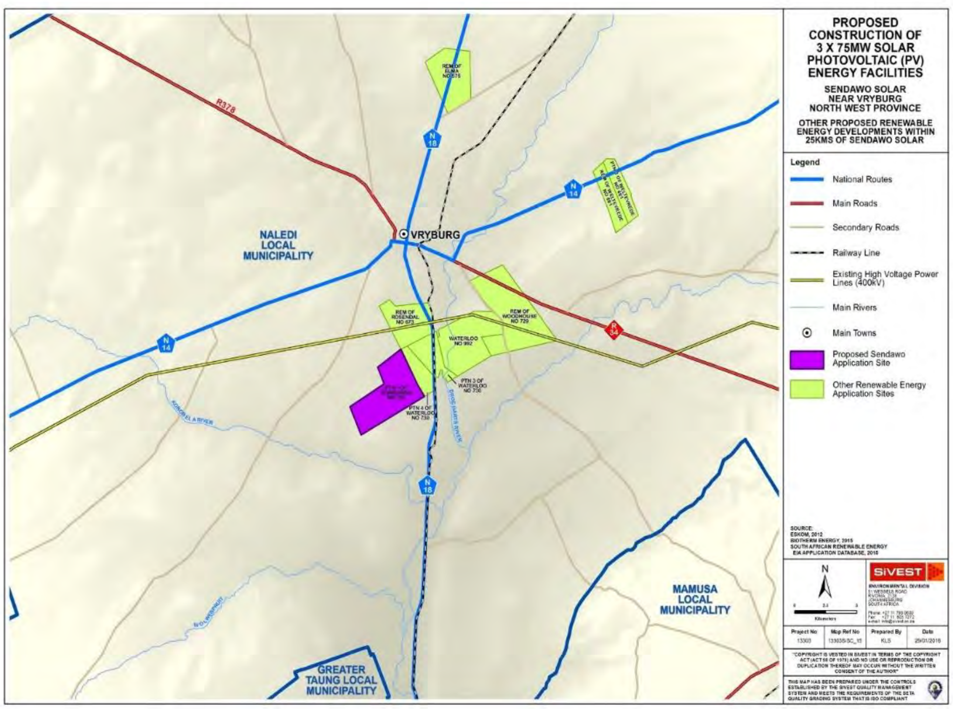
3.7.2 Access to infrastructure

Consultation with the land owner of the farm where the proposed project is to be developed revealed that Farm Edinburgh 735 is connected to the national electricity grid; however, solar power is used for the electric fences and other security matters. The farm uses borehole water, and it was expressly stated by the land owner that this water will not be made available for use during construction and operation of the proposed Sendawo 2 project. Provision of water to the project would thus be something that must be provided for in the final design of the project's infrastructure requirements.

The only option available for access to Sendawo 2 is currently small farm tracks. Should it be negotiated to use these for access to the proposed site; these roads will need to be upgraded.

3.8 Existing and planned developments in the area

Various other Renewable Energy (RE) projects in the vicinity of the Sendawo application site are in differing stages of the planning and approval process. Map 3-5 depicts those RE projects that are in close proximity to the Sendawo solar PV application site, while Table 3-5 elaborates on the various proposed developments and the current status of the application.



Map 3-4: Locality of proposed RE developments in the vicinity of the Sendawo application site

Table 3-5: Renewable Energy developments proposed within a 25km radius from the Sendawo PV application site

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Scoping and EIA processes underway.	Kabi Solar (Pty) Ltd	75MW	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390	Environmental authorisation received	Sediba Power Plant (Pty) Ltd	75MW	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308	Environmental authorisation received and preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75MW	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	Environmental authorisation received	Cronos Energy (Pty) Ltd	75MW	Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	Environmental authorisation received 29 June 2013. Amended to 75MW on 4 April 2014.	Carocraft (Pty) Ltd	75MW	Portion 1 and the Remainder of the Farm Weltevrede 681
Expansion of the Carocraft Solar Park	14/12/16/3/3/2/699	Scoping and EIA processes underway.	Carocraft (Pty) Ltd	75MW	Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 1 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 1 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729
Woodhouse Solar 2 PV Facility	TBC	Scoping and EIA processes underway..	Genesis Woodhouse Solar 2 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729

Cumulative impacts can be defined as changes to the environment, which are caused by an action in combination with other past, present, and future human actions; however, in practice the assessment of cumulative impacts as on a single-project basis relates to one concept: the specific consideration of effects due to other projects. It follows that in general, the expected impacts that may ensue from the project being evaluated is similar to the cumulative impacts that may be observed (The Cumulative Effects Assessment Working Group, 1999).

Various reasons exist for the projects listed above not all becoming operational:

- Limitations to the capacity of the existing Eskom grid.
- Not all environmental authorisation applications will be successful.
- Appeals and objections to the process by various stakeholders could potentially delay implementation and operation of the various projects.
- Project not approved under the existing Renewable Energy Independent Power Producer Procurement Programme and not developed due to challenge in securing alternative off-taker (i.e. municipality or private company).

If the assumption is applied that these projects will receive environmental authorisation and become operational, the possibility of a more significant cumulative impact becomes more likely. Especially when considering the fact that developments are planned for farms directly adjacent to the application site (Waterloo and Rosendal). Moreover, the fact that there are numerous developments planned for the rest of the North West Province (the project proponent is proposing two more in Lichtenburg in addition to the three in Vryburg) by the project proponent and other developers, the case can be made that any cumulative impact will spread further than the Sendawo zone of influence, into the Province. Some of the more prominent effects may be:

- The development of solar energy projects in the area will considerably increase the demand for goods and services required for the construction of these facilities. Depending on the timing of these listed solar PV facilities, it could extend the demand for these goods and services for a longer period than the construction phase of one project, which would be more beneficial than if all projects were to be built over the same timeframe. Since the development of the majority of solar PV projects at the moment follows a bid process, it is likely that some developments will also follow one after another. Coupled with projects developed in other parts of the Province, this could provide sufficient economies of scale and thus open opportunities for the establishment of supporting industries, leading to a growth of the economy and sustainable job creation.
- Aside from positive cumulative impacts, the development of solar energy projects in the area at the same time or one after another, will also increase the negative cumulative impacts during construction periods of these projects. The magnitude of these impacts will be dependent on whether the construction of solar PV projects in the area is done within the same period of time or whether they are distributed over a longer period. The more projects are built during the same period, the greater the cumulative impact will be as the local economy and communities in and around Vryburg have a small economic base and are not capable to absorb the demand for additional services and goods, while their social and economic infrastructure (i.e. affordable housing, water, sanitation, roads, etc.) might not be able to deal with the sharp increase in demand for these amenities that would be stimulated from an increase in construction workers and job seekers in the area. The increase in the number of construction workers and generally job seekers in the area could have a detrimental impact on the ability of the local authorities to service their residents, which could further translate into growing un-satisfaction with

performance of local government and create unrest in the areas. A significant change in demographics, i.e. sharp increase in male population as observed in mining areas, growth of informal settlements, and increase in social pathologies (health issues, crime, prostitution, xenophobia, etc.) could also become bigger problems in the local community.

- The land uses in the local municipality and areas surrounding Vryburg are largely dominated by agricultural activities. Solar energy facilities tend to sterilise the land from agricultural uses. The bigger the number of projects developed in the region, the greater the losses of the agricultural sector will be. While one project might not impact on food security and the performance of the sector in general, a sterilisation of productive agricultural land on multiple sites could potentially create concerns over supply of meat and other produce in the area and the growth potential of the local agricultural sector.
- Last but not least is the assessment of the cumulative impact if all three solar PV projects are to be built on Farm Edinburgh 735. If these activities are approved, the commercial cattle and game farming operations undertaken by the owner will be significantly scaled down. This may also impact on Middelkop Safaris, which is run in a joint venture between the owner of Farm Edinburgh 735 and adjacent Farm Frankfurt 672 focusing on game breeding for commercial purposes. Commercial production of cattle may also be downscaled due to the loss of grazing land.

4 IMPACT ANALYSIS

The following sections discuss the socio-economic impacts that the proposed project is envisaged to create, considering the knowledge of the potentially affected socio-economic environment and the project components. The analysis of impacts is divided into the following groups:

- Impact on natural capital
- Impact on human capital
- Impact on social capital
- Impact on cultural and spiritual capital
- Impact on physical capital
- Impact on financial capital
- Impact on political and institutional capital

The review of the potential impact takes into account the entire project inclusive of all of its components and considered alternatives. Where applicable, differentiation between the alternatives for various project components is provided. Otherwise, it is assumed that the impact will be the same regardless of the selected alternative for a project component.

4.1 Impact on natural capital

Currently, the land proposed for the development of Sendawo 2 is used mainly for breeding buffalo and Sable Antelope, as well as for grazing of other game and some cattle. Should the proposed project be implemented, the animals will need to be relocated, at or before **construction** starts, to the other portions of the farm, or alternatively to Portion 2 and Remainder of Farm Frankfort, where the Middelkop Safari is located. Therefore, it is likely that the livestock density on the other portions of Farm Edinburgh 735 an/or Portion 2 and Remainder of Farm Frankfort will increase if the game is to be moved. The land owners of the farms; however, are not concerned about the move and believe that they will continue to maintain their existing operations without any loss of revenue.

Although the Sendawo 2 development would appear to have a limited negative impact on the agricultural activities, the combination of the various solar PV facilities planned by the same developer (Sendawo 1, 2, and 3) and others companies in the area may result in a significant cumulative **loss of grazing agricultural land** for the region as a whole. A cumulative impact directly linked to the Sendawo project is the possibility of all three of the developments being approved and constructed. This would result in just about the entire Portion 1 of Farm Edinburgh no longer being available for commercial game breeding and cattle farming.

The Sendawo application site and its surrounds are described as non-arable grazing land. The potential loss of agricultural land can be described as a long-term impact due to the fact that the land will be neutralised for agriculture activities for at least the lifespan of the Sendawo project (20 years). The cumulative impact of the loss of agricultural land across the region and the North West Province may last even longer as a result of the fact that the proposed projects will not all begin and end at the same time. Rehabilitation of land to grazing potential will thus not happen all at once, resulting in less land available for agriculture use over the long-term across the North West Province, the impact of which may be significant over the long-term. The Sendawo 2 development in itself may not negatively impact on food security of the bigger region; however, as more grazing land is neutralised due to the envisaged developments of solar PV facilities, food security (beef) may be put under threat.

4.2 Impact on human capital

4.2.1 Impact on employment

The project proponent estimates that the **construction** of the proposed Sendawo 2 development will generate approximately 68 employment opportunities for skilled individuals and 62 job opportunities for unskilled individuals. Of these opportunities, between 40% and 50% will be made available to local labour.

Literacy levels in the Naledi LM can be considered as low. It is estimated that only 21.5% of the Naledi LM population older than 20 has achieved a matric qualification, while 16.5% has had no formal education. it can then be argued that the 40% - 50% of employment opportunities made available to the local labour will be largely filled by unskilled labour since it is unlikely that the local area will be able to supply workers with skills required for the skilled positions. Therefore, all of the unskilled employment opportunities to be created on site will be filled by workers from the local community. These will be short term, temporary opportunities as they will last only for the duration of the construction of Sendawo 2.

Once the Sendawo 2 development becomes **operational,** it is expected that 43 new sustainable jobs will be created, i.e. 14 permanent skilled positions and 29 permanent unskilled and semi-skilled positions. Most of these positions will be possible to fill by people from the local communities.

It is estimated that unemployment in the Naledi LM is 26.5% of the labour force, which equates to 6 512 individuals looking for work and who are unable to find any opportunities. In Vryburg, the number of hopeful individuals unable to find employment is 1 509. The magnitude of the impact on employment creation that is envisaged to be generated by the Sendawo 2 development is therefore, relatively low. This is however, limited to the individual impact of the development of Sendawo 2; should the other PV energy developments planned for the region be implemented, it can be expected that local employment procurement will notably increase and have a far noticeable positive effect on the local employment situation.

Considering the current level of unemployment within the local economy, the employment that may be generated for the local community by the proposed project may seem almost insignificant. However, when compared to the employment created by existing activities observed on the site, the potential is significantly higher. Currently, the agricultural activities taking place on Portion 1 of Farm Edinburgh 735 employs two farm workers on a permanent basis with an average of five casual opportunities per day as and when required. The establishment of the proposed Sendawo 2 will not only allow to retain the existing jobs for these farm workers but will also create 43 jobs in the economy.

Should the three Sendawo applications receive environmental authorisation and be approved for development, the **cumulative** impact will be more noticeable:

- Between 390 temporary job opportunities could be created during the construction phase, of which 186 could be filled by locals.
- Up to 129 sustainable jobs could be created during operations, of which the majority could be filled by people residing in the local community.

Considering that all three developments may not be constructed at exactly the same time, it could be suggested that:

- Either the length of time the people will be employed will increases as the same individual moves from development to development as the construction progresses, or
- The number of local community members benefitting from temporary employment increases.

As the PV industry further develops in the region, local procurement of labour may increase with obvious benefits to the local community. Moreover, as the number of solar PV facilities being implemented across the Province grows, the possibility exists that sufficient economies of scale may be reached to support the development of local supporting industries. It would then be expected that these supporting industries would create additional job opportunities.

4.2.2 Impact on skills and knowledge

The project proponent estimates that 68 temporary opportunities will be created during the construction phase and 14 permanent opportunities during the operational phase, which will require skilled labour. Based on the community's current literacy profile, it is unlikely that the skilled labour will be sourced locally. Although an overabundance of unskilled labour is available, the proponent estimates that initial local employment will be limited to between 40% and 50% of the total jobs available.

During the **construction** phase of Sendawo 2, the local community members who benefit from temporary employment creation will benefit from certain **skills development** and on the job training. The impact of this training does not end as once an individual has obtained a certain skill it cannot be lost. This will be especially beneficial should a solar PV industry develop in the area since these individuals may now have a higher likelihood of obtaining construction-related employment at one of the other PV developments that may be approved for the area.

Once the Sendawo 2 development is **operational,** it will offer skills development and training with a focus on the community's women and youth, should this be appropriate. The proponent was not yet able to provide more information on any training or skills programme to be implemented. It can however, be assumed that the developer will have to invest into the community in the form of Enterprise Development or Social Development Initiatives to be funded through allocation of a portion of the revenue to be derived by the project during its operations. Some of these activities could entail skills development programmes targeting the broader community.

Should a solar PV industry develop in the Province, the **cumulative** benefit from a skills development perspective, would be twofold.

- Firstly, the individuals obtaining employment (even temporarily) will gain some of the skills required to put them in a position of becoming more attractive for employment at another PV development or permanent employment in the PV sector.
- Secondly, as the range of PV facilities grows in the region, the necessary economies of scale may be reached to justify the development of supporting industries. This will in turn result in a whole new set of skills being developed by other segments of the local community as these supporting businesses grow and employ more individuals.

4.2.3 Impact on health (and nutrition) of the community

Numerous Interested and Affected Parties(I&APs) raised a concern about dust as a result of the required removal of vegetation for the development of the proposed Sendawo 2. It is anticipated that the area will be paved or covered in some way to avoid ongoing dust disturbance to the immediate community. However, some **dust disturbance** may take place during the **construction** period of the proposed Sendawo project and movement of vehicles. This is a short-term impact, however, and expected to be more of a nuisance than a health risk to the people working and residing in the nearby farms.

The magnitude of the dust disturbance experienced by the local community will increase should the other two proposed Sendawo PV facilities also receive environmental authorisation and be implemented. Moreover, the **cumulative impact** across the region is likely to be experienced in an even more magnified manner due to the fact that the various proposed PV developments across the region are unlikely to be constructed at the same time. The fact that construction will take place over a longer period will mean that a dust disturbance is experienced over a longer period. The magnitude and potential significance of such an impact is, however, outside the expertise of the socio-economic specialist and expected to be investigated by the relevant specialist.

Another aspect that should be noted is the potential for increase in sexually transmitted diseases due to the influx of migrant workers and job seekers to the area that may lead to a spike in prostitution in the area. With the greater number of projects being developed in the area, if approved, the influx of job seekers may become more apparent and therefore will lead to a far greater spread of diseases.

On the other hand, it could be argued that the **higher standard of living** achieved through an income generated from working on the project during **construction and operation** of the proposed Sendawo 2 development would lead to **improved nutrition levels** for those local households whose members will be employed by the project. Currently, 12.9% of the Naledi LM's households are not receiving any income, while two thirds of households have to survive on less that R3 200 per month. As higher income is generated within these communities, it can be expected that a higher standard of living would be experienced through variables such as improved nutrition, access to higher quality health care, more varied choices, and options with regard to education, retail etc.

Should more PV facilities develop in the region, it is likely that, on average, the community would experience a **collective increase in living standard, health, and nutrition** as more job opportunities are made available for locals and greater sustainable income increase is experienced. The fact that the developments are likely to be constructed and operated at different times, further increases the **cumulative** benefit to the local community as the positive impact will be experienced over a longer period than just the 20-year lifespan of the Sendawo 2 development.

4.3 Impact on social capital

4.3.1 Impact on social relations (i.e. social ills)

The study area does not possess a sufficiently skilled workforce to supply all the labour requirements for the construction and operation of the proposed PV facility. Some of the unskilled and semi-skilled labour requirements can be procured locally, as mentioned earlier; however, many of the specialised and skilled workers will be migrant workers. Further, in addition to the construction crew, the area's population may increase due to the influx of job seekers.

Unemployed individuals from other areas are likely to migrate to the study area, hopeful of obtaining employment at the Sendawo 2 development during the **construction** phase and, whether successful or not, may stay for the chance of getting employment during the **operational** phase of the project. This may result in a short- to medium-term change in the demographics of the area. As the number of proposed PV facilities receiving authorisation increases, it is likely that the number of job seekers will grow, resulting in a greater **cumulative impact** on demographics.

A change in demographics, especially one that is influenced by the influx of male job seekers, is often associated with an **increase in social pathologies**:

- The influx of people from other parts of the country could result in tension between locals and migrants (who may be of South African and non-south African citizenship) vying for the same job opportunity.
- Moreover, an influx of people from other parts of the Province who are unable to find job opportunities at the project site would likely lead to an increase in criminal activity in the area. Not all of the jobseekers may be able to obtain employment, which may force them to resort to criminal activity and further increase the tension between the local community members and migrant workers and job seekers.

4.3.2 Impact on safety

All of the land owners and interested and affected individuals who were consulted reported that one of their major concerns is the risk to their personal safety and increased possibility of stock theft at their farming operations as a result of an influx of people when construction of the proposed Sendawo 2 PV facility begins.

If expectations surrounding employment provision is not carefully managed by the project proponent, an influx of hopeful job seekers is indeed a common occurrence. As the movement of people increases in the proposed study area, specifically during the **construction period**, the risk of **stock theft or attacks on personal safety** experienced by the impacted community may increase.

Considering the relatively high level of unemployment in the Dr. Ruth S. Mompati DM (35.8%) and the North West Province (31.4%), it is reasonable to state that should word spread of the potential development of a solar PV industry in the study area and its broader region, as more and more proposed developments are approved and implemented, there is likely to be a higher occurrence of an influx of job seekers into the area from other parts of the district and the province at large. The **cumulative impact** would therefore, be that the impact discussed above is experienced in a magnified manner.

The impact is also likely to last beyond the construction period, which would further increase the potential negative cumulative impact. As more people migrate to the community in hope to find employment, it will become increasingly unlikely that they will all find employment and if some do find employment, in most cases it will be of a temporary nature. These individuals may not all be able to return home, or choose to stay as they wait for employment to become available at construction of another PV facility since these facilities will not all be developed at the same time, if approved, or generally look for other opportunities in the area. This will increase the duration of the impact to a medium- to long-term impact.

4.4 Impact on cultural and spiritual capital

The effects on the cultural and spiritual capital of the community can be examined through the review of the changes to the sense of place. Professor Loretta Feris of the University of Cape Town (UCT) explains that the concept “sense of place” consists of three elements: identity, attachment, and dependence (Feris, 2014):

- Identity: the way an individual shapes and places himself with regards to culture and heritage due to that person’s experience of his environment or particular setting.
- Attachment: the symbolic relationship formed by people ascribing shared emotional or cultural meaning to a place, and
- Dependence: the degree to which occupants feel associated with, and dependent on a particular space.

According to Feris (2014), there is little guidance on how the law will protect the health and wellbeing with regard to environmental change in accordance with Section 24 of the Constitution. Protecting the health of the citizens of South Africa is easy to define, however, the well-being concept suggests that social, economic, mental, and emotional factors all play a role. If adapting to this viewpoint, it is clear that it must be accepted that an impacted individual’s wellbeing can be affected by a change in the environment influencing one of these factors.

If accepting the human rights approach as the preferred manner to measure the potential impact of a proposed development on the sense of place, it will necessitate that all the human dynamics of the biophysical place, including dignity and equality, be considered.

Consultation with community leaders in Huhudi (Vryburg’s neighbouring township) revealed that local community members and especially the previously disadvantaged community of the Naledi LM are in dire need of job creation as joblessness is the biggest socio-economic ill facing the community. At the same time, the interview with the directly impacted land owner, Mrs Adele Oberholzer, revealed that the farms used to provide the bulk of the employment in the region and now that farmers are struggling or operations become more automated, the number of community members employed at these farms have drastically decreased, leaving these individuals with limited skills unable to find alternative employment. It could therefore, be argued that the broader community may see the existing land uses of the proposed development site and its adjacent farms as a further sign of the fact that they are being excluded from the potential for wealth creation with the land being owned by a select few.

In the context of the proposed Sendawo 2 development, the potential change in the sense of place and associated impact on cultural capital of the impacted individuals can be analysed on two levels:

- The negative experience of the land owners and indirectly or adjacent land users as an area that they may have used to identify their social and cultural capital is changed from relatively rural to more industrialised, and
- The positive experience for the broader community as they realise that the land will now be used for an activity that could create economic opportunity for them.

None of the interviewed land owners who are most likely to be impacted by the Sendawo 2 development expressed concern regarding the possible change in the sense of place. At the same time, the development of one PV facility will not likely change the broader community’s perception to such a degree that it will impact on the cultural and spiritual capital of these community members. The impact resulting in a **change in the sense of place** as a result of the **construction** of the proposed Sendawo 2 development is therefore, expected to be minimal.

However, a far more significant long-term **cumulative impact** on the **sense of place** of the local communities could ensue as the number of developments receiving approval for construction and operation in the region increases. The sense of place in the area will then be changed from a rural, farming community where the land is perceived by the community to be used to benefit the few with access to it, while the larger community is left in poverty due to joblessness, to an area where economic opportunity exists and investment into the local community is present to stimulate the rest of the economy.

In each case, the potential negative impact on the land owner's cultural capital as the sense of place changes with the commencement of construction will need to be investigated. The cumulative impact is however, expected to be predominantly positive as the cultural and social capital of the majority of the community is likely to increase due to the emergence of a more dignified sense of place over the long-term, as the construction and operation of the various proposed developments continue to transform and develop the region.

4.5 Impact on physical capital

4.5.1 Impact on production

The project proponent estimates that the construction of the proposed Sendawo 2 PV facility will require capital expenditure (CAPEX) of R1.85 billion in 2015 prices. This investment is required for the purchase of the goods, services, and labour needed as inputs to construct the PV facility. It is estimated that 45% of the CAPEX will be spent on procurement from within South Africa; however, considering the specialised nature of most of the goods and services required it is likely that a large portion of this will be sourced from outside the local community and possibly the province in general.

Steps will need to be taken to increase the benefit of **increased production** for the local community during the **construction phase.** This includes measures such as increased levels of local labour procurement, and ensuring that local small businesses are used to provide goods and services where possible. No estimate can be made on what the economic benefit to the local community will be; however, it is likely to be small and last a short-term.

Regardless of the value of local procurement, procurement of inputs required for construction (i.e. good, services or labour) will create multiplier effects through production-induced and consumptions-induced impacts that will further stimulate the local economy and the economy of the country. Procurement of services and goods by the contractor involved in the development of the facility, will temporarily increase the production of domestic companies leading to the production-induced impacts. Some of these impact may be localised in the community depending on the range of services procured by the contractor from local small and medium enterprises. Local community members employed at the construction of the Sendawo 2 facility will temporarily be able to demand and afford purchasing of more personal goods and services, further stimulating the local economy's tertiary industry.

Sendawo 2 will require R1.75 million in annual operating expenditure (OPEX) over the 20-year lifespan of the development. Based on current economic structure of the Naledi LM, it is unlikely that all of this OPEX will be spent in the local economy. However, steps such as those discussed above can be taken to ensure that the local benefit of **increased production during the operation phase** is as high as possible. Multiplier effects will be present as a result of OPEX in the local economy, further increasing the sustainable, long-term benefit to the local economy.

Overtime, as more PV facilities are approved and implemented in the region and the North West Province and the PV industry develop, the economies of scale required to facilitate the development of support businesses could be achieved. It can be assumed that local procurement would then increase significantly by all PV project contractors and owners operating in the region. The **cumulative impact** on **economic production** is therefore, likely to be a significant, sustained, long-term impact.

4.5.2 Impact on road infrastructure

Details on the design and layout of infrastructure associated with Sendawo 2 are not yet known. It can however, be assumed that where required, gravel farm roads would be upgraded to act as formal access roads. If and when applicable, the **upgraded road**s would then benefit the neighbouring farmers who may also be using these roads. This will be a long-term positive effect of the low- to medium- impact that will take effect once **construction** begins.

At the same time, it can be expected that **increased traffic** associated with the construction of the PV facility will temporarily negatively impact on the experience of other road users. The Sendawo proposed project site is located in a rural part of the Province, where a drastic increase in traffic will be noticed and negatively experienced by the local community. This is however, more of a nuisance which can be effectively managed through the correct mitigation measures. The impact associated with Sendawo 2 is only expected to be of a low magnitude short-term **construction phase impact.**

However, should a PV facility develop in the region, the **cumulative impact on road infrastructure** could become more significant if not managed effectively. With construction activities taking place across the LM at different times, the area will experience higher levels of traffic over a longer period, inconveniencing the local road users. Furthermore, should the roads not receive the maintenance required, the increased traffic will contribute to increased and accelerated deterioration of local road infrastructure.

4.5.3 Impact on social facilities

Based on a review of the LM's most recent IDP, the current situation with regard to the provision of social facilities in the Naledi LM is that there is only one hospital in the LM that is located in Vryburg. The LM identified the need for additional hospitals, the IDP also states that the LM does not have sufficient number of HIV counselling facilities.

With an influx of migrant job seekers, especially during the **construction period** of the proposed Sendawo PV facility, the municipality will experience an **increase in demand for personal services** such as health care. Therefore, should expectation of job creation not be properly managed by the project proponent, the development will increase the strain on government to deliver the required social services. The impact directly associated with Sendawo 2 can be expected to be low-medium, and short-term as it should dissipate as construction of Sendawo 2 reaches completion. However, it is also likely that some of the temporary workers and unemployed job seekers will stay in the area, hoping to find employment during the operational phase or seeking other opportunities in the area. Therefore, the impact on social services, particularly health-related services, is likely to extend over the **operational** phase of the proposed project.

Should the other Sendawo PV developments also receive authorisation in conjunction with the other developments planned for the region, a **cumulative impact** of greater magnitude is likely to result. As word spreads of the numerous developments and the PV energy sector starts taking form in the local area, the number of hopeful job seekers to the area will noticeably increase, as mentioned earlier. The fact that construction of the various proposed developments will most likely not take place concurrently means that the impact will be medium- to long-term. The increased pressure on social infrastructure may even become permanent as migrant workers and job seekers settle in the region either waiting for temporary work during construction at one of the sites, or perhaps due to becoming permanently employed at the operation of one of the proposed developments.

4.5.4 Impact on service delivery

The local municipality recognises the housing backlog in Vryburg, where 18.3% of households reside in informal dwellings. In addition to the significant housing backlog, the municipality is also struggling to provide adequate water, electricity, and sewerage services to the LM as a whole, and Vryburg in particular.

Should the proposed Sendawo 2 development be approved, it can be expected that **construction and operation** of the PV facility will lead to the migration of workers and attract some migrant labourers looking for employment opportunities. These people will create a demand for temporary accommodation and basic services. This may lead to the growth of the informal settlement if they do not find the means to sustain themselves (i.e. paid job) and appropriate accommodation. If assessed independently, it is likely that the impact of the Sendawo 2 development will be limited to a low scale short-term impact on service delivery for the duration of the **construction period.** Once construction is complete, the number of migrant workers and job seekers should decrease; however, some may remain in the area, increasing the time during which the negative impact on **service delivery** are experienced by the local authorities.

However, should the other two Sendawo facilities and proposed developments in the region also receive environmental authorisation and be approved for development, the **cumulative impact** on the broader study area will become more substantial. Due to the fact that the various developments are unlikely to begin construction at the same time, the impact will be spread over a longer period, further increasing pressure on the LM. Job seekers may decide to settle in the area, hopeful of finding employment at one of the developments. This will increase the demand for housing provision and the demand for all basic services.

Strategically, though, the proposed project and other proposed PV developments in the region would assist is improving electricity security and reducing transmission losses in the national grid. Moreover, it will advance the mandate of greening the economy by adding 75 MW to the grid in the case of Sendawo 2 alone.

4.6 Impacts on financial capital

4.6.1 Impact on household income and financial resources

It is estimated that two thirds of households in the Naledi LM earn less than R3 200 per month. In Vryburg, the situation is only slightly less dire with 46.4% of households earning R3 200 or less per month.

The project proponent estimates that labour costs associated with the **construction** and the 20-year **operational** period of the proposed Sendawo 2 development will amount to R223.4 million in 2015 prices. Considering the fact that the most likely level of local labour procurement at this stage is between 40% and 50% of available positons, it can be argued that the benefit that will accrue to local community members will be limited. However, the benefitting households will experience an **increase in disposable income**. An increase in disposable income is often associated with an increased standard of living due to factors such as access to better nutrition, improved living conditions, improved ability to make economic choices among others.

To maximise the benefit from the Sendawo 2 development for the local community, local procurement practices can be devised to ensure that, where feasible, local labour, goods, and services are used. Should the other two Sendawo projects and proposed developments in the area receive environmental authorisation, the **cumulative** positive impact will be a marked increase in household income for the local community.

The direct cumulative impact will be that more households will now have access to opportunities, even if temporarily, during the construction of the various proposed developments. Alternatively, the same households will benefit from having a member being employed for a longer period since this worker gains the relative experience at one development and has a better chance to move from one construction site to another construction site. Certain individuals could even secure permanent employment at one of the proposed developments once it is operational, creating a sustained, long-term benefit for the respective households. Indirectly, the cumulative impact could result in additional job creation and a subsequent increase in household income resulting from supporting businesses developing in response to the development of the PV industry in the region.

The impacts discussed will also create various multiplier effects over the long-term as a result of consumption and production induced multipliers. As the local economy grows, the production driving this growth will require increased levels of inputs. The companies and individuals providing these inputs into production will experience an increase in income. While those with a higher disposable income will be creating jobs through their changed consumption patterns.

4.6.2 Impact on property values

The farms located on or near to the proposed development site are mainly used for commercial livestock farming and game breeding. The owners of these farms have indicated that they plan to continue with their commercial agricultural activities regardless of whether the Sendawo 2 PV facility is established or not. Income earned from the potentially affected properties is thus not sensitive to the proposed project. However, concerns relating to dust and water pollution, theft, and personal safety and vegetation were raised by these landowners.

In general, any development with the potential for negative environmental effects could have one of two primary impacts on property values:

- Land value could be reduced based on real or perceived adverse effects of the proposed development such as noise levels; traffic; and aesthetics, or
- The demand for surrounding properties could increase, leading to a rise in the area's property value. This could occur when considering the accessibility to transmission infrastructure and resource potential.

Based on the fact that the farms directly affected by the project's proposed footprint and those in the vicinity will continue with current commercial agriculture activities, it is reasonable to assume that the property values will remain unaffected by the project. Moreover, property values in the LM, and more specifically Vryburg and surrounds, could potentially experience an increase based on the fact that **demand for residential and commercial property** is likely to increase in line with the expected development and growth of the local economy as more of the proposed solar PV developments are approved (**operational and cumulative impacts).**

4.7 Impacts on political and institutional capital

The Naledi LM recognises the significant housing backlog faced by the municipality, specifically in the town of Vryburg. In addition to 16% of the households in the LM residing in informal dwellings, the LM is also not able to provide adequate basic services to its entire population. Furthermore, there is also a recorded lack of sufficient provision of social infrastructure such as health care and sports facilities in the LM.

Should the proposed Sendawo 2 development receive authorisation, the **construction and operation** of the PV facility will **generate revenue for the government**. This will include both the tax-related revenue collected by national government (i.e. VAT, payroll, and income taxes) and tax- and rates-related revenue collected by the local government (i.e. property rates, services rates, etc.).

Although the spending of the money earned by national government through tax collection is difficult to associate with a specific budget item, any revenue received by government is allocated towards certain budget items, provinces or local municipalities to support and assist with the improvement of their service delivery. Increases in local government earnings from rates collected will also assist it in supplementing the revenue derived from national government. Thus, without a doubt, government revenue will be spent on improving socio-economic conditions of the population one way or another. Considering the fact that the revenue collection will continue throughout the various life stages of the proposed Sendawo 2 development, the impact can be considered to potentially have a long-term impact.

The significance of the increase in the local government's ability to deliver services will intensify due to the potential **cumulative impact** of various proposed solar developments receiving approval to be developed within the LM. Each of these developments will lead to an array of rates and taxes collected through various channels, with the same multiplier effects applying to every development's employees and service providers. Importantly, the potential for the local government to benefit significantly from an increased tax base is rooted in the support of the eventual development of the PV industry and associated support businesses in the LM. The income and employment generation that will result from this will produce the revenue streams required for better service provision enabling the LM to potentially become a catalyst for growth and development.

5 IMPACT EVALUATION AND PROPOSED MITIGATION MEASURES

The impact analysis undertaken in the previous section revealed that the following impacts will likely ensue during construction and operations of the proposed Sendawo 2 PV facility, should it be approved for development:

- Impacts that will ensue as a result of construction-related activities, i.e. construction phase impacts:
  - Loss of agricultural land
  - Employment creation
  - Skills development
  - Increase in living standard
  - Increased social pathologies
  - Personal and business safety and security
  - Change in the sense of place
  - Increased production
  - Upgrade of existing road networks
  - Increased traffic
  - Increased demand for social facilities
  - Increased demand for service delivery
  - Increase in disposable income
  - Increased tax revenue for government
- Impacts that will ensure as a result of operational activities, i.e. operational phase impacts:
  - Employment creation
  - Skills development
  - Increase in living standard
  - Increased social pathologies
  - Increased production
  - Increased demand for social facilities
  - Increased demand for service delivery
  - Increase in disposable income
  - Impact on property values
  - Increased tax revenue for government

The following sections evaluate each of the impacts listed above and described in detail in the previous section by making use of the impact ratings methodology as prescribed by the Environmental Assessment Practitioner (EAP) (see Annexure A). It should be noted that some impacts that are to be exerted by activities during construction may remain during the operation phase. In this instance, impacts are analysed under the phase when they were first experienced and their duration reflected over a period that lasts beyond the construction phase.

Where applicable, differentiation between alternatives for selected project components is provided. Otherwise, it implies that the impact will be the same regardless of the alternative chosen for a specific project component.

5.1 Impacts during construction

Table 5-1: Impact Table (construction phase)

Loss of productive agriculture land		
Environmental Parameter	The current economic activity on the directly impacted farm portion is game and cattle farming. Similar commercial agriculture activities are taking place on the farms directly adjacent to the Sendawo 2 array.	
Issue/Impact/Environmental Effect/Nature	Loss of productive agriculture land.	
Extent	The impact is only expected to affect the site.	
Probability	The impact will occur (greater than 75% chance).	
Reversibility	The impact is partly reversible but more intense mitigation is required.	
Irreplaceable loss of resources	The impact will result in significant loss of resources.	
Duration	The impact and its effects will continue and last for the entire operational life of the development, but will be mitigated by direct human action or natural processes thereafter (10 – 50 years).	
Cumulative effect	The impact could contribute towards a significant cumulative effect as the food security is threatened due to lower beef production in the province as more PV facilities are developed.	
Intensity/magnitude	Impact alters the quality, use, and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance rating	**Prior to mitigation measures:** Negative medium: The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** The proposed mitigation measures should achieve the desired low negative rating due to decreased intensity of the impact as the productive land negatively impacted is successfully managed.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	2	2

Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	34	17
Mitigation measures	• Consultation with the directly affected and adjacent land owners must be on-going to limit the effect on productive agriculture land. • The recommendations made by the other relevant specialists must be implemented where possible to ensure that the effects of the impact are minimised. • Areas of high agriculture potential should be avoided to curb the cumulative effect on food security.	
Temporary employment creation		
Environmental Parameter	Skills and literature levels in the Naledi LM is low with high levels of unemployment. The result is that although the area has sufficient labourers it is most likely limited to unskilled opportunities. The local community is not likely to have the skills required for the skilled and highly skilled job opportunities.	
Issue/Impact/Environmental Effect/Nature	The impact will create at least 62 temporary job opportunities for the local community members and up to 130 employment opportunities in total.	
Extent	The impact will affect the local community.	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence).	
Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Short-term – the impact and its effects will disappear once the construction period is over.	
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time.	

Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the high levels of unemployment prevalent in the study area.	
Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** Promoting and ensuring local procurement of labour, goods, and services by the project proponent will increase the significance of the impact to Positive Medium, due to an increase in the intensity of the proposed impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	12	26
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • Public consultation and information sharing will ensure that the proposed development is understood, enabling those individuals with fitting skills, if any, to make their services and/or knowledge available to the project proponent. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation.	
Skills development		
Environmental Parameter	Skills and literature levels in the Naledi LM is low with high levels of unemployment.	
Issue/Impact/Environmental Effect/Nature	Employed individuals will benefit from on-the-job training and experience. No certainty exists at this stage, but the project	

	proponent could initiate skills development as a part of the Enterprise Development and Social Development requirement.	
Extent	The impact will affect the local community	
Probability	The impact will may occur (between 25% and 50% chance of occurrence)	
Reversibility	The effect of the impact (increased experience and knowledge) is unlikely to be reversed.	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Permanent – knowledge and experience cannot be considered to stop over a certain period, the effect of the impact will continue indefinitely.	
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time. Individuals will work and gain experience for longer periods, or more local community members will gain employment.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the current low levels of skills and literacy in the study area.	
Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The proposed mitigation measures should increase the significance of the impact to medium positive impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	4
Reversibility	3	3
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	4	4

Intensity/magnitude	1	2
Significance rating	16	36
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation. • Knowledge sharing and on-the-job training should be viewed as a prerequisite, where feasible, for all contractors/service providers working on the project and employing local labour. • Research should be undertaken to determine the viability of a skills development programme as a part of the Enterprise Development and Social Development initiatives that will have to be implemented by the project proponent.	
Impact on living standard (due to temporary increase in income)		
Environmental Parameter	Living standard, and a community's ability to afford health care and quality nutrition is greatly influenced by the income earned by that community. It is estimated that 12.9% of the households living in the Naledi LM is not receiving any income while two thirds are living on an income of less than R3 200 per month.	
Issue/Impact/Environmental Effect/Nature	About 130 in total and 62 employment opportunities for the local community members will be created. The individuals hired for these positions, and their family members, will experience a temporary increase in living standards due to an increase in disposable income, albeit temporarily and short term.	
Extent	The impact will affect the local community	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)	
Reversibility	The positive effects of the impact is completely reversible, will cease to exist once the construction phase is completed.	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Short term, the higher standard of living resulting from the increased disposable income is temporary, as the employment generating the income is temporary.	
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time. Employed	

	individuals and their families will benefit from higher income for longer.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the employment creation in relation to the high levels of joblessness.	
Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The mitigation, although positive measures to increase local benefit, does not change the significance of the impact's effect.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	12	12
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation.	
Temporary increase in social pathologies		
Environmental Parameter	Large construction activities associated with projects such as these often attract large numbers of hopeful job seekers, which result in a change in demographics of the area, which is often associated with an increase in social pathologies or ills.	
Issue/Impact/Environmental Effect/Nature	Although temporary in nature, the construction activities may attract migrant workers and job seekers if expectations are not managed.	

Extent	The impact will affect the local community	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)	
Reversibility	The impact is reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in significant loss of resources.	
Duration	Medium term – the impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter.	
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time. Migrant job seekers may therefore decide to stay in the area for longer with the activities attracting even more work seekers, making the changes of not finding employment even greater.	
Intensity/magnitude	Impact alters the quality, use, and integrity of the system but the system still continues to function in a moderately modified way and maintains general integrity.	
Significance rating	**Prior to mitigation measures:** Negative medium impact: the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the mitigation measures decreases the significance rating resulting in an impact rating of negative low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	3
Duration	2	2
Cumulative effect	4	4

Intensity/magnitude	2	1
Significance rating	32	16
Mitigation measures	• Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers.	
Impact on safety and security		
Environmental Parameter	The study area is characterised by rural nature. All of the land owners expressed concern about the increase of human movement and the impact this may have on their personal and business security.	
Issue/Impact/Environmental Effect/Nature	Although temporary in nature, the construction activities may attract migrant workers and job seekers if expectations are not managed. All of these individuals will nor find employment with some of them deciding to stay in the area the risk of crime increases.	
Extent	The impact will affect the local area or district.	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)	
Reversibility	The impact is reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in marginal loss of resources.	
Duration	Medium term – the impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter.	
Cumulative effect	The impact could contribute towards a significant cumulative effect since temporary job opportunities on offer will increase and be available over longer time periods as the construction of the various facilities will not be taking place at the same time. Migrant job seekers may therefore decide to stay in the area for longer with the activities attracting even more work seekers, making the changes of not finding employment even greater.	
Intensity/magnitude	Impact alters the quality, use, and integrity of the system but the system still continues to function in a moderately modified way and maintains general integrity.	
Significance rating	**Prior to mitigation measures:**	

	Negative medium impact: the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the mitigation measures decreases the significance rating resulting in an impact rating of negative low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	30	14
Mitigation measures	• Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers. • During construction the rules and regulations must be clearly communicated to all workers, personal property must be respected and avoided. • Manage workers to ensure that they are only on site during the reasonable working hours.	
Change in the sense of place		
Environmental Parameter	"Sense of place" consists of three elements: identity, attachment and dependence, with these aspects together impacting on an individual's cultural capital.	
Issue/Impact/Environmental Effect/Nature	The directly and indirectly affected land owners will experience a negative change in sense of place, albeit small. This is not a concern raised at all during consultation with the land owners.	
Extent	The impact will affect the local area or district.	
Probability	The impact will certainly occur (greater 75% chance of occurrence).	

Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in marginal loss of resources.	
Duration	Permanent – The impact can be considered indefinite.	
Cumulative effect	The cumulative impact on the sense of place could be a significant positive impact since the broader community's perception on the land use of the proposed site will be changed to a land use that create opportunities for all.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system/component in a way that is barely perceptible.	
Significance rating	**Prior to mitigation measures:** Negative low impact: the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the mitigation measures decreases the significance rating, however, the impact remains to be rated as negative low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	4	4
Cumulative effect	4 (positive)	4 (positive)
Intensity/magnitude	1	1
Significance rating	18	15
Mitigation measures	• Adhere to the mitigation measures recommended by the visual, noise, and air quality specialists, this will limit the negative impact on sense of place of the directly and indirectly affected community members. • Ensure that expectations are carefully managed so that the perception of the proposed land use is not negatively affected	

	by community members who feel that promises made have not been kept.	
Temporary increase in production		
Environmental Parameter	The project requires capital investment during the construction phase, this CAPEX investment will stimulate the South African economy and create various other multiplier effects for production. The benefit to the local community will, however, be limited due to the specialised nature of the bulk of the inputs required.	
Issue/Impact/Environmental Effect/Nature	It is expected that 45% of the R1.85 billion CAPEX requirement will be spent in South Africa, the local spent is not known.	
Extent	The impact will affect the entire country.	
Probability	The impact will certainly occur (greater 75% chance of occurrence).	
Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Short term: the impact will continue for the duration of the construction period.	
Cumulative effect	The impact could result in a significant cumulative impact. The national economy will be stimulated by the various investments. At the same time, the local economy may be able to achieve the economies of scale required for the development of a local support industry, increasing the benefit to the local economy.	
Intensity/magnitude	High, the investment value is considerate.	
Significance rating	**Prior to mitigation measures:** Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** No mitigation exists that will increase the significance rating of the impact. However, certain measures may be implemented that will increase the benefit to the local economy.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1

Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	45	45
Mitigation measures	• Where possible and feasible, local procurement of labour, goods, and services must be practiced to maximise the benefit to the local economy.	
Upgrading of existing local road infrastructure		
Environmental Parameter	The existing tarred roads are of a fair quality, however, some gravel roads exist which may be upgraded due to the project's associated infrastructure requirements.	
Issue/Impact/Environmental Effect/Nature	At this stage the layout and design of the infrastructure associated with Sendawo 2 is not known, however, it can be expected that some of the gravel roads in the area will be updated to accommodate the proposed development.	
Extent	The impact will only affect the site.	
Probability	The impact may occur (between 25% and 50% chance of occurrence).	
Reversibility	The impact is partly reversible	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Medium term: the upgrading of some roads may coincide with the construction of the proposed Sendawo 2 development. However, maintenance of the road networks cannot reasonably be expected to be the responsibility of the project proponent.	
Cumulative effect	The impact will result in insignificant cumulative effects.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Positive low impact. The anticipated impact will have minor positive effects. **After mitigation measures:**	

	No mitigation exists for this impact, the rating remains at low positive.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	20	20
Mitigation measures	No mitigation measures exist.	
Temporarily increased traffic and the impact on road infrastructure		
Environmental Parameter	The traffic observed during the site visit is that what would be perceived to be common for a relatively quiet farming area. Big trucks were observed on a regular basis though, on the national routes closest to the proposed study area.	
Issue/Impact/Environmental Effect/Nature	The construction of the proposed Sendawo 2 facility can be expected to impact on the amount of traffic on the local road network and could contribute toward sits deterioration.	
Extent	The impact will only affect the local area/district	
Probability	The impact may occur (between 25% and 50% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact may result in marginal loss of resources.	
Duration	Short term: the impact and its effects will cease to exists once the construction period is completed.	
Cumulative effect	The impact could result in a significant cumulative impact. The development and construction of numerous PV facilities in the area	

	would impact on the traffic numbers in the area and thus also the increased need for maintenance of the local road infrastructure	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Negative low impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measure would retain the rating.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	26	13
Mitigation measures	• Where feasible implement the mitigation measures recommended by the various other specialists to minimise the negative impacts of increased traffic during the construction period. • Limit construction activity to normal working hours and avoid activity over weekends.	
Increased demand for social facilities		
Environmental Parameter	The status quo in the area with regards to the provision of social infrastructure is that the study area does not have sufficient health infrastructure.	
Issue/Impact/Environmental Effect/Nature	If unmanaged, expectations about job opportunities during the construction of the proposed project may attract numerous migrant workers. The result will be increased pressure on the local social facilities.	
Extent	The impact will affect the local area.	

Probability	The impact will likely occur (between 50% and 75% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Medium term, the effect may last slightly longer than the construction phase since some migrant job seekers could linger in the area.	
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the job creation during construction of the projects will increase. At the same time, the construction is not likely to all take place at the same time, increasing the length of the impact by acting as motivation for migrants to remain in the area longer in hopes of finding employment.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Negative medium impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measure would retain the rating.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	28	13
Mitigation measures	• Ensure effective communication of the project information throughout all stages to effectively manage expectations.	

	• Ongoing consultation with the municipality to prepare local authorities for the activity and the increase demands that may result from this.	
Impact on service delivery		
Environmental Parameter	The Naledi LM has a housing backlog of 18%. Furthermore, there is also problems with the provision of adequate water, electricity, and sewerage provision.	
Issue/Impact/Environmental Effect/Nature	If unmanaged, expectations about job opportunities during the construction of the proposed project may attract numerous migrant workers. The result will be increased pressure on the local authorities to adequately provide basic services.	
Extent	The impact will affect the local area.	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Medium term, the effect may last slightly longer than the construction phase since some migrant job seekers could linger in the area.	
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the job creation during construction of the projects will increase. At the same time, the construction is not likely to all take place at the same time, increasing the length of the impact by acting as motivation for migrants to remain in the area longer in hopes of finding employment.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Negative low impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measure would retain the rating.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2

Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	28	13
Mitigation measures	• Ensure effective communication of the project information throughout all stages to effectively manage expectations. • Ongoing consultation with the municipality to prepare local authorities for the activity and the increase demands that may result from this.	
Temporary increase in household disposable income		
Environmental Parameter	It is estimated that two thirds of the households in the Naledi LM earn less than R3 200 per month.	
Issue/Impact/Environmental Effect/Nature	An estimated minimum of 62 households in the Naledi LM may temporarily benefit from an increase in disposable income directly as a result of the proposed development. Since skilled labour will come from outside the local area, and even the province it can be stated that the rest of the impact's effects will be felt in the rest of South Africa.	
Extent	The impact will affect the country	
Probability	The impact will certainly occur (greater than 75% chance of occurrence).	
Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Short term, the increased disposable income will disappear once the construction is completed.	
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the job creation during construction of the projects will increase. At the same time, the construction is not likely to all take place at the same time, increasing the length of the	

	impact. The benefitting households will benefit for longer or more households will benefit.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** The proposed mitigation measures will increase the benefit to the local community but will not change the significance rating of the impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	30	30
Mitigation measures	• Where possible, local labour should be used during the construction activities. • When feasible local procurement of goods and services should be implemented to further increase the benefit to the local community.	
Temporary increase in tax revenue for government		
Environmental Parameter	The government will benefit from an increased local tax base in the Naledi LM due to the proposed investment. This will increase the ability of the government to deliver on basic services.	
Issue/Impact/Environmental Effect/Nature	The project proponent will have to pay taxes such as income taxes and payroll taxes. It cannot be said with certainty how this income will be applied, however, the government will no doubt utilise it to better service provision somewhere in South Africa.	
Extent	The impact will affect the entire country	

Probability	The impact will certainly occur (greater than a 75% chance of occurrence).	
Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Short term, the increase in government revenue linked to the construction of the development will cease once construction is completed.	
Cumulative effect	The impact could result in a significant cumulative impact.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** No mitigation measures exist the impact rating will thus remain positive medium.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	30	30
Mitigation measures	No mitigation measures exist.	

5.2 Impacts during operations

Table 5-2: Impact Table (operations phase)

Employment creation

Environmental Parameter	Skills and literature levels in the Naledi LM is low with high levels of unemployment. The result is that although the area has sufficient labourers it is most likely limited to unskilled opportunities. The local community is not likely to have the skills required for the skilled and highly skilled job opportunities.	
Issue/Impact/Environmental Effect/Nature	It is most likely that the project will create at least 29 permanent employment opportunities for local community members. An additional 14 jobs will be created for skilled positions, which may need to be filled by workers from outside the local community.	
Extent	The impact will affect the local community	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)	
Reversibility	The impact is completely reversible	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Long term: the impact and its effects will continue and last for the entire operational life of the development.	
Cumulative effect	The impact could contribute towards a significant cumulative effect since the region may develop a PV industry which would improve the local skills base, in addition the supporting businesses would then create additional job opportunities.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the high levels of unemployment prevalent in the study area.	
Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The impact rating will stay the same.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1

Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	12	28
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • Public consultation and information sharing will ensure that the proposed development is understood, enabling those individuals with fitting skills, if any, to make their services and/or knowledge available to the project proponent. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation.	
Skills development		
Environmental Parameter	Skills and literature levels in the Naledi LM is low with high levels of unemployment.	
Issue/Impact/Environmental Effect/Nature	Permanently employed individuals (43) will benefit from on-the-job training and experience. No certainty exists at this stage, but the project proponent could initiate skills development as a part of the Enterprise Development and Social Development requirement.	
Extent	The impact will affect the local community	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)	
Reversibility	The effect of the impact (increased experience and knowledge) is unlikely to be reversed.	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Permanent – knowledge and experience cannot be considered to stop over a certain period, the effect of the impact will continue indefinitely.	
Cumulative effect	The impact could contribute towards a significant cumulative effect as a PV facility develops in the area due to economies of scale being achieved.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the current low levels of skills and literacy in the study area.	

Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The proposed mitigation measures should increase the significance of the impact to medium positive impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	4
Reversibility	3	3
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	17	34
Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation. • Knowledge sharing and on-the-job training should be viewed as a prerequisite, where feasible, for all contractors/service providers working on the project and employing local labour. • Research should be undertaken to determine the viability of a skills development programme as a part of the Enterprise Development and Social Development initiatives that will have to be implemented by the project proponent.	
Impact on living standard		
Environmental Parameter	Living standard, and a community's ability to afford health care and quality nutrition is greatly influenced by the income earned by that community. It is estimated that 12.9% of the households living in the Naledi LM is not receiving any income while two thirds are living on an income of less than R3 200 per month.	
Issue/Impact/Environmental Effect/Nature	A total of 43 households will benefit from the project, of which 29 will most definitely come from the local community. These	

	individuals, and their family members, will experience an increase in living standards due to an increase in disposable income, in a sustained long term manner.	
Extent	The impact will affect the local community	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)	
Reversibility	The positive effects of the impact are completely reversible	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Long term: the impact and its affects will continue and last for the entire operational life of the development.	
Cumulative effect	The impact could contribute towards a significant cumulative effect as a local PV facility develops over time.	
Intensity/magnitude	Impact affects the quality, use, and integrity of the system in a way that is barely perceptible. Low intensity considering the employment creation in relation to the high levels of joblessness.	
Significance rating	**Prior to mitigation measures:** Positive low impact: the anticipated impact will have minor positive effects. **After mitigation measures:** The mitigation, although positive measures to increase local benefit, does not change the significance of the impact's effect.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	14	14

Mitigation measures	• Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community. • If possible, goods and services should be procured from local small businesses; this will stimulate indirect job creation.
Increased social pathologies	
Environmental Parameter	Migrant job seekers attracted to the area during the construction of the proposed project may stay in the area into the operational phase of the project, which result in a more permanent change in demographics of the area, which is often associated with an increase in social pathologies or ills.
Issue/Impact/Environmental Effect/Nature	Migrant job seekers attracted to the construction of the proposed project, and even some of those temporarily employed during construction may decide to stay in the area longer in hopes of finding permanent employment.
Extent	The impact will affect the local area
Probability	The impact will likely occur (between 50% and 75% chance of occurrence)
Reversibility	The impact is reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will result in significant loss of resources.
Duration	Long term – The impact and its effects will continue and last for the entire operational life of the development.
Cumulative effect	The impact could contribute towards a significant cumulative effect. Migrant job seekers may therefore decide to stay in the area for longer with the activities attracting even more work seekers, making the changes of not finding employment even greater.
Intensity/magnitude	Impact alters the quality, use, and integrity of the system but the system still continues to function in a moderately modified way and maintains general integrity.
Significance rating	**Prior to mitigation measures:** Negative medium impact: the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the mitigation measures decreases the significance rating resulting in an impact rating of negative low.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	34	16
Mitigation measures	• Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers.	
Increase in production		
Environmental Parameter	Once operational the project will incur operation expenditure which will benefit the South African economy and create various other multiplier effects for production. The benefit to the local community will, however, be limited due to the specialised nature of the bulk of the inputs required.	
Issue/Impact/Environmental Effect/Nature	The OPEX associated with the proposed Sendawo 2 development is expected to be roughly R1.75 billion in 2015 prices over the 20-year lifespan of the project. South African procurement is 45% with local procurement unsure but estimated to be limited due to the specialised nature of the inputs required.	
Extent	The impact will affect the entire country.	
Probability	The impact will certainly occur (greater 75% chance of occurrence).	
Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources	
Duration	Long term – the impact and its effects will continue and last for the entire operational life of the development.	
Cumulative effect	The impact could result in a significant cumulative impact. The national economy will be stimulated by the various investments. At the same time, the local economy may be able to achieve the	

	economies of scale required for the development of a local support industry, increasing the benefit to the local economy.	
Intensity/magnitude	Medium considering the investment value is for the entire 20-year lifespan of the project.	
Significance rating	**Prior to mitigation measures:** Positive low impact. The anticipated impact will have minor positive effects. **After mitigation measures:** No mitigation exists that will increase the significance rating of the impact. However, certain measures may be implemented that will increase the benefit to the local economy.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	26	26
Mitigation measures	• Where possible and feasible, local procurement of labour, goods, and services must be practiced to maximise the benefit to the local economy.	
Increased demand for social facilities		
Environmental Parameter	The status quo in the area with regards to the provision of social infrastructure is that the study area does not have sufficient health infrastructure.	
Issue/Impact/Environmental Effect/Nature	Some migrant workers may stay in on in the area with the hopes of finding permanent employment, increasing pressure on local authorities.	
Extent	The impact will affect the local area.	

Probability	The impact will likely occur (between 50% and 75% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Long term, the impact and its effects will continue and last for the entire operational life of the development.	
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the job creation during construction of the projects will increase which would attract more individuals hopeful of finding permanent employment.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Negative medium impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measure could decrease he rating to negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	30	15
Mitigation measures	• Ensure effective communication of the project information throughout all stages to effectively manage expectations.	

	• Ongoing consultation with the municipality to prepare local authorities for the activity and the increase demands that may result from this.	
Impact on service delivery		
Environmental Parameter	The Naledi LM has a housing backlog of 18%. Furthermore, there is also problems with the provision of adequate water, electricity, and sewerage provision.	
Issue/Impact/Environmental Effect/Nature	If unmanaged, migrant workers will stay in the area post the construction phase and even more workers may be attracted to the area in the hopes of finding permanent employment. The result will be increased pressure on the local authorities to adequately provide basic services.	
Extent	The impact will affect the local area.	
Probability	The impact will likely occur (between 50% and 75% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Long term, the impact and its effects will continue and last for the entire operational life of the development.	
Cumulative effect	The impact could result in a significant cumulative impact. As an industry is developed in the area more migrant workers will settle there, hoping to find permanent employment.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Negative medium impact. The anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** Implementation of the proposed mitigation measure could decrease he rating to negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	2

Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	30	14
Mitigation measures	• Ensure effective communication of the project information throughout all stages to effectively manage expectations. • Ongoing consultation with the municipality to prepare local authorities for the activity and the increase demands that may result from this.	
Increased household disposable income		
Environmental Parameter	It is estimated that two thirds of the households in the Naledi LM earn less than R3 200 per month.	
Issue/Impact/Environmental Effect/Nature	At least 29 households from the local community may benefit from a sustained increase in disposable income directly as a result of the proposed development. Since skilled labour will come from outside the local area, and even the province it can be stated that the rest of the impact's effects will be felt in the rest of South Africa.	
Extent	The impact will affect the local area	
Probability	The impact will certainly occur (greater than 75% chance of occurrence).	
Reversibility	The impact is completely reversible	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Long term – the impact and its effects will continue and last for the entire operational life of the development.	
Cumulative effect	The impact could result in a significant cumulative impact. As more projects are approved, the local area will be able to develop a supporting industry due to economies of scale. Increasing the number of local community members who can benefit.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:**	

	Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** The proposed mitigation measures will increase the benefit to the local community but will not change the significance rating of the impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	30	30
Mitigation measures	• Where possible, local labour should be used. • When feasible local procurement of goods and services should be implemented to further increase the benefit to the local community.	
Impact on property values		
Environmental Parameter	Any development with the potential for negative environmental impacts will have an impact on property values in the area.	
Issue/Impact/Environmental Effect/Nature	It is expected that the demand for residential and commercial property will increase in line with the economic stimulation and development that the project will result in, increasing property value in the region.	
Extent	The impact will affect the local area.	
Probability	The impact may occur (between an 25% and 50% chance of occurrence).	
Reversibility	The impact is partly reversible	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	

Duration	Long term – the impact and its effects will continue and last for the entire operational life of the development	
Cumulative effect	The impact could result in a significant cumulative impact.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Positive low impact. The anticipated impact will have marginal positive effects. **After mitigation measures:** No mitigation measures exist the impact rating will thus remain positive low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	28	28
Mitigation measures	No mitigation measures can be applied.	
Increased government tax revenue		
Environmental Parameter	The government will benefit from an increased local tax base in the Naledi LM due to the proposed investment. This will increase the ability of the government to deliver on basic services.	
Issue/Impact/Environmental Effect/Nature	The project proponent will have to pay taxes such as income taxes and payroll taxes. It cannot be said with certainty how this income will be applied, however, the government will no doubt utilise it to better service provision somewhere in South Africa.	
Extent	The impact will affect the entire country	

Probability	The impact will certainly occur (greater than a 75% chance of occurrence).	
Reversibility	The impact is completely reversible.	
Irreplaceable loss of resources	The impact will not result in any loss of resources.	
Duration	Long term, the impact and its effects will last and continue for the operational span of the project	
Cumulative effect	The impact could result in a significant cumulative impact.	
Intensity/magnitude	Medium, the quality and use will be slightly modified and affected.	
Significance rating	**Prior to mitigation measures:** Positive medium impact. The anticipated impact will have moderate positive effects. **After mitigation measures:** No mitigation measures exist the impact rating will thus remain positive medium.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	34	34
Mitigation measures	No mitigation measures exist.	

6 NEEDS AND DESIRABILITY FROM A LOCATIONAL PERSPECTIVE

The following table outlines the need and desirability of the proposed project from a locational perspective. It informs the justification of the project to be built in the proposed time and location from a socio-economic perspective.

Table 6-1: needs and desirability from a locational perspective

Aspect	Comment
Creation of residential and employment opportunities in close proximity to or integrated with each other	The proposed Sendawo 2 development will be developed in an area that is situated relatively close to the established settlement of Huhudi and the town of Vryburg. The employment opportunities created at Sendawo 2 should therefore aid integration of these two variables.
Reduced the need for transport of people and goods	The project will create new employment opportunities that will be filled either by locals or by migrant workers who will have to settle in the nearby communities of Vryburg and Huhudi. Due to the unemployment situation in these areas, the provision of new job opportunities may reduce the need of some of the members of local communities to commute long distances for work or in search of jobs.
Access to public transport or enable non-motorised and pedestrian transport	The project is not expected to aid in achieving this goal.
Complimenting other uses in the area	The dominant land use in the area is commercial agriculture. However, there are various other PV facilities at different stages of the application and approval process in the area. The area is not considered to be high potential agriculture land; the change in land use should therefore not be viewed as significant, especially if managed well. Solar PV facilities are also not perceived to be of heavy or hazardous build, although they do change the sense of place in the areas. Nonetheless, numerous similar facilities have already been successfully constructed in the Northern Cape and the Free State with similar surrounding land uses. Thus, here is empirical evidence that such facilities integrate well with commercial livestock farming activities.
Alignment with planning for the area	The review of applicable key policy documents revealed that all spheres of government support the establishment of the proposed project at the envisaged location. No red flags could be identified that could raise a concern over the project's development from a policy perspective. Although care will have to be taken to ensure that the establishment and growth of activities identified as drivers of economic development in the study area are not unduly negatively impacted by the establishment of the project in the proposed region.

Aspect	Comment
Use of underutilised land available (only for urban related development)	N/A
Optimisation of the use of existing resources and infrastructure	The resource potential of the land where the proposed project is to be built is considered to be limited. It cannot be used for crop farming and can only be used for livestock farming. The production and employment to be created by the propose project is expected to be greater than that created by the current activities on site. Moreover, the proposed project is not envisaged to negatively impact these activities, as they will be moved to a different location. Therefore, the project offers an opportunity to improve the product of the land, as a resource, where the proposed development is to be located. Furthermore, the proposed project site is located in close proximity to the Mookodi MTS, making connection to the national grid more feasible. If approved, it will also aid in the decrease of transmission losses on the national grid.
Discouragement of "urban sprawl" and contribute to compaction/densification	The project is not envisaged to have any direct effect on urban sprawl. The project will employ local community members and will require relocation of skilled employees and their families from other areas. However, the number of families that will need to be relocated is not envisaged to of such significance as to lead to “urban sprawl” in the nearby township and the town.
Contribution to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current need	The proposed development will assist in bringing employment opportunities closer to the communities who were previously more removed from economic opportunities.
Encouragement of environmentally sustainable land development practices and processes	The proposed project is aligned with the advancement of RE initiatives in the country. However, care should be taken to ensure that food security is not adversely impacted by the loss of productive agricultural land as the cumulative impact of the project increases.
Consideration of special locational factors that might favour the specific location	The North West Province is considered to be ideal for the development of Solar PV energy facilities.
Generation of the highest socio-economic returns	The proposed development will most likely generate a more beneficial socio-economic return than the current land use. More local community members will find employment. It will also generate higher income and production than the current land uses, thus stimulating the local and national economies to a greater degree. Once again the only potential concern may be that f food security as agricultural land suitable for

Aspect	Comment
	livestock grazing will be lost. However, as mentioned, this project itself should not result in significant losses in the production of meat in the country.
Impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area	The farming activities in the area are no longer able to create the amount of employment opportunities as was previously the case. The result is that a small number of farmers are able to use the land to produce and create income with limited opportunities offered to the rest of the local community. The broader community may therefore view the change in land use as a result of the proposed project development as positive since it will benefit them in terms of greater employment opportunities and stimulation of SMMEs.
Promotion or contribution to create a more integrated settlement	The project will create employment opportunities for the local communities, which may reduce the need of some of the people to look for these in other more remote locations. Furthermore, the project is likely to investment in the community development through Socio-Economic Development and enterprise Development contributions during its operation. These could further improve the universal access to services and various facilities in the area and aid in creating a more integrated community.

7 CONCLUSION

BioTherm proposes the development of the Sendawo 2 Solar PV energy facility near Vryburg in the North West Province. It is intended that the PV facility, with a 75 MW export capacity and its associated infrastructure, will be established on Portion 1 of Farm Edinburgh 735. BioTherm is furthermore, proposing the development of two more PV facilities on Portion 1 of Farm Edinburgh 735. Sendawo 2, or all three Sendawo developments, should they all receive authorisation, will be connected to the onsite Sendawo substation. Grid access will be via the Mookodi MTS.

The review of applicable key policy documents revealed that all spheres of government support the establishment of the proposed project at the envisaged location. No red flags could be identified that could impact the project from a policy perspective, although care will have to be taken to ensure that the establishment and growth of activities identified as drivers of economic development in the study area is not unduly negatively impacted by the establishment of the project in the proposed region.

The local community of Vryburg, and the Naledi LM at large, is faced with significant levels of illiteracy, high unemployment, and limited economic opportunities. It is estimated that two thirds of the households residing within the LM survive on less than R3 200 per month. Consultation with community leaders revealed that the most significant socio-economic challenge facing the population of the study area is the lack of employment opportunities. This was confirmed during the consultation with the directly impacted land owner, who stated that the farmers are no longer able to employ as many local community members as previously, leaving these individuals with limited other skills and opportunities for re-employment.

Portion 1 of Farm Edinburgh 735 is currently being used for predominantly livestock farming and game breeding. The proposed development will not affect these operations, as they are expected to be moved to the adjacent farm. Overall, the impacts discussion and evaluation revealed that no fatal flaws are present from a socio-economic perspective, preventing the proposed development from being approved and implemented. In fact, as can be seen from Table 7-1 that all of the expected negative socio-economic impacts can be mitigated to low significance.

Table 7-1: Post mitigation impact significant ratings

Construction phase		Operations phase	
Impact	**Post mitigation significance rating**	**Impact**	**Post mitigation significance rating**
Loss of productive agriculture land	Negative low (17)	Employment creation	Positive low (28)
Temporary employment creation	Positive low (26)	Skills development	Positive medium (34)
Skills development	Positive medium (36)	Increase in living standard	Positive low (14)
Temporary increase in living standard	Positive low (12)	Increased social pathologies	Negative low (16)
Temporary increase in social pathologies	Negative low (16)	Increase in production	Positive low (26)
Impact on business and personal security	Negative low (14)	Increased demand for social facilities	Negative low (15)

Construction phase		Operations phase	
Change in sense of place	Negative low (15)	Impact on service delivery	Negative low (14)
Temporary increase in production	Positive medium (45)	Increase in household disposable income	Positive medium (30)
Upgrading of existing local road infrastructure	Positive low (20)	Increased property values	Positive low (28)
Temporary increase in traffic	Negative low (13)	Increase in government revenue	Positive medium (34)
Increased demand for social facilities	Negative low (13)		
Impact on basic service delivery	Negative low (13)		
Temporary increase in household disposable income	Positive medium (30)		
Temporary increase in tax revenue for government	Positive medium (30)		

With respect to the proposed alternatives for selected project components, no differentiation thereof from a socio-economic respective can be made. As such, all alternatives will be considered as having NO PREFERENCE.

Table 7-2: Comparison of alternatives

Alternative	Preference	Reasons
OPERATIONS BUILDING AND SUBSTATION		
Sendawo PV 2 Operations Building and Substation Alternative 1	NO PREFERENCE	No differentiation from a socio-economic perspective
Sendawo PV 2 Operations Building and Substation Alternative 2	NO PREFERENCE	No differentiation from a socio-economic perspective
LAYDOWN AREA		
Sendawo PV 2 Laydown Area Alternative 1	NO PREFERENCE	No differentiation from a socio-economic perspective
Sendawo PV 2 Laydown Area Alternative 2	NO PREFERENCE	No differentiation from a socio-economic perspective

Overall, considering the fact that the significance of the possible positive impacts of the proposed development outweighs the negative impacts, and based on the needs and desirability assessment from a locational perspective, it can be concluded that the project would generate positive socio-economic returns for the local economy and its community and should therefore, be considered for implementation. However, considering the possible cumulative impact of the project and the potential effect on food security, care should be taken to not unduly negatively impact on agriculture production in the region. Based on the fact that the land is not considered as high potential agricultural land and the consultation with the impacted land owner, this is not a significant concern for the development of Sendawo 2, assuming mitigation measures are implemented.

ANNEXURE A: IMPACT RATING CRITERIA AND METHODOOGY

The rating system will be applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts will be consolidated into one rating. In assessing the significance of each issue the following criteria is used:

Table 1: Description of terms

Nature		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
Geographical Extent		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such, bracketing ranges are often required. This is often useful during a detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
Probability		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (less than 25% chance of occurrence).
2	Possible	The impact may occur (between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (greater than a 75% chance of occurrence).
Reversibility		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures

2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
Irreplaceable Loss of Resources		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resource	The impact will result in significant loss of resources.
4	Complete loss of resource	The impact results in a complete loss of all resources.
Duration		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue and last for the entire operational life of the development, but will be mitigated by direct human action or natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (indefinite).
Cumulative Effect		

This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects.
Intensity/Magnitude		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use, and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use, and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity, and functionality of the system or component is severly impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very High	Impact affects the continued viability of the system/component and the quality, use, integrity, and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation is often impossible. If possible rehabilitation and remediation is often unfeasible due to extremely high costs of rehabilitation and remediation.
Significance		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:		

(Extent + Probability + Reversibility + Irreplaceability + Duration + Cumulative Effect) x Magnitude/Intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
6 - 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 - 28	Positive low impact	The anticipated impact will have minor positive effects.
29 - 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 - 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 - 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 - 73	Positive high impact	The anticipated impact will have significant positive effects.
74 - 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered “fatal flaws”.
74 - 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

REFERENCES

Chief Surveyor-General. (2016, February 11). Spatial Cadastral Data. Retrieved from Chief Surveyor-General.

Department of Economic Development. (2010). The New Growth Path: The Framework.

Department of Economic Development, Environment, Conservation, and Tourism. (2008). North West Provincial Spatial Development Framework and Environmental Management Plan . *Vol 7/8 of the North West Environmental Management Series*.

Department of Economic Development, Environment, Conservation, and Tourism. (2012). Renewable Energy Strategy for the North West Province.

Department of Minerals and Energy. (2003). White Paper on Renewable Energy.

Dr. Ruth Segomotsi Mompati DM. (2015/16). Integrated Devlopment Plan: Third generation.

Feris, P. L. (2014). A Sense of Place: New frontiers for the law. *UCT Inaugural lectures*.

Modise, M. (2013). Overview of Renewable Energy Roadmap - Public workshop on Draft Integrated Energy Planning Report. Department of Energy.

Naledi Local Municipality. (2013). Integrated Development Plan 2012 - 2017.

National Planning Commission. (2011). National Development Plan 2010 - 2030.

North West Planning Commission. (2013). North West Provincial Development Plan 2030.

North West Province: Office of the Premier. (2004). North West Provincial Growth and Development Strategy (2004 - 2014).

Quantec. (2014). Standard Regionalised Data Series.

Republic of South Africa. (2008). National Energy Act.

Republic of South Africa. (2011). Integrated Resource Plan for South Africa (2010 - 2030).

Stats SA. (2012). National Census 2011.

The Cumulative Effects Assessment Working Group. (1999). *Cumulative Effects Assessment Practitioners Guide.* Canadian Environmental Assessment Agency.

The Presidency of the Republic of South Africa. (2006). National Spatial Development Perspective.

Urban-Econ . (2016). GIS Department.

Appendix 6H:

Traffic Assessment

Sendawo 2 PV Energy Facility

TRANSPORT STUDY AND TRAFFIC IMPACT ASSESSMENT

Reference: 112509

Prepared for: BioTherm Energy (Pty) Ltd.

Revision: 3

10 May 2016

Document control record

Document prepared by:

Aurecon South Africa (Pty) Ltd

Aurecon Centre

1 Century City Drive

Waterford Precinct
Century City, Cape Town, 7441

T +27 21 526 9400
F +27 21 526 9500
E capetown@aurecongroup.com
W www.aurecongroup.com

Document control							aurecon
Report title		TRANSPORT STUDY AND TRAFFIC IMPACT ASSESSMENT					
Document ID		BTE\SendawoPV\TIA	**Phase number**		112509		
File path		P:\Projects\112509 BioTherm Energy- Solar Facilities\03 PRJ Del\6 REP\Tlisiiteng&Sendawo PV - TIA\BTE_Sendawo_SolarFacility_TIA_Mar2016_R3_S2.docx					
Client		BioTherm Energy (Pty) Ltd.	**Client contact**		**Hleziphi Mtshizana**		
Rev	**Date**	**Revision details/status**	**Prepared by**	**Author**	**Verifier**	**Approver**	
1	**31 March 2016**	First Draft	SHL	SHL	HS	JHBC	
2	**22 April 2016**	Revised with Client Comments	SHL	SHL	HS	JHBC	
3	**10 May 2016**	Revised with Client Comments	SHL	SHL	HS	JHBC	
Current Revision		**3**					

Approval			
Author signature		Approver signature	
Name		Name	
Title		Title	

Sendawo 2 PV Energy Facility

Date 10 May 2016
Reference 112509
Revision 3

Aurecon South Africa (Pty) Ltd
Aurecon Centre
1 Century City Drive
Waterford Precinct
Century City, Cape Town, 7441

T +27 21 526 9400
F +27 21 526 9500
E capetown@aurecongroup.com
W www.aurecongroup.com

Contents

Figures

Tables

EXECUTIVE SUMMARY

The transport needs for the proposed Sendawo 2 Solar PV Energy Facility, with a generating capacity of 75MW on Portion 1 of Farm Edinburgh 735 near Vryburg, were investigated to confirm access route alternatives and site access for the development of a solar facility.

The general requirements are:

- Legal limits for normal heavy vehicle freight
- Abnormal Permits required for transport of transformers
- Maximum vertical clearance on most routes is 5,2m for Abnormal Load but should preferably be limited to 4,8m.

The general freight for the solar farms comprise of building materials, solar panels and frames and an 80MVA transformer(s). The imported freight will be transported from South African ports to the site. Building materials will be transported from sources in surrounding towns while certain elements will be transported from various manufacturing centres in South Africa.

The preferred import origin of the imported elements to the proposed Sendawo 2 Solar PV Energy Facility will be from the Durban Port. The distance of 828 km comprises of surfaced roads the full way. However, should the Durban Port not be available for handling the freight, the Port Elizabath/Coega Port could be used as an alternative port. The transport distance in this case is 925 km.

Toll fees are required on the route from the preferred port. Abnormal Permits will be required for transport of the transformer in any event. The traffic during construction and during operation will have negligible impact on existing and future traffic.

The route is predominantly on National or Provincial Roads with suitable standards for transport of container freight. It is also suitable for abnormal loads with permits. There is a possibility of limited risk of delays for normal routine maintenance works (repairs and reseals) depending of the time of transport and scheduling of roads contracts.

The transport of elements from manufacturing centres within South Africa is predominantly on National and Provincial roads, which presents no limitations for normal freight.

The proposed preferred access road from the N18 to the site is situated in the middle of the proposed site at an existing farm access. The access is at an acceptable safe point with sufficient sight distance which would be acceptable to SANRAL.

In general, no obvious problems are expected with freight transport along the proposed routes to the site necessary for the construction and maintenance of the site.

1 INTRODUCTION

BioTherm Energy (Pty) Ltd engaged Aurecon to prepare a Transport Impact Assessment for the implementation of the Sendawo Solar Photovoltaic ("PV") Energy Facilities approximately 8 km south of Vryburg in the North-West Province on Portion 1 of Farm Edinburgh 735, in the Naledi Local Municipality. The site location is indicated on the key plan below:

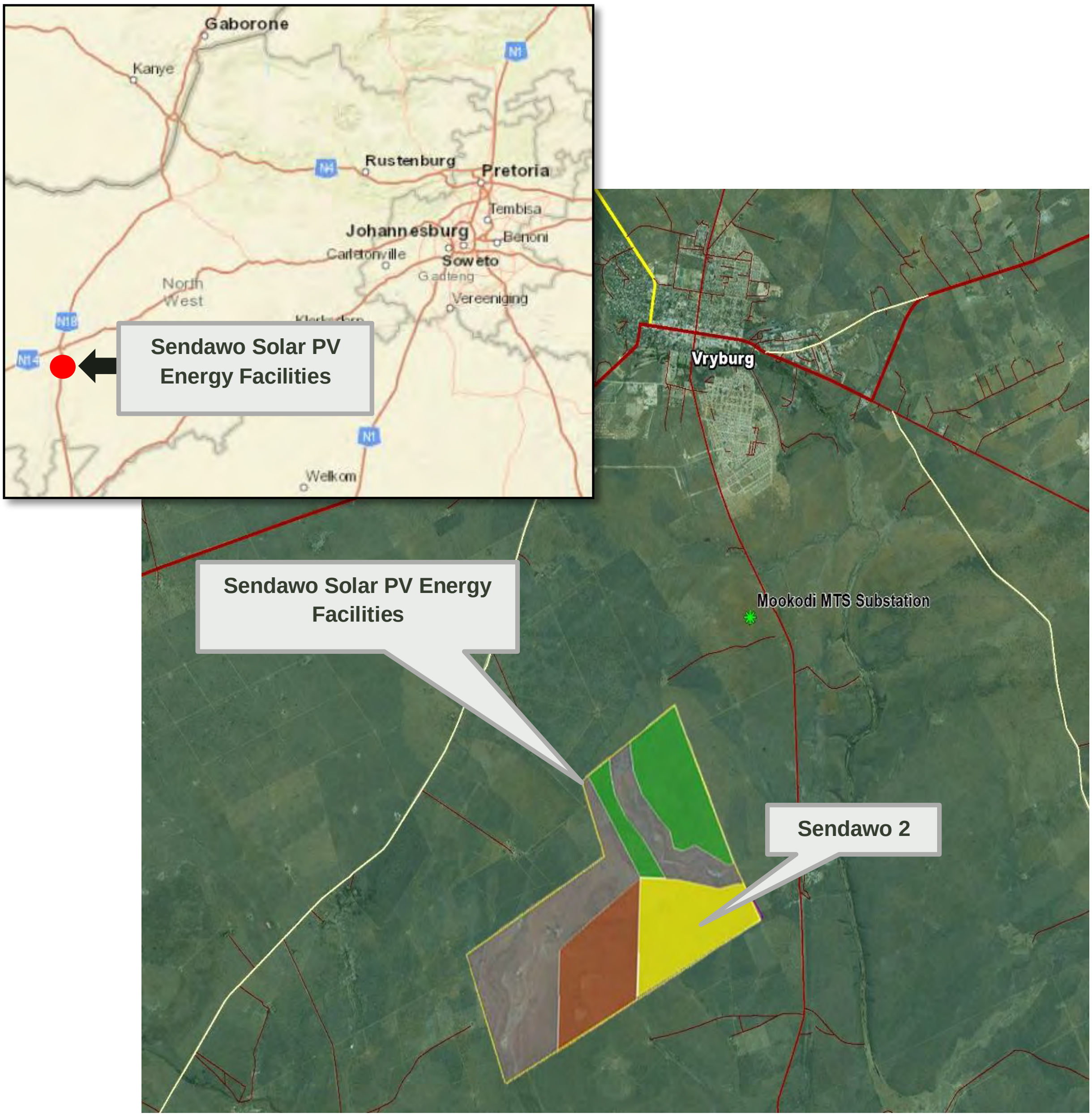


Figure 1: Key Plan

The proposed phase 1 for the Solar PV facility will be developed to a 75 MW capacity.

The scope of this Transport Study and Traffic Impact Assessment will focus primarily on the development of Phase 2 (Sendawo 2) of the proposed Sendawo Solar PV Energy Facilities and addressing the requirements from DEA for the relevant Environmental Assessment Process, therefore will the following be included:

- Assess the access road entry to the site,
- Determine the access freight routes between points of delivery and departure for the components,
- Determine traffic volumes due to transportation of equipment and personnel,
- Propose measure to minimise impact on local commuters,
- Confirm the associated clearances required for the necessary equipment to be transported from the point of delivery to the various sites,
- Confirm freight and transport requirements during construction and maintenance,
- Propose origins and destinations of equipment,
- Determine (Abnormal) Permit requirements if any,
- Propose traffic accommodation measures during construction of the access on the National Road.

2 DEFINITIONS / ASSUMPTIONS

The following assumptions are made:

- Imported elements are shipped to and transported from the nearest and most practical South African Port to the site.
- Certain elements are transported from manufacturing centres within South Africa.
- Material for supports and road construction are obtained locally from closest available commercial source.
- The largest potential load will be single 80MVA transformer, with a payload of approximately 80t.
- Freight will be transported predominantly on surfaced roads.
- Foundations will ultimately be dictated by site geotechnical conditions but generally comprise of driven steel piles to reduce risk of failures due to varying conditions for the developer.

3 EVALUATION OF SITE TRANSPORT

3.1 General Freight Requirements

3.1.1 Legislation

The general limitations on road freight transport are currently:

- Axle load limitation of 7,7t on front axle, 9,0t on single rear axles.
- Axle unit limitations are 18t for dual axle unit and 24t for 3 axle unit.
- Bridge formula requirements to limit concentration of loads and to regulate load distribution on the vehicle.
- Gross vehicle mass of 56t. This means a typical payload of about 30t.
- Maximum vehicle length of 22m for interlinks, 18,5m for horse and trailer and 13,5m for a single unit.
- Width limit of 2,6m.
- Height limit 4,3m.

Abnormal permits are required for vehicles exceeding these limits.

3.1.2 Solar Facility Freight

Materials and equipment transported to the site comprise of:

- Building materials (concrete aggregates, cement and gravel).
- Construction equipment such as piling rigs and cranes.
- Solar panels (panels and frames).
- Transformers and cables.
- Inverters possibly containerised.

The following is anticipated:

a) Building materials comprising of concrete materials for strip footings or steel piles will be transported using conventional trucks which should adhere to legal loading limits.

b) Solar Panels and frames will probably be transported in containers using conventional heavy vehicles within the legal limits from nearest South African port. The number of loads will be a function of the capacity of the solar farm and the extent of the frames.

c) Transformers will most probably be transported by abnormal vehicles from the nearest South African port.

3.2 Traffic Statement

It is estimated from experience on other similar projects that the number of heavy vehicles per 1MW installation would be between 15 and 20 heavy vehicle trips depending on the site condition and foundation requirements. The total trips for the 75 MW plant would be between 1100 and 1500 heavy vehicle trips. These trips would be made over an estimated period of 12 months.

In the worst case the number of heavy vehicle trips per day would be in the order of 5 to 10 trips. The impact of this on the general traffic would therefore be negligible as the additional peak hour traffic would be at most 2 trips.

Personnel during construction is estimate to be 400 and will most likely reside in Vryburg as the closest community or alternatively a compound on site or close by. It is recommended that the majority of construction personnel is transported to and from site by means of buses and some by private vehicles.

Assuming that busses with an average of 20 passengers will be used to transport personnel, the personnel transport will contribute to approximately 15 to 25 daily trips of which 50% is assumed to be within the traffic peak hour.

The additional peak hour trips during construction would therefore be in the order of 10 to 15 vehicles (2 transporting equipment and 12 transporting construction personnel)

After construction, the generated site traffic would be limited to maintenance support, with only a few light vehicles per day.

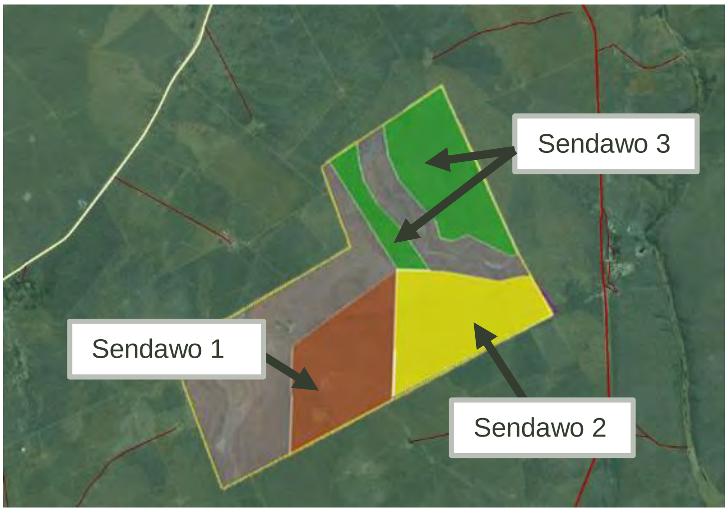
Access to the site will be directly from the N18. The current available Annual Average Daily Traffic (AADT) traffic volumes on N18 is estimated from the 2013 SANRAL yearbook for the station approximately 30 km North-West from Vryburg. It is estimated to be around 2000 and a maximum hourly flow of about 200 veh/h according to data interpolated from SANRAL traffic counts in the greater Vryburg area.

It can therefore be stated that the construction traffic of less than 20 vehicles during the peak hour (<10% impact) and the post construction traffic of less than 5 vehicles per day (<3% impact) would have almost no noticeable impact on the existing traffic service levels.

3.3 Sendawo Solar PV Energy Facilities - Access Route

3.3.1 Site Description

The site description is as follows:



Location	27°03'33.57"S 24°43'27.62"E
Distance from Vryburg **Distance from Schweizer-Reneke**	7.5 km 65 km
Generation Capacity	3x75MW
Distance from Ports **Durban** **Port Elizabeth/Coega** **Saldanha**	 828 km 925 km 1150 km
Farm	Portion 1 of Farm Edinburgh 735

Figure 2: Site Description for Sendawo Solar PV Energy Facilities

The site is proposed to be developed in three separate phases as seen in Figure 2 above. These will however be assessed separately as they may or may not be implemented at the same time.

3.3.2 Preferred Route from Port

The route for transportation of imported equipment is either from Port Elizabeth/Coega or Durban with the latter having a shorter travelling distance of only 828 km. The preferred route avoids busy towns such as Kroonstad and was therefore chosen as the preferred route.

An alternative route from the port indicated in red in Figure 3 below can also be utilised if the preferred route is unavailable due to maintenance or any other reason. The two routes are similar in length, where the alternative route passes through Kroonstad, Bothaville and Wolmaransstad.

It should be noted that the Ports Authority also has preferences on freight import, which should be considered.

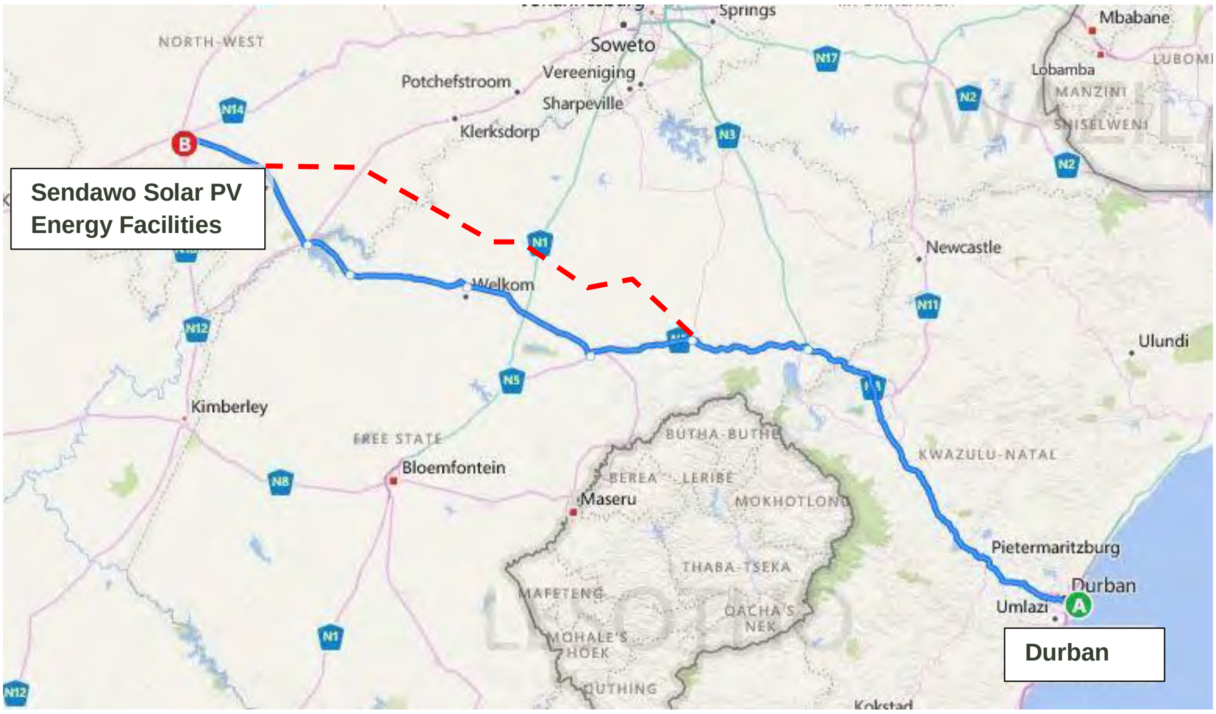


Figure 3: Preferred Route from Port

The Preferred Route's elements are shown in Appendix A.

3.3.3 Route from Alternative Port

Should the preferred port not be available for any reason – especially in view of the large volume of wind turbine equipment currently imported, then the Port Elizabeth/Coega Port could be used as alternative. The route from Port Elizabeth (a distance of 925km) is shown in Figure 4.

Figure 4: Alternative Port Route

3.3.4 Route for Construction Materials

Material sources for road building and concrete works is available in Vryburg and all material will most likely be transported from these and possibly other surrounding towns on the National and Provincial roads. If not it will have to be transported from larger manufacturing centres discussed in section 3.3.5.

3.3.5 Routes from other Larger Manufacturing Centres

The other main manufacturing centres include

- Greater Johannesburg area (Modderfontein, Edenvale, Nigel, Germiston, Brakpan, Elandsfontein) for inverters and support structures.
- Cape Town – greater metropolitan area for some of the components.

The routes to the site from these centres are predominantly on Provincial and National roads. There are no limitations on normal freight within the legal limits on these routes.

3.3.6 Authority and Permit Requirements

The following is noted:

a) Toll fees are required on the routes from the port. On the routes from the other manufacturing centres certain portions of the national routes are also tolled which will require toll fees. Toll fees are estimated at approximately R550 per heavy vehicle with 5+ axles for a single one-way trip.

b) Abnormal permit(s) will be required for the transport of the transformer by the logistics contractor for each province as these are issued by each Provincial Authority. The estimated total permit value will be a function of the actual vehicle configuration as well as the convoy requirements, but is estimated at R9000 – R15000 per trip. This application process would take approximately a month to complete and should be applied for once the project has reached financial close.

3.3.7 Route Limitations of the Preferred Route from the Port

The identified routes have possible limitations that will require more detailed investigations to determine the level of upgrading that will be required (if any) to accommodate the abnormal loads. All the possible limitations will potentially be encountered on the gravel roads from the N18 intersection to the prospective site, even though the length to be travelled on these roads are minimal. Other possible limitations might include: overhead power and telecommunication lines with an insufficient ground clearance, substandard geometry and drainage issues.

3.3.8 Site Access Road

3.3.8.1 Access to Road Network

The access to the site is proposed off the National Road N18. The access position could be at one of three positions, which should be approved by SANRAL as sufficient sight distances (stopping and shoulder) are present, as follows:

- **Access Road Option 1**: Off the N18 in the middle of the Sendawo 2 Solar PV Energy Facility. There is an existing road where minor upgrades will be required along approximately 1km of the road as well as an upgrade of the intersection itself. The location of the access to the newly proposed road is shown in Figure 5 below.

Figure 5: Sendawo 2 Solar PV Energy Facility - Access Option 1

- **Access Road Option 2**: Off the N18 just north of the Sendawo 2 Solar PV Energy Facility. There is an existing road where minor upgrades will be required along approximately 3km of the road. The intersection will also require an upgrade. The location of the access to the newly proposed road is shown in the Figure 6 below.

Figure 6: Sendawo 2 Solar PV Energy Facility - Access Option 2

- **Access Road Option 3**: Off the N18 just south of the Sendawo 2 Solar PV Energy Facility. There is an existing road where minor upgrades will be required along approximately 4km of the road. The intersection with the N18 will also require an upgrade, along with potential widening of farm gates and cattle grids. The location of the access to the newly proposed road is shown in Figure 7 below.

Figure 7: Sendawo 2 Solar PV Energy Facility - Access Option 3

The different options are indicated in the following figure:

Figure 8: Sendawo Solar PV Energy Facilities - Access Options and Access Roads.

3.3.8.2 Preferred Access Route

All of the access options illustrated above are considered to be viable from environment and technical viewpoints, however access option 1 is preferred because it is situated in the middle of the solar facility and requires the least upgrades. Regardless of the project phase, each site will be reachable from this access. An application for using any of the accesses must be submitted to SANRAL. These alternatives must be investigated in further detail at a later stage.

The access road should be upgraded to at least a 5m width (preferable 6m with sufficient shoulders) finished with a gravel wearing course layer.

3.3.8.3 Structures and Services

Existing structures and services such as drainage structures and pipelines will be evaluated at crossings and suitably strengthened if required.

The site drains to the west. Suitable drainage elements will be provided on the access road to ensure minimal disturbance of the existing drainage patterns.

3.3.9 Accommodation of Traffic during Construction

During construction of the access, traffic will have to be accommodated as per SADC Road Traffic Signs Manual requirements. The following typical minimum signage requirements will have to be implemented to ensure safety if the road needs closure during construction on the public road.

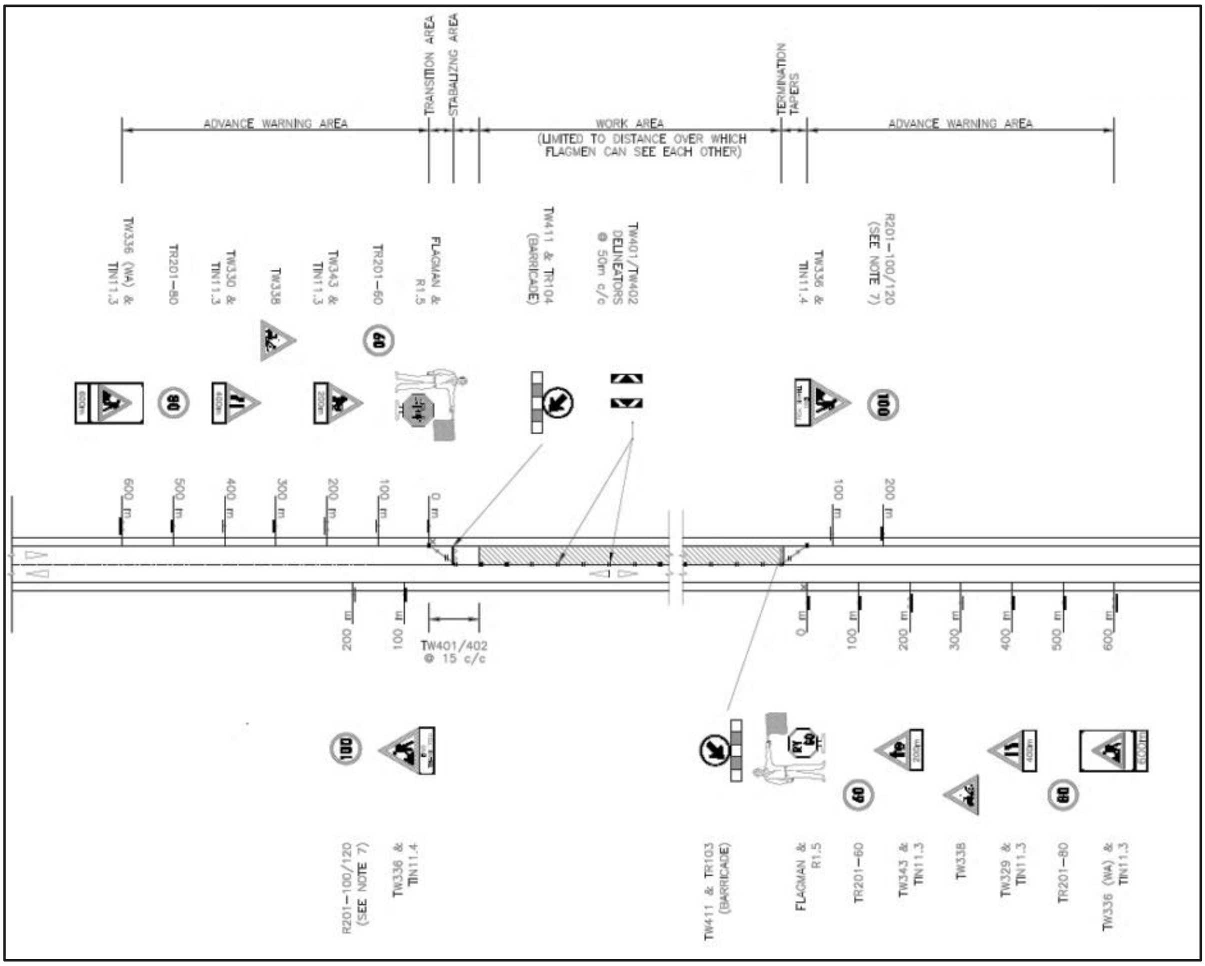


Figure 9: Accommodation of Traffic - Typical Layout

4 CONCLUSION

The transport needs for the proposed Sendawo 2 Solar PV Energy Facility, with a generating capacity of 75MW on Portion 1 of Farm Edinburgh 735 near Vryburg, were investigated to confirm access route alternatives and site access for the development of a solar facility.

The general requirements are:

- Legal limits for normal heavy vehicle freight
- Abnormal Permits required for transport of transformers
- Maximum vertical clearance on most routes is 5,2m for Abnormal Load but should preferably be limited to 4,8m.

The general freight for the solar farms comprise of building materials, solar panels and frames and an 80MVA transformer(s). The imported freight will be transported from South African ports to the site. Building materials will be transported from sources in surrounding towns while certain elements will be transported from various manufacturing centres in South Africa.

The preferred import origin of the imported elements to the proposed Sendawo 2 Solar PV Energy Facility will be from the Durban Port. The distance of 828 km comprises of surfaced roads the full way. However, should the Durban Port not be available for handling the freight, the Port Elizabath/Coega Port could be used as an alternative port. The transport distance in this case is 925 km.

Toll fees are required on the route from the preferred port. Abnormal Permits will be required for transport of the transformer in any event. The traffic during construction and during operation will have negligible impact on existing and future traffic.

The route is predominantly on National or Provincial Roads with suitable standards for transport of container freight. It is also suitable for abnormal loads with permits. There is a possibility of limited risk of delays for normal routine maintenance works (repairs and reseals) depending of the time of transport and scheduling of roads contracts.

The transport of elements from manufacturing centres within South Africa is predominantly on National and Provincial roads, which presents no limitations for normal freight.

The proposed preferred access road from the N18 to the site is situated in the middle of the proposed site at an existing farm access. The access is at an acceptable safe point with sufficient sight distance which would be acceptable to SANRAL.

In general, no obvious problems are expected with freight transport along the proposed routes to the site necessary for the construction and maintenance of the site.

Appendix A: Elements of Preferred Route

Table 1: Elements of preferred route

Element	Route Name	From	To	Distance [km]	Type
1	N3	Durban	Harrismith	298	Surfaced National Road
				The N3 is a dual carriageway two lane road with surfaced shoulders for most parts.	
2	N5	Harrismith	Senekal	162	Surfaced National Road
				The N5 is a dual/single carriageway two lane road with surfaced shoulders.	
3	R70	Senekal	Odendaalsrus	110	Surfaced Provincial Road
				The R70 is a single carriageway two lane road with gravel shoulders.	

Element	Route Name	From	To	Distance [km]	Type
4	R34	Odendaalsrus	Vryburg	245	Surfaced Regional Road
				The R34 is a single carriageway two lane road with gravel shoulders.	
5	N18	Vryburg	Site Access	11.2	Surfaced National Road
				The N18 is a single carriageway two lane road with gravel shoulders.	

Aurecon South Africa (Pty) Ltd
Aurecon Centre
1 Century City Drive
Waterford Precinct
Century City, Cape Town, 7441

T +27 21 526 9400
F +27 21 526 9500
E capetown@aurecongroup.com
W www.aurecongroup.com

Appendix 7:
A3 Maps

Appendix 8:

Environmental Management Programme (EMPr)

Appendix 9:
Coordinates

SENDAWO PV APPLICATION SITE

COORDINATES (DD MM SS.sss)

NORTH-WEST CORNER	NORTH-EAST CORNER	CENTRE POINT	SOUTH-WEST CORNER	SOUTH-EAST CORNER
S27° 4' 13.872" E24° 41' 10.716"	S27° 1' 52.680" E24° 43' 39.900"	S27° 3' 40.690" E24° 43' 0.553"	S27° 5' 22.740" E24° 41' 43.116"	S27° 3' 48.672" E24° 44' 48.228"

AREA (HA): **1708.756**

DEVELOPMENT AREA SUMMARY

PROJECT	AREA (HECTARES)	CENTRE POINT COORDINATES (DD MM SS.sss)	
		SOUTH	EAST
SENDAWO SOLAR 2 DEVELOPMENT AREA	431.42	S27° 4' 10.495"	E24° 42' 35.805"

SENDAWO SOLAR 2: DEVELOPMENT AREA

CORNER POINT COORDINATES (DD MM SS.sss)

POINT	SOUTH	EAST
S2_01 (NW)	S27° 3' 44.408"	E24° 42' 3.155"
S2_02 (NE)	S27° 3' 12.583"	E24° 43' 6.852"
S2_03 (SE)	S27° 4' 40.049"	E24° 43' 7.152"
S2_04 (SW)	S27° 5' 7.389"	E24° 42' 13.340"
S2_05	S27° 4' 25.387"	E24° 42' 0.437"
S2_06	S27° 4' 17.078"	E24° 42' 20.357"

SENDAWO SOLAR 2: COMPONENTS

CENTRE POINT COORDINATES (DD MM SS.sss)

COMPONENT	ALTERNATIVE 1	ALTERNATIVE 2
SUBSTATION (132kv)	S27° 3' 43.692" E24° 43' 1.569"	S27° 4' 39.046" E24° 43' 1.464"
O&M BUILDINGS	S27° 3' 46.895" E24° 43' 2.726"	S27° 4' 42.262" E24° 42' 59.553"
LAYDOWN AREA	S27° 4' 45.916" E24° 42' 47.711"	S27° 3' 57.391" E24° 42' 43.656"

SENDAWO SOLAR 2

PROPOSED 132kV POWER LINE CORRIDOR - CENTRE LINE

SUMMARY COORDINATES (DD MM SS.sss)

PROJECT	START POINT	MIDDLE POINT	END POINT	APPROX LENGTH (KM)
SENDAWO SOLAR 2	S27° 4' 39.046" E24° 43' 1.464"	S27° 3' 6.215" E24° 42' 47.572"	S27° 2' 0.103" E24° 43' 37.337"	5.98

SENDAWO SOLAR 2

PROPOSED 132kV POWER LINE CORRIDOR - CENTRE LINE

COORDINATES AT BEND POINTS (DD MM SS.sss)

POINT	**SOUTH**	**EAST**
1 (PROPOSED SUBSTATION ALT 2)	S27° 4' 39.046"	E24° 43' 1.464"
2	S27° 4' 38.954"	E24° 43' 6.165"
3	S27° 3' 47.449"	E24° 43' 8.133"
4	S27° 3' 16.850"	E24° 42' 52.417"
5	S27° 3' 16.885"	E24° 42' 52.433"
6	S27° 2' 37.208"	E24° 42' 34.359"
7 (PROPOSED COMBINED 400kV SENDAWO SUBSTATION)	S27° 2' 0.103"	E24° 43' 37.337"

SENDAWO SOLAR 2

PROPOSED 132kV POWER LINE CORRIDOR - CENTRE LINE

COORDINATES AT 250m INTERVALS (DD MM SS.sss)

POINT	SOUTH	EAST
1 (PROPOSED SUBSTATION ALT 1)	S27° 4' 39.046"	E24° 43' 1.464"
2	S27° 4' 33.410"	E24° 43' 6.378"
3	S27° 4' 25.293"	E24° 43' 6.690"
4	S27° 4' 17.175"	E24° 43' 7.001"
5	S27° 4' 9.057"	E24° 43' 7.311"
6	S27° 4' 0.940"	E24° 43' 7.619"
7	S27° 3' 52.822"	E24° 43' 7.928"
8	S27° 3' 44.945"	E24° 43' 6.874"
9	S27° 3' 37.548"	E24° 43' 3.127"
10	S27° 3' 30.178"	E24° 42' 59.313"
11	S27° 3' 22.808"	E24° 42' 55.500"
12	S27° 3' 15.479"	E24° 42' 51.792"
13	S27° 3' 7.958"	E24° 42' 48.366"
14	S27° 3' 0.438"	E24° 42' 44.940"
15	S27° 2' 52.917"	E24° 42' 41.514"
16	S27° 2' 45.396"	E24° 42' 38.088"
17	S27° 2' 37.875"	E24° 42' 34.663"
18	S27° 2' 32.865"	E24° 42' 41.053"
19	S27° 2' 28.100"	E24° 42' 48.399"
20	S27° 2' 23.335"	E24° 42' 55.745"
21	S27° 2' 18.570"	E24° 43' 3.090"
22	S27° 2' 13.804"	E24° 43' 10.436"
23	S27° 2' 9.039"	E24° 43' 17.781"
24	S27° 2' 4.273"	E24° 43' 25.126"
25 (PROPOSED COMBINED 400kV SENDAWO SUBSTATION)	S27° 2' 0.103"	E24° 43' 37.337"

DEVELOPMENT AREA SUMMARY

PROJECT	AREA (HECTARES)	CENTRE POINT COORDINATES	
		SOUTH	EAST
SENDAWO SOLAR 2 DEVELOPMENT AREA	431.42	S27° 4' 10.495"	E24° 42' 35.805"

SENDAWO SOLAR 2: DEVELOPMENT AREA

CORNER POINT COORDINATES (DD MM SS.sss)

POINT	SOUTH	EAST
S2_01 (NW)	S27° 3' 44.408"	E24° 42' 3.155"
S2_02 (NE)	S27° 3' 12.583"	E24° 43' 6.852"
S2_03 (SE)	S27° 4' 40.049"	E24° 43' 7.152"
S2_04 (SW)	S27° 5' 7.389"	E24° 42' 13.340"
S2_05	S27° 4' 25.387"	E24° 42' 0.437"
S2_06	S27° 4' 17.078"	E24° 42' 20.357"

SENDAWO SOLAR 2: COMPONENTS

CENTRE POINT COORDINATES (DD MM SS.sss)

COMPONENT	
SUBSTATION (132kv) ALT 1	S27° 3' 43.692" E24° 43' 1.569"
O&M BUILDINGS ALT 1	S27° 3' 46.895" E24° 43' 2.726"
LAYDOWN AREA ALT 2	S27° 3' 57.391" E24° 42' 43.656"

SENDAWO SOLAR 2

PREFERRED 132kV POWER LINE CORRIDOR - CENTRE LINE

SUMMARY COORDINATES (DD MM SS.sss)

PROJECT	START POINT	MIDDLE POINT	END POINT	APPROX LENGTH (KM)
SENDAWO SOLAR 2	S27° 3' 43.692" E24° 43' 1.569"	S27° 2' 39.803" E24° 42' 35.541"	S27° 2' 0.103" E24° 43' 37.337"	4.20

SENDAWO SOLAR 2

PREFERRED 132kV POWER LINE CORRIDOR - CENTRE LINE

COORDINATES AT BEND POINTS (DD MM SS.sss)

POINT	SOUTH	EAST
1 (PROPOSED SUBSTATION ALT 1)	S27° 3' 43.692"	E24° 43' 1.569"
2	S27° 3' 42.122"	E24° 43' 5.455"
3	S27° 3' 16.885"	E24° 42' 52.433"
4	S27° 2' 37.208"	E24° 42' 34.359"
5 (PROPOSED COMBINED 400kV SENDAWO SUBSTATION)	S27° 2' 0.103"	E24° 43' 37.337"

SENDAWO SOLAR 2

PREFERRED 132kV POWER LINE CORRIDOR - CENTRE LINE
COORDINATES AT 250m INTERVALS (DD MM SS.sss)

POINT	SOUTH	EAST
1 (PROPOSED SUBSTATION ALT 1)	S27° 3' 43.692"	E24° 43' 1.569"
2	S27° 3' 37.548"	E24° 43' 3.127"
3	S27° 3' 30.178"	E24° 42' 59.313"
4	S27° 3' 22.808"	E24° 42' 55.500"
5	S27° 3' 15.479"	E24° 42' 51.792"
6	S27° 3' 7.958"	E24° 42' 48.366"
7	S27° 3' 0.438"	E24° 42' 44.940"
8	S27° 2' 52.917"	E24° 42' 41.514"
9	S27° 2' 45.396"	E24° 42' 38.088"
10	S27° 2' 37.875"	E24° 42' 34.663"
11	S27° 2' 32.865"	E24° 42' 41.053"
12	S27° 2' 28.100"	E24° 42' 48.399"
13	S27° 2' 23.335"	E24° 42' 55.745"
14	S27° 2' 18.570"	E24° 43' 3.090"
15	S27° 2' 13.804"	E24° 43' 10.436"
16	S27° 2' 9.039"	E24° 43' 17.781"
17	S27° 2' 4.273"	E24° 43' 25.126"
18 (PROPOSED COMBINED 400kV SENDAWO SUBSTATION)	S27° 2' 0.103"	E24° 43' 37.337"

Appendix 10:
IFC Performance Standards

Performance Standards on Environmental and Social Sustainability

January 1, 2012

Overview of Performance Standards on Environmental and Social Sustainability

1. IFC's Sustainability Framework articulates the Corporation's strategic commitment to sustainable development, and is an integral part of IFC's approach to risk management. The Sustainability Framework comprises IFC's Policy and Performance Standards on Environmental and Social Sustainability, and IFC's Access to Information Policy. The Policy on Environmental and Social Sustainability describes IFC's commitments, roles, and responsibilities related to environmental and social sustainability. IFC's Access to Information Policy reflects IFC's commitment to transparency and good governance on its operations, and outlines the Corporation's institutional disclosure obligations regarding its investment and advisory services. The Performance Standards are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC requires its clients to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced. IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation in order to achieve its overall development objectives. The Performance Standards may also be applied by other financial institutions.

2. Together, the eight Performance Standards establish standards that the client[1] is to meet throughout the life of an investment by IFC:

Performance Standard 1:	Assessment and Management of Environmental and Social Risks and Impacts
Performance Standard 2:	Labor and Working Conditions
Performance Standard 3:	Resource Efficiency and Pollution Prevention
Performance Standard 4:	Community Health, Safety, and Security
Performance Standard 5:	Land Acquisition and Involuntary Resettlement
Performance Standard 6:	Biodiversity Conservation and Sustainable Management of Living Natural Resources
Performance Standard 7:	Indigenous Peoples
Performance Standard 8:	Cultural Heritage

3. Performance Standard 1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of environmental and social performance throughout the life of the project. Performance Standards 2 through 8 establish objectives and requirements to avoid, minimize, and where residual impacts remain, to compensate/offset for risks and impacts to workers, Affected Communities, and the environment. While all relevant environmental and social risks and potential impacts should be considered as part of the assessment, Performance Standards 2 through 8 describe potential environmental and social risks and impacts that require particular attention. Where environmental or social risks and impacts

[1] The term "client" is used throughout the Performance Standards broadly to refer to the party responsible for implementing and operating the project that is being financed, or the recipient of the financing, depending on the project structure and type of financing. The term "project" is defined in Performance Standard 1.

are identified, the client is required to manage them through its Environmental and Social Management System (ESMS) consistent with Performance Standard 1.

4. Performance Standard 1 applies to all projects that have environmental and social risks and impacts. Depending on project circumstances, other Performance Standards may apply as well. The Performance Standards should be read together and cross-referenced as needed. The requirements section of each Performance Standard applies to all activities financed under the project, unless otherwise noted in the specific limitations described in each paragraph. Clients are encouraged to apply the ESMS developed under Performance Standard 1 to all their project activities, regardless of financing source. A number of cross-cutting topics such as climate change, gender, human rights, and water, are addressed across multiple Performance Standards.

5. In addition to meeting the requirements under the Performance Standards, clients must comply with applicable national law, including those laws implementing host country obligations under international law.

6. The World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) are technical reference documents with general and industry-specific examples of good international industry practice. IFC uses the EHS Guidelines as a technical source of information during project appraisal. The EHS Guidelines contain the performance levels and measures that are normally acceptable to IFC, and that are generally considered to be achievable in new facilities at reasonable costs by existing technology. For IFC-financed projects, application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets with an appropriate timetable for achieving them. The environmental assessment process may recommend alternative (higher or lower) levels or measures, which, if acceptable to IFC, become project- or site-specific requirements. The General EHS Guideline contains information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors. It should be used together with the relevant industry sector guideline(s). The EHS Guidelines may be occasionally updated.

7. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternative performance level is protective of human health and the environment.

8. A set of eight Guidance Notes, corresponding to each Performance Standard, and an additional Interpretation Note on Financial Intermediaries offer guidance on the requirements contained in the Performance Standards, including reference materials, and on good sustainability practices to help clients improve project performance. These Guidance/Interpretation Notes may be occasionally updated.

Performance Standard 1
Assessment and Management of Environmental and Social Risks and Impacts

January 1, 2012

Introduction

1. Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders.[1] Drawing on the elements of the established business management process of "plan, do, check, and act," the ESMS entails a methodological approach to managing environmental and social risks[2] and impacts[3] in a structured way on an ongoing basis. A good ESMS appropriate to the nature and scale of the project promotes sound and sustainable environmental and social performance, and can lead to improved financial, social, and environmental outcomes.

2. At times, the assessment and management of certain environmental and social risks and impacts may be the responsibility of the government or other third parties over which the client does not have control or influence.[4] Examples of where this may happen include: (i) when early planning decisions are made by the government or third parties which affect the project site selection and/or design; and/or (ii) when specific actions directly related to the project are carried out by the government or third parties such as providing land for a project which may have previously involved the resettlement of communities or individuals and/or leading to loss of biodiversity. While the client cannot control these government or third party actions, an effective ESMS should identify the different entities involved and the roles they play, the corresponding risks they present to the client, and opportunities to collaborate with these third parties in order to help achieve environmental and social outcomes that are consistent with the Performance Standards. In addition, this Performance Standard supports the use of an effective grievance mechanism that can facilitate early indication of, and prompt remediation for those who believe that they have been harmed by a client's actions.

3. Business should respect human rights, which means to avoid infringing on the human rights of others and address adverse human rights impacts business may cause or contribute to. Each of the Performance Standards has elements related to human rights dimensions that a project may face in the course of its operations. Due diligence against these Performance Standards will enable the client to address many relevant human rights issues in its project.

Objectives

- To identify and evaluate environmental and social risks and impacts of the project.
- To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize,[5] and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment.

[1] Other stakeholders are those not directly affected by the project but that have an interest in it. These could include national and local authorities, neighboring projects, and/or nongovernmental organizations.

[2] Environmental and social risk is a combination of the probability of certain hazard occurrences and the severity of impacts resulting from such an occurrence.

[3] Environmental and social impacts refer to any change, potential or actual, to (i) the physical, natural, or cultural environment, and (ii) impacts on surrounding community and workers, resulting from the business activity to be supported.

[4] Contractors retained by, or acting on behalf of the client(s), are considered to be under direct control of the client and not considered third parties for the purposes of this Performance Standard.

[5] Acceptable options to minimize will vary and include: abate, rectify, repair, and/or restore impacts, as appropriate. The risk and impact mitigation hierarchy is further discussed and specified in the context of Performance Standards 2 through 8, where relevant.

- To promote improved environmental and social performance of clients through the effective use of management systems.
- To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately.
- To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.

Scope of Application

4. This Performance Standard applies to business activities with environmental and/or social risks and/or impacts. For the purposes of this Performance Standard, the term "project" refers to a defined set of business activities, including those where specific physical elements, aspects, and facilities likely to generate risks and impacts, have yet to be identified.[6] Where applicable, this could include aspects from the early developmental stages through the entire life cycle (design, construction, commissioning, operation, decommissioning, closure or, where applicable, post-closure) of a physical asset.[7] The requirements of this Performance Standard apply to all business activities unless otherwise noted in the specific limitations described in each of the paragraphs below.

Requirements

Environmental and Social Assessment and Management System

5. The client, in coordination with other responsible government agencies and third parties as appropriate,[8] will conduct a process of environmental and social assessment, and establish and maintain an ESMS appropriate to the nature and scale of the project and commensurate with the level of its environmental and social risks and impacts. The ESMS will incorporate the following elements: (i) policy; (ii) identification of risks and impacts; (iii) management programs; (iv) organizational capacity and competency; (v) emergency preparedness and response; (vi) stakeholder engagement; and (vii) monitoring and review.

Policy

6. The client will establish an overarching policy defining the environmental and social objectives and principles that guide the project to achieve sound environmental and social performance.[9] The policy provides a framework for the environmental and social assessment and management process, and specifies that the project (or business activities, as appropriate) will comply with the applicable laws and regulations of the jurisdictions in which it is being undertaken, including those laws implementing host country obligations under international law. The policy should be consistent with the principles of the Performance Standards. Under some circumstances, clients may also subscribe

[6] For example, corporate entities which have portfolios of existing physical assets, and/or intend to develop or acquire new facilities, and investment funds or financial intermediaries with existing portfolios of assets and/or which intend to invest in new facilities.

[7] Recognizing that this Performance Standard is used by a variety of financial institutions, investors, insurers, and owner/operators, each user should separately specify the business activities to which this Performance Standard should apply.

[8] That is, those parties legally obligated and responsible for assessing and managing specific risks and impacts (e.g., government-led resettlement).

[9] This requirement is a stand-alone, project-specific policy and is not intended to affect (or require alteration of) existing policies the client may have defined for non-related projects, business activities, or higher-level corporate activities.

to other internationally recognized standards, certification schemes, or codes of practice and these too should be included in the policy. The policy will indicate who, within the client's organization, will ensure conformance with the policy and be responsible for its execution (with reference to an appropriate responsible government agency or third party, as necessary). The client will communicate the policy to all levels of its organization.

Identification of Risks and Impacts

7. The client will establish and maintain a process for identifying the environmental and social risks and impacts of the project (see paragraph 18 for competency requirements). The type, scale, and location of the project guide the scope and level of effort devoted to the risks and impacts identification process. The scope of the risks and impacts identification process will be consistent with good international industry practice,[10] and will determine the appropriate and relevant methods and assessment tools. The process may comprise a full-scale environmental and social impact assessment, a limited or focused environmental and social assessment, or straightforward application of environmental siting, pollution standards, design criteria, or construction standards.[11] When the project involves existing assets, environmental and/or social audits or risk/hazard assessments can be appropriate and sufficient to identify risks and impacts. If assets to be developed, acquired or financed have yet to be defined, the establishment of an environmental and social due diligence process will identify risks and impacts at a point in the future when the physical elements, assets, and facilities are reasonably understood. The risks and impacts identification process will be based on recent environmental and social baseline data at an appropriate level of detail. The process will consider all relevant environmental and social risks and impacts of the project, including the issues identified in Performance Standards 2 through 8, and those who are likely to be affected by such risks and impacts.[12] The risks and impacts identification process will consider the emissions of greenhouse gases, the relevant risks associated with a changing climate and the adaptation opportunities, and potential transboundary effects, such as pollution of air, or use or pollution of international waterways.

8. Where the project involves specifically identified physical elements, aspects, and facilities that are likely to generate impacts, environmental and social risks and impacts will be identified in the context of the project's area of influence. This area of influence encompasses, as appropriate:

- The area likely to be affected by: (i) the project[13] and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project;[14] (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.

[10] Defined as the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally or regionally.

[11] For greenfield developments or large expansions with specifically indentified physical elements, aspects, and facilities that are likely to generate potential significant environmental or social impacts, the client will conduct a comprehensive Environmental and Social Impact Assessment, including an examination of alternatives, where appropriate.

[12] In limited high risk circumstances, it may be appropriate for the client to complement its environmental and social risks and impacts identification process with specific human rights due diligence as relevant to the particular business.

[13] Examples include the project's sites, the immediate airshed and watershed, or transport corridors.

[14] Examples include power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow and disposal areas, construction camps, and contaminated land (e.g., soil, groundwater, surface water, and sediments).

- Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.[15]
- Cumulative impacts[16] that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

9. In the event of risks and impacts in the project's area of influence resulting from a third party's actions, the client will address those risks and impacts in a manner commensurate with the client's control and influence over the third parties, and with due regard to conflict of interest.

10. Where the client can reasonably exercise control, the risks and impacts identification process will also consider those risks and impacts associated with primary supply chains, as defined in Performance Standard 2 (paragraphs 27–29) and Performance Standard 6 (paragraph 30).

11. Where the project involves specifically identified physical elements, aspects and facilities that are likely to generate environmental and social impacts, the identification of risks and impacts will take into account the findings and conclusions of related and applicable plans, studies, or assessments prepared by relevant government authorities or other parties that are directly related to the project and its area of influence.[17] These include master economic development plans, country or regional plans, feasibility studies, alternatives analyses, and cumulative, regional, sectoral, or strategic environmental assessments where relevant. The risks and impacts identification will take account of the outcome of the engagement process with Affected Communities as appropriate.

12. Where the project involves specifically identified physical elements, aspects and facilities that are likely to generate impacts, and as part of the process of identifying risks and impacts, the client will identify individuals and groups that may be directly and differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status.[18] Where individuals or groups are identified as disadvantaged or vulnerable, the client will propose and implement differentiated measures so that adverse impacts do not fall disproportionately on them and they are not disadvantaged in sharing development benefits and opportunities.

Management Programs

13. Consistent with the client's policy and the objectives and principles described therein, the client will establish management programs that, in sum, will describe mitigation and performance improvement measures and actions that address the identified environmental and social risks and impacts of the project.

[15] Associated facilities may include railways, roads, captive power plants or transmission lines, pipelines, utilities, warehouses, and logistics terminals.

[16] Cumulative impacts are limited to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities. Examples of cumulative impacts include: incremental contribution of gaseous emissions to an airshed; reduction of water flows in a watershed due to multiple withdrawals; increases in sediment loads to a watershed; interference with migratory routes or wildlife movement; or more traffic congestion and accidents due to increases in vehicular traffic on community roadways.

[17] The client can take these into account by focusing on the project's incremental contribution to selected impacts generally recognized as important on the basis of scientific concern or concerns from the Affected Communities within the area addressed by these larger scope regional studies or cumulative assessments.

[18] This disadvantaged or vulnerable status may stem from an individual's or group's race, color, sex, language, religion, political or other opinion, national or social origin, property, birth, or other status. The client should also consider factors such as gender, age, ethnicity, culture, literacy, sickness, physical or mental disability, poverty or economic disadvantage, and dependence on unique natural resources.

14. Depending on the nature and scale of the project, these programs may consist of some documented combination of operational procedures, practices, plans, and related supporting documents (including legal agreements) that are managed in a systematic way.[19] The programs may apply broadly across the client's organization, including contractors and primary suppliers over which the organization has control or influence, or to specific sites, facilities, or activities. The mitigation hierarchy to address identified risks and impacts will favor the avoidance of impacts over minimization, and, where residual impacts remain, compensation/offset, wherever technically[20] and financially feasible.[21]

15. Where the identified risks and impacts cannot be avoided, the client will identify mitigation and performance measures and establish corresponding actions to ensure the project will operate in compliance with applicable laws and regulations, and meet the requirements of Performance Standards 1 through 8. The level of detail and complexity of this collective management program and the priority of the identified measures and actions will be commensurate with the project's risks and impacts, and will take account of the outcome of the engagement process with Affected Communities as appropriate.

16. The management programs will establish environmental and social Action Plans,[22] which will define desired outcomes and actions to address the issues raised in the risks and impacts identification process, as measurable events to the extent possible, with elements such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods, and with estimates of the resources and responsibilities for implementation. As appropriate, the management program will recognize and incorporate the role of relevant actions and events controlled by third parties to address identified risks and impacts. Recognizing the dynamic nature of the project, the management program will be responsive to changes in circumstances, unforeseen events, and the results of monitoring and review.

Organizational Capacity and Competency

17. The client, in collaboration with appropriate and relevant third parties, will establish, maintain, and strengthen as necessary an organizational structure that defines roles, responsibilities, and authority to implement the ESMS. Specific personnel, including management representative(s), with clear lines of responsibility and authority should be designated. Key environmental and social responsibilities should be well defined and communicated to the relevant personnel and to the rest of the client's organization. Sufficient management sponsorship and human and financial resources will be provided on an ongoing basis to achieve effective and continuous environmental and social performance.

---

[19] Existing legal agreements between the client and third parties that address mitigation actions with regard to specific impacts constitute part of a program. Examples are government-managed resettlement responsibilities specified in an agreement.

[20] Technical feasibility is based on whether the proposed measures and actions can be implemented with commercially available skills, equipment, and materials, taking into consideration prevailing local factors such as climate, geography, demography, infrastructure, security, governance, capacity, and operational reliability.

[21] Financial feasibility is based on commercial considerations, including relative magnitude of the incremental cost of adopting such measures and actions compared to the project's investment, operating, and maintenance costs, and on whether this incremental cost could make the project nonviable to the client.

[22] Action plans may include an overall Environmental and Social Action Plan necessary for carrying out a suite of mitigation measures or thematic action plans, such as Resettlement Action Plans or Biodiversity Action Plans. Action plans may be plans designed to fill in the gaps of existing management programs to ensure consistency with the Performance Standards, or they may be stand alone plans that specify the project's mitigation strategy. The "Action plan" terminology is understood by some communities of practice to mean Management plans, or Development plans. In this case, examples are numerous and include various types of environmental and social management plans.

18. Personnel within the client's organization with direct responsibility for the project's environmental and social performance will have the knowledge, skills, and experience necessary to perform their work, including current knowledge of the host country's regulatory requirements and the applicable requirements of Performance Standards 1 through 8. Personnel will also possess the knowledge, skills, and experience to implement the specific measures and actions required under the ESMS and the methods required to perform the actions in a competent and efficient manner.

19. The process of identification of risks and impacts will consist of an adequate, accurate, and objective evaluation and presentation, prepared by competent professionals. For projects posing potentially significant adverse impacts or where technically complex issues are involved, clients may be required to involve external experts to assist in the risks and impacts identification process.

Emergency Preparedness and Response

20. Where the project involves specifically identified physical elements, aspects and facilities that are likely to generate impacts, the ESMS will establish and maintain an emergency preparedness and response system so that the client, in collaboration with appropriate and relevant third parties, will be prepared to respond to accidental and emergency situations associated with the project in a manner appropriate to prevent and mitigate any harm to people and/or the environment. This preparation will include the identification of areas where accidents and emergency situations may occur, communities and individuals that may be impacted, response procedures, provision of equipment and resources, designation of responsibilities, communication, including that with potentially Affected Communities and periodic training to ensure effective response. The emergency preparedness and response activities will be periodically reviewed and revised, as necessary, to reflect changing conditions.

21. Where applicable, the client will also assist and collaborate with the potentially Affected Communities (see Performance Standard 4) and the local government agencies in their preparations to respond effectively to emergency situations, especially when their participation and collaboration are necessary to ensure effective response. If local government agencies have little or no capacity to respond effectively, the client will play an active role in preparing for and responding to emergencies associated with the project. The client will document its emergency preparedness and response activities, resources, and responsibilities, and will provide appropriate information to potentially Affected Community and relevant government agencies.

Monitoring and Review

22. The client will establish procedures to monitor and measure the effectiveness of the management program, as well as compliance with any related legal and/or contractual obligations and regulatory requirements. Where the government or other third party has responsibility for managing specific risks and impacts and associated mitigation measures, the client will collaborate in establishing and monitoring such mitigation measures. Where appropriate, clients will consider involving representatives from Affected Communities to participate in monitoring activities.[23] The client's monitoring program should be overseen by the appropriate level in the organization. For projects with significant impacts, the client will retain external experts to verify its monitoring information. The extent of monitoring should be commensurate with the project's environmental and social risks and impacts and with compliance requirements.

23. In addition to recording information to track performance and establishing relevant operational controls, the client should use dynamic mechanisms, such as internal inspections and audits, where relevant, to verify compliance and progress toward the desired outcomes. Monitoring will normally

[23] For example, participatory water monitoring.

include recording information to track performance and comparing this against the previously established benchmarks or requirements in the management program. Monitoring should be adjusted according to performance experience and actions requested by relevant regulatory authorities. The client will document monitoring results and identify and reflect the necessary corrective and preventive actions in the amended management program and plans. The client, in collaboration with appropriate and relevant third parties, will implement these corrective and preventive actions, and follow up on these actions in upcoming monitoring cycles to ensure their effectiveness.

24. Senior management in the client organization will receive periodic performance reviews of the effectiveness of the ESMS, based on systematic data collection and analysis. The scope and frequency of such reporting will depend upon the nature and scope of the activities identified and undertaken in accordance with the client's ESMS and other applicable project requirements. Based on results within these performance reviews, senior management will take the necessary and appropriate steps to ensure the intent of the client's policy is met, that procedures, practices, and plans are being implemented, and are seen to be effective.

Stakeholder Engagement

25. Stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts.[24] Stakeholder engagement is an ongoing process that may involve, in varying degrees, the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and ongoing reporting to Affected Communities. The nature, frequency, and level of effort of stakeholder engagement may vary considerably and will be commensurate with the project's risks and adverse impacts, and the project's phase of development.

Stakeholder Analysis and Engagement Planning

26. Clients should identify the range of stakeholders that may be interested in their actions and consider how external communications might facilitate a dialog with all stakeholders (paragraph 34 below). Where projects involve specifically identified physical elements, aspects and/or facilities that are likely to generate adverse environmental and social impacts to Affected Communities the client will identify the Affected Communities and will meet the relevant requirements described below.

27. The client will develop and implement a Stakeholder Engagement Plan that is scaled to the project risks and impacts and development stage, and be tailored to the characteristics and interests of the Affected Communities. Where applicable, the Stakeholder Engagement Plan will include differentiated measures to allow the effective participation of those identified as disadvantaged or vulnerable. When the stakeholder engagement process depends substantially on community representatives,[25] the client will make every reasonable effort to verify that such persons do in fact represent the views of Affected Communities and that they can be relied upon to faithfully communicate the results of consultations to their constituents.

28. In cases where the exact location of the project is not known, but it is reasonably expected to have significant impacts on local communities, the client will prepare a Stakeholder Engagement Framework, as part of its management program, outlining general principles and a strategy to identify Affected Communities and other relevant stakeholders and plan for an engagement process

[24] Requirements regarding engagement of workers and related grievance redress procedures are found in Performance Standard 2.

[25] For example, community and religious leaders, local government representatives, civil society representatives, politicians, school teachers, and/or others representing one or more affected stakeholder groups.

compatible with this Performance Standard that will be implemented once the physical location of the project is known.

Disclosure of Information

29. Disclosure of relevant project information helps Affected Communities and other stakeholders understand the risks, impacts and opportunities of the project. The client will provide Affected Communities with access to relevant information[26] on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such communities and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism.

Consultation

30. When Affected Communities are subject to identified risks and adverse impacts from a project, the client will undertake a process of consultation in a manner that provides the Affected Communities with opportunities to express their views on project risks, impacts and mitigation measures, and allows the client to consider and respond to them. The extent and degree of engagement required by the consultation process should be commensurate with the project's risks and adverse impacts and with the concerns raised by the Affected Communities. Effective consultation is a two-way process that should: (i) begin early in the process of identification of environmental and social risks and impacts and continue on an ongoing basis as risks and impacts arise; (ii) be based on the prior disclosure and dissemination of relevant, transparent, objective, meaningful and easily accessible information which is in a culturally appropriate local language(s) and format and is understandable to Affected Communities; (iii) focus inclusive[27] engagement on those directly affected as opposed to those not directly affected; (iv) be free of external manipulation, interference, coercion, or intimidation; (v) enable meaningful participation, where applicable; and (vi) be documented. The client will tailor its consultation process to the language preferences of the Affected Communities, their decision-making process, and the needs of disadvantaged or vulnerable groups. If clients have already engaged in such a process, they will provide adequate documented evidence of such engagement.

Informed Consultation and Participation

31. For projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation (ICP) process that will build upon the steps outlined above in Consultation and will result in the Affected Communities' informed participation. ICP involves a more in-depth exchange of views and information, and an organized and iterative consultation, leading to the client's incorporating into their decision-making process the views of the Affected Communities on matters that affect them directly, such as the proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues. The consultation process should (i) capture both men's and women's views, if necessary through separate forums or engagements, and (ii) reflect men's and women's different concerns and priorities about impacts, mitigation mechanisms, and benefits, where appropriate. The client will document the process, in particular the measures taken to avoid or minimize risks to and adverse impacts on the

[26] Depending on the scale of the project and significance of the risks and impacts, relevant document(s) could range from full Environmental and Social Assessments and Action Plans (i.e., Stakeholder Engagement Plan, Resettlement Action Plans, Biodiversity Action Plans, Hazardous Materials Management Plans, Emergency Preparedness and Response Plans, Community Health and Safety Plans, Ecosystem Restoration Plans, and Indigenous Peoples Development Plans, etc.) to easy-to-understand summaries of key issues and commitments. These documents could also include the client's environmental and social policy and any supplemental measures and actions defined as a result of independent due diligence conducted by financiers.

[27] Such as men, women, the elderly, youth, displaced persons, and vulnerable and disadvantaged persons or groups.

Affected Communities, and will inform those affected about how their concerns have been considered.

Indigenous Peoples
32. For projects with adverse impacts to Indigenous Peoples, the client is required to engage them in a process of ICP and in certain circumstances the client is required to obtain their Free, Prior, and Informed Consent (FPIC). The requirements related to Indigenous Peoples and the definition of the special circumstances requiring FPIC are described in Performance Standard 7.

Private Sector Responsibilities Under Government-Led Stakeholder Engagement
33. Where stakeholder engagement is the responsibility of the host government, the client will collaborate with the responsible government agency, to the extent permitted by the agency, to achieve outcomes that are consistent with the objectives of this Performance Standard. In addition, where government capacity is limited, the client will play an active role during the stakeholder engagement planning, implementation, and monitoring. If the process conducted by the government does not meet the relevant requirements of this Performance Standard, the client will conduct a complementary process and, where appropriate, identify supplemental actions.

External Communications and Grievance Mechanisms

External Communications
34. Clients will implement and maintain a procedure for external communications that includes methods to (i) receive and register external communications from the public; (ii) screen and assess the issues raised and determine how to address them; (iii) provide, track, and document responses, if any; and (iv) adjust the management program, as appropriate. In addition, clients are encouraged to make publicly available periodic reports on their environmental and social sustainability.

Grievance Mechanism for Affected Communities
35. Where there are Affected Communities, the client will establish a grievance mechanism to receive and facilitate resolution of Affected Communities' concerns and grievances about the client's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project and have Affected Communities as its primary user. It should seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate and readily accessible, and at no cost and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the stakeholder engagement process.

Ongoing Reporting to Affected Communities

36. The client will provide periodic reports to the Affected Communities that describe progress with implementation of the project Action Plans on issues that involve ongoing risk to or impacts on Affected Communities and on issues that the consultation process or grievance mechanism have identified as a concern to those Communities. If the management program results in material changes in or additions to the mitigation measures or actions described in the Action Plans on issues of concern to the Affected Communities, the updated relevant mitigation measures or actions will be communicated to them. The frequency of these reports will be proportionate to the concerns of Affected Communities but not less than annually.

Performance Standard 2
Labor and Working Conditions

January 1, 2012

Introduction

1. Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental[1] rights of workers. For any business, the workforce is a valuable asset, and a sound worker-management relationship is a key ingredient in the sustainability of a company. Failure to establish and foster a sound worker-management relationship can undermine worker commitment and retention, and can jeopardize a project. Conversely, through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.

2. The requirements set out in this Performance Standard have been in part guided by a number of international conventions and instruments, including those of the International Labour Organization (ILO) and the United Nations (UN).[2]

Objectives

- To promote the fair treatment, non-discrimination, and equal opportunity of workers.
- To establish, maintain, and improve the worker-management relationship.
- To promote compliance with national employment and labor laws.
- To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain.
- To promote safe and healthy working conditions, and the health of workers.
- To avoid the use of forced labor.

Scope of Application

3. The applicability of this Performance Standard is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System (ESMS), the elements of which are outlined in Performance Standard 1.

4. The scope of application of this Performance Standard depends on the type of employment relationship between the client and the worker. It applies to workers directly engaged by the client (direct workers), workers engaged through third parties to perform work related to core business

[1] As guided by the ILO Conventions listed in footnote 2.

[2] These conventions are:
ILO Convention 87 on Freedom of Association and Protection of the Right to Organize
ILO Convention 98 on the Right to Organize and Collective Bargaining
ILO Convention 29 on Forced Labor
ILO Convention 105 on the Abolition of Forced Labor
ILO Convention 138 on Minimum Age (of Employment)
ILO Convention 182 on the Worst Forms of Child Labor
ILO Convention 100 on Equal Remuneration
ILO Convention 111 on Discrimination (Employment and Occupation)
UN Convention on the Rights of the Child, Article 32.1
UN Convention on the Protection of the Rights of all Migrant Workers and Members of their Families

processes[3] of the project for a substantial duration (contracted workers), as well as workers engaged by the client's primary suppliers (supply chain workers).[4]

Direct Workers

5. With respect to direct workers, the client will apply the requirements of paragraphs 8–23 of this Performance Standard.

Contracted Workers

6. With respect to contracted workers, the client will apply the requirements of paragraphs 23–26 of this Performance Standard.

Supply Chain Workers

7. With respect to supply chain workers, the client will apply the requirements of paragraphs 27–29 of this Performance Standard.

Requirements

Working Conditions and Management of Worker Relationship

Human Resources Policies and Procedures

8. The client will adopt and implement human resources policies and procedures appropriate to its size and workforce that set out its approach to managing workers consistent with the requirements of this Performance Standard and national law.

9. The client will provide workers with documented information that is clear and understandable, regarding their rights under national labor and employment law and any applicable collective agreements, including their rights related to hours of work, wages, overtime, compensation, and benefits upon beginning the working relationship and when any material changes occur.

Working Conditions and Terms of Employment

10. Where the client is a party to a collective bargaining agreement with a workers' organization, such agreement will be respected. Where such agreements do not exist, or do not address working conditions and terms of employment,[5] the client will provide reasonable working conditions and terms of employment.[6]

11. The client will identify migrant workers and ensure that they are engaged on substantially equivalent terms and conditions to non-migrant workers carrying out similar work.

---

[3] Core business processes constitute those production and/or service processes essential for a specific business activity without which the business activity could not continue.

[4] Primary suppliers are those suppliers who, on an ongoing basis, provide goods or materials essential for the core business processes of the project.

[5] Working conditions and terms of employment examples are wages and benefits; wage deductions; hours of work; overtime arrangements and overtime compensation; breaks; rest days; and leave for illness, maternity, vacation or holiday.

[6] Reasonable working conditions and terms of employment could be assessed by reference to (i) conditions established for work of the same character in the trade or industry concerned in the area/region where the work is carried out; (ii) collective agreement or other recognized negotiation between other organizations of employers and workers' representatives in the trade or industry concerned; (iii) arbitration award; or (iv) conditions established by national law.

12. Where accommodation services[7] are provided to workers covered by the scope of this Performance Standard, the client will put in place and implement policies on the quality and management of the accommodation and provision of basic services.[8] The accommodation services will be provided in a manner consistent with the principles of non-discrimination and equal opportunity. Workers' accommodation arrangements should not restrict workers' freedom of movement or of association.

Workers' Organizations

13. In countries where national law recognizes workers' rights to form and to join workers' organizations of their choosing without interference and to bargain collectively, the client will comply with national law. Where national law substantially restricts workers' organizations, the client will not restrict workers from developing alternative mechanisms to express their grievances and protect their rights regarding working conditions and terms of employment. The client should not seek to influence or control these mechanisms

14. In either case described in paragraph 13 of this Performance Standard, and where national law is silent, the client will not discourage workers from electing worker representatives, forming or joining workers' organizations of their choosing, or from bargaining collectively, and will not discriminate or retaliate against workers who participate, or seek to participate, in such organizations and collective bargaining. The client will engage with such workers' representatives and workers' organizations, and provide them with information needed for meaningful negotiation in a timely manner. Workers' organizations are expected to fairly represent the workers in the workforce.

Non-Discrimination and Equal Opportunity

15. The client will not make employment decisions on the basis of personal characteristics[9] unrelated to inherent job requirements. The client will base the employment relationship on the principle of equal opportunity and fair treatment, and will not discriminate with respect to any aspects of the employment relationship, such as recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices. The client will take measures to prevent and address harassment, intimidation, and/or exploitation, especially in regard to women. The principles of non-discrimination apply to migrant workers.

16. In countries where national law provides for non-discrimination in employment, the client will comply with national law. When national laws are silent on non-discrimination in employment, the client will meet this Performance Standard. In circumstances where national law is inconsistent with this Performance Standard, the client is encouraged to carry out its operations consistent with the intent of paragraph 15 above without contravening applicable laws.

17. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job will not be deemed as discrimination, provided they are consistent with national law.

[7] Those services might be provided either directly by the client or by third parties.

[8] Basic services requirements refer to minimum space, supply of water, adequate sewage and garbage disposal system, appropriate protection against heat, cold, damp, noise, fire and disease-carrying animals, adequate sanitary and washing facilities, ventilation, cooking and storage facilities and natural and artificial lighting, and in some cases basic medical services.

[9] Such as gender, race, nationality, ethnic, social and indigenous origin, religion or belief, disability, age, or sexual orientation.

Retrenchment

18. Prior to implementing any collective dismissals,[10] the client will carry out an analysis of alternatives to retrenchment.[11] If the analysis does not identify viable alternatives to retrenchment, a retrenchment plan will be developed and implemented to reduce the adverse impacts of retrenchment on workers. The retrenchment plan will be based on the principle of non-discrimination and will reflect the client's consultation with workers, their organizations, and, where appropriate, the government, and comply with collective bargaining agreements if they exist. The client will comply with all legal and contractual requirements related to notification of public authorities, and provision of information to, and consultation with workers and their organizations.

19. The client should ensure that all workers receive notice of dismissal and severance payments mandated by law and collective agreements in a timely manner. All outstanding back pay and social security benefits and pension contributions and benefits will be paid (i) on or before termination of the working relationship to the workers, (ii) where appropriate, for the benefit of the workers, or (iii) payment will be made in accordance with a timeline agreed through a collective agreement. Where payments are made for the benefit of workers, workers will be provided with evidence of such payments.

Grievance Mechanism

20. The client will provide a grievance mechanism for workers (and their organizations, where they exist) to raise workplace concerns. The client will inform the workers of the grievance mechanism at the time of recruitment and make it easily accessible to them. The mechanism should involve an appropriate level of management and address concerns promptly, using an understandable and transparent process that provides timely feedback to those concerned, without any retribution. The mechanism should also allow for anonymous complaints to be raised and addressed. The mechanism should not impede access to other judicial or administrative remedies that might be available under the law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.

Protecting the Work Force

Child Labor

21. The client will not employ children in any manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. The client will identify the presence of all persons under the age of 18. Where national laws have provisions for the employment of minors, the client will follow those laws applicable to the client. Children under the age of 18 will not be employed in hazardous work.[12] All work of persons under the age of 18 will be subject to an appropriate risk assessment and regular monitoring of health, working conditions, and hours of work.

---

[10] Collective dismissals cover all multiple dismissals that are a result of an economic, technical, or organizational reason; or other reasons that are not related to performance or other personal reasons.

[11] Examples of alternatives may include negotiated working-time reduction programs, employee capacity-building programs; long-term maintenance works during low production periods, etc.

[12] Examples of hazardous work activities include work (i) with exposure to physical, psychological, or sexual abuse; (ii) underground, underwater, working at heights, or in confined spaces; (iii) with dangerous machinery, equipment, or tools, or involving handling of heavy loads; (iv) in unhealthy environments exposing the worker to hazardous substances, agents, processes, temperatures, noise, or vibration damaging to health; or (v) under difficult conditions such as long hours, late night, or confinement by employer.

Forced Labor

22. The client will not employ forced labor, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labor, such as indentured labor, bonded labor, or similar labor-contracting arrangements. The client will not employ trafficked persons.[13]

Occupational Health and Safety

23. The client will provide a safe and healthy work environment, taking into account inherent risks in its particular sector and specific classes of hazards in the client's work areas, including physical, chemical, biological, and radiological hazards, and specific threats to women. The client will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, as far as reasonably practicable, the causes of hazards. In a manner consistent with good international industry practice,[14] as reflected in various internationally recognized sources including the World Bank Group Environmental, Health and Safety Guidelines, the client will address areas that include the (i) identification of potential hazards to workers, particularly those that may be life-threatening; (ii) provision of preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) training of workers; (iv) documentation and reporting of occupational accidents, diseases, and incidents; and (v) emergency prevention, preparedness, and response arrangements. For additional information related to emergency preparedness and response refer to Performance Standard 1.

Workers Engaged by Third Parties

24. With respect to contracted workers the client will take commercially reasonable efforts to ascertain that the third parties who engage these workers are reputable and legitimate enterprises and have an appropriate ESMS that will allow them to operate in a manner consistent with the requirements of this Performance Standard, except for paragraphs 18–19, and 27–29.

25. The client will establish policies and procedures for managing and monitoring the performance of such third party employers in relation to the requirements of this Performance Standard. In addition, the client will use commercially reasonable efforts to incorporate these requirements in contractual agreements with such third party employers.

26. The client will ensure that contracted workers, covered in paragraphs 24–25 of this Performance Standard, have access to a grievance mechanism. In cases where the third party is not able to provide a grievance mechanism the client will extend its own grievance mechanism to serve workers engaged by the third party.

---

[13] Trafficking in persons is defined as the recruitment, transportation, transfer, harboring, or receipt of persons, by means of the threat or use of force or other forms of coercion, abduction, fraud, deception, abuse of power, or of a position of vulnerability, or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation. Women and children are particularly vulnerable to trafficking practices.

[14] Defined as the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances, globally or regionally.

Supply Chain

27. Where there is a high risk of child labor or forced labor[15] in the primary supply chain, the client will identify those risks consistent with paragraphs 21 and 22 above. If child labor or forced labor cases are identified, the client will take appropriate steps to remedy them. The client will monitor its primary supply chain on an ongoing basis in order to identify any significant changes in its supply chain and if new risks or incidents of child and/or forced labor are identified, the client will take appropriate steps to remedy them.

28. Additionally, where there is a high risk of significant safety issues related to supply chain workers, the client will introduce procedures and mitigation measures to ensure that primary suppliers within the supply chain are taking steps to prevent or to correct life-threatening situations.

29. The ability of the client to fully address these risks will depend upon the client's level of management control or influence over its primary suppliers. Where remedy is not possible, the client will shift the project's primary supply chain over time to suppliers that can demonstrate that they are complying with this Performance Standard.

[15] The potential risk of child labor and forced labor will be determined during the risks and impacts identification process as required in Performance Standard 1.

Performance Standard 3
Resource Efficiency and Pollution Prevention

January 1, 2012

Introduction

1. Performance Standard 3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.[1] There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use and pollution prevention[2] and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world. These are often implemented through continuous improvement methodologies similar to those used to enhance quality or productivity, which are generally well known to most industrial, agricultural, and service sector companies.

2. This Performance Standard outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices. In addition, this Performance Standard promotes the ability of private sector companies to adopt such technologies and practices as far as their use is feasible in the context of a project that relies on commercially available skills and resources.

Objectives

- To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities.
- To promote more sustainable use of resources, including energy and water.
- To reduce project-related GHG emissions.

Scope of Application

3. The applicability of this Performance Standard is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System, the elements of which are outlined in Performance Standard 1.

Requirements

4. During the project life-cycle, the client will consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimize adverse impacts on human health and the environment.[3] The principles and techniques applied during the project life-cycle will be

[1] For the purposes of this Performance Standard, the term "pollution" is used to refer to both hazardous and non-hazardous chemical pollutants in the solid, liquid, or gaseous phases, and includes other components such as pests, pathogens, thermal discharge to water, GHG emissions, nuisance odors, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts including light.

[2] For the purpose of this Performance Standard, the term "pollution prevention" does not mean absolute elimination of emissions, but the avoidance at source whenever possible, and, if not possible, then subsequent minimization of pollution to the extent that the Performance Standard objectives are satisfied.

[3] Technical feasibility is based on whether the proposed measures and actions can be implemented with commercially available skills, equipment, and materials, taking into consideration prevailing local factors such as climate, geography, infrastructure, security, governance, capacity and operational reliability. Financial feasibility is

tailored to the hazards and risks associated with the nature of the project and consistent with good international industry practice (GIIP),[4] as reflected in various internationally recognized sources, including the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines).

5. The client will refer to the EHS Guidelines or other internationally recognized sources, as appropriate, when evaluating and selecting resource efficiency and pollution prevention and control techniques for the project. The EHS Guidelines contain the performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from the levels and measures presented in the EHS Guidelines, clients will be required to achieve whichever is more stringent. If less stringent levels or measures than those provided in the EHS Guidelines are appropriate in view of specific project circumstances, the client will provide full and detailed justification for any proposed alternatives through the environmental and social risks and impacts identification and assessment process. This justification must demonstrate that the choice for any alternate performance levels is consistent with the objectives of this Performance Standard.

Resource Efficiency

6. The client will implement technically and financially feasible and cost effective[5] measures for improving efficiency in its consumption of energy, water, as well as other resources and material inputs, with a focus on areas that are considered core business activities. Such measures will integrate the principles of cleaner production into product design and production processes with the objective of conserving raw materials, energy, and water. Where benchmarking data are available, the client will make a comparison to establish the relative level of efficiency.

Greenhouse Gases

7. In addition to the resource efficiency measures described above, the client will consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project. These options may include, but are not limited to, alternative project locations, adoption of renewable or low carbon energy sources, sustainable agricultural, forestry and livestock management practices, the reduction of fugitive emissions and the reduction of gas flaring.

8. For projects that are expected to or currently produce more than 25,000 tonnes of CO_2-equivalent annually,[6] the client will quantify direct emissions from the facilities owned or controlled within the physical project boundary,[7] as well as indirect emissions associated with the off-site

based on commercial considerations, including relative magnitude of the incremental cost of adopting such measures and actions compared to the project's investment, operating, and maintenance costs.

[4] GIIP is defined as the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally or regionally. The outcome of such exercise should be that the project employs the most appropriate technologies in the project-specific circumstances.

[5] Cost-effectiveness is determined according to the capital and operational cost and financial benefits of the measure considered over the life of the measure. For the purpose of this Performance Standard, a resource efficiency or GHG emissions reduction measure is considered cost-effective if it is expected to provide a risk-rated return on investment at least comparable to the project itself.

[6] The quantification of emissions should consider all significant sources of greenhouse gas emissions, including non-energy related sources such as methane and nitrous oxide, among others.

[7] Project-induced changes in soil carbon content or above ground biomass, and project-induced decay of organic matter may contribute to direct emissions sources and shall be included in this emissions quantification where such emissions are expected to be significant.

production of energy[8] used by the project. Quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognized methodologies and good practice.[9]

Water Consumption

9. When the project is a potentially significant consumer of water, in addition to applying the resource efficiency requirements of this Performance Standard, the client shall adopt measures that avoid or reduce water usage so that the project's water consumption does not have significant adverse impacts on others. These measures include, but are not limited to, the use of additional technically feasible water conservation measures within the client's operations, the use of alternative water supplies, water consumption offsets to reduce total demand for water resources to within the available supply, and evaluation of alternative project locations.

Pollution Prevention

10. The client will avoid the release of pollutants or, when avoidance is not feasible, minimize and/or control the intensity and mass flow of their release. This applies to the release of pollutants to air, water, and land due to routine, non-routine, and accidental circumstances with the potential for local, regional, and transboundary impacts.[10] Where historical pollution such as land or ground water contamination exists, the client will seek to determine whether it is responsible for mitigation measures. If it is determined that the client is legally responsible, then these liabilities will be resolved in accordance with national law, or where this is silent, with GIIP.[11]

11. To address potential adverse project impacts on existing ambient conditions,[12] the client will consider relevant factors, including, for example (i) existing ambient conditions; (ii) the finite assimilative capacity[13] of the environment; (iii) existing and future land use; (iv) the project's proximity to areas of importance to biodiversity; and (v) the potential for cumulative impacts with uncertain and/or irreversible consequences. In addition to applying resource efficiency and pollution control measures as required in this Performance Standard, when the project has the potential to constitute a significant source of emissions in an already degraded area, the client will consider additional strategies and adopt measures that avoid or reduce negative effects. These strategies include, but are not limited to, evaluation of project location alternatives and emissions offsets.

Wastes

12. The client will avoid the generation of hazardous and non-hazardous waste materials. Where waste generation cannot be avoided, the client will reduce the generation of waste, and recover and reuse waste in a manner that is safe for human health and the environment. Where waste cannot be recovered or reused, the client will treat, destroy, or dispose of it in an environmentally sound manner that includes the appropriate control of emissions and residues resulting from the handling and processing of the waste material. If the generated waste is considered hazardous,[14] the client will

[8] Refers to the off-site generation by others of electricity, and heating and cooling energy used in the project.

[9] Estimation methodologies are provided by the Intergovernmental Panel on Climate Change, various international organizations, and relevant host country agencies.

[10] Transboundary pollutants include those covered under the Convention on Long-Range Transboundary Air Pollution.

[11] This may require coordination with national and local government, communities, and the contributors to the contamination, and that any assessment follows a risk-based approach consistent with GIIP as reflected in the EHS Guidelines.

[12] Such as air, surface and groundwater, and soils.

[13] The capacity of the environment for absorbing an incremental load of pollutants while remaining below a threshold of unacceptable risk to human health and the environment.

[14] As defined by international conventions or local legislation.

adopt GIIP alternatives for its environmentally sound disposal while adhering to the limitations applicable to its transboundary movement.[15] When hazardous waste disposal is conducted by third parties, the client will use contractors that are reputable and legitimate enterprises licensed by the relevant government regulatory agencies and obtain chain of custody documentation to the final destination. The client should ascertain whether licensed disposal sites are being operated to acceptable standards and where they are, the client will use these sites. Where this is not the case, clients should reduce waste sent to such sites and consider alternative disposal options, including the possibility of developing their own recovery or disposal facilities at the project site.

Hazardous Materials Management

13. Hazardous materials are sometimes used as raw material or produced as product by the project. The client will avoid or, when avoidance is not possible, minimize and control the release of hazardous materials. In this context, the production, transportation, handling, storage, and use of hazardous materials for project activities should be assessed. The client will consider less hazardous substitutes where hazardous materials are intended to be used in manufacturing processes or other operations. The client will avoid the manufacture, trade, and use of chemicals and hazardous materials subject to international bans or phase-outs due to their high toxicity to living organisms, environmental persistence, potential for bioaccumulation, or potential for depletion of the ozone layer.[16]

Pesticide Use and Management

14. The client will, where appropriate, formulate and implement an integrated pest management (IPM) and/or integrated vector management (IVM) approach targeting economically significant pest infestations and disease vectors of public health significance. The client's IPM and IVM program will integrate coordinated use of pest and environmental information along with available pest control methods, including cultural practices, biological, genetic, and, as a last resort, chemical means to prevent economically significant pest damage and/or disease transmission to humans and animals.

15. When pest management activities include the use of chemical pesticides, the client will select chemical pesticides that are low in human toxicity, that are known to be effective against the target species, and that have minimal effects on non-target species and the environment. When the client selects chemical pesticides, the selection will be based upon requirements that the pesticides be packaged in safe containers, be clearly labeled for safe and proper use, and that the pesticides have been manufactured by an entity currently licensed by relevant regulatory agencies.

16. The client will design its pesticide application regime to (i) avoid damage to natural enemies of the target pest, and where avoidance is not possible, minimize, and (ii) avoid the risks associated with the development of resistance in pests and vectors, and where avoidance is not possible minimize. In addition, pesticides will be handled, stored, applied, and disposed of in accordance with the Food and Agriculture Organization's International Code of Conduct on the Distribution and Use of Pesticides or other GIIP.

17. The client will not purchase, store, use, manufacture, or trade in products that fall in WHO Recommended Classification of Pesticides by Hazard Class Ia (extremely hazardous); or Ib (highly

[15] Transboundary movement of hazardous materials should be consistent with national, regional and international law, including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

[16] Consistent with the objectives of the Stockholm Convention on Persistent Organic Pollutants and the Montreal Protocol on Substances that Deplete the Ozone Layer. Similar considerations will apply to certain World Health Organization (WHO) classes of pesticides.

hazardous). The client will not purchase, store, use, manufacture or trade in Class II (moderately hazardous) pesticides, unless the project has appropriate controls on manufacture, procurement, or distribution and/or use of these chemicals. These chemicals should not be accessible to personnel without proper training, equipment, and facilities to handle, store, apply, and dispose of these products properly.

Performance Standard 4
Community Health, Safety, and Security

January 1, 2012

Introduction

1. Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups.

2. In conflict and post-conflict areas, the level of risks and impacts described in this Performance Standard may be greater. The risks that a project could exacerbate an already sensitive local situation and stress scarce local resources should not be overlooked as it may lead to further conflict.

Objectives

- To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances.
- To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.

Scope of Application

3. The applicability of this Performance Standard is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System, the elements of which are outlined in Performance Standard 1.

4. This Performance Standard addresses potential risks and impacts to the Affected Communities from project activities. Occupational health and safety requirements for workers are included in Performance Standard 2, and environmental standards to avoid or minimize impacts on human health and the environment due to pollution are included in Performance Standard 3.

Requirements

Community Health and Safety

5. The client will evaluate the risks and impacts to the health and safety of the Affected Communities during the project life-cycle and will establish preventive and control measures consistent with good international industry practice (GIIP),[1] such as in the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) or other internationally recognized sources. The client will identify risks and impacts and propose mitigation measures that are commensurate with their nature and magnitude. These measures will favor the avoidance of risks and impacts over minimization.

[1] Defined as the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally or regionally.

Infrastructure and Equipment Design and Safety

6. The client will design, construct, operate, and decommission the structural elements or components of the project in accordance with GIIP, taking into consideration safety risks to third parties or Affected Communities. When new buildings and structures will be accessed by members of the public, the client will consider incremental risks of the public's potential exposure to operational accidents and/or natural hazards and be consistent with the principles of universal access. Structural elements will be designed and constructed by competent professionals, and certified or approved by competent authorities or professionals. When structural elements or components, such as dams, tailings dams, or ash ponds are situated in high-risk locations, and their failure or malfunction may threaten the safety of communities, the client will engage one or more external experts with relevant and recognized experience in similar projects, separate from those responsible for the design and construction, to conduct a review as early as possible in project development and throughout the stages of project design, construction, operation, and decommissioning. For projects that operate moving equipment on public roads and other forms of infrastructure, the client will seek to avoid the occurrence of incidents and injuries to members of the public associated with the operation of such equipment.

Hazardous Materials Management and Safety

7. The client will avoid or minimize the potential for community exposure to hazardous materials and substances that may be released by the project. Where there is a potential for the public (including workers and their families) to be exposed to hazards, particularly those that may be life-threatening, the client will exercise special care to avoid or minimize their exposure by modifying, substituting, or eliminating the condition or material causing the potential hazards. Where hazardous materials are part of existing project infrastructure or components, the client will exercise special care when conducting decommissioning activities in order to avoid exposure to the community. The client will exercise commercially reasonable efforts to control the safety of deliveries of hazardous materials, and of transportation and disposal of hazardous wastes, and will implement measures to avoid or control community exposure to pesticides, in accordance with the requirements of Performance Standard 3.

Ecosystem Services

8. The project's direct impacts on priority ecosystem services may result in adverse health and safety risks and impacts to Affected Communities. With respect to this Performance Standard, ecosystem services are limited to provisioning and regulating services as defined in paragraph 2 of Performance Standard 6. For example, land use changes or the loss of natural buffer areas such as wetlands, mangroves, and upland forests that mitigate the effects of natural hazards such as flooding, landslides, and fire, may result in increased vulnerability and community safety-related risks and impacts. The diminution or degradation of natural resources, such as adverse impacts on the quality, quantity, and availability of freshwater,[2] may result in health-related risks and impacts. Where appropriate and feasible, the client will identify those risks and potential impacts on priority ecosystem services that may be exacerbated by climate change. Adverse impacts should be avoided, and if these impacts are unavoidable, the client will implement mitigation measures in accordance with paragraphs 24 and 25 of Performance Standard 6. With respect to the use of and loss of access to provisioning services, clients will implement mitigation measures in accordance with paragraphs 25–29 of Performance Standard 5.

[2] Freshwater is an example of provisioning ecosystem services.

Community Exposure to Disease

9. The client will avoid or minimize the potential for community exposure to water-borne, water-based, water-related, and vector-borne diseases, and communicable diseases that could result from project activities, taking into consideration differentiated exposure to and higher sensitivity of vulnerable groups. Where specific diseases are endemic in communities in the project area of influence, the client is encouraged to explore opportunities during the project life-cycle to improve environmental conditions that could help minimize their incidence.

10. The client will avoid or minimize transmission of communicable diseases that may be associated with the influx of temporary or permanent project labor.

Emergency Preparedness and Response

11. In addition to the emergency preparedness and response requirements described in Performance Standard 1, the client will also assist and collaborate with the Affected Communities, local government agencies, and other relevant parties, in their preparations to respond effectively to emergency situations, especially when their participation and collaboration are necessary to respond to such emergency situations. If local government agencies have little or no capacity to respond effectively, the client will play an active role in preparing for and responding to emergencies associated with the project. The client will document its emergency preparedness and response activities, resources, and responsibilities, and will disclose appropriate information to Affected Communities, relevant government agencies, or other relevant parties.

Security Personnel

12. When the client retains direct or contracted workers to provide security to safeguard its personnel and property, it will assess risks posed by its security arrangements to those within and outside the project site. In making such arrangements, the client will be guided by the principles of proportionality and good international practice[3] in relation to hiring, rules of conduct, training, equipping, and monitoring of such workers, and by applicable law. The client will make reasonable inquiries to ensure that those providing security are not implicated in past abuses; will train them adequately in the use of force (and where applicable, firearms), and appropriate conduct toward workers and Affected Communities; and require them to act within the applicable law. The client will not sanction any use of force except when used for preventive and defensive purposes in proportion to the nature and extent of the threat. The client will provide a grievance mechanism for Affected Communities to express concerns about the security arrangements and acts of security personnel.

13. The client will assess and document risks arising from the project's use of government security personnel deployed to provide security services. The client will seek to ensure that security personnel will act in a manner consistent with paragraph 12 above, and encourage the relevant public authorities to disclose the security arrangements for the client's facilities to the public, subject to overriding security concerns.

14. The client will consider and, where appropriate, investigate all allegations of unlawful or abusive acts of security personnel, take action (or urge appropriate parties to take action) to prevent recurrence, and report unlawful and abusive acts to public authorities.

[3] Including practice consistent with the United Nation's (UN) Code of Conduct for Law Enforcement Officials, and UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials.

Performance Standard 5
Land Acquisition and Involuntary Resettlement

January 1, 2012

Introduction

1. Performance Standard 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood[1]) as a result of project-related land acquisition[2] and/or restrictions on land use. Resettlement is considered involuntary when affected persons or communities do not have the right to refuse land acquisition or restrictions on land use that result in physical or economic displacement. This occurs in cases of (i) lawful expropriation or temporary or permanent restrictions on land use and (ii) negotiated settlements in which the buyer can resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail.

2. Unless properly managed, involuntary resettlement may result in long-term hardship and impoverishment for the Affected Communities and persons, as well as environmental damage and adverse socio-economic impacts in areas to which they have been displaced. For these reasons, involuntary resettlement should be avoided. However, where involuntary resettlement is unavoidable, it should be minimized and appropriate measures to mitigate adverse impacts on displaced persons and host communities[3] should be carefully planned and implemented. The government often plays a central role in the land acquisition and resettlement process, including the determination of compensation, and is therefore an important third party in many situations. Experience demonstrates that the direct involvement of the client in resettlement activities can result in more cost-effective, efficient, and timely implementation of those activities, as well as in the introduction of innovative approaches to improving the livelihoods of those affected by resettlement.

3. To help avoid expropriation and eliminate the need to use governmental authority to enforce relocation, clients are encouraged to use negotiated settlements meeting the requirements of this Performance Standard, even if they have the legal means to acquire land without the seller's consent.

Objectives

- To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs.
- To avoid forced eviction.
- To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost[4] and (ii) ensuring

[1] The term "livelihood" refers to the full range of means that individuals, families, and communities utilize to make a living, such as wage-based income, agriculture, fishing, foraging, other natural resource-based livelihoods, petty trade, and bartering.

[2] Land acquisition includes both outright purchases of property and acquisition of access rights, such as easements or rights of way.

[3] A host community is any community receiving displaced persons.

[4] Replacement cost is defined as the market value of the assets plus transaction costs. In applying this method of valuation, depreciation of structures and assets should not be taken into account. Market value is defined as the value required to allow Affected Communities and persons to replace lost assets with assets of similar value. The valuation method for determining replacement cost should be documented and included in applicable Resettlement and/or Livelihood Restoration plans (see paragraphs 18 and 25).

that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.

- To improve, or restore, the livelihoods and standards of living of displaced persons.
- To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure[5] at resettlement sites.

Scope of Application

4. The applicability of this Performance Standard is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System, the elements of which are outlined in Performance Standard 1.

5. This Performance Standard applies to physical and/or economic displacement resulting from the following types of land-related transactions:

- Land rights or land use rights acquired through expropriation or other compulsory procedures in accordance with the legal system of the host country;
- Land rights or land use rights acquired through negotiated settlements with property owners or those with legal rights to the land if failure to reach settlement would have resulted in expropriation or other compulsory procedures;[6]
- Project situations where involuntary restrictions on land use and access to natural resources cause a community or groups within a community to lose access to resource usage where they have traditional or recognizable usage rights;[7]
- Certain project situations requiring evictions of people occupying land without formal, traditional, or recognizable usage rights;[8] or
- Restriction on access to land or use of other resources including communal property and natural resources such as marine and aquatic resources, timber and non-timber forest products, freshwater, medicinal plants, hunting and gathering grounds and grazing and cropping areas.[9]

6. This Performance Standard does not apply to resettlement resulting from voluntary land transactions (i.e., market transactions in which the seller is not obliged to sell and the buyer cannot resort to expropriation or other compulsory procedures sanctioned by the legal system of the host country if negotiations fail). It also does not apply to impacts on livelihoods where the project is not changing the land use of the affected groups or communities.[10]

[5] Security of tenure means that resettled individuals or communities are resettled to a site that they can legally occupy and where they are protected from the risk of eviction.

[6] This also applies to customary or traditional rights recognized or recognizable under the laws of the host country. The negotiations may be carried out by the government or by the company (in some circumstances, as an agent of the government).

[7] In such situations, affected persons frequently do not have formal ownership. This may include freshwater and marine environments. This Performance Standard may also apply when project-related biodiversity areas or legally designated buffer zones are established but not acquired by the client.

[8] While some people do not have rights over the land they occupy, this Performance Standard requires that non-land assets be retained, replaced, or compensated for; relocation take place with security of tenure; and lost livelihoods be restored.

[9] Natural resource assets referred to in this Performance Standard are equivalent to ecosystem provisioning services as described in Performance Standard 6.

[10] More generalized impacts on communities or groups of people are covered in Performance Standard 1. For example, disruption of access to mineral deposits by artisanal miners is covered by Performance Standard 1.

7. Where project impacts on land, assets, or access to assets become significantly adverse at any stage of the project, the client should consider applying requirements of this Performance Standard, even where no land acquisition or land use restriction is involved.

Requirements

General

Project Design

8. The client will consider feasible alternative project designs to avoid or minimize physical and/or economic displacement, while balancing environmental, social, and financial costs and benefits, paying particular attention to impacts on the poor and vulnerable.

Compensation and Benefits for Displaced Persons

9. When displacement cannot be avoided, the client will offer displaced communities and persons compensation for loss of assets at full replacement cost and other assistance[11] to help them improve or restore their standards of living or livelihoods, as provided in this Performance Standard. Compensation standards will be transparent and applied consistently to all communities and persons affected by the displacement. Where livelihoods of displaced persons are land-based,[12] or where land is collectively owned, the client will, where feasible,[13] offer the displaced land-based compensation. The client will take possession of acquired land and related assets only after compensation has been made available[14] and, where applicable, resettlement sites and moving allowances have been provided to the displaced persons in addition to compensation.[15] The client will also provide opportunities to displaced communities and persons to derive appropriate development benefits from the project.

Community Engagement

10. The client will engage with Affected Communities, including host communities, through the process of stakeholder engagement described in Performance Standard 1. Decision-making processes related to resettlement and livelihood restoration should include options and alternatives, where applicable. Disclosure of relevant information and participation of Affected Communities and persons will continue during the planning, implementation, monitoring, and evaluation of compensation payments, livelihood restoration activities, and resettlement to achieve outcomes that are consistent with the objectives of this Performance Standard.[16] Additional provisions apply to consultations with Indigenous Peoples, in accordance with Performance Standard 7.

---

[11] As described in paragraphs 19 and 26.

[12] The term "land-based" includes livelihood activities such as subsistence cropping and grazing of livestock as well as the harvesting of natural resources.

[13] Refer to paragraph 26 of this Performance Standard for further requirements.

[14] In certain cases it may not be feasible to pay compensation to all those affected before taking possession of the land, for example when the ownership of the land in question is in dispute. Such circumstances shall be identified and agreed on a case-by-case basis, and compensation funds shall be made available for example through deposit into an escrow account before displacement takes place.

[15] Unless government-managed resettlement is involved and where the client has no direct influence over the timing of compensation payments. Such cases should be handled in accordance with paragraphs 27–29 of this Performance Standard. Staggered compensation payments may be made where one-off cash payments would demonstrably undermine social and/or resettlement objectives, or where there are ongoing impacts to livelihood activities.

[16] The consultation process should ensure that women's perspectives are obtained and their interests factored into all aspects of resettlement planning and implementation. Addressing livelihood impacts may require intra-household analysis in cases where women's and men's livelihoods are affected differently. Women's and men's preferences in terms of compensation mechanisms, such as compensation in kind rather than in cash, should be explored.

Grievance Mechanism

11. The client will establish a grievance mechanism consistent with Performance Standard 1 as early as possible in the project development phase. This will allow the client to receive and address specific concerns about compensation and relocation raised by displaced persons or members of host communities in a timely fashion, including a recourse mechanism designed to resolve disputes in an impartial manner.

Resettlement and Livelihood Restoration Planning and Implementation

12. Where involuntary resettlement is unavoidable, either as a result of a negotiated settlement or expropriation, a census will be carried out to collect appropriate socio-economic baseline data to identify the persons who will be displaced by the project, determine who will be eligible for compensation and assistance,[17] and discourage ineligible persons, such as opportunistic settlers, from claiming benefits. In the absence of host government procedures, the client will establish a cut-off date for eligibility. Information regarding the cut-off date will be well documented and disseminated throughout the project area.

13. In cases where affected persons reject compensation offers that meet the requirements of this Performance Standard and, as a result, expropriation or other legal procedures are initiated, the client will explore opportunities to collaborate with the responsible government agency, and, if permitted by the agency, play an active role in resettlement planning, implementation, and monitoring (see paragraphs 30–32).

14. The client will establish procedures to monitor and evaluate the implementation of a Resettlement Action Plan or Livelihood Restoration Plan (see paragraphs 19 and 25) and take corrective action as necessary. The extent of monitoring activities will be commensurate with the project's risks and impacts. For projects with significant involuntary resettlement risks, the client will retain competent resettlement professionals to provide advice on compliance with this Performance Standard and to verify the client's monitoring information. Affected persons will be consulted during the monitoring process.

15. Implementation of a Resettlement Action Plan or Livelihood Restoration Plan will be considered completed when the adverse impacts of resettlement have been addressed in a manner that is consistent with the relevant plan as well as the objectives of this Performance Standard. It may be necessary for the client to commission an external completion audit of the Resettlement Action Plan or Livelihood Restoration Plan to assess whether the provisions have been met, depending on the scale and/or complexity of physical and economic displacement associated with a project. The completion audit should be undertaken once all mitigation measures have been substantially completed and once displaced persons are deemed to have been provided adequate opportunity and assistance to sustainably restore their livelihoods. The completion audit will be undertaken by competent resettlement professionals once the agreed monitoring period is concluded. The completion audit will include, at a minimum, a review of the totality of mitigation measures implemented by the Client, a comparison of implementation outcomes against agreed objectives, and a conclusion as to whether the monitoring process can be ended.[18]

[17] Documentation of ownership or occupancy and compensation arrangements should be issued in the names of both spouses or heads of households, and other resettlement assistance, such as skills training, access to credit, and job opportunities, should be equally available to women and adapted to their needs. Where national law and tenure systems do not recognize the rights of women to hold or contract in property, measures should be considered to provide women as much protection as possible with the objective to achieve equity with men.

[18] The completion audit of the Resettlement Action Plan and/or Livelihood Restoration Plan, will be undertaken by external resettlement experts once the agreed monitoring period is concluded, and will involve a more in-depth assessment than regular resettlement monitoring activities, including at a minimum a review of all mitigation

16. Where the exact nature or magnitude of the land acquisition or restrictions on land use related to a project with potential to cause physical and/or economic displacement is unknown due to the stage of project development, the client will develop a Resettlement and/or Livelihood Restoration Framework outlining general principles compatible with this Performance Standard. Once the individual project components are defined and the necessary information becomes available, such a framework will be expanded into a specific Resettlement Action Plan or Livelihood Restoration Plan and procedures in accordance with paragraphs 19 and 25 below.

Displacement

17. Displaced persons may be classified as persons (i) who have formal legal rights to the land or assets they occupy or use; (ii) who do not have formal legal rights to land or assets, but have a claim to land that is recognized or recognizable under national law;[19] or (iii) who have no recognizable legal right or claim to the land or assets they occupy or use. The census will establish the status of the displaced persons.

18. Project-related land acquisition and/or restrictions on land use may result in the physical displacement of people as well as their economic displacement. Consequently, requirements of this Performance Standard in respect of physical displacement and economic displacement may apply simultaneously.[20]

Physical Displacement

19. In the case of physical displacement, the client will develop a Resettlement Action Plan that covers, at a minimum, the applicable requirements of this Performance Standard regardless of the number of people affected. This will include compensation at full replacement cost for land and other assets lost. The Plan will be designed to mitigate the negative impacts of displacement; identify development opportunities; develop a resettlement budget and schedule; and establish the entitlements of all categories of affected persons (including host communities). Particular attention will be paid to the needs of the poor and the vulnerable. The client will document all transactions to acquire land rights, as well as compensation measures and relocation activities.

20. If people living in the project area are required to move to another location, the client will (i) offer displaced persons choices among feasible resettlement options, including adequate replacement housing or cash compensation where appropriate; and (ii) provide relocation assistance suited to the needs of each group of displaced persons. New resettlement sites built for displaced persons must offer improved living conditions. The displaced persons' preferences with respect to relocating in preexisting communities and groups will be taken into consideration. Existing social and cultural institutions of the displaced persons and any host communities will be respected.

21. In the case of physically displaced persons under paragraph 17 (i) or (ii), the client will offer the choice of replacement property of equal or higher value, security of tenure, equivalent or better characteristics, and advantages of location or cash compensation where appropriate. Compensation

---

measures with respect to the physical and/or economic displacement implemented by the Client, a comparison of implementation outcomes against agreed objectives, a conclusion as to whether the monitoring process can be ended and, where necessary, a Corrective Action Plan listing outstanding actions necessary to met the objectives.

[19] Such claims could be derived from adverse possession or from customary or traditional tenure arrangements.

[20] Where a project results in both physical and economic displacement, the requirements of paragraphs 25 and 26 (Economic Displacement) should be incorporated into the Resettlement Action Plan or Framework (i.e., there is no need to have a separate Resettlement Action Plan and Livelihood Restoration Plan).

in kind should be considered in lieu of cash. Cash compensation levels should be sufficient to replace the lost land and other assets at full replacement cost in local markets.[21]

22. In the case of physically displaced persons under paragraph 17 (iii), the client will offer them a choice of options for adequate housing with security of tenure so that they can resettle legally without having to face the risk of forced eviction. Where these displaced persons own and occupy structures, the client will compensate them for the loss of assets other than land, such as dwellings and other improvements to the land, at full replacement cost, provided that these persons have been occupying the project area prior to the cut-off date for eligibility. Based on consultation with such displaced persons, the client will provide relocation assistance sufficient for them to restore their standard of living at an adequate alternative site.[22]

23. The client is not required to compensate or assist those who encroach on the project area after the cut-off date for eligibility, provided the cut-off date has been clearly established and made public.

24. Forced evictions[23] will not be carried out except in accordance with law and the requirements of this Performance Standard.

Economic Displacement

25. In the case of projects involving economic displacement only, the client will develop a Livelihood Restoration Plan to compensate affected persons and/or communities and offer other assistance that meet the objectives of this Performance Standard. The Livelihood Restoration Plan will establish the entitlements of affected persons and/or communities and will ensure that these are provided in a transparent, consistent, and equitable manner. The mitigation of economic displacement will be considered complete when affected persons or communities have received compensation and other assistance according to the requirements of the Livelihood Restoration Plan and this Performance Standard, and are deemed to have been provided with adequate opportunity to reestablish their livelihoods.

26. If land acquisition or restrictions on land use result in economic displacement defined as loss of assets and/or means of livelihood, regardless of whether or not the affected people are physically displaced, the client will meet the requirements in paragraphs 27–29 below, as applicable.

27. Economically displaced persons who face loss of assets or access to assets will be compensated for such loss at full replacement cost.

- In cases where land acquisition or restrictions on land use affect commercial structures, affected business owners will be compensated for the cost of reestablishing commercial activities elsewhere, for lost net income during the

[21] Payment of cash compensation for lost assets may be appropriate where (i) livelihoods are not land-based; (ii) livelihoods are land-based but the land taken for the project is a small fraction of the affected asset and the residual land is economically viable; or (iii) active markets for land, housing, and labor exist, displaced persons use such markets, and there is sufficient supply of land and housing.

[22] Relocation of informal settlers in urban areas may involve trade-offs. For example, the relocated families may gain security of tenure, but they may lose advantages of location. Changes in location that may affect livelihood opportunities should be addressed in accordance with the principles of this Performance Standard (see in particular paragraph 25).

[23] The permanent or temporary removal against the will of individuals, families, and/or communities from the homes and/or lands which they occupy without the provision of, and access to, appropriate forms of legal and other protection.

period of transition, and for the costs of the transfer and reinstallation of the plant, machinery, or other equipment.

- In cases affecting persons with legal rights or claims to land which are recognized or recognizable under national law (see paragraph 17 (i) and (ii)), replacement property (e.g., agricultural or commercial sites) of equal or greater value will be provided, or, where appropriate, cash compensation at full replacement cost.
- Economically displaced persons who are without legally recognizable claims to land (see paragraph 17 (iii)) will be compensated for lost assets other than land (such as crops, irrigation infrastructure and other improvements made to the land), at full replacement cost. The client is not required to compensate or assist opportunistic settlers who encroach on the project area after the cut-off date for eligibility.

28. In addition to compensation for lost assets, if any, as required under paragraph 27, economically displaced persons whose livelihoods or income levels are adversely affected will also be provided opportunities to improve, or at least restore, their means of income-earning capacity, production levels, and standards of living:

- For persons whose livelihoods are land-based, replacement land that has a combination of productive potential, locational advantages, and other factors at least equivalent to that being lost should be offered as a matter of priority.
- For persons whose livelihoods are natural resource-based and where project-related restrictions on access envisaged in paragraph 5 apply, implementation of measures will be made to either allow continued access to affected resources or provide access to alternative resources with equivalent livelihood-earning potential and accessibility. Where appropriate, benefits and compensation associated with natural resource usage may be collective in nature rather than directly oriented towards individuals or households.
- If circumstances prevent the client from providing land or similar resources as described above, alternative income earning opportunities may be provided, such as credit facilities, training, cash, or employment opportunities. Cash compensation alone, however, is frequently insufficient to restore livelihoods.

29. Transitional support should be provided as necessary to all economically displaced persons, based on a reasonable estimate of the time required to restore their income-earning capacity, production levels, and standards of living.

Private Sector Responsibilities Under Government-Managed Resettlement

30. Where land acquisition and resettlement are the responsibility of the government, the client will collaborate with the responsible government agency, to the extent permitted by the agency, to achieve outcomes that are consistent with this Performance Standard. In addition, where government capacity is limited, the client will play an active role during resettlement planning, implementation, and monitoring, as described below.

31. In the case of acquisition of land rights or access to land through compulsory means or negotiated settlements involving physical displacement, the client will identify and describe[24] government resettlement measures. If these measures do not meet the relevant requirements of this Performance Standard, the client will prepare a Supplemental Resettlement Plan that, together with

[24] Government documents, where available, may be used to identify such measures.

the documents prepared by the responsible government agency, will address the relevant requirements of this Performance Standard (the General Requirements and requirements for Physical Displacement and Economic Displacement above). The client will need to include in its Supplemental Resettlement Plan, at a minimum (i) identification of affected people and impacts; (ii) a description of regulated activities, including the entitlements of displaced persons provided under applicable national laws and regulations; (iii) the supplemental measures to achieve the requirements of this Performance Standard as described in paragraphs 19–29 in a way that is permitted by the responsible agency and implementation time schedule; and (iv) the financial and implementation responsibilities of the client in the execution of its Supplemental Resettlement Plan.

32. In the case of projects involving economic displacement only, the client will identify and describe the measures that the responsible government agency plans to use to compensate Affected Communities and persons. If these measures do not meet the relevant requirements of this Performance Standard, the client will develop an Environmental and Social Action Plan to complement government action. This may include additional compensation for lost assets, and additional efforts to restore lost livelihoods where applicable.

Performance Standard 6

Biodiversity Conservation and Sustainable Management of Living Natural Resources

January 1, 2012

Introduction

1. Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard have been guided by the Convention on Biological Diversity, which defines biodiversity as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems.”

2. Ecosystem services are the benefits that people, including businesses, derive from ecosystems. Ecosystem services are organized into four types: (i) provisioning services, which are the products people obtain from ecosystems; (ii) regulating services, which are the benefits people obtain from the regulation of ecosystem processes; (iii) cultural services, which are the nonmaterial benefits people obtain from ecosystems; and (iv) supporting services, which are the natural processes that maintain the other services.[1]

3. Ecosystem services valued by humans are often underpinned by biodiversity. Impacts on biodiversity can therefore often adversely affect the delivery of ecosystem services. This Performance Standard addresses how clients can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout the project’s lifecycle.

Objectives

- To protect and conserve biodiversity.
- To maintain the benefits from ecosystem services.
- To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

Scope of Application

4. The applicability of this Performance Standard is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client’s Environmental and Social Management System (ESMS), the elements of which are outlined in Performance Standard 1.

5. Based on the risks and impacts identification process, the requirements of this Performance Standard are applied to projects (i) located in modified, natural, and critical habitats; (ii) that potentially impact on or are dependent on ecosystem services over which the client has direct management control or significant influence; or (iii) that include the production of living natural resources (e.g., agriculture, animal husbandry, fisheries, forestry).

[1] Examples are as follows: (i) provisioning services may include food, freshwater, timber, fibers, medicinal plants; (ii) regulating services may include surface water purification, carbon storage and sequestration, climate regulation, protection from natural hazards; (iii) cultural services may include natural areas that are sacred sites and areas of importance for recreation and aesthetic enjoyment; and (iv) supporting services may include soil formation, nutrient cycling, primary production.

Requirements

General

6. The risks and impacts identification process as set out in Performance Standard 1 should consider direct and indirect project-related impacts on biodiversity and ecosystem services and identify any significant residual impacts. This process will consider relevant threats to biodiversity and ecosystem services, especially focusing on habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution. It will also take into account the differing values attached to biodiversity and ecosystem services by Affected Communities and, where appropriate, other stakeholders. Where paragraphs 13–19 are applicable, the client should consider project-related impacts across the potentially affected landscape or seascape.

7. As a matter of priority, the client should seek to avoid impacts on biodiversity and ecosystem services. When avoidance of impacts is not possible, measures to minimize impacts and restore biodiversity and ecosystem services should be implemented. Given the complexity in predicting project impacts on biodiversity and ecosystem services over the long term, the client should adopt a practice of adaptive management in which the implementation of mitigation and management measures are responsive to changing conditions and the results of monitoring throughout the project's lifecycle.

8. Where paragraphs 13–15 are applicable, the client will retain competent professionals to assist in conducting the risks and impacts identification process. Where paragraphs 16–19 are applicable, the client should retain external experts with appropriate regional experience to assist in the development of a mitigation hierarchy that complies with this Performance Standard and to verify the implementation of those measures.

Protection and Conservation of Biodiversity

9. Habitat is defined as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment. For the purposes of implementation of this Performance Standard, habitats are divided into modified, natural, and critical. Critical habitats are a subset of modified or natural habitats.

10. For the protection and conservation of biodiversity, the mitigation hierarchy includes biodiversity offsets, which may be considered only after appropriate avoidance, minimization, and restoration measures have been applied.[2] A biodiversity offset should be designed and implemented to achieve measurable conservation outcomes[3] that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity; however, a net gain is required in critical habitats. The design of a biodiversity offset must adhere to the "like-for-like or better" principle[4] and must be carried out in

---

[2] Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimization and restoration measures have been taken.

[3] Measurable conservation outcomes for biodiversity must be demonstrated in situ (on-the-ground) and on an appropriate geographic scale (e.g., local, landscape-level, national, regional).

[4] The principle of "like-for-like or better" indicates that biodiversity offsets must be designed to conserve the same biodiversity values that are being impacted by the project (an "in-kind" offset). In certain situations, however, areas of biodiversity to be impacted by the project may be neither a national nor a local priority, and there may be other areas of biodiversity with like values that are a higher priority for conservation and sustainable use and under imminent threat or need of protection or effective management. In these situations, it may be appropriate to consider an "out-of-kind" offset that involves "trading up" (i.e., where the offset targets biodiversity of higher

alignment with best available information and current practices. When a client is considering the development of an offset as part of the mitigation strategy, external experts with knowledge in offset design and implementation must be involved.

Modified Habitat

11. Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition.[5] Modified habitats may include areas managed for agriculture, forest plantations, reclaimed[6] coastal zones, and reclaimed wetlands.

12. This Performance Standard applies to those areas of modified habitat that include significant biodiversity value, as determined by the risks and impacts identification process required in Performance Standard 1. The client should minimize impacts on such biodiversity and implement mitigation measures as appropriate.

Natural Habitat

13. Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

14. The client will not significantly convert or degrade[7] natural habitats, unless all of the following are demonstrated:

- No other viable alternatives within the region exist for development of the project on modified habitat;
- Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation;[8] and
- Any conversion or degradation is mitigated according to the mitigation hierarchy.

15. In areas of natural habitat, mitigation measures will be designed to achieve no net loss[9] of biodiversity where feasible. Appropriate actions include:

- Avoiding impacts on biodiversity through the identification and protection of set-asides;[10]

---

priority than that affected by the project) that will, for critical habitats, meet the requirements of paragraph 17 of this Performance Standard.

[5] This excludes habitat that has been converted in anticipation of the project.

[6] Reclamation as used in this context is the process of creating new land from sea or other aquatic areas for productive use.

[7] Significant conversion or degradation is (i) the elimination or severe diminution of the integrity of a habitat caused by a major and/or long-term change in land or water use; or (ii) a modification that substantially minimizes the habitat's ability to maintain viable populations of its native species.

[8] Conducted as part of the stakeholder engagement and consultation process, as described in Performance Standard 1.

[9] No net loss is defined as the point at which project-related impacts on biodiversity are balanced by measures taken to avoid and minimize the project's impacts, to undertake on-site restoration and finally to offset significant residual impacts, if any, on an appropriate geographic scale (e.g., local, landscape-level, national, regional).

[10] Set-asides are land areas within the project site, or areas over which the client has management control, that are excluded from development and are targeted for the implementation of conservation enhancement measures. Set-asides will likely contain significant biodiversity values and/or provide ecosystem services of significance at the local, national and/or regional level. Set-asides should be defined using internationally recognized approaches or methodologies (e.g., High Conservation Value, systematic conservation planning).

- Implementing measures to minimize habitat fragmentation, such as biological corridors;
- Restoring habitats during operations and/or after operations; and
- Implementing biodiversity offsets.

Critical Habitat

16. Critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered[11] species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.

17. In areas of critical habitat, the client will not implement any project activities unless all of the following are demonstrated:

- No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;
- The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;[12]
- The project does not lead to a net reduction in the global and/or national/regional population[13] of any Critically Endangered or Endangered species over a reasonable period of time;[14] and
- A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program.

18. In such cases where a client is able to meet the requirements defined in paragraph 17, the project's mitigation strategy will be described in a Biodiversity Action Plan and will be designed to achieve net gains[15] of those biodiversity values for which the critical habitat was designated.

[11] As listed on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species. The determination of critical habitat based on other listings is as follows: (i) If the species is listed nationally / regionally as critically endangered or endangered, in countries that have adhered to IUCN guidance, the critical habitat determination will be made on a project by project basis in consultation with competent professionals; and (ii) in instances where nationally or regionally listed species' categorizations do not correspond well to those of the IUCN (e.g., some countries more generally list species as "protected" or "restricted"), an assessment will be conducted to determine the rationale and purpose of the listing. In this case, the critical habitat determination will be based on such an assessment.

[12] Biodiversity values and their supporting ecological processes will be determined on an ecologically relevant scale.

[13] Net reduction is a singular or cumulative loss of individuals that impacts on the species' ability to persist at the global and/or regional/national scales for many generations or over a long period of time. The scale (i.e., global and/or regional/national) of the potential net reduction is determined based on the species' listing on either the (global) IUCN Red List and/or on regional/national lists. For species listed on both the (global) IUCN Red List and the national/regional lists, the net reduction will be based on the national/regional population.

[14] The timeframe in which clients must demonstrate "no net reduction" of Critically Endangered and Endangered species will be determined on a case-by-case basis in consultation with external experts.

[15] Net gains are additional conservation outcomes that can be achieved for the biodiversity values for which the critical habitat was designated. Net gains may be achieved through the development of a biodiversity offset and/or, in instances where the client could meet the requirements of paragraph 17 of this Performance Standard without a biodiversity offset, the client should achieve net gains through the implementation of programs that could be implemented in situ (on-the-ground) to enhance habitat, and protect and conserve biodiversity.

19. In instances where biodiversity offsets are proposed as part of the mitigation strategy, the client must demonstrate through an assessment that the project's significant residual impacts on biodiversity will be adequately mitigated to meet the requirements of paragraph 17.

Legally Protected and Internationally Recognized Areas

20. In circumstances where a proposed project is located within a legally protected area[16] or an internationally recognized area,[17] the client will meet the requirements of paragraphs 13 through 19 of this Performance Standard, as applicable. In addition, the client will:

- Demonstrate that the proposed development in such areas is legally permitted;
- Act in a manner consistent with any government recognized management plans for such areas;
- Consult protected area sponsors and managers, Affected Communities, Indigenous Peoples and other stakeholders on the proposed project, as appropriate; and
- Implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of the area.[18]

Invasive Alien Species

21. Intentional or accidental introduction of alien, or non-native, species of flora and fauna into areas where they are not normally found can be a significant threat to biodiversity, since some alien species can become invasive, spreading rapidly and out-competing native species.

22. The client will not intentionally introduce any new alien species (not currently established in the country or region of the project) unless this is carried out in accordance with the existing regulatory framework for such introduction. Notwithstanding the above, the client will not deliberately introduce any alien species with a high risk of invasive behavior regardless of whether such introductions are permitted under the existing regulatory framework. All introductions of alien species will be subject to a risk assessment (as part of the client's environmental and social risks and impacts identification process) to determine the potential for invasive behavior. The client will implement measures to avoid the potential for accidental or unintended introductions including the transportation of substrates and vectors (such as soil, ballast, and plant materials) that may harbor alien species.

23. Where alien species are already established in the country or region of the proposed project, the client will exercise diligence in not spreading them into areas in which they have not already been established. As practicable, the client should take measures to eradicate such species from the natural habitats over which they have management control.

Management of Ecosystem Services

24. Where a project is likely to adversely impact ecosystem services, as determined by the risks and impacts identification process, the client will conduct a systematic review to identify priority

[16] This Performance Standard recognizes legally protected areas that meet the IUCN definition: "A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values." For the purposes of this Performance Standard, this includes areas proposed by governments for such designation.

[17] Exclusively defined as UNESCO Natural World Heritage Sites, UNESCO Man and the Biosphere Reserves, Key Biodiversity Areas, and wetlands designated under the Convention on Wetlands of International Importance (the Ramsar Convention).

[18] Implementing additional programs may not be necessary for projects that do not create a new footprint.

ecosystem services. Priority ecosystem services are two-fold: (i) those services on which project operations are most likely to have an impact and, therefore, which result in adverse impacts to Affected Communities; and/or (ii) those services on which the project is directly dependent for its operations (e.g., water). When Affected Communities are likely to be impacted, they should participate in the determination of priority ecosystem services in accordance with the stakeholder engagement process as defined in Performance Standard 1.

25. With respect to impacts on priority ecosystem services of relevance to Affected Communities and where the client has direct management control or significant influence over such ecosystem services, adverse impacts should be avoided. If these impacts are unavoidable, the client will minimize them and implement mitigation measures that aim to maintain the value and functionality of priority services. With respect to impacts on priority ecosystem services on which the project depends, clients should minimize impacts on ecosystem services and implement measures that increase resource efficiency of their operations, as described in Performance Standard 3. Additional provisions for ecosystem services are included in Performance Standards 4, 5, 7, and 8.[19]

Sustainable Management of Living Natural Resources

26. Clients who are engaged in the primary production of living natural resources, including natural and plantation forestry, agriculture, animal husbandry, aquaculture, and fisheries, will be subject to the requirements of paragraphs 26 through 30, in addition to the rest of this Performance Standard. Where feasible, the client will locate land-based agribusiness and forestry projects on unforested land or land already converted. Clients who are engaged in such industries will manage living natural resources in a sustainable manner, through the application of industry-specific good management practices and available technologies. Where such primary production practices are codified in globally, regionally, or nationally recognized standards, the client will implement sustainable management practices to one or more relevant and credible standards as demonstrated by independent verification or certification.

27. Credible globally, regionally, or nationally recognized standards for sustainable management of living natural resources are those which (i) are objective and achievable; (ii) are founded on a multi-stakeholder consultative process; (iii) encourage step-wise and continual improvements; and (iv) provide for independent verification or certification through appropriate accredited bodies for such standards.[20]

28. Where relevant and credible standard(s) exist, but the client has not yet obtained independent verification or certification to such standard(s), the client will conduct a pre-assessment of its conformity to the applicable standard(s) and take actions to achieve such verification or certification over an appropriate period of time.

29. In the absence of a relevant and credible global, regional, or national standard for the particular living natural resource in the country concerned, the client will:

[19] Ecosystem service references are located in Performance Standard 4, paragraph 8; Performance Standard 5, paragraphs 5 and 25–29; Performance Standard 7, paragraphs 13–17 and 20; and Performance Standard 8, paragraph 11.

[20] A credible certification system would be one which is independent, cost-effective, based on objective and measurable performance standards and developed through consultation with relevant stakeholders, such as local people and communities, Indigenous Peoples, and civil society organizations representing consumer, producer and conservation interests. Such a system has fair, transparent and independent decision-making procedures that avoid conflicts of interest.

- Commit to applying good international industry operating principles, management practices, and technologies; and
- Actively engage and support the development of a national standard, where relevant, including studies that contribute to the definition and demonstration of sustainable practices.

Supply Chain

30. Where a client is purchasing primary production (especially but not exclusively food and fiber commodities) that is known to be produced in regions where there is a risk of significant conversion of natural and/or critical habitats, systems and verification practices will be adopted as part of the client's ESMS to evaluate its primary suppliers.[21] The systems and verification practices will (i) identify where the supply is coming from and the habitat type of this area; (ii) provide for an ongoing review of the client's primary supply chains; (iii) limit procurement to those suppliers that can demonstrate that they are not contributing to significant conversion of natural and/or critical habitats (this may be demonstrated by delivery of certified product, or progress towards verification or certification under a credible scheme in certain commodities and/or locations); and (iv) where possible, require actions to shift the client's primary supply chain over time to suppliers that can demonstrate that they are not significantly adversely impacting these areas. The ability of the client to fully address these risks will depend upon the client's level of management control or influence over its primary suppliers.

[21] Primary suppliers are those suppliers who, on an ongoing basis, provide the majority of living natural resources, goods, and materials essential for the core business processes of the project.

Performance Standard 7
Indigenous Peoples

January 1, 2012

Introduction

1. Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also come under threat. As a consequence, Indigenous Peoples may be more vulnerable to the adverse impacts associated with project development than non-indigenous communities. This vulnerability may include loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and diseases.

2. Private sector projects can create opportunities for Indigenous Peoples to participate in, and benefit from project-related activities that may help them fulfill their aspiration for economic and social development. Furthermore, Indigenous Peoples may play a role in sustainable development by promoting and managing activities and enterprises as partners in development. Government often plays a central role in the management of Indigenous Peoples' issues, and clients should collaborate with the responsible authorities in managing the risks and impacts of their activities.[1]

Objectives

- To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples.
- To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts.
- To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner.
- To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle.
- To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present.
- To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.

Scope of Application

3. The applicability of this Performance Standard is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System, the elements of which are outlined in Performance Standard 1.

---

[1] In addition to meeting the requirements under this Performance Standard, clients must comply with applicable national law, including those laws implementing host country obligations under international law.

4. There is no universally accepted definition of "Indigenous Peoples." Indigenous Peoples may be referred to in different countries by such terms as "Indigenous ethnic minorities," "aboriginals," "hill tribes," "minority nationalities," "scheduled tribes," "first nations," or "tribal groups."

5. In this Performance Standard, the term "Indigenous Peoples" is used in a generic sense to refer to a distinct social and cultural group possessing the following characteristics in varying degrees:

- Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- Collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- Customary cultural, economic, social, or political institutions that are separate from those of the mainstream society or culture; or
- A distinct language or dialect, often different from the official language or languages of the country or region in which they reside.

6. This Performance Standard applies to communities or groups of Indigenous Peoples who maintain a collective attachment, i.e., whose identity as a group or community is linked, to distinct habitats or ancestral territories and the natural resources therein. It may also apply to communities or groups that have lost collective attachment to distinct habitats or ancestral territories in the project area, occurring within the concerned group members' lifetime, because of forced severance, conflict, government resettlement programs, dispossession of their lands, natural disasters, or incorporation of such territories into an urban area.

7. The client may be required to seek inputs from competent professionals to ascertain whether a particular group is considered as Indigenous Peoples for the purpose of this Performance Standard.

Requirements

General

Avoidance of Adverse Impacts

8. The client will identify, through an environmental and social risks and impacts assessment process, all communities of Indigenous Peoples within the project area of influence who may be affected by the project, as well as the nature and degree of the expected direct and indirect economic, social, cultural (including cultural heritage[2]), and environmental impacts on them.

9. Adverse impacts on Affected Communities of Indigenous Peoples should be avoided where possible. Where alternatives have been explored and adverse impacts are unavoidable, the client will minimize, restore, and/or compensate for these impacts in a culturally appropriate manner commensurate with the nature and scale of such impacts and the vulnerability of the Affected Communities of Indigenous Peoples. The client's proposed actions will be developed with the ICP of the Affected Communities of Indigenous Peoples and contained in a time-bound plan, such as an Indigenous Peoples Plan, or a broader community development plan with separate components for Indigenous Peoples.[3]

[2] Additional requirements on protection of cultural heritage are set out in Performance Standard 8.

[3] The determination of the appropriate plan may require the input of competent professionals. A community development plan may be appropriate in circumstances where Indigenous Peoples are a part of larger Affected Communities.

Participation and Consent

10. The client will undertake an engagement process with the Affected Communities of Indigenous Peoples as required in Performance Standard 1. This engagement process includes stakeholder analysis and engagement planning, disclosure of information, consultation, and participation, in a culturally appropriate manner. In addition, this process will:

- Involve Indigenous Peoples' representative bodies and organizations (e.g., councils of elders or village councils), as well as members of the Affected Communities of Indigenous Peoples; and
- Provide sufficient time for Indigenous Peoples' decision-making processes.[4]

11. Affected Communities of Indigenous Peoples may be particularly vulnerable to the loss of, alienation from or exploitation of their land and access to natural and cultural resources.[5] In recognition of this vulnerability, in addition to the General Requirements of this Performance Standard, the client will obtain the FPIC of the Affected Communities of Indigenous Peoples in the circumstances described in paragraphs 13–17 of this Performance Standard. FPIC applies to project design, implementation, and expected outcomes related to impacts affecting the communities of Indigenous Peoples. When any of these circumstances apply, the client will engage external experts to assist in the identification of the project risks and impacts.

12. There is no universally accepted definition of FPIC. For the purposes of Performance Standards 1, 7 and 8, "FPIC" has the meaning described in this paragraph. FPIC builds on and expands the process of ICP described in Performance Standard 1 and will be established through good faith negotiation between the client and the Affected Communities of Indigenous Peoples. The client will document: (i) the mutually accepted process between the client and Affected Communities of Indigenous Peoples, and (ii) evidence of agreement between the parties as the outcome of the negotiations. FPIC does not necessarily require unanimity and may be achieved even when individuals or groups within the community explicitly disagree.

Circumstances Requiring Free, Prior, and Informed Consent

Impacts on Lands and Natural Resources Subject to Traditional Ownership or Under Customary Use

13. Indigenous Peoples are often closely tied to their lands and related natural resources.[6] Frequently, these lands are traditionally owned or under customary use.[7] While Indigenous Peoples may not possess legal title to these lands as defined by national law, their use of these lands, including seasonal or cyclical use, for their livelihoods, or cultural, ceremonial, and spiritual purposes that define their identity and community, can often be substantiated and documented.

---

[4] Internal decision making processes are generally but not always collective in nature. There may be internal dissent, and decisions may be challenged by some in the community. The consultation process should be sensitive to such dynamics and allow sufficient time for internal decision making processes to reach conclusions that are considered legitimate by the majority of the concerned participants.

[5] Natural resources and natural areas with cultural value referred to in this Performance Standard are equivalent to ecosystem provisioning and cultural services as described in Performance Standard 6.

[6] Examples include marine and aquatic resources timber, and non-timber forest products, medicinal plants, hunting and gathering grounds, and grazing and cropping areas. Natural resource assets, as referred to in this Performance Standard, are equivalent to provisioning ecosystem services as described in Performance Standard 6.

[7] The acquisition and/or leasing of lands with legal title is addressed in Performance Standard 5: Land Acquisition and Involuntary Resettlement.

14. If the client proposes to locate a project on, or commercially develop natural resources on lands traditionally owned by, or under the customary use of, Indigenous Peoples, and adverse impacts[8] can be expected, the client will take the following steps:

- Document efforts to avoid and otherwise minimize the area of land proposed for the project;
- Document efforts to avoid and otherwise minimize impacts on natural resources and natural areas of importance[9] to Indigenous People;
- Identify and review all property interests and traditional resource uses prior to purchasing or leasing land;
- Assess and document the Affected Communities of Indigenous Peoples' resource use without prejudicing any Indigenous Peoples' land claim.[10] The assessment of land and natural resource use should be gender inclusive and specifically consider women's role in the management and use of these resources;
- Ensure that Affected Communities of Indigenous Peoples are informed of their land rights under national law, including any national law recognizing customary use rights; and
- Offer Affected Communities of Indigenous Peoples compensation and due process in the case of commercial development of their land and natural resources, together with culturally appropriate sustainable development opportunities, including:
  - Providing land-based compensation or compensation-in-kind in lieu of cash compensation where feasible.[11]
  - Ensuring continued access to natural resources, identifying the equivalent replacement resources, or, as a last option, providing compensation and identifying alternative livelihoods if project development results in the loss of access to and the loss of natural resources independent of project land acquisition.
  - Ensuring fair and equitable sharing of benefits associated with project usage of the resources where the client intends to utilize natural resources that are central to the identity and livelihood of Affected Communities of Indigenous People and their usage thereof exacerbates livelihood risk.
  - Providing Affected Communities of Indigenous Peoples with access, usage, and transit on land it is developing subject to overriding health, safety, and security considerations.

Relocation of Indigenous Peoples from Lands and Natural Resources Subject to Traditional Ownership or Under Customary Use

15. The client will consider feasible alternative project designs to avoid the relocation of Indigenous Peoples from communally held[12] lands and natural resources subject to traditional ownership or

[8] Such adverse impacts may include impacts from loss of access to assets or resources or restrictions on land use resulting from project activities.

[9] "Natural resources and natural areas of importance" as referred to in this Performance Standard are equivalent to priority ecosystem services as defined in Performance Standard 6. They refer to those services over which the client has direct management control or significant influence, and those services most likely to be sources of risk in terms of impacts on Affected Communities of Indigenous Peoples.

[10] While this Performance Standard requires substantiation and documentation of the use of such land, clients should also be aware that the land may already be under alternative use, as designated by the host government.

[11] If circumstances prevent the client from offering suitable replacement land, the client must provide verification that such is the case. Under such circumstances, the client will provide non land-based income-earning opportunities over and above cash compensation to the Affected Communities of Indigenous Peoples.

under customary use. If such relocation is unavoidable the client will not proceed with the project unless FPIC has been obtained as described above. Any relocation of Indigenous Peoples will be consistent with the requirements of Performance Standard 5. Where feasible, the relocated Indigenous Peoples should be able to return to their traditional or customary lands, should the cause of their relocation cease to exist.

Critical Cultural Heritage

16. Where a project may significantly impact on critical cultural heritage[13] that is essential to the identity and/or cultural, ceremonial, or spiritual aspects of Indigenous Peoples lives, priority will be given to the avoidance of such impacts. Where significant project impacts on critical cultural heritage are unavoidable, the client will obtain the FPIC of the Affected Communities of Indigenous Peoples.

17. Where a project proposes to use the cultural heritage including knowledge, innovations, or practices of Indigenous Peoples for commercial purposes, the client will inform the Affected Communities of Indigenous Peoples of (i) their rights under national law; (ii) the scope and nature of the proposed commercial development; (iii) the potential consequences of such development; and (iv) obtain their FPIC. The client will also ensure fair and equitable sharing of benefits from commercialization of such knowledge, innovation, or practice, consistent with the customs and traditions of the Indigenous Peoples.

Mitigation and Development Benefits

18. The client and the Affected Communities of Indigenous Peoples will identify mitigation measures in alignment with the mitigation hierarchy described in Performance Standard 1 as well as opportunities for culturally appropriate and sustainable development benefits. The client will ensure the timely and equitable delivery of agreed measures to the Affected Communities of Indigenous Peoples.

19. The determination, delivery, and distribution of compensation and other benefit sharing measures to the Affected Communities of Indigenous Peoples will take account of the laws, institutions, and customs of these communities as well as their level of interaction with mainstream society. Eligibility for compensation can either be individually or collectively-based, or be a combination of both.[14] Where compensation occurs on a collective basis, mechanisms that promote the effective delivery and distribution of compensation to all eligible members of the group will be defined and implemented.

20. Various factors including, but not limited to, the nature of the project, the project context and the vulnerability of the Affected Communities of Indigenous Peoples will determine how these communities should benefit from the project. Identified opportunities should aim to address the goals

[12] Typically, Indigenous Peoples claim rights and access to, and use of land and resources through traditional or customary systems, many of which entail communal property rights. These traditional claims to land and resources may not be recognized under national laws. Where members of the Affected Communities of Indigenous Peoples individually hold legal title, or where the relevant national law recognizes customary rights for individuals, the requirements of Performance Standard 5 will apply, rather than the requirements under paragraph 17 of this Performance Standard.

[13] Includes natural areas with cultural and/or spiritual value such as sacred groves, sacred bodies of water and waterways, sacred trees, and sacred rocks. Natural areas with cultural value are equivalent to priority ecosystem cultural services as defined in Performance Standard 6.

[14] Where control of resources, assets and decision making are predominantly collective in nature, efforts will be made to ensure that, where possible, benefits and compensation are collective, and take account of intergenerational differences and needs.

and preferences of the Indigenous Peoples including improving their standard of living and livelihoods in a culturally appropriate manner, and to foster the long-term sustainability of the natural resources on which they depend.

Private Sector Responsibilities Where Government is Responsible for Managing Indigenous Peoples Issues

21. Where the government has a defined role in the management of Indigenous Peoples issues in relation to the project, the client will collaborate with the responsible government agency, to the extent feasible and permitted by the agency, to achieve outcomes that are consistent with the objectives of this Performance Standard. In addition, where government capacity is limited, the client will play an active role during planning, implementation, and monitoring of activities to the extent permitted by the agency.

22. The client will prepare a plan that, together with the documents prepared by the responsible government agency, will address the relevant requirements of this Performance Standard. The client may need to include (i) the plan, implementation, and documentation of the process of ICP and engagement and FPIC where relevant; (ii) a description of the government-provided entitlements of affected Indigenous Peoples; (iii) the measures proposed to bridge any gaps between such entitlements, and the requirements of this Performance Standard; and (iv) the financial and implementation responsibilities of the government agency and/or the client.

Performance Standard 8
Cultural Heritage

January 1, 2012

Introduction

1. Performance Standard 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

Objectives

- To protect cultural heritage from the adverse impacts of project activities and support its preservation.
- To promote the equitable sharing of benefits from the use of cultural heritage.

Scope of Application

2. The applicability of this Performance Standard is established during the environmental and social risks and impacts identification process. The implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Environmental and Social Management System (ESMS), the elements of which are outlined in Performance Standard 1. During the project life-cycle, the client will consider potential project impacts to cultural heritage and will apply the provisions of this Performance Standard.

3. For the purposes of this Performance Standard, cultural heritage refers to (i) tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values; (ii) unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.

4. Requirements with respect to tangible forms of cultural heritage are contained in paragraphs 6–16. For requirements with respect to specific instances of intangible forms of cultural heritage described in paragraph 3 (iii) see paragraph 16.

5. The requirements of this Performance Standard apply to cultural heritage regardless of whether or not it has been legally protected or previously disturbed. The requirements of this Performance Standard do not apply to cultural heritage of Indigenous Peoples; Performance Standard 7 describes those requirements.

Requirements

Protection of Cultural Heritage in Project Design and Execution

6. In addition to complying with applicable law on the protection of cultural heritage, including national law implementing the host country's obligations under the Convention Concerning the Protection of the World Cultural and Natural Heritage, the client will identify and protect cultural heritage by ensuring that internationally recognized practices for the protection, field-based study, and documentation of cultural heritage are implemented.

7. Where the risk and identification process determines that there is a chance of impacts to cultural heritage, the client will retain competent professionals to assist in the identification and protection of cultural heritage. The removal of nonreplicable cultural heritage is subject to the additional requirements of paragraph 10 below. In the case of critical cultural heritage, the requirements of paragraphs 13–15 will apply.

Chance Find Procedures

8. The client is responsible for siting and designing a project to avoid significant adverse impacts to cultural heritage. The environmental and social risks and impacts identification process should determine whether the proposed location of a project is in areas where cultural heritage is expected to be found, either during construction or operations. In such cases, as part of the client's ESMS, the client will develop provisions for managing chance finds[1] through a chance find procedure[2] which will be applied in the event that cultural heritage is subsequently discovered. The client will not disturb any chance find further until an assessment by competent professionals is made and actions consistent with the requirements of this Performance Standard are identified.

Consultation

9. Where a project may affect cultural heritage, the client will consult with Affected Communities within the host country who use, or have used within living memory, the cultural heritage for long-standing cultural purposes. The client will consult with the Affected Communities to identify cultural heritage of importance, and to incorporate into the client's decision-making process the views of the Affected Communities on such cultural heritage. Consultation will also involve the relevant national or local regulatory agencies that are entrusted with the protection of cultural heritage.

Community Access

10. Where the client's project site contains cultural heritage or prevents access to previously accessible cultural heritage sites being used by, or that have been used by, Affected Communities within living memory for long-standing cultural purposes, the client will, based on consultations under paragraph 9, allow continued access to the cultural site or will provide an alternative access route, subject to overriding health, safety, and security considerations.

Removal of Replicable Cultural Heritage

11. Where the client has encountered tangible cultural heritage that is replicable[3] and not critical, the client will apply mitigation measures that favor avoidance. Where avoidance is not feasible, the client will apply a mitigation hierarchy as follows:

- Minimize adverse impacts and implement restoration measures, in situ, that ensure maintenance of the value and functionality of the cultural heritage, including maintaining or restoring any ecosystem processes[4] needed to support it;
- Where restoration in situ is not possible, restore the functionality of the cultural heritage, in a different location, including the ecosystem processes needed to support it;

[1] Tangible cultural heritage encountered unexpectedly during project construction or operation.

[2] A chance find procedure is a project-specific procedure that outlines the actions to be taken if previously unknown cultural heritage is encountered.

[3] Replicable cultural heritage is defined as tangible forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which the cultural values can be transferred by appropriate measures. Archeological or historical sites may be considered replicable where the particular eras and cultural values they represent are well represented by other sites and/or structures.

[4] Consistent with requirements in Performance Standard 6 related to ecosystem services and conservation of biodiversity.

- The permanent removal of historical and archeological artifacts and structures is carried out according to the principles of paragraphs 6 and 7 above; and
- Only where minimization of adverse impacts and restoration to ensure maintenance of the value and functionality of the cultural heritage are demonstrably not feasible, and where the Affected Communities are using the tangible cultural heritage for long-standing cultural purposes, compensate for loss of that tangible cultural heritage.

Removal of Non-Replicable Cultural Heritage

12. Most cultural heritage is best protected by preservation in its place, since removal is likely to result in irreparable damage or destruction of the cultural heritage. The client will not remove any nonreplicable cultural heritage,[5] unless all of the following conditions are met:

- There are no technically or financially feasible alternatives to removal;
- The overall benefits of the project conclusively outweigh the anticipated cultural heritage loss from removal; and
- Any removal of cultural heritage is conducted using the best available technique.

Critical Cultural Heritage

13. Critical cultural heritage consists of one or both of the following types of cultural heritage: (i) the internationally recognized heritage of communities who use, or have used within living memory the cultural heritage for long-standing cultural purposes; or (ii) legally protected cultural heritage areas, including those proposed by host governments for such designation.

14. The client should not remove, significantly alter, or damage critical cultural heritage. In exceptional circumstances when impacts on critical cultural heritage are unavoidable, the client will use a process of Informed Consultation and Participation (ICP) of the Affected Communities as described in Performance Standard 1 and which uses a good faith negotiation process that results in a documented outcome. The client will retain external experts to assist in the assessment and protection of critical cultural heritage.

15. Legally protected cultural heritage areas[6] are important for the protection and conservation of cultural heritage, and additional measures are needed for any projects that would be permitted under the applicable national law in these areas. In circumstances where a proposed project is located within a legally protected area or a legally defined buffer zone, the client, in addition to the requirements for critical cultural heritage cited in paragraph 14 above, will meet the following requirements:

- Comply with defined national or local cultural heritage regulations or the protected area management plans;
- Consult the protected area sponsors and managers, local communities and other key stakeholders on the proposed project; and
- Implement additional programs, as appropriate, to promote and enhance the conservation aims of the protected area.

[5] Nonreplicable cultural heritage may relate to the social, economic, cultural, environmental, and climatic conditions of past peoples, their evolving ecologies, adaptive strategies, and early forms of environmental management, where the (i) cultural heritage is unique or relatively unique for the period it represents, or (ii) cultural heritage is unique or relatively unique in linking several periods in the same site.

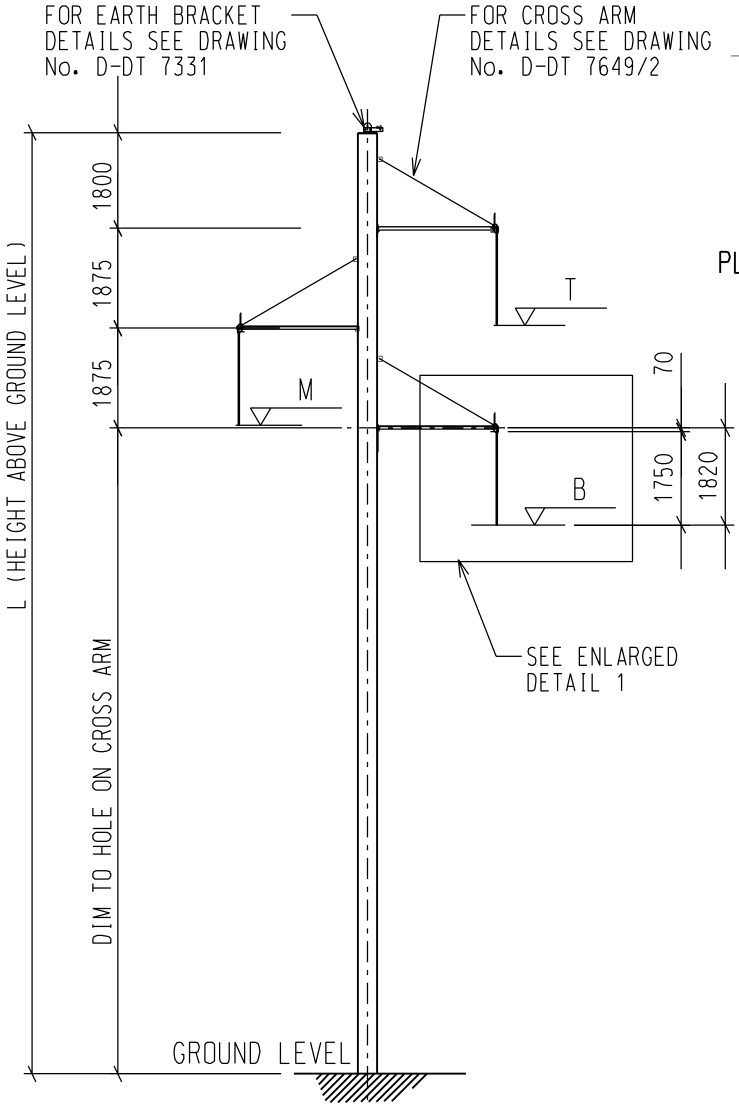
[6] Examples include world heritage sites and nationally protected areas.

Project's Use of Cultural Heritage

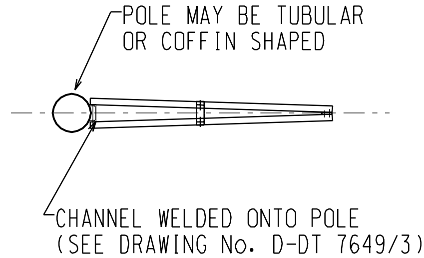
16. Where a project proposes to use the cultural heritage, including knowledge, innovations, or practices of local communities for commercial purposes,[7] the client will inform these communities of (i) their rights under national law; (ii) the scope and nature of the proposed commercial development; and (iii) the potential consequences of such development. The client will not proceed with such commercialization unless it (i) enters into a process of ICP as described in Performance Standard 1 and which uses a good faith negotiation process that results in a documented outcome and (ii) provides for fair and equitable sharing of benefits from commercialization of such knowledge, innovation, or practice, consistent with their customs and traditions.

[7] Examples include, but are not limited to, commercialization of traditional medicinal knowledge or other sacred or traditional technique for processing plants, fibers, or metals.

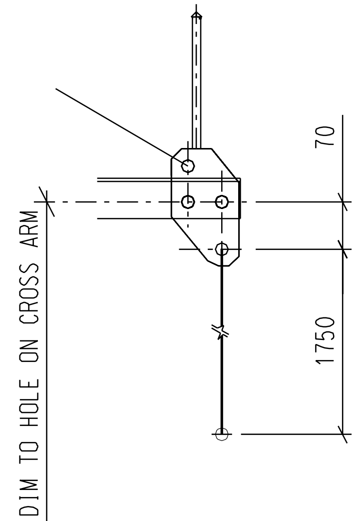
Appendix 11:
Diagrams



ELEVATION ON POLE



PLAN ON CROSS ARM ANGLES



ENLARGED DETAIL 1

THIS DRAWING IS RELEVANT FOR
GUYED AND FREESTANDING STRUCTURES

ATTACHMENT HEIGHT DETAIL

HEIGHT A.G.L.(m) L	C A H(m)			
	B	M	T	E/W
18.2	10.83	12.7	14.58	18.2
19.2	11.83	13.7	15.58	19.2
20.1	12.73	14.6	16.48	20.1
21.2	13.83	15.7	17.58	21.2
22.7	15.33	17.2	19.08	22.7
24.2	16.83	18.7	20.58	24.2

REV	AUTH MAG	DATE DATUM	REVISION/REVISIES INDEX REF/INDEKSVERW	BY DEUR	CHKD NAGES	D-DT-	REFERENCE DRAWINGS
Ø	AB	15.03 2002	FIRST ISSUE/EERSTE UITREIKING	SLR	RAB		

DRG.TEK REGISTR		
CHKD NAGES	RAB	16.03 2002
DRAWN GETEKEN	SLR	15.03 2002
SCALE SKAAL	NTS	

ESKOM

DISTRIBUTION TECHNOLOGY
132KV SUSPENSION X-ARM
GENERAL ARRANGEMENT FOR
SINGLE STEEL POLE STRUCTURE

APPROVED AB

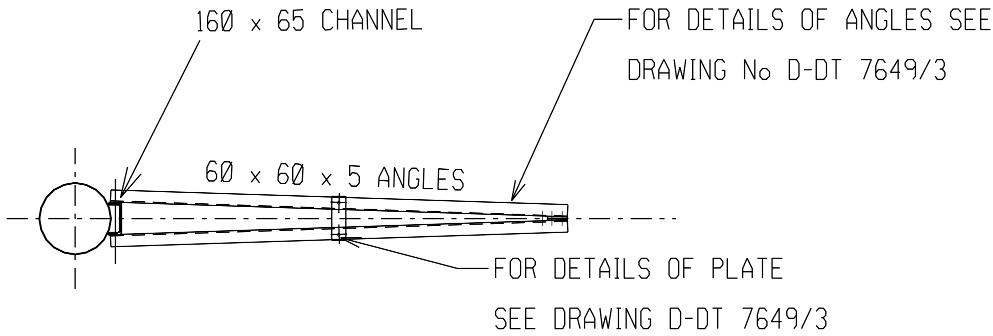
26/04/2002

CAD.REF:

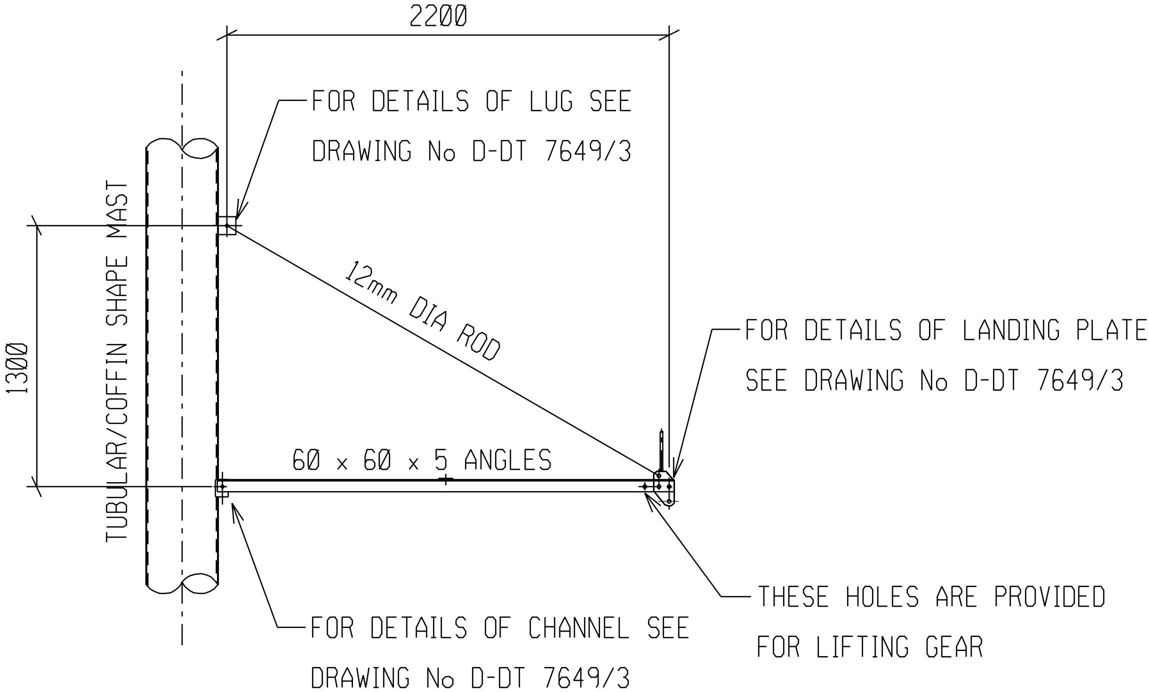
FILE No.:

D-DT 7649/1

REV 0



PLAN ON CROSS ARM ANGLES



ELEVATION ON CROSS ARM

NOTE:

ALL BOLTS USED TO BE M16 GRADE 8.8 BOLTS

REV	AUTH MAG	DATE DATUM	REVISION/REVISIES INDEX REF/INDEKSVERW	BY DEUR	CHKD NAGES	D-DT-	REFERENCE DRAWINGS
0	AB	15.03 2002	FIRST ISSUE/EERSTE UITREIKING	SLR	RAB		

DRG.TEK REGISTR		
CHKD NAGES	RAB	16.03 2002
DRAWN GETEKEN	SLR	15.03 2002
SCALE SKAAL	NTS	

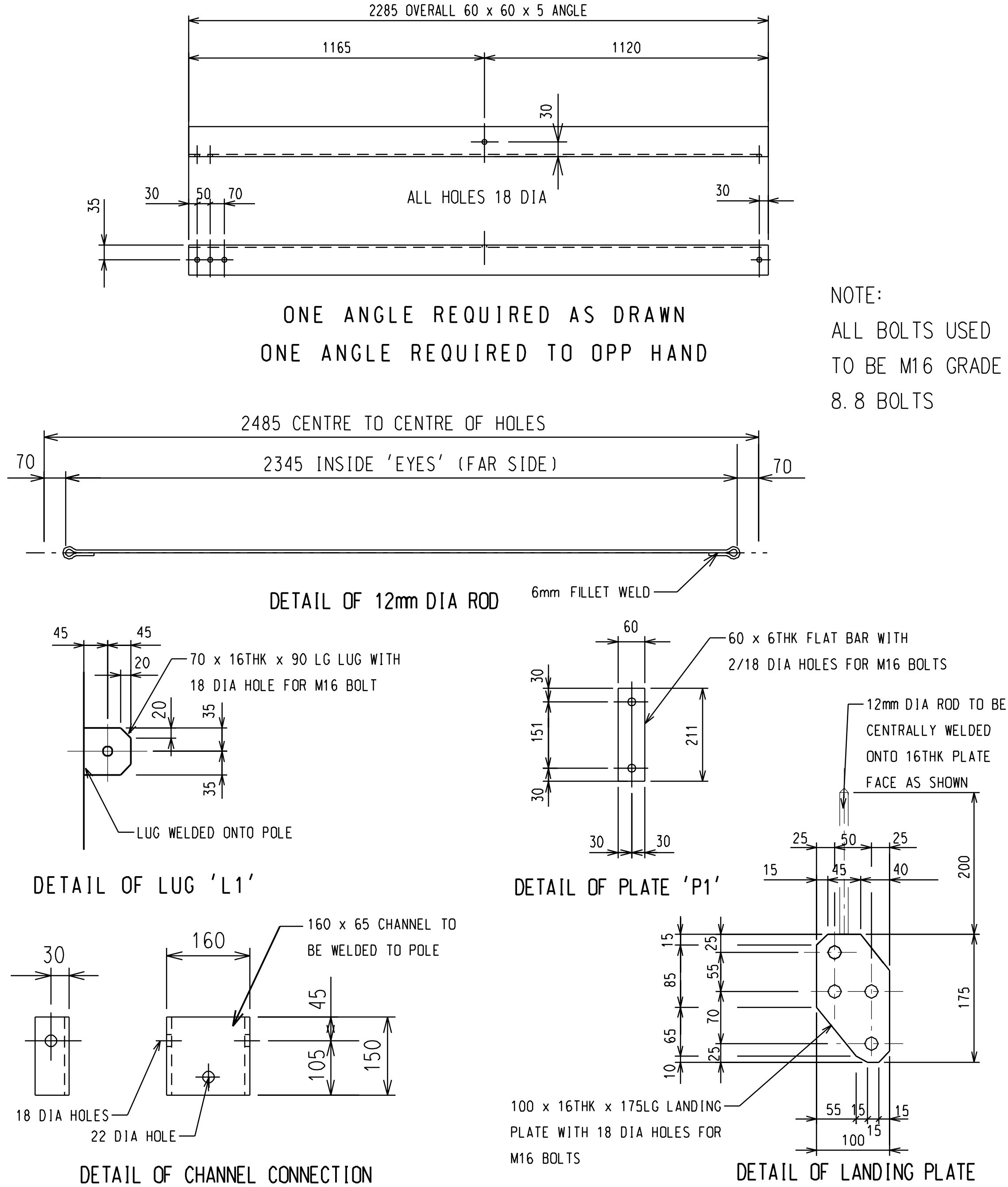
ESKOM

DISTRIBUTION TECHNOLOGY

132KV SUSPENSION X-ARM

LAYOUT OF CROSS ARM

APPROVED	CAD.REF:		REV
AB	FILE No.:	D-DT 7649/2	0
26/04/2002			



Ø	AB	15.03 2002	FIRST ISSUE/EERSTE UITREIKING	SLR	RAB	
REV	AUTH MAG	DATE DATUM	REVISION/REVISIES INDEX REF/INDEKSVERW	BY DEUR	CHKD NAGES	D-DT- REFERENCE DRAWINGS

DRG.TEK REGISTR		
CHKD NAGES	RAB	16.03 2002
DRAWN GETEKEN	SLR	15.03 2002
SCALE SKAAL	NTS	

ESKOM

DISTRIBUTION TECHNOLOGY
132KV SUSPENSION X-ARM
FABRICATION DRAWING

APPROVED AB

26/04/2002

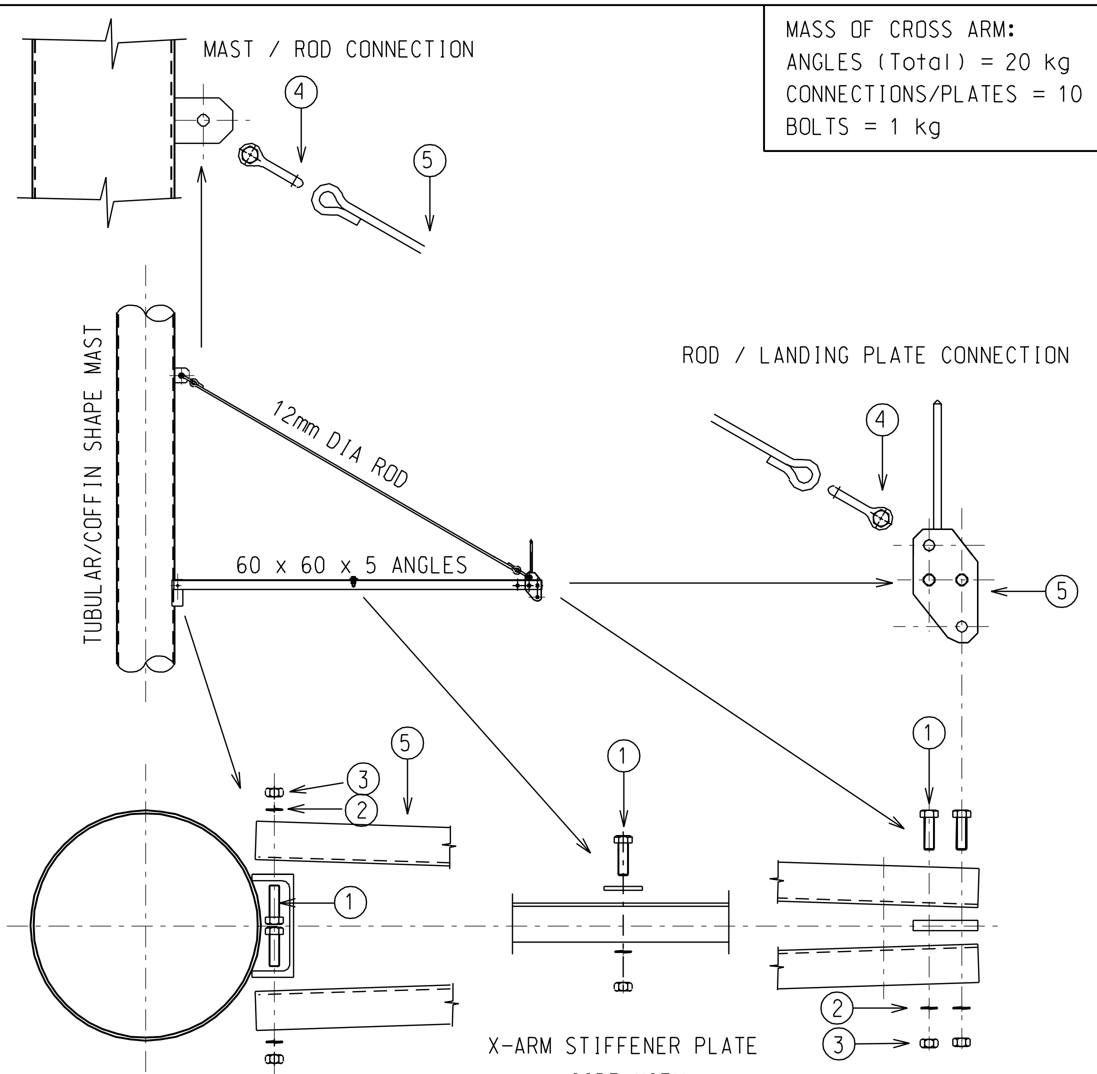
CAD.REF:

FILE No.:

D-DT 7649/3

REV 0

MASS OF CROSS ARM:
ANGLES (Total) = 20 kg
CONNECTIONS/PLATES = 10 kg
BOLTS = 1 kg



X-ARM / MAST CONNECTION
PLAN VIEW

X-ARM LANDING PLATE
PLAN VIEW

REF	DESCRIPTION	DRAWING NO.
1	SET SCREW, M16 x 50 LG GRADE 8.8	
2	WASHER, SPRING, M16	
3	NUT, M16	
4	SHACKLE, D 120KN	D-DT 7017
5	SUSP. ARM ASSEMB, 132KV	

REV	AUTH MAG	DATE DATUM	REVISION/REVISIES INDEX REF/INDEKSVERW	BY DEUR	CHKD NAGES	D-DT-	REFERENCE DRAWINGS VERWYSINGSTEKENINGE
0	AB	15.03 2002	FIRST ISSUE / EERSTE UITREIKING	SLR	RAB		

DRG.TEK REGISTR		
CHKD NAGES	RAB	16.03. 2002
DRAWN GETEKEN	SLR	15.03. 2002
SCALE SKAAL	N.T.S.	

ESKOM

DISTRIBUTION TECHNOLOGY
132KV SUSPENSION X-ARM ASSEMBLY

APPROVED AB

26/04/2002

CAD.REF:

FILE No.:

D-DT 7649/4

REV 0