BIOTHERM ENERGY

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

Draft Environmental Impact Assessment Report

DEA Ref No: 14/12/16/3/3/2/975
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Project No.: 13303 - Tlisitseng

Date:	09 March 2017
Document Title:	Proposed Construction of the Tlisitseng 2 75MW Solar Photovoltaic (PV) Energy Facility near Lichtenburg, North West Province: Draft Environmental Impact Assessment Report
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Revision Number:	1
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Approved:	Kelly Tucker
Signature:	
For:	SiVEST Environmental Division

KEY PROJECT INFORMATION

FARM DESCRIPTION	21 DIGIT SURVEYOR GENERAL CODE
Portion 25 of the Farm Houthaalboomen No 31	T0IP00000000003100025

TLISITSENG PV APPLICATION SITE				
NORTH-WEST CORNER	NORTH-EAST CORNER	CENTRE POINT	SOUTH-WEST CORNER	SOUTH-EAST CORNER
S26° 3' 46.260"	S26° 3' 38.304"	S26° 4' 41.311"	S26° 5' 39.732"	S26° 5' 38.292"
E26° 5' 42.756"	E26° 7' 2.100"	E26° 7' 5.734"	E26° 6' 32.976"	E26° 8' 34.116"

DEVELOPMENT AREA			
PHASE	AREA (HECTARES)	CENTRE POINT COORDINATES (DD MM SS.sss)	
		SOUTH	EAST
TLISITSENG SOLAR 2 DEVELOPMENT AREA - WESTERN PORTION	235.870	S26°4' 56.625"	E26° 7' 26.484"
TLISITSENG SOLAR 2 DEVELOPMENT AREA - EASTERN PORTION	108.552	S26°4' 47.604"	E26° 7' 59.539"

PV ARRAYS		
PHASE	CENTRE POINT COORDINATES (DD MM SS.sss)	
	SOUTH	EAST
TLISITSENG SOLAR 2 PV ARRAY AREA - WESTERN PORTION	S26°4' 57.159"	E26° 7' 22.844"
TLISITSENG SOLAR 2 PV ARRAY AREA - EASTERN PORTION	S26°4' 49.642"	E26° 7' 59.254"

TLISITSENG SOLAR 2: DEVELOPMENT AREA – WESTERN PORTION		
CORNER POINT COORDINATES (DD MM SS.sss)		
POINT	SOUTH	EAST
T2_01 (NW)	S26° 4' 25.711"	E26° 7' 4.567"
T2_02 (NE)	S26° 4' 19.105"	E26° 7' 29.391"
T2_03 (SE)	S26° 5' 15.504"	E26° 8' 1.641"
T2_04 (SW)	S26° 5' 31.103"	E26° 7' 4.077"

TLISITSENG SOLAR 2: DEVELOPMENT AREA – EASTERN PORTION

CORNER POINT COORDINATES (DD MM SS.sss)		
POINT	**SOUTH**	**EAST**
T2_05 (NW)	S26° 4' 21.970"	E26° 7' 34.890"
T2_06 (NE)	S26° 4' 14.674"	E26° 7' 55.004"
T2_07 (SE)	S26° 5' 17.841"	E26° 8' 23.290"
T2_08 (SW)	S26° 5' 21.955"	E26° 8' 6.071"

TLISITSENG SOLAR 2: COMPONENTS		
CENTRE POINT COORDINATES (DD MM SS.sss)		
COMPONENT	**ALTERNATIVE 1**	**ALTERNATIVE 2**
SUBSTATION (132kV)	S26° 5' 18.361"	S26° 5' 15.026"
	E26° 7' 6.122"	E26° 8' 16.043"
O&M BUILDINGS	S26° 5' 16.158"	S26° 5' 12.759"
	E26° 7' 4.887"	E26° 8' 14.808"
LAYDOWN AREA	S26° 5' 17.714"	S26° 4' 39.958"
	E26° 7' 13.984"	E26° 7' 48.239"

PREFERRED TLISITSENG SOLAR 2: COMPONENTS		
CENTRE POINT COORDINATES (DD MM SS.sss)		
COMPONENT	**ALTERNATIVE 1**	**ALTERNATIVE 2**
PREFERRED SUBSTATION (132kV)		S26° 5' 15.026"
		E26° 8' 16.043"
PREFERRED O&M BUILDINGS		S26° 5' 12.759"
		E26° 8' 14.808"
PREFERRED LAYDOWN AREA		S26° 4' 39.958"
		E26° 7' 48.239"

Refer to **Appendix 9** for the full list of coordinates.

TITLE DEEDS: These are included in **Appendix 1**

PHOTOGRAPHS OF SITE:

General Characteristics of the study area

TYPE OF TECHNOLOGY: Solar Photovoltaic (PV)

STRUCTURE HEIGHT: The height of the PV panels is estimated to be approximately 4m although the final design details are yet to be confirmed. These details will become available during the detailed design phase of the project.

SURFACE AREA TO BE COVERED: The total area of the application site is approximately 1024 hectares (ha). It should however be noted that the proposed Tlisitseng 2 development area has been split into two (2) portions, namely the Western Portion and the Eastern Portion. The Western Portion will occupy an area of approximately 236 ha, while the Eastern Portion will occupy an area of approximately 109 ha. As such, the proposed Tlisitseng 2 development will occupy a total area of approximately 345 ha. The proposed 132kV onsite Tlisitseng substation layout will require up to approximately 2.25 ha. The footprint of the Operations and Maintenance (O&M) buildings will be approximately 225m^2. The final design details are yet to be confirmed. These details will become available during the detailed design phase of the project.

PV DESIGN: The energy facility will comprise of either fixed tilt or horizontal single axis tracking structures. Either thin film or crystalline silicon modules will be used. The modules will be mounted in rows on the support structures. An onsite switching substation will contain transformer (s) for voltage step up from medium voltage to high voltage. DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to medium voltage in the inverter transformers. The medium voltage cables will be run underground in the facility, to a common point before being fed to the onsite substation.

STRUCTURE ORIENTATION: This will be confirmed during the detailed design phase of the project. For single axis tracking the structures will be mounted on a north-south horizontal axis and will track the sun from east to west. For fixed tilt structures the modules will be north facing tilted at an angle of between 15-30 degrees.

FOUNDATIONS: The foundations will be either concrete or rammed pile. The final foundation design will be determined at the detailed design phase of the project.

LAY-DOWN AREA DIMENSIONS: Approximately 5ha is required for the temporary laydown area. Permanent laydown for the containers will be required for the storage of spares, which is to be located close to the O&M building. Approximately 6, 3x12m containers will be required.

GENERATION CAPACITY: The project will have a total generation capacity of 75MW.

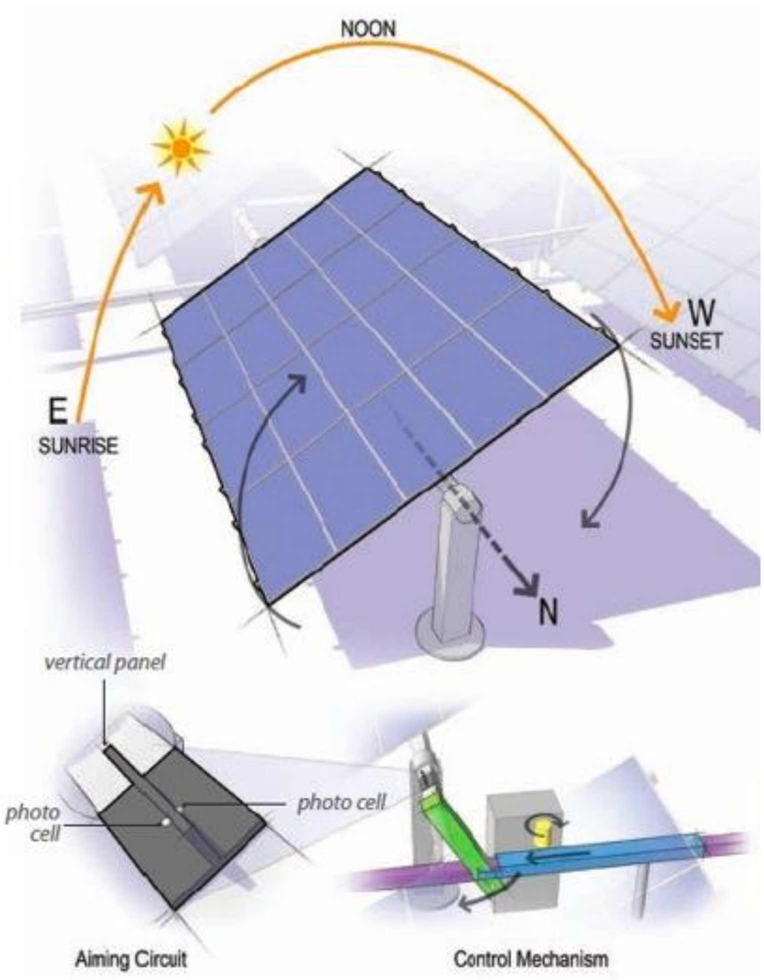

Figure i. Example of a Photovoltaic Panel with tracking capability
(Source: http://solartoday.org/2009/07/single-axis-solar-tracking).

TECHNICAL DETAILS:

Component	Description / Dimensions
Generation capacity	Maximum of 75MW
Capacity of the on-site substation	132kV
Number of Panels	Approx. 275 000
Area occupied by each panel	Approx. 2m^2 per panel
Dimensions of panels	1956mm x 992mm x 40mm
Max panel height from the ground	Approx. 4m
Area of the application site	Approx. 1024 hectares
Development area	Approx. 345 hectares (236 ha for the Western Portion and 109 ha for the Eastern Portion)

Footprint of Substation	Substation will require a footprint area of up to approx. 2.25 ha
Footprint of O&M building(s)	Approx. 225 m^2
Area of construction laydown area	Up to approx. 5 ha
Area of permanent laydown area	Permanent laydown for the containers will be required for the storage of spares, which is to be located close to the O&M building. Approximately 6, 3x12m containers will be required.
Width of internal roads	Up to 8m wide.
Length of internal roads	To be confirmed once the EPC contractor has been selected and the design is finalised.
Number of inverters required	To be confirmed once the EPC contractor has been selected and the design is finalised.
Area occupied by inverter / transformer stations / substations	To be confirmed once the EPC contractor has been selected and the design is finalised.
Proximity to grid connection	Grid connection is to the existing Eskom Watershed substation. A **power line** with a voltage of 132kV is proposed and will run from the onsite substation to the Eskom Watershed substation. The power line is not part of this EIA, and are being applied for as part of a separate ongoing Basic Assessment (BA) process.
Width of the power line servitude	A 31m wide servitude will be required, however, the power line is not part of this EIA, and are being applied for as part of a separate ongoing BA process.
Power line tower types and height	Power line is likely to be standard self-supporting suspension monopole structures where the line is relatively straight. However the power line is not part of this EIA, and are being applied for as part of a separate ongoing BA process.
Diagrams of tower types	The power line is not part of this EIA, and are being applied for as part of a separate ongoing BA process.
Approximate distance between towers	200m to 250m apart
Height of fencing	Approx. 2m high.
Type of fencing	Galvanized steel.

A3 Maps of all smaller maps included in the report are included in Appendix 7.

BIOTHERM ENERGY

PROPOSED CONSTRUCTION OF THE TLISITSENG 2 SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR LICHTENBURG, NORTH WEST PROVINCE

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Executive Summary

BioTherm Energy (Pty) Ltd (hereafter referred to as BioTherm) intends to develop the Tlisitseng 2 Solar Photovoltaic (PV) Energy Facility and associated infrastructure near Lichtenburg in the North West Province of South Africa. SiVEST Environmental Division has subsequently been appointed as independent consultants to undertake the Environmental Impact Assessment (EIA) for the proposed energy facility and associated onsite substation. The overall objective of the project is to generate electricity to feed into the National Grid. The proposed project will therefore consist of a 75MW export capacity solar PV energy facility and associated infrastructure which includes an onsite substation with a voltage capacity of up to 132kV.

This proposed PV energy facility forms one (1) of two (2) PV energy facilities with a 75MW export capacity that BioTherm are proposing to develop on Portion 25 of the Farm Houthaalboomen No 31 (**Figure ii**). In addition, BioTherm are proposing to construct two (2) 132kV onsite substations namely Tlisitseng 1 and Tlisitseng 2 Substations, and two (2) 132kV power lines, which will feed the electricity generated by the proposed PV energy facility into the National grid. In order to accommodate the Department of Energy's (DoE) competitive bidding process for procuring renewable energy from Independent Power Producers in South Africa, each PV energy facility will be developed under a separate Special Purpose Vehicle (SPV) and therefore each requires a separate Environmental Authorisation (EA). Additionally, the two (2) 132kV power lines which will connect each of the proposed Tlisitseng onsite Substations to the existing Eskom Watershed Main Transmission Substation (MTS) will also require a separate EA. It must however be noted that the proposed 132kV power lines will require a Basic Assessment (BA) process and not an Environmental Impact Assessment (EIA). Although each PV energy facility and the electrical infrastructure will be assessed separately, a single public participation process is being undertaken to consider all four (4) proposed developments. The potential environmental impacts associated with all four (4) developments will be assessed as part of the cumulative impact assessment. The reference number allocated by the Department of Environmental Affairs (DEA) for the other proposed PV energy facility, Tlisitseng 2 is 14/12/16/3/3/2/975. The reference numbers for the 132kV power line BAs, have not as yet been allocated by the DEA. They will be provided in the Final Environmental Impact Assessment Report (FEIAr).

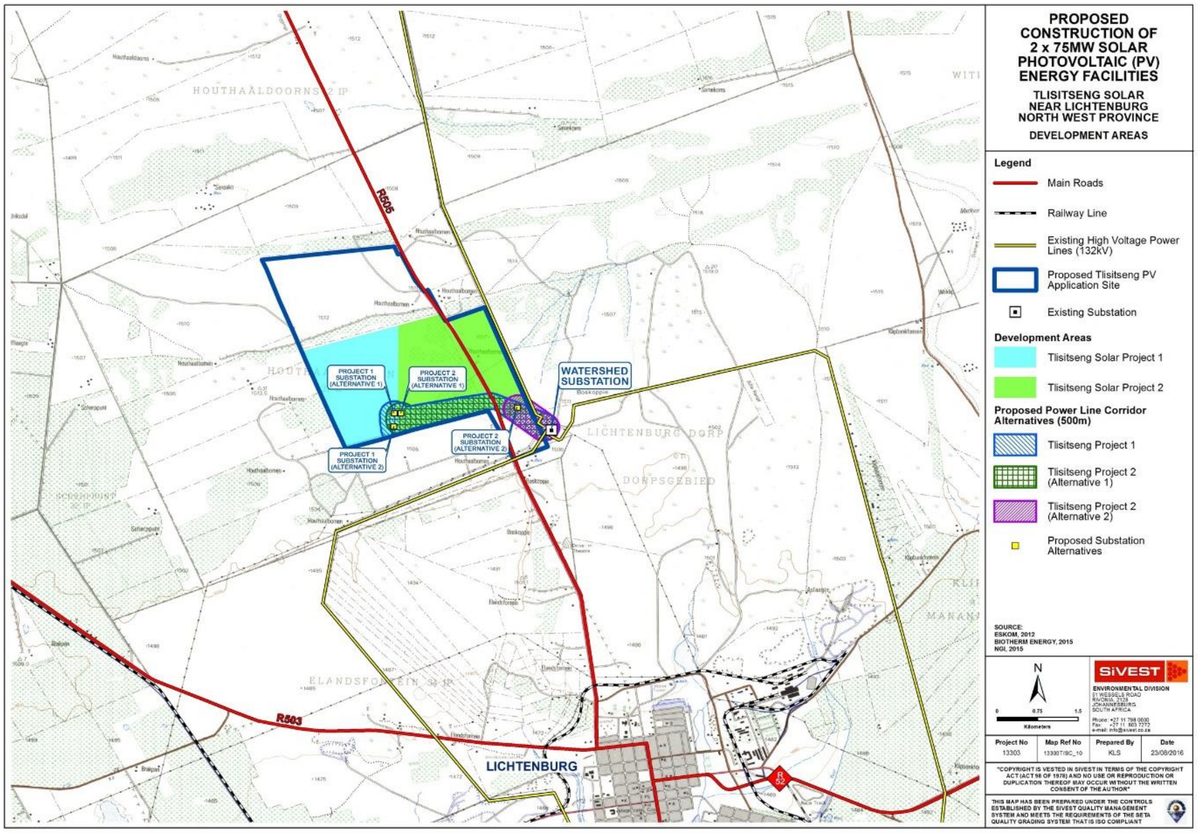

Figure ii: Site locality for the proposed PV energy facility

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Refer to Appendix 9 for the full project coordinates.

The total area of the assessed application site is 1024 hectares, with the proposed Tlisitseng 2 development taking up approximately 345 hectares (approximately 236 ha for the Western Portion and 109 ha for the Eastern Portion).

The proposed development requires Environmental Authorisation (EA) from the Department of Environmental Affairs (DEA). However, the provincial authority will also be consulted (i.e. the North West Department of Rural, Environment and Agricultural Development). The EIA for the proposed development will be conducted in terms of the EIA Regulations promulgated in terms of Chapter 5 NEMA (National Environmental Management Act), which came into effect on the 8th of December 2014. In terms of these regulations, a full EIA is required for the proposed project. All relevant legislation and guidelines (including Equator Principles) will be consulted during the EIA process and will be complied with at all times. The Scoping Phase of the project has been completed and has been accepted by the DEA. The EIA phase is currently in progress.

As previously mentioned, proposed project involves the construction of one 75MV solar PV energy facility and associated infrastructure. Layout alternatives have been investigated which relate to the location of the infrastructure on the site. These are illustrated below:

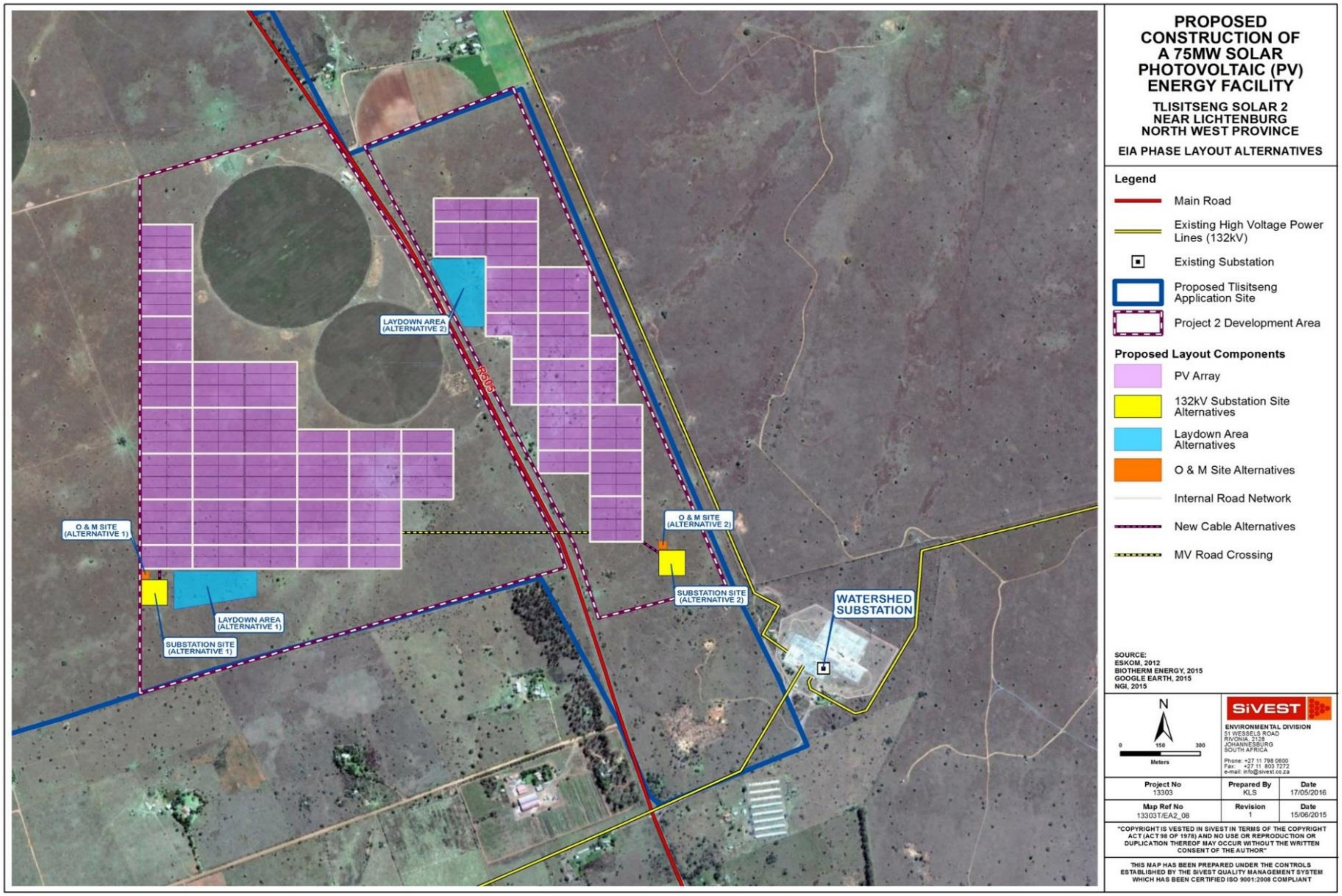


Figure iii: Tlisitseng 2 Layout Alternatives

It is important to that that on the 18th of January 2016 an application for EA and the DSR for the proposed Tlisitseng 2 Solar PV energy facility were received by the DEA and a reference number was allocated to the proposed development (**DEA reference number: 14/12/16/3/3/2/890**). The original DSR was made available for public review from the 11th of January 2016 to the 9th of February 2016. The DSR was thereafter updated and the Final Scoping Report (FSR) was submitted to the DEA on the 19th of February 2016. After evaluating the FSR the DEA issued a letter indicating that the documents complied with the minimum requirements of the EIA Regulations, 2014 and that SiVEST could proceed with the EIA process (i.e. Draft Environmental Impact Assessment Report (DEIAr) and Final Environmental Impact Assessment Report (FEIAr)). The original FSR was therefore accepted by the DEA. It should however be noted that due to a change in the layout of the proposed Tlisitseng 2 Solar PV energy facility, SiVEST was not able to submit the FEIAr within the legislated timeframes. On the 20th of June 2016, SiVEST therefore sent the DEA a letter requesting a sixty (60) day extension in terms of Regulation 3 (7) of the EIA Regulations, 2014, in order to provide the specialists with the opportunity to update their specialist reports in-line with the revised layouts. On the 20th of July 2016, the DEA issued a letter refusing the extension request. For this reason the application for EA lapsed in accordance with Regulation 45 of the EIA Regulations, 2014 and the departmental file was closed for the project.

In order to reapply for EA for the proposed Tlisitseng 2 Solar PV energy facility BioTherm has appointed SiVEST to recommence with the EIA process. It should however be noted that all comments received by Interested and Affected Parties (I&APs) during the Public Participation Process (PPP) which was undertaken for the original EIA process (including those received during meetings) will form part of this EIA process. The public participation process is being re-conducted in accordance with the EIA Regulations, 2014 and all I&APs, Stakeholders and Organs of State were afforded an extra opportunity to review the DSR and to provide comments. As such, the second version of the DSR and application form for the Tlisitseng 2 Solar PV energy facility, was submitted to the DEA and made available for public comment from the 29th of September 2016 to the 31st of October 2016. On the 3rd of October 2016, the DEA acknowledged having received the application for EA and the DSR for the proposed Tlisitseng 2 Solar PV energy facility on the 30th of September 2016 and a new reference number was allocated to the proposed development **(DEA reference number: 14/12/16/3/3/2/975).** The DSR was thereafter updated and the Final Scoping Report (FSR) was submitted to the DEA on the 11th November 2016. After evaluating the FSR the DEA issued a letter on the 12 December 2016, indicating that the documents complied with the minimum requirements of the EIA Regulations, 2014 and that SiVEST could proceed with the EIA process (i.e. DEIAr and FEIAr). The FSR was therefore accepted by the DEA.

Specialist studies were conducted for the following environmental parameters, as part of the EIA phase and as stipulated in the Plan of Study for EIA:

- Biodiversity Assessment;
- Avifauna Assessment;
- Surface Water Impact Assessment;

- Soils and Agricultural Potential Assessment;
- Visual Impact Assessment;
- Heritage and Palaeontological Assessment;
- Socio-economic Impact Assessment;
- Traffic Impact Assessment; and
- Geotechnical Impact Assessment.

Table i: Summary of findings

Environmental Parameter	Summary of major findings	Recommendations
Biodiversity	The vegetation type that occurs on site (Carletonville Dolomite Grassland) is classified as Vulnerable, but has a wide distribution and extent. The natural vegetation on the sites is therefore considered from this perspective to have moderately high conservation value. The area is not within a Centre of Plant Endemism, nor does it occur in close proximity to an area identified as part of the National Parks Area Expansion Strategy. However, the site is within areas identified in the Provincial Conservation Assessment to be of importance for various reasons, including as buffer areas for protected areas, as part of a biodiversity feature, as part of a biodiversity node and as part of a dolomite aquifer recharge zone. Local factors that may lead to parts of the sites having elevated ecological sensitivity are the potential presence of the following: ▪ Presence of natural vegetation on site, some of which is of elevated conservation priority. ▪ Potential presence of four plant species of concern, the bulb, *Boophone disticha* (occurs on site), listed as Declining, the bulb, *Crinum macowanii* (possibly occurs on site - individuals seen were not flowering), listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened.	Proposed mitigation measures include compiling a surface runoff and stormwater management plan, formalising a rehabilitation programme, undertaking a botanical walk-through survey, undertaking search-and-rescue for any appropriate species, obtaining permits for any protected species that will be affected, undertaking a search and rescue of plants that can be rescued, compiling an alien plant management plan and undertaking regular monitoring.

	▪ Potential presence of one protected plant species, *Harpagophytum procumbens.*
	▪ Potential presence of three protected tree species, *Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*. The tree *Acacia erioloba* occurs in large numbers on site.
	▪ Potential presence of the following animals of potential conservation concern:
	    o Brown Hyaena (NT)
	    o Honey badger (NT)
	    o Southern African Hedgehog (NT)
	    o White-tailed Rat (EN)
	    o Giant Bullfrog (NT/LC).
	▪ Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.
	
	Potential risks (impacts) to the ecological receiving environment are as follows:
	▪ Loss of indigenous natural vegetation during construction;
	▪ Impacts on listed plant species;
	▪ Impacts on a protected plant species;
	▪ Impacts on protected tree species;
	▪ Mortality of populations of sedentary species during construction;
	▪ Displacement of populations of mobile species (terrestrial);
	▪ Introduction and/or spread of declared weeds and alien invasive plants in terrestrial habitats.
	
	Cumulative impacts of this project in combination with similar projects is likely to be of low significance, with the exception of	

	impacts on pan depressions, which may possibly be moderate due to impacts from other sources.	
Avifauna	The proposed Tlisitseng PV 1 facility is located in the endemic region with the fourth highest number of endemics in southern Africa. With 18% 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. Within the core study area, potential high sensitive areas are surface water (boreholes). Within the adjacent surroundings, high voltage lines, a vulture restaurant, and wetlands and dams are potential high sensitive areas, as all of these micro-habitats are potential focal points of bird activity. When full, the wetlands and dams may be an aggravating factor in that birds commuting to and from them could mistake the solar panels for surface water and attempt to land on them, thereby exposing themselves to the risk of collision. Boreholes could potentially be declassified as high sensitivity should it be confirmed that they will be relocated and therefore cease to function as potential focal points for bird activity after the construction of the solar panels. The potential impact of displacement of priority species due to disturbance associated with construction of the PV 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 plant and associated infrastructure, are 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	▪ 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 used should be made of existing access roads and the construction of new roads should be kept to a minimum. ▪ 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. ▪ 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.

	of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure is likewise rated as low and could be further reduced through mitigation.	▪ 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.
Surface Water	Ultimately, it was found that there is one ephemeral pan wetland within close proximity (approximately 18m to the west) of the PV layout area and approximately 35m to the east of the R505. A 15m construction buffer zone and 18m operation phase buffer zone is to be applied to the wetland based on the type and condition of the wetland, as well as the potential impacts expected and mitigations measures to be implemented. In terms of potentially applicable environmental and water related legislature, one listed activity and two 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), Activity 12 of Government Notice 983 was identified as being applicable where the proposed development will take place within 32m of the identified wetland, respectively. With respect to the NWA (1998), water uses (c) and (i) are assessed to potentially be applicable where the proposed development will be within 500m of the identified wetland. The above identified environmental activity and water uses should however be confirmed with the relevant government departments.	▪ Should no direct impacts need to take place to the identified wetland, the need for water use licensing can be avoided where it can be demonstrated to DWS that significant impacts will not take place and/or where other water uses are not required. ▪ Where impacts to surface water resources is not avoidable, the relevant water use license and environmental authorisations are to be applied for before construction is allowed to commence. ▪ All identified mitigation measures are to be implemented in order to minimise the identified potential impacts.
Agricultural Potential and Soils	Despite the dominance of shallow soils in the area, areas of cultivation on the deeper soils can be seen in the vicinity. These include the various centre pivot fields, two of which occur in or close	▪ Due to the generally low potential agricultural environment, little or no mitigation measures are required. The footprint of the development should be

	to the north-west corner of the part of the PV 2 site occurring to the west of the R505 road. The rainfall in the area is adequate for rain-fed cultivation, but due to the unreliability of the distribution, irrigation is a viable means of supplementing the rainfall in times of shortage, especially in the areas where deeper soils occur. The climatic parameters 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. The land use in the area is dominantly grazing, but with areas of cultivation, some under irrigation as classified by the National Land Cover.	kept to a minimum, so that at least the effect on grazing land for livestock is reduced. ▪ 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 loamy nature of the soils means that if exposed, there is only a small hazard of soil removal by wind erosion, especially in the drier winter months. However, 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.
Visual	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 three (3) sensitive receptors are present in the study area, namely Rafters Pub (VR 14), the Lichtenburg Vakansie Oord (VR 69) and the Lichtenburg Game Breeding Centre (VR 71). These three (3) visually sensitive receptors are regarded as facilities with current and future tourism potential and are therefore expected to experience the most significant visual impacts as a result of the proposed development. It should however be noted that at this stage, the game breeding centre is not operational. Despite the tourism significance of the three (3) sensitive visual receptor locations, the proposed development is	▪ Where possible, 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.

	expected to have a low visual impact on the Lichtenburg Vakansie Oord while it will have a moderate visual impact on Rafters Pub as well as the Lichtenburg Game Breeding Centre. It must also be noted that the R505 main road, which traverses the application site as well as 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 the potentially visual receptors. It must however be noted that the proposed development would have high visual impact on only one (1) potentially sensitive visual receptor location, namely VR 1. 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 Tlisitseng 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.	▪ 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). ▪ 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. ▪ The operations and maintenance (O&M) buildings should not be illuminated at night. ▪ If overhead power lines are required, align power lines to run parallel to other linear elements and the farm boundaries, where possible. ▪ 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. ▪ Non-reflective surfaces should be utilised where possible.
Heritage	The Heritage Impact Assessment has shown that the proposed Tlisitseng Solar projects does have heritage resources present on	▪ Although no significant fossils were recorded in situ in both PV sites as well as the proposed alternative route corridors for the power lines, several well-

	the property. This has been confirmed through archival research, evaluation of aerial photography of the sites and a field survey. During the fieldwork 3 heritage resources were identified in or close to the footprint area of the PV site 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.	defined micro-stromatolites and possible sites with cave breccia have been identified. Depending on the results of the geotechnical investigation and where potential excavations for foundations will exceed 1.5m, the ECO must investigate the possible presence of stromatolites and/or cave breccia and inform the HIA consultants immediately for appropriate action and appointment of a qualified palaeontologist to investigate the site before destruction of fossils occurs. ▪ Site visits as stipulated in the management tables will include an initial 2 day site visit and then fortnightly during construction. ▪ 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.
Socio-economic	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; however, 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. Portion 25 of Farm Houthaalboomen 31 is currently being used for irrigated maize farming and some commercial livestock farming. The land owner has indicated that the proposed development will impact the grazing land only and irrigated land will remain. He plans	▪ Consultation with the directly affected land owner 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. ▪ 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

	to acquire alternative land to continue with commercial livestock farming. Overall, the impact analysis and evaluation revealed that no fatal flaws are present from a socio-economic perspective preventing the proposed development from being approved and implemented. All of the expected negative socio-economic impacts can be mitigated to low significance. 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 ▪ Severing of existing community ties ▪ 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: ▪ Impact on commercial agriculture activities ▪ Employment creation ▪ Skills development ▪ Increase in living standard	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. ▪ Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers. ▪ 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. ▪ During construction the rules and regulations must be clearly communicated to all workers, personal property must be respected and avoided. ▪ Participate in ongoing consultation with directly and indirectly affected land owners to avoid unduly influencing any processes or day to day activities of these individuals. Ensure that all interested and affected parties understand the project and its requirements as far as is feasible, reasonable, and possible.

	- Increased social pathologies - Increased production - Increased demand for social facilities - Increased demand for service delivery - Increase in disposable income - Impact on realisation of nearby properties' tourism business potential - Impact on property values - Increased tax revenue for government 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 be considered for implementation. However, care should be taken that the proposed development does not affect the supply of water extracted from boreholes located on the nearby farms and access to some of the nearby farms. The issues of safety and livestock theft should also be addressed and proposed mitigation measures for these are implemented.	- Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers. - Set up a recruitment office in the nearby town of Lichtenburg and adhere to strict labour recruitment practices that would reduce the desire of potential job seekers to loiter around the properties in hope to find temporary employment - Employ locals as far as feasible through the creation of the local skills database and recruitment of suitable candidates. - Set up a gate or access control to site to limit or completely eliminate the possibility of loitering on site and movement of people from site to the adjacent properties. - Movement of workers and vehicles on the roads linked to the construction activities should be limited to working hours and workdays - 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. - Limit construction activity to normal working hours and avoid activity over weekends - 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. ▪ 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. ▪ The water supply options will need to be considered and discussed with the interested and affected parties in the area prior the operations to discard any of the above-mentioned concerns. ▪ Engage with the owners of the local tourist attractions (Portion 1 of Farm Talene 25 specifically) and discuss with them the opportunities to establish educational tours in partnership between the two (or more) local parties that could be packaged, advertised and sold by the businesses surrounding the solar farm. ▪ Other opportunities linked to realising the potential for eco-tourism linked to the proposed solar PV project/s need to be examined. This could include the use of Socio-Economic Development and Enterprise Development funding allocated by the project during operations on realising these opportunities and developing the local tourism industry. Ensure that the establishments surrounding the farms are kept safe by insetting a stringent access control and proper fencing between the boundaries of properties.

Geotechnical	For the substation, build on a 1 hectare property, this DSI will comprise a gravity survey and the drilling of a minimum of 3 boreholes for a feasibility level (Phase 1) investigation. It is also evident from the Topographical maps and Google Images that a water borehole is present between the two alternative sites. This borehole is probably used for irrigation purpose and as mentioned in above, dewatering has a significant effect on the underlying dolomite stability.	Due to fact that this entire site is underlain at depth by dolomite, it is a legal requirement that a Dolomite Stability Investigation (DSI) be undertaken in accordance with the South African National Standards SANS 1936-Parts 1 to 4 Development of Dolomitic Land.
Traffic	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 Tlisitseng 2 Solar PV Energy Facilities will be from the Durban Port. The distance of 765 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 1035 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	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. It is recommended that the majority of construction personnel is transported to and from site by means of buses and some by private vehicles. The access road should be upgraded to at least a 5m width (preferable 6m with sufficient shoulders) finished with a gravel wearing course layer.

	within South Africa is predominantly on National and Provincial roads, which presents no limitations for normal freight. The proposed preferred access roads from the R505 to the site for is situated close to the site and requires minimal upgrades. 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.	

These specialist studies were conducted to address the potential impacts relating to the proposed development that were identified during the scoping phase. An impact assessment was conducted to ascertain the level of each identified impact, as well as mitigation measures which may be required. The potential positive and negative impacts associated within these studies have been evaluated and rated accordingly. The results of the specialist studies have indicated that no fatal flaws exist as a result of the proposed project. Additionally, the specialists comparatively assessed the alternatives as provided in Figure iii, the results of the comparative assessment are summarised below in Table ii.

Table ii: Summary of comparative assessment

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
SUBSTATION SITE				
Tlisitseng PV 2 Substation Site Alternative 1	Biodiversity	FAVOURABLE	Affects similar habitat to Alternative 2.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts.	No Fatal Flaws
	Surface Water	NO PREFERENCE	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws
	Agricultural Potential and Soils	PREFERRED	Shallow soils, low agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	FAVOURABLE	No sensitive or potentially sensitive visual receptors can be found within 500m of the substation site alternative, within the high impact zone. Eleven (11) potentially sensitive visual receptors can be found within 2km of this proposed substation site alternative, within the moderate impact zone. In addition, one (1) sensitive visual receptor, namely VR 14 – Rafters Pub, can also be found within 2km of this proposed substation site alternative, within the moderate impact zone and one (1) sensitive visual receptor, namely VR 71 – Lichtenburg Game Breeding Centre,	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
			is situated further than 2km from the proposed alternative, within the low impact zone. It must also be noted that one (1) sensitive visual receptor, namely VR 69 – Lichtenburg Vakansie Oord, is situated further than 5km from this alternative, and will therefore be negligible from a visual perspective. Although Substation and O&M Building Alternative 1 is located slightly closer to one (1) of the sensitive receptor locations, it is still favourable as the substation and O&M building would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible. In addition, one (1) of the sensitive visual receptors will be located further than 5km from this alternative and is therefore not expected to be impacted on from a visual perspective.	
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws
Tlisitseng PV 2 Substation Site Alternative 2	Biodiversity	PREFERRED	Closer to existing disturbance and will be situated between the solar arrays and the existing disturbance.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts.	No Fatal Flaws
	Surface Water	NO PREFERENCE	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Agricultural Potential and Soils	FAVOURABLE	Possibility of deeper soils, moderate to high agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	PREFERRED	No sensitive or potentially sensitive visual receptors can be found within 500m of the substation and O&M building site alternative, within the high impact zone. Twelve (12) potentially sensitive visual receptors can be found within 2km of this proposed substation & O&M building site alternative, within the moderate impact zone. The rest of the potentially sensitive visual receptors can be found further than 2km from the proposed alternative. It must be noted that three (3) sensitive visual receptors, namely VR 14 – Rafters Pub, VR 69 – Lichtenburg Vakansie Oord and VR 71 – Lichtenburg Game Breeding Centre, can be found further than 2km from this proposed substation & O&M building site alternative, within the low impact zone. Despite the fact that Substation and O&M Building Alternative 2 is located slightly closer to most of the potentially sensitive visual receptors, it will be marginally preferred as it is located slightly further from one (1) of the sensitive receptor locations. In addition, the substation and O&M building would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws
O&M BUILDING				
Tlisitseng PV 2 Internal Road Alternative 1	Biodiversity	FAVOURABLE	Affects similar habitat to Alternative 2.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts	No Fatal Flaws
	Surface Water	NO PREFERENCE	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws
	Agricultural Potential and Soils	PREFERRED	Closer to existing disturbance and will be situated between the solar arrays and the existing disturbance.Shallow soils, low agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	FAVOURABLE	No sensitive or potentially sensitive visual receptors can be found within 500m of the substation site alternative, within the high impact zone. Eleven (11) potentially sensitive visual receptors can be found within 2km of this proposed substation site alternative, within the moderate impact zone. In addition, one (1) sensitive visual receptor, namely VR 14 – Rafters Pub, can also be found within 2km of this proposed substation site alternative, within the moderate impact zone and one (1) sensitive visual receptor, namely VR 71 – Lichtenburg Game Breeding Centre, is situated further than 2km from the	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
			proposed alternative, within the low impact zone. It must also be noted that one (1) sensitive visual receptor, namely VR 69 – Lichtenburg Vakansie Oord, is situated further than 5km from this alternative, and will therefore be negligible from a visual perspective. Although Substation and O&M Building Alternative 1 is located slightly closer to one (1) of the sensitive receptor locations, it is still favourable as the substation and O&M building would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible. In addition, one (1) of the sensitive visual receptors will be located further than 5km from this alternative and is therefore not expected to be impacted on from a visual perspective.	
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws
Tlisitseng PV 2 Internal Road Alternative 2	Biodiversity	PREFERRED	Closer to existing disturbance and will be situated between the solar arrays and the existing disturbance.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts	No Fatal Flaws
	Surface Water	NO PREFERENCE	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Agricultural Potential and Soils	FAVOURABLE	Possibility of deeper soils, moderate to high agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	PREFERRED	No sensitive or potentially sensitive visual receptors can be found within 500m of the substation and O&M building site alternative, within the high impact zone. Twelve (12) potentially sensitive visual receptors can be found within 2km of this proposed substation & O&M building site alternative, within the moderate impact zone. The rest of the potentially sensitive visual receptors can be found further than 2km from the proposed alternative. It must be noted that three (3) sensitive visual receptors, namely VR 14 – Rafters Pub, VR 69 – Lichtenburg Vakansie Oord and VR 71 – Lichtenburg Game Breeding Centre, can be found further than 2km from this proposed substation & O&M building site alternative, within the low impact zone. Despite the fact that Substation and O&M Building Alternative 2 is located slightly closer to most of the potentially sensitive visual receptors, it will be marginally preferred as it is located slightly further from one (1) of the sensitive receptor locations. In addition, the substation and O&M building would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws
LAYDOWN AREAS				
Tlisitseng PV 2 Laydown Area Alternative 1	Biodiversity	FAVOURABLE	Affects similar habitat to Alternative 2.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts	No Fatal Flaws
	Surface Water	PREFERRED	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws
	Agricultural Potential and Soils	PREFERRED	Shallow soils, low agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	FAVOURABLE	No sensitive or potentially sensitive visual receptors can be found within 500m of Laydown Area Alternative 1, within the high impact zone. Thirteen (13) potentially sensitive visual receptors can be found within 2km of this proposed laydown area alternative, within the moderate impact zone. In addition, one (1) sensitive visual receptor, namely VR 14 – Rafters Pub, can also be found within 2km of this alternative, within the moderate impact zone. It must be noted that VR 71 – Lichtenburg Game Breeding Centre is located further than 2km from the laydown area alternative, within the low impact zone, while VR 69 – Lichtenburg	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
			Vakansie Oord is located further than 5km from the alternative and will therefore be negligible from a visual perspective. Although Laydown Area Alternative 1 is located slightly closer to one (1) of the sensitive receptor locations, as well as most of the potentially sensitive visual receptors, it is still considered to be favourable	
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws
Tlisitseng PV 2 Laydown Area Alternative 2	Biodiversity	PREFERRED	Closer to existing disturbance and will be situated between the solar arrays and the existing disturbance.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts	No Fatal Flaws
	Surface Water	FAVOURABLE	Pan wetland located approximately 300m to the south east of the Laydown Area. No direct impact to the wetland will result. However, indirect increased run-off and sedimentation impacts may occur. This alternative is viewed as favourable in that no direct impact will occur to the wetland. Additionally, the potential impacts can be mitigated to acceptable levels during construction to minimise any impact taking place during this period.	No Fatal Flaws
	Agricultural Potential and Soils	FAVOURABLE	Possibility of deeper soils, moderate to high agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Visual	PREFERRED	No sensitive or potentially sensitive visual receptors can be found within 500m of Laydown Area Alternative 2, within the high impact zone. Six (6) potentially sensitive visual receptors can be found within 2km of this proposed laydown area alternative, within the moderate impact zone. The rest of the potentially sensitive visual receptors can be found further than 2km from this alternative. It must be noted that two (2) sensitive visual receptors, namely VR 14 – Rafters Pub and VR 71 – Lichtenburg Game Breeding Centre, can be found further than 2km from Laydown Area Alternative 2, within the Low impact zone. In addition, one (1) sensitive visual receptor, namely VR 69 – Lichtenburg Vakansie Oord, can be found further than 5km from this alternative and is therefore considered to be negligible from a visual perspective. As such, Laydown Area Alternative 2 will be preferred as it is located slightly further from one (1) of the sensitive receptor locations, as well as most of the potentially sensitive visual receptors.	No Fatal Flaws
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws

Tlisitseng PV 2 Substation Alternative 2 and **O&M building Alternative 2** is preferred from a biodiversity and visual perspective as the proposed substation alternative is located closer to existing disturbance and will be situated between the solar arrays and the existing disturbance and no sensitive or potentially sensitive visual receptors can be found within 500m of the substation and O&M building site alternative, within the high impact zone. However, from an agricultural and soils perspective Substation Alternative 1 is preferred due to the shallow soils and the low agricultural potential.

Tlisitseng PV 2 Laydown area alternative 2 is preferred from a biodiversity and visual perspective as the proposed substation alternative is located closer to existing disturbance and will be situated between the solar arrays and the existing disturbance and no sensitive or potentially sensitive visual receptors can be found within 500m of the substation and O&M building site alternative, within the high impact zone. However, from a surface water and agricultural perspective **Tlisitseng PV 2 Laydown area alternative 1 is the preferred alternatives as there are n**o wetlands in the proposed location or nearby vicinity (500m) in conjunction with the presence of shallow soils, low agricultural potential. Based on this either alternative is favourable.

As a result **Tlisitseng PV 2 Substation Alternative 2, O&M building Alternative 2 and Laydown area alternative 2** are considered the preferred alternative for the proposed development.

As such, the preferred site layout is indicated in Figure iv below. The preferred site layout in relation to the sensitive areas identified by the specialists is indicated in Figure v.

It should be noted that some micro siting may be required at the construction phase within the authorised buildable area. This is to enable the avoidance of any unidentified features on site or any design constraints when the project reaches construction.

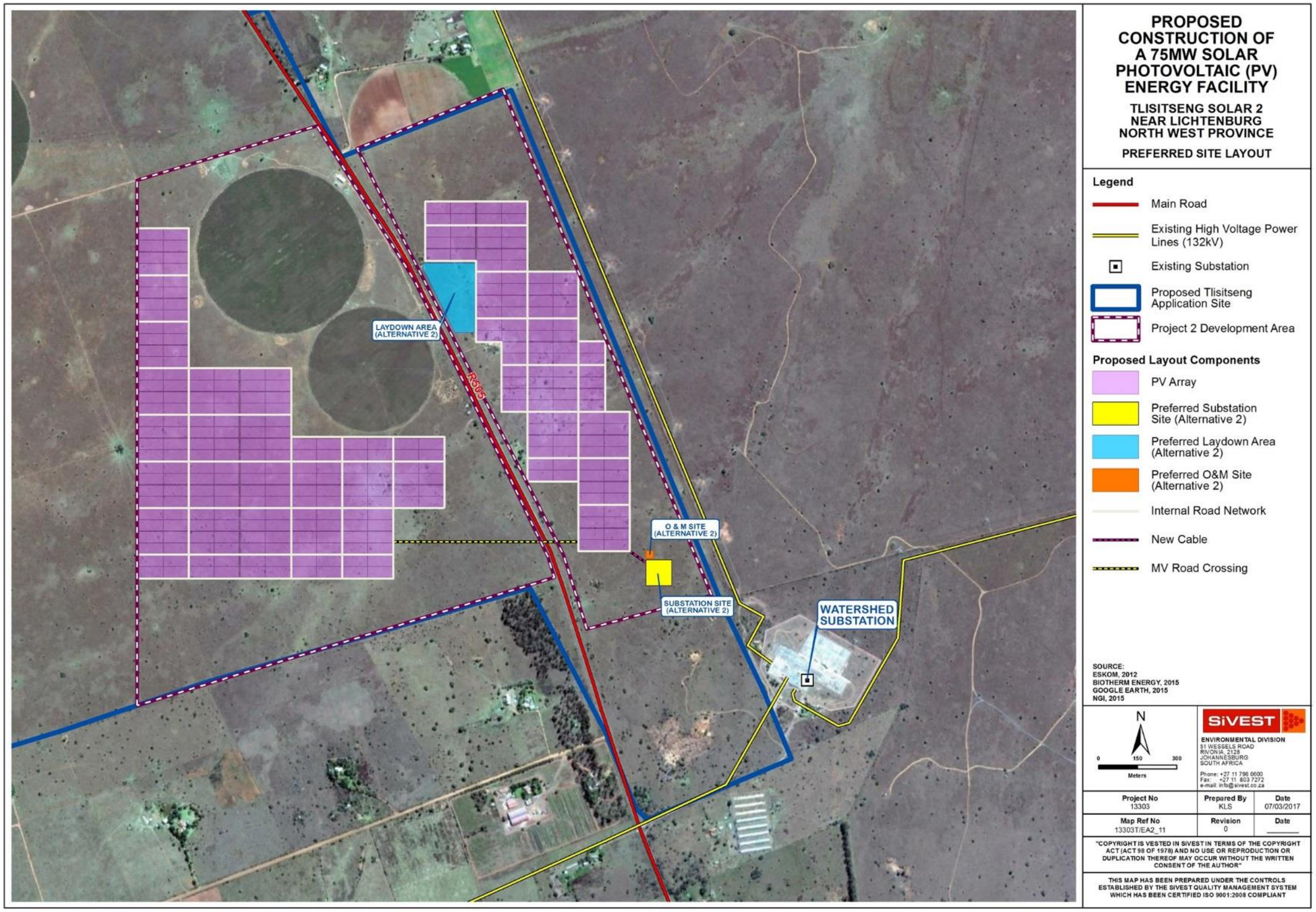


Figure iv: Preferred Site Layout

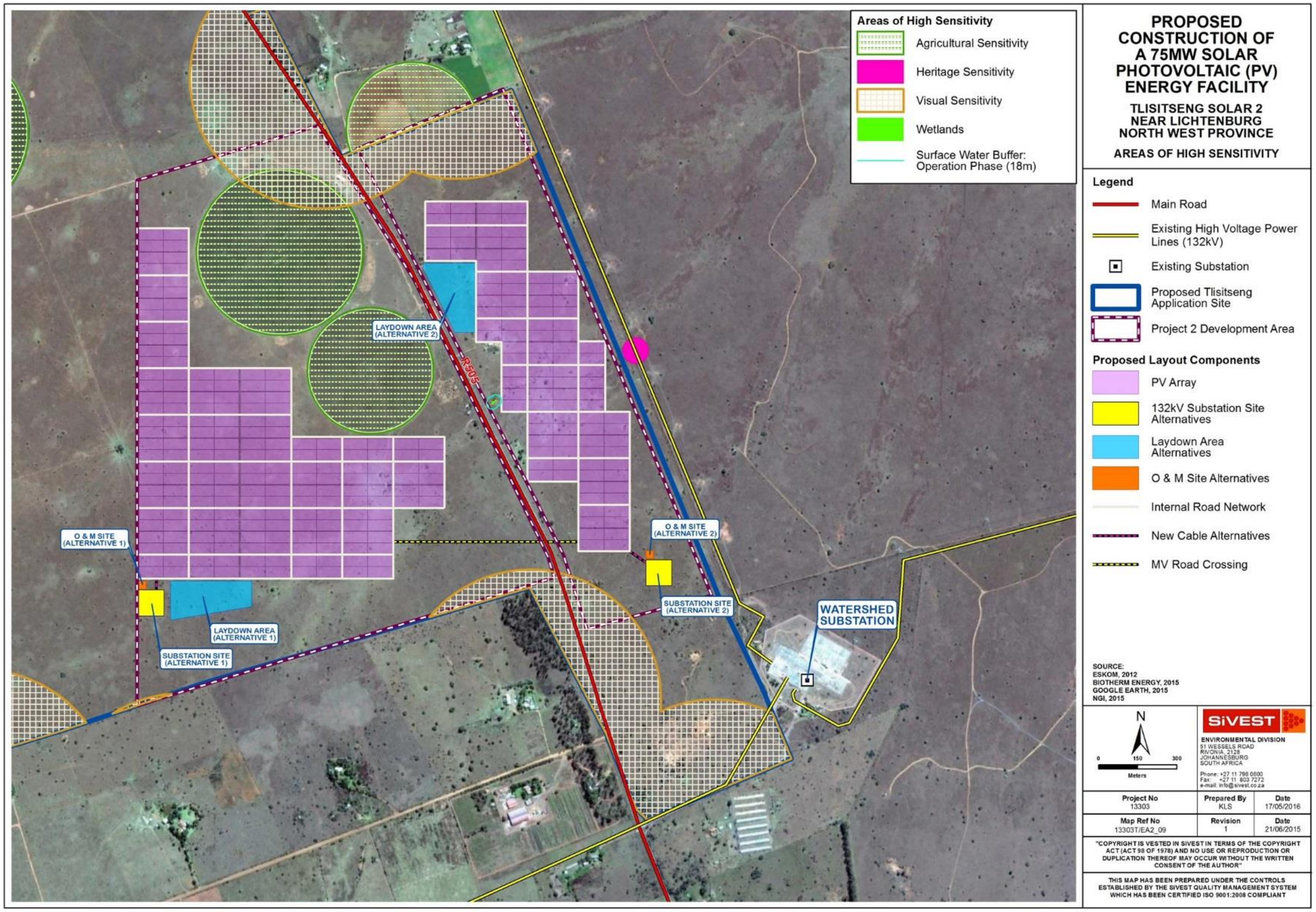


Figure v: Preferred Site Layout in relation to Sensitive Areas

It is the opinion of the EAP that the information and data provided in this DEIAr is sufficient to enable the DEA to consider all identified potentially significant impacts and to make an informed decision on the application. Further, it is the opinion of the EAP that based on the findings of the EIA that the proposed project should be granted an EA and allowed to proceed provided the following conditions are adhered to:

- The substation and O&M building should be constructed within the preferred substation and O&M building sites 2.
- The laydown site should be located in the area designated for the laydown alternative 2.
- Where applicable monitoring should be undertaken to evaluate the success of the mitigation measures recommended by the various specialists.
- Final EMPr should be approved by DEA prior to construction.
- The final layouts should be submitted to the DEA for approval prior to commencing with the activity.

SiVEST as the EAP is therefore of the view that:

- An environmentally preferred substation site, as well as an O&M building site has been identified which is less environmentally sensitive compared to the other site considered during the EIA phase.
- Through the implementation of mitigation measures, together with adequate compliance monitoring, auditing and enforcement thereof by the appointed ECO as well as competent authority, the potential detrimental impacts associated with the proposed project can be mitigated to acceptable levels.
- A cumulative impact assessments of similar development in the area was undertaken by the specialist. Based on their findings the cumulative impacts associated with the proposed development will be low.

It is trusted that the DEIAr provides the reviewing authority with adequate information to make an informed decision regarding the proposed project.

BIOTHERM ENERGY

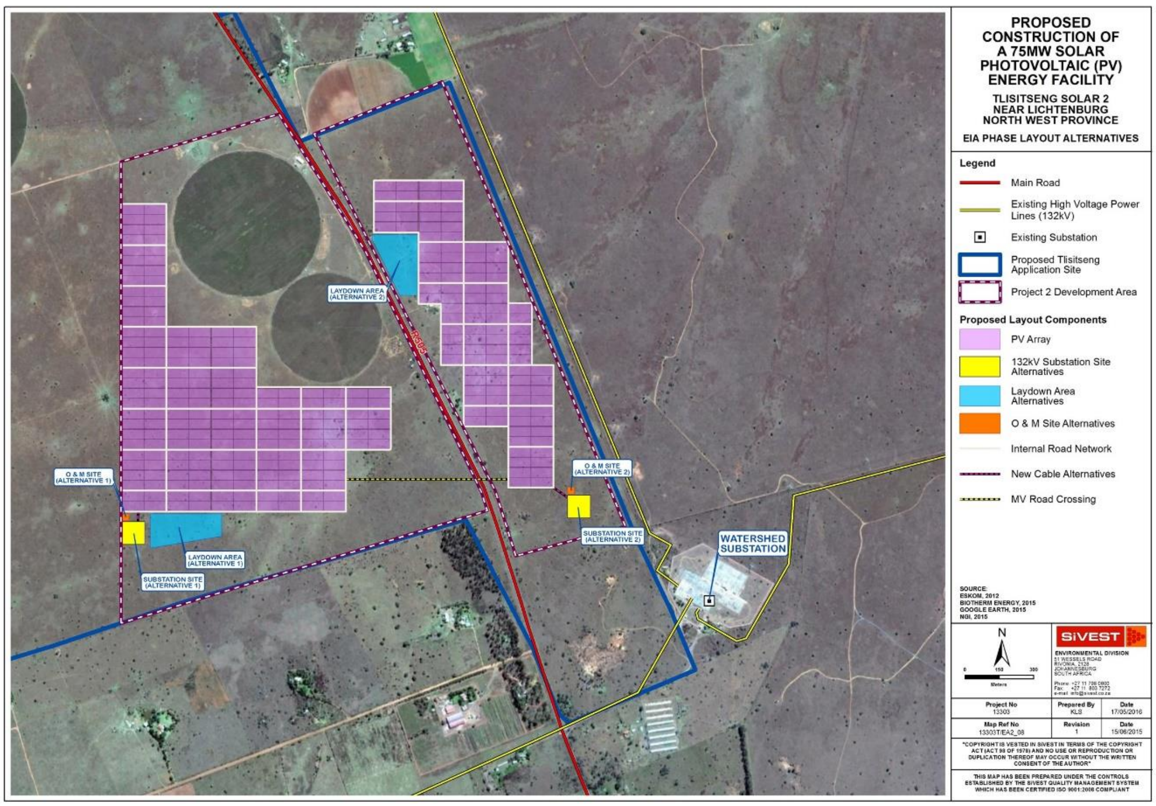
PROPOSED CONSTRUCTION OF THE TLISITSENG 2 SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR LICHTENBURG, NORTH WEST PROVINCE

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Contents Page

List of Tables

List of Figures



List of Appendices

Glossary of Terms

Alluvial: Resulting from the action of rivers, whereby sedimentary deposits are laid down in river channels, floodplains, lakes, depressions etc.

Biodiversity: The variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas where they are found.

Cumulative Impact: In relation to an activity, cumulative impact means the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

"Equator Principles": A financial industry benchmark for determining, assessing and managing social & environmental risk in project financing

Environmental Impact Assessment: In relation to an application, to which Scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of the application.

Environmental Impact Assessment Report: In-depth assessment of impacts associated with a proposed development. This forms the second phase of an Environmental Impact Assessment and follows on from the Scoping Report.

Environmental Management Programme: A legally binding working document, which stipulates environmental and socio-economic mitigation measures which must be implemented by several responsible parties throughout the duration of the proposed project.

Heritage Resources: This means any place or object of cultural significance. See also archaeological resources above

Kilovolt (kV): a unit of electric potential equal to a thousand volts (a volt being the standard unit of electric potential. It is defined as the amount of electrical potential between two points on a conductor carrying a current of one ampere while one watt of power is dissipated between the two points).

Precipitation: Any form of water, such as rain, snow, sleet, or hail that falls to the earth's surface.

Red Data Species: All those species included in the categories of endangered, vulnerable or rare, as defined by the International Union for the Conservation of Nature and Natural Resources.

Riparian: The area of land adjacent to a stream or river that is influenced by stream induced or related processes.

Scoping Report: An "issues-based" report which forms the first phase of an Environmental Impact Assessment process

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.
Early Stone Age 2 000 000 - 150 000 Before Present
Middle Stone Age 150 000 - 30 000 BP
Late Stone Age 30 000 - until c. AD 200

List of Abbreviations

AP	- Action Plan
ATNS	- Air Traffic and Navigation Services Company Limited
AIA	- Archaeological Impact Assessment
ADT	- Average Daily Traffic
ADTT	- Average Daily Truck Traffic
BA	- Basic Assessment
BID	- Background Information Document
BLSA	- Bird Life South Africa
CARA	- Conservation of Agricultural Resources Act
CBA	- Critical Biodiversity Area
CSW	- Continuous Surface WaveCRM - Cost Recovery Mechanism
DEA	- Department of Environmental Affairs
DEIAr	- Draft Environmental Impact Assessment Report
DDD	- Data Deficient
DDT	- Taxonomically uncertainDoE - Department of Energy
DM	- District Municipality
DSR	- Draft Scoping Report
DWS	- Department of Water and Sanitation
EAP	- Environmental Assessment Practitioner
ECA	- Environmental Conservation Act No 73 of 1989
ECO	- Environmental Control Officer
ED	- Economic Development
EHS	- Environmental, Health, and Safety
EIA	- Environmental Impact Assessment
EIR	- Environmental Impact Report
EMC	- Electromagnetic Compatibility
EMI	- Electromagnetic interference
EMPr	- Environmental Management Programme
ENPAT	- Environmental Potential Atlas
EP	- Equator Principles
EPFI	- Equator Principles Financial Institutions
ERA	- The Electricity Regulation Act No. 4 of 2006
ESA	- Ecological Support Area
EAS	- Early Stone Ages
ESMP	- Environmental and Social Management Plan
ESMS	- Environmental and Social Management System
FD	- Frequency Domain
FEIAr	- Final Environmental Impact Assessment Report
FGM	- Focus Group Meeting

FSR	- Final Scoping Report
GDP	- Gross Domestic Product
GHG	- Green House Gases
GIIP	- Good International Industry Practice
GIS	- Geographic Information System
GPS	- Global Positioning System
GW	- Gigawatts
HIA	- Heritage Impact Assessment
I&AP(s)	- Interested and Affected Parties
IBA(s)	- Important Bird Area(s)
IDP	- Integrated Development Plan
IEP	- Integrated Energy Plan
IFC	- International Finance Corporation
IPP(s)	- Independent Power Producers
IRP	- Integrated Resource Plan
IUCN	- International Union for the Conservation of Nature and Natural Resources
KSW	- Key Stakeholder Workshop
kV	- Kilo Volt
LM	- Local Municipality
LED	-Local Economic Development
LSA	- Late Stone Age
MSA	- Middle Stone Age
MLL	- Minimum Living Level
MW	- Megawatt
NEA	- The National Energy Act No. 34 of 2008
ERA	- The Electricity Regulation Act No. 4 of 2006
IRP	- Integrated Resource Plan
NEMA	- National Environmental Management Act No. 107 of 1998
NEMBA	- National Environmental Management: Biodiversity Act No. 10 of 2004
NFEPA	- National Freshwater Ecological Priority Areas
NHRA	- National Heritage Resources Act No. 25 of 1999
NSBA	- National Spatial Biodiversity Assessment
NWA	- National Water Act No. 36 of 1998
NEMAA	- National Environmental Management: Air Quality Act of 2004
NPAES	- National Parks Area Expansion Strategy
NRTA	- The National Road Traffic Act No. 93 of 1996
OHL	- Overhead Line
OHSA	- Occupational Health and Safety Act No. 85 of 1993
PoS	- Plan of Study
PM	- Public Meeting
PPA	- Power Purchase Agreement

PPP - Public Participation Process
PV - Photovoltaic
RBS - Revised Balanced Scenario
REFIT - Renewable Feed-In Tariff Programme
REIPPP - Renewable Energy Independent Power Producer Procurement Programme
RE - Renewable Energy
RFI - Radio frequency interference
RFP - Request for Proposals
RFQ - Request for Qualifications
SA - South Africa
SABAP 2 - Southern African Bird Atlas Project 2
SAHRA - South African Heritage Resources Agency
SANBI - South African National Biodiversity Institute
SALT - Southern African Large Telescope
SDF - Spatial Development Framework
SKA - Square Kilometre Array
SPVs - Special Purpose VehiclesSDF - Spatial Development Framework
TD - Time Domain
TL - Terrain Loss
WETFEPA - Wetland Freshwater Priority Areas
WMA - Water Management Area

BIOTHERM ENERGY

PROPOSED CONSTRUCTION OF THE TLISITSENG 2 SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR LICHTENBURG, NORTH WEST PROVINCE

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

1 INTRODUCTION

BioTherm Energy (Pty) Ltd (hereafter referred to as BioTherm) intends to develop the Tlisitseng 2 Solar Photovoltaic (PV) Energy Facility and associated infrastructure near Lichtenburg in the North West Province of South Africa. SiVEST Environmental Division has subsequently been appointed as independent environmental assessment practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) for the proposed energy facility and associated onsite substation. The overall objective of the project is to generate electricity to feed into the National Grid. The proposed project will therefore consist of a 75MW export capacity solar PV energy facility and associated infrastructure which includes an onsite substation with a voltage capacity of up to 132kV.

This proposed PV energy facility forms one (1) of two (2) PV energy facilities with a 75MW export capacity that BioTherm are proposing to develop on Portion 25 of the Farm Houthaalboomen No 31 (**Figure ii**). In addition, BioTherm are proposing to construct two (2) 132kV onsite substations namely Tlisitseng 1 and Tlisitseng 2 Substations, and two (2) 132kV power lines, which will feed the electricity generated by the proposed PV energy facility into the National grid. In order to accommodate the Department of Energy's (DoE) competitive bidding process for procuring renewable energy from Independent Power Producers in South Africa, each PV energy facility will be developed under a separate Special Purpose Vehicle (SPV) and therefore each requires a separate Environmental Authorisation (EA). Additionally, the two (2) 132kV power lines which will connect each of the proposed Tlisitseng onsite Substations to the existing Eskom Watershed Main Transmission Substation (MTS) will also require a separate EA. It must however be noted that the proposed 132kV power lines will require a Basic Assessment (BA) process and not an Environmental Impact Assessment (EIA). Although each PV energy facility and the electrical infrastructure will be assessed separately, a single public participation process is being undertaken to consider all four (4) proposed developments. The potential environmental impacts associated with all four (4) developments will be assessed as part of the cumulative impact assessment. The reference number allocated by the Department of Environmental Affairs (DEA) for the other proposed PV energy facility, Tlisitseng 1 is 14/12/16/3/3/2/974. The reference numbers for the 132kV power line BAs, have not as yet been allocated by the DEA. They will be provided in the Final Environmental Impact Assessment Report (FEIAr).

The proposed development requires Environmental Authorisation (EA) from the Department of Environmental Affairs (DEA). However, the provincial authority will also be consulted (i.e. the North West Department of Rural, Environment and Agricultural Development). The EIA for the proposed development will be conducted in terms of the EIA Regulations promulgated in terms of Chapter 5 NEMA (National Environmental Management Act), which came into effect on the 8th of December 2014. In terms of these regulations, a full EIA is required for the proposed project. All relevant legislation and guidelines (including Equator Principles) will be consulted during the EIA process and will be complied with at all times. The Scoping Phase of the project has been completed and has been accepted by the DEA. The EIA phase is currently in progress.

It is important to that that on the 18th of January 2016 an application for EA and the DSR for the proposed Tlisitseng 2 Solar PV energy facility were received by the DEA and a reference number was allocated to the proposed development (**DEA reference number: 14/12/16/3/3/2/890**). The original DSR was made available for public review from the 11th of January 2016 to the 9th of February 2016. The DSR was thereafter updated and the Final Scoping Report (FSR) was submitted to the DEA on the 19th of February 2016. After evaluating the FSR the DEA issued a letter indicating that the documents complied with the minimum requirements of the EIA Regulations, 2014 and that SiVEST could proceed with the EIA process (i.e. DEIAr and FEIAr). The original FSR was therefore accepted by the DEA. It should however be noted that due to a change in the layout of the proposed Tlisitseng 2 Solar PV energy facility, SiVEST was not able to submit the FEIAr within the legislated timeframes. On the 20th of June 2016, SiVEST therefore sent the DEA a letter requesting a sixty (60) day extension in terms of Regulation 3 (7) of the EIA Regulations, 2014, in order to provide the specialists with the opportunity to update their specialist reports in-line with the revised layouts. On the 20th of July 2016, the DEA issued a letter refusing the extension request. For this reason the application for EA lapsed in accordance with Regulation 45 of the EIA Regulations, 2014 and the departmental file was closed for the project.

In order to reapply for EA for the proposed Tlisitseng 2 Solar PV energy facility BioTherm has appointed SiVEST to recommence with the EIA process. It should however be noted that all comments received by Interested and Affected Parties (I&APs) during the Public Participation Process (PPP) which was undertaken for the original EIA process (including those received during meetings) will form part of this EIA process. The public participation process was being -conducted in accordance with the EIA Regulations, 2014 and all I&APs, Stakeholders and Organs of State were afforded an extra opportunity to review the DSR and to provide comments. As such, the second version of the DSR and application form for the Tlisitseng 2 Solar PV energy facility, was submitted to the DEA and made available for public comment from the 29th of September 2016 to the 31st of October 2016. On the 3rd of October 2016, the DEA acknowledged having received the application for EA and the DSR for the proposed Tlisitseng 2 Solar PV energy facility on the 30th of September 2016 and a new reference number was allocated to the proposed development **(DEA reference number: 14/12/16/3/3/2/975).** The DSR was thereafter updated and the Final Scoping Report (FSR) was submitted to the DEA on the 11th November 2016. After evaluating the FSR the DEA issued a letter on the 12 December 2016, indicating that the documents complied with the minimum requirements of the EIA Regulations, 2014 and that SiVEST could proceed with the EIA process (i.e. DEIAr and FEIAr). The FSR was therefore accepted by the DEA.

This report has been compiled in accordance with World Bank standards, the Equator Principles and the International Finance Corporation (IFC) Standards. The Equator Principles ("EP") is a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing (Equator Principles, 2013). This PV project is considered a Category B project. Category B Projects are those with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures (Equator Principles, 2013). The project will also comply with the International Finance Corporation's (IFC) Social and Environmental Performance Standards (2012) and General Environmental Health and Safety (EHS) Guidelines (2007).

1.1 Structure of this Report

This Draft Environmental Impact Assessment Report (DEIAr) is structured as follows:

- Chapter 1 introduces the project and discusses the experience of the Environmental Assessment Practitioners (EAP), including specialists, who have contributed to the report. It expands on the relevant legal ramifications applicable to the project and describes the Equator Principles, IFC Performance Standards and the relevant development strategies and guidelines.
- Chapter 2 details the approach used to undertake the study i.e. the scoping study, authority consultation and the DEIAr.
- Chapter 3 elaborates on the assumptions and limitations pertaining to the EIA process for the proposed development.
- Chapter 4 provides explanation to the need and desirability of the proposed project by highlighting issues such as security of power supply; local employment as well as regional and local income profile.
- Chapter 5 gives detailed technical descriptions of the solar PV energy facility as well as the alternatives involved.
- Chapter 6 provides a description of the region in which the proposed development is intended to be located. Although the chapter provides a broad overview of the region, it is also specific to the application. It contains descriptions of the site and the specialist studies conducted during scoping phase are also summarised.
- Chapter 7 describes the Public Participation Process (PPP) undertaken during the EIA Phase and tables issues and concerns raised by Interested and Affected Parties (I&APs).
- Chapter 8 documents the findings of the specialist studies and associated potential impacts of the proposed solar PV energy facility.
- Chapter 9 presents a rating of each environmental issue before and after mitigation measures.
- Chapter 10 identifies recommendations from the specialists that have a bearing on the layout alternatives as well as proposed mitigation measures.
- Chapter 11 identifies potential cumulative impacts per environmental issue (specialist study).
- Chapter 12 gives a comparative assessment of all identified alternatives based on the various environmental issues (specialist studies).

- Chapter 13 provides a description of the environmental monitoring and auditing process to be undertaken for the proposed solar PV energy facility.
- Chapter 14 presents a checklist that ensures that the report has been compiled according to the requirements of the World Bank Standards and Equator Principles.
- Chapter 15 summarises the findings and recommendations per specialist study and provides the overall conclusion.
- Chapter 16 lists references indicated in the DEIAr.

1.2 Expertise of Environmental Assessment Practitioner

SiVEST has considerable experience in the undertaking of EIAs. Staff and specialists who have worked on this project and contributed to the compilation of this report are detailed in Table 1 below.

Table 1: Project Team

Name and Organisation	Role
Andrea Gibb – SiVEST	EAP, Senior Environmental Practitioner and Visual specialist
Veronique Evans – SiVEST	Environmental Consultant / Public Participation Practitioner
Stephan Jacobs - SiVEST	Environmental Consultant / Public Participation Practitioner and Visual
David Hoare – David Hoare Consulting	Biodiversity
Chris van Rooyen – Chris van Rooyen Consulting	Avifauna
Shaun Taylor – SiVEST	Surface Water
D.G. Paterson – ARC Institute for Soil, Climate and Water	Agricultural Potential
Wouter Fourie – PGS	Heritage
Gideon Groenewald – PGS Heritage	Palaeontology
Elena Broughton– Urban-Econ Development Economists	Socio-economic
Hermanus Steyn – Aurecon	Traffic
Thanduxolo Msengana - Geopractica	Geotechnical
Nicolene Venter – previously Zitholele Consulting, now Imaginative Africa	Senior Public Participation Practitioner
Kerry Schwartz – SiVEST	GIS and Mapping and Visual

As per the requirements of the NEMA (2014), the details and level of expertise of the persons who prepared the DEIAr are provided in Table 2 below.

Table 2: Expertise of the EAP

Environmental Practitioner	SiVEST (Pty) Ltd – Andrea Gibb

Contact Details	andreag@sivest.co.za
Qualifications	BSc Landscape Architecture and BSc (Hons) Environmental Management
Expertise to carry out the EMPr	Andrea has 9 years' work experience and specialises in undertaking and managing Environmental Impact Assessments (EIAs) and Basic Assessment (BAs), primarily related to energy generation and electrical distribution projects. She also specialises in undertaking visual impact and landscape assessments, by making use of ArcGIS technology and field surveys. She has extensive experience in overseeing public participation and stakeholder engagement processes and has been involved in environmental baseline assessments, fatal flaw / feasibility assessments and environmental negative mapping / sensitivity analyses. From a business and administrative side, Andrea is actively involved in maintaining good client relationships, mentoring junior staff and maintaining financial performance of the projects she leads. **Environmental Impact Assessments and Basic Assessments:** ▪ EIA for the proposed construction of a 75MW Solar Photovoltaic (PV) Power Plant near Dennilton, Limpopo Province. ▪ EIA for the proposed development of the Dwarsrug Wind Farm near Loeriesfontein, Northern Cape Province. ▪ BA for the proposed construction of two 132kV power lines and associated infrastructure from the Redstone Solar Thermal Power Project site to the Olien MTS near Lime Acres, Northern Cape Province. ▪ BA for the proposed construction of two 132kV power lines and associated infrastructure from Silverstreams DS to the Olien MTS near Lime Acres, Northern Cape Province. ▪ BA for the proposed Construction of the SSS1 5MW Solar Photovoltaic (PV) Plant on the Western Part of Portion 6 (Portion of Portion 5) of Farm Spes Bona 2355 near Bloemfontein, Free State Province. ▪ BA for the proposed Construction of the SSS2 5MW Solar Photovoltaic (PV) Plant on the Eastern Part of Portion 6 (Portion of Portion 5) of Farm Spes Bona 2355 near Bloemfontein, Free State Province. ▪ BA for the proposed Mookodi Integration Phase 2: Proposed Construction of a 132kV power line from the proposed Bophirima Substation to the existing Schweizer-Reneke Substation, North West Province. ▪ BA for the proposed Mookodi Integration Phase 2: Proposed Construction of a 132kV power line from the Mookodi Substation to the existing Magopela Substation, North West Province. ▪ BA for the proposed Mookodi Integration Phase 2: Proposed Construction of the Mookodi - Ganyesa 132kV power line, proposed Ganyesa Substation and Havelock LILO, North West Province. ▪ Amendment of the Final Environmental Impact Report for the Proposed Mookodi 1 Integration Project near Vryburg, North West Province. ▪ BA for the proposed 132kV power line and associated infrastructure for

	the proposed Redstone Solar Thermal Energy Plant near Lime Acres, Northern Cape Province. ▪ BA for the proposed construction of a 132kV power line and substation associated with the 75MW Photovoltaic (PV) Plant on the Farm Droogfontein (PV 3) in Kimberley, Northern Cape Province. ▪ BA for the proposed establishment of a Learning and Development Retreat and an Executive Staff and Client Lodge at Mogale's Gate, Gauteng Province. ▪ Amendment application in order to increase the output of the proposed 40MW PV Facility on the farm Mierdam to 75MW, Northern Cape Province. ▪ BA for the proposed construction of a power line and substation near Postmasburg, Northern Cape Province. ▪ BA for the proposed West Rand Strengthening Project – 400kV double circuit power line and substation extension in the West Rand, Gauteng. ▪ EIA for the proposed construction of a wind farm and PV plant near Prieska, Northern Cape Province. ▪ Public Participation assistance as part of the EIA for the proposed Thyspunt Transmission Lines Integration Project – EIA for the proposed construction of 5 x 400kV transmission power lines between Thyspunt to Port Elizabeth, Eastern Cape Province. ▪ EIA assistance for the proposed construction of three Solar Power Plants in the Northern Cape Province. ▪ Public Participation as part of the EIA for the proposed Delareyille Kopela Power Line and Substation, North West Province. ▪ Public Participation as part of the EIA for the Middelburg Water Reclamation Project, Mpumalanga Province.
Environmental Consultant	SiVEST (Pty) Ltd – Veronique Evans
Contact Details	veroniquee@sivest.co.za
Qualifications	BSc Environmental Conservation and Ecology, Zoology and Geography, BSc (Hons), Environmental Science in Conservation and Ecology, MSc Environmental Science in Conservation and Ecology
Expertise to carry out the EMPr	Veronique has 5 years of experience and has been public participation aspect on numerous projects including Environmental Impact Assessments, Water Use License applications and amendment impact assessments. She has been involved in the compilation of Environmental Impact Assessment (EIA) and Basic Assessments (BA) and Environmental Management Plans primarily related to energy generation and electrical distribution projects. She also assists and undertakes visual impact assessments, by making use of ArcGIS technology and undertaking field surveys. ▪ Basic Assessment (BA) and Environmental Management Plan (EMPr) for the Ermelo-Richards Bay Coal Line Upgrade Project: Proposed

	Development of the Duma 400kv Main Transmission Station and Associated 88kv and 400kv turn in Power Lines Near Ulundi, Kwazulu-Natal Province (2013/2015) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental management Plan (EMPr) for the Ermelo-Richards Bay Coal Line Upgrade Project: Proposed Development of the New Nzalo (Mqwabe) 400/88 Kv, 160mva Substation With Associated 88kv And 400kv Turn-In Power Lines East of Vryheid, Kwazulu-Natal, South Africa (2013/2015) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental management Plan (EMPr) for the Ermelo-Richards Bay Coal Line Upgrade Project: Proposed Development of the Vryheid Traction Station and the Associated Eskom Turn In Power Lines In Kwazulu- Natal, South Africa (2013/2015) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental management Plan (EMPr) for the Ermelo-Richards Bay Coal Line Upgrade Project: Proposed Development of the Sheepmoor Traction Station and Two New Associated 88/25kv Turn In Lines with 20mva Transformer Bays, Mpumalanga Province, South Africa (2013/2015) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental management Plan (EMPr) for theErmelo-Richards Bay Coal Line Upgrade Project: Proposed Rebuild of the 88kv Power Line from Uitkoms Substation to Antra T-Off, Approximately 3.5km in length, Mpumalanga Province, South Africa (2013/2015) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental management Plan (EMPr) for the Ermelo-Richards Bay Coal Line Upgrade Project: Proposed Upgrade of the 24 Km Twin Wolf Power Lines from Normandie To Hlungwana Substation in Mpumalanga and Kwazulu-Natal, South Africa (2013/2015) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental management Plan (EMPr) for the Ermelo-Richards Bay Coal Line Upgrade Project: Proposed Upgrade of 11.27km of the Umfolozi to Eqwasha Twin Wolf Eskom Power Line and 0.5km of the Umfolozi to Dubula Twin Wolf Eskom Power Line in Kwazulu-Natal, South Africa (2013/2015) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental management Plan (EMPr) for the proposed construction of a 132kv Power Line, Substation and the extension of Homestead Substation associated with the Concentrating Photovoltaic (CPV) / Photovoltaic (Pv) Plant (PV 3) on the Farm Droogfontein in Kimberley, Northern Cape Province (2012/2013) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental Management Programme

	(EMPr) for the Proposed Mookodi Integration Phase 2 132kv Power Lines and Ganyesa Substation Near Vryburg, North West Province (2012) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) for the upgrade of the Silver Lakes outfall sewer pipeline (2012) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental Management Programme (EMPr) for the Proposed construction of the Sheepmoor traction substation with two 20MVA transformer bays and a new associated 88kV turn-in power line, Mpumalanga Province (2013) SiVEST - Graduate Environmental Consultant; ▪ Basic Assessment (BA) and Environmental Management Programme (EMPr) for the Proposed rebuild of the 88kV power line from Uitkoms substation to Antra T-off, Mpumalanga Province (2013) SiVEST - Graduate Environmental Consultant; ▪ EIA for the proposed 25 MW Community Wind Farm in St Helena Bay, Western Cape Province. The EIA includes the scoping process and detailed environmental impact assessment. The project includes detailed specialist studies such as social, visual and biophysical as well as a full public participation process. Junior Environmental Scientist. Just Energy, 2011 -2012, closed. ▪ EIA for the proposed 300 MW Caledon Wind Farm, Western Cape Province. The EIA includes the scoping process and detailed environmental impact assessment. The project includes detailed specialist studies such as social, visual and biophysical as well as a full public participation process. Junior Environmental Scientist, GIBB. Caledon Wind, 2011 – 2012, closed. ▪ EIA and EMP for the proposed South African Nuclear Energy Corporation (Necsa) Dedicated Isotope Production Reactor (DIPR) at the Pelindaba Site near Hartebeespoort in the North West Province. The EIA includes the scoping process and detailed environmental impact assessment. The project includes detailed specialist studies such as social, visual and air quality as well as a full public participation process. Junior Environmental Scientist, GIBB. Necsa, 2011 -current. ▪ BA for the proposed 25 MW Community Wind Farm in St Helena Bay, Western Cape Province. The BA includes the scoping process and detailed environmental impact assessments. The project includes detailed specialist studies such as social, visual and biophysical as well as a full public participation process. Junior Environmental Scientist, GIBB. Just Energy, 2012 - current.
Environmental Consultant	SiVEST (Pty) Ltd – Stephan Jacobs
Contact Details	stephanj@sivest.co.za
Qualifications	BSc Environmental Sciences and BSc (Hons) Environmental Management and Analysis

Expertise to carry out the EMPr	Stephan joined SiVEST in May 2015 and holds the position of Graduate Environmental Consultant in the Johannesburg office. Stephan specialises in the field of Environmental Management and has been involved in the compilation of Environmental Impact Assessments (EIAs) and Basic Assessments (BAs). Stephan has also assisted extensively in the undertaking of field work and the compilation of reports for specialist studies such as surface water and visual impact assessments. Stephan also has experience in Environmental Compliance and Auditing and has acted as an Environmental Control Officer (ECO) for several infrastructure projects. **Project Experience:** ▪ Environmental Control Officer (ECO) for the Polokwane Integrated Rapid Public Transport System (IRPTS), Limpopo Province. ▪ BA for the construction of a Non-Motorised Transport (NMT) Training and Recreational Park adjacent to the Peter Mokaba Stadium in Polokwane, Limpopo Province. ▪ Environmental Control Officer (ECO) for the Newmarket Retail Development, Gauteng Province. ▪ Visual Impact Assessment for the Helena Solar PV Plant, Northern Cape Province. ▪ Visual Impact Assessment for the Nsoko Msele Integrated Sugar Project, Swaziland. ▪ Surface Water Assessment for the Steve Tshwete Local Municipality, Mpumalanga Province. ▪ Surface Water Delineation and Assessment for the proposed coal Railway Siding at the Welgedacht Marshalling Yard and associated Milner Road Upgrade near Springs, Ekurhuleni Metropolitan Municipality.

Please refer to Appendix 2 for CV's of each team member. Declarations of Independence and the EAP Affirmation are included in Appendix 4.

1.3 Key Legal and Administrative Requirements Relating to the Proposed Development

1.3.1 National Environmental Management Act No. 107 of 1998 – NEMA EIA Requirements

The National Environmental Management Act (Act No. 107 of 1998) was promulgated in 1998 but has since been amended on several occasions from this date. This Act replaces parts of the Environment Conservation Act (Act No 73 of 1989) with exception to certain parts pertaining to Integrated Environmental Management. The act intends to provide for:

- co-operative environmental governance by establishing principles for decision-making on matters affecting the environment;
- institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state;
- to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment; and
- to provide for matters connected therewith.

NEMA now governs the EIA process with the recent promulgation of the new EIA regulations in December 2014 (Government Gazette No. 38282 of 4th December 2014).

Activities that may significantly affect the environment must be considered, investigated and assessed prior to implementation.

In terms of the newly released EIA Regulations promulgated in terms of Chapter 5 NEMA (National Environmental Management Act), which came into effect on 8th December 2014, a full EIA is required for the proposed project.

1.3.2 NEMA EIA Regulations (2014)

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an environmental authorisation, the result being that NEMA now governs the EIA process with the said promulgation of EIA Regulations in December 2014 (Government Gazette No. 38282 of 04 December 2014). This EIA has therefore been undertaken in accordance with the NEMA EIA 2014 Regulations which are contained in four Government Notices (GN R 982, 983, 984, and 985) which came into effect on 8th December 2015.

In terms of these Regulations, a full Environmental Impact Assessment is required for the proposed development based on triggered activities. However, several activities which trigger a basic assessment were also identified and need also be specified. Ultimately, these activities will not form a separate assessment, but will fall into the greater EIA.

The following Schedules of the Government Notice No. R. 983 – 985 of the 8th December 2015 are of relevance to the project in question. All of the Listed Activities identified in terms of Sections 24(2) and 24D include:

Table 3: Listed activities in terms of the NEMA Regulations

Activity number of the relevant notice:	**Listed activity as described in GNR 983, 984 and 985**	**Description of Listed Activity**
GN R. 983 Item 11	*The development of facilities or infrastructure for the transmission and distribution of electricity-*	**An onsite substation is required to connect the PV energy facility to the Eskom grid. The proposed Substation will**

	(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts	**be located outside an urban area and will have a voltage capacity of 132kV.**
GN R. 983 Item 12	*The development of :* *x) buildings exceeding 100 square metres in size;* *xii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs-* *(a) within a watercourse;* *(b) in front of a development setback; or* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;*	**The proposed project will entail the development of buildings and other infrastructure exceeding 100 square metres in size. The surface water assessment revealed that there are surface water features located on the proposed site.**
GN R. 983 Item 19	*The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from-* *(i) a watercourse;* *But excluding where such infilling, depositing , dredging, excavation, removal or moving-* *(a) will occur behind a development setback;* *(b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or* *(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.*	**The surface water assessment revealed that there are surface water features located on the proposed site. Should construction activities take place within a watercourse soil is likely to be removed**.
GN R. 983 Item 28	*Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 01 April 1998 and where such development:* *(ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare;* *excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.*	**The proposed project site is currently used for cattle and crop farming, and the proposed project will result in an area greater than 1 hectare being transformed into an industrial land use.**
GN R. 983 Item 56	*The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre -*	**It is likely that existing access roads will need to be upgraded in order to access the site. The required width and length of the expansion will be determined during detailed design phase.**

	(i) where the existing reserve is wider than 13,5 meters; or *(ii) where no reserve exists, where the existing road is wider than 8 metres –* *excluding where widening or lengthening occur inside urban areas.*	
GN R. 984 Item 1	*The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs* *(a) within an urban area; or* *(b) on rooftops.";*	**It is proposed that a solar PV energy facility with a maximum export capacity of 75MW will be constructed.**
GN R. 984 Item 15	*The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for-* *(i) the undertaking of a linear activity; or* *(ii) maintenance purposes undertaken in accordance with a maintenance management plan.*	**The proposed development will transform more than 20 hectares (ha) of undeveloped, vacant or derelict land to industrial use (solar PV energy facility and 132kV onsite substation). The proposed PV energy facility is expected to have a footprint area of approximately 345 ha while the onsite substation will require an area of up to approximately 2.25 ha.**
GN R. 985 Item 4	The development of a road wider than 4 metres with a reserve less than 13,5 metres. *(e) In the North West Province* *i Outside urban areas, in:* *(ee) Critical biodiversity areas (Terrestrial Type 1 and 2) as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans*	**Internal roads will be constructed and these are planned to be 5m wide. The project is located within a critical biodiversity area (CBA). Refer to the CBA map in Appendix 7.**
GN R. 985 Item 12	*The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.* *(a) In the North West Province* *ii. Within critical biodiversity areas identified in bioregional plans*	**Existing access roads will need to be upgraded in order to access the site. The access roads will be located within a critical biodiversity area (CBA). Refer to the CBA map in Appendix 7.**
GN R. 985 Item 14	*The development of-*	**The proposed project will entail the development of buildings and other**

	(x) buildings exceeding 10 square metres in size; *(xii) infrastructure or structures with a physical footprint of 10 square metres or more;* *where such development occurs-* *(a) within a watercourse;* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse* *(e) In the North West Province* i *Outside urban areas, in:* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans*	**infrastructure exceeding 100 square metres in size. The proposed development will take up a total area of approximately 345 hectares with the operations and maintenance building requiring an area of approximately 225m^2.In addition, the proposed 132kV onsite substation is expected to require an area of up to approximately 2.25 ha. The surface water assessment revealed that there are surface water features located within the proposed development area. The project is located within a critical biodiversity area (CBA). Refer to the CBA map in Appendix 7.**
GN R. 985 Item 18	*The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.* *(e) In the North West Province* i *Outside urban areas, in:* *(ee) Critical biodiversity areas (Terrestrial Type 1 and 2) as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans*	**Existing access roads will need to be upgraded in order to access the site. The access roads will be located within a critical biodiversity area (CBA). Refer to the CBA map in Appendix 5.**

1.3.3 Environmental Impact Assessment Guideline for Renewable Energy Projects, DEA Notice 989 of 2015

The purpose of this document is primarily to provide guidance on the environmental management legal framework applicable to renewable energy operations and all the role players in the sector. The guideline is principally intended for use by the following stakeholder groups:

- Public Sector Authorities (as regulator and/or competent authority);
- Joint public sector authorities and project funders, e.g., Eskom, IDC, etc.
- Private Sector Entities (as project funder/developer/consultant);
- Other interested and affected parties (as determined by the project location and/or scope).

This guideline seeks to identify activities requiring authorisation prior to commencement of that activity, and provide an interface between national EIA regulations and other legislative requirements of various authorities.

The guidelines are applicable for the construction, installation and/or development of the following renewable energy projects:

- Concentrating Solar Power Energy facility;
- Wind Farm;
- Hydropower Station; and
- Photovoltaic Power Facility.

As the proposed development is for a photovoltaic energy facility it is subject to the recommendations proposed in the guidelines.

1.3.4 National Energy Act No. 34 of 2008

The National Energy Act (Act no, 34 of 2008), promulgated in 2008, has, as one of its key objectives, the promotion of diversity of supply of energy and its sources. From this standpoint, the Act directly references the importance of the renewable energy (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).

1.3.5 National Heritage Resources Act No. 25 of 1999

This Act requires all developers to undertake archaeological impact studies whenever any type of development activity is undertaken. Preliminary archaeological impact studies will consequently become a common procedure for all development activities, even if such development may be exempted in terms of the National Environmental Management Act (Act No 107 of 1998).

The law ensures community participation in the protection of national heritage resources and will involve all three levels of government in the management of the country's national heritage. The South African Heritage Resources Agency (SAHRA) will establish and maintain a national policy, strategy plans and standards for heritage resources management and will monitor the system as a whole.

Heritage authorities will assist and co-operate with individuals and organisations concerned with the study, the conservation, promotion and utilisation of national heritage resources. A newly established National Heritage Resources Fund will provide financial assistance for heritage projects.

A heritage assessment has been conducted to explore how the proposed development may impact on heritage resources as protected by the Act.

1.3.6 National Water Act No. 36 of 1998, as amended

The National Water Act (NWA) No 36 of 1998 was promulgated on the 20th August 1998. This Act is important in that it provides a framework to protect water resources against over exploitation and to ensure that there is water for socio-economic and economic development, human needs and to meet the needs of the aquatic environment. The Act also recognises that water belongs to the whole nation for the benefit of all people.

It is important to note that water resources are protected under the Act. Under the act, water resources as defined include a watercourse, surface water, estuary or aquifer. A watercourse is defined as a river or spring, a natural channel in which water flows regularly or intermittently, or a wetland, lake or dam into which, or from which water flows.

One of the main aims of the Act is the protection of water resources. 'Protection' in relation to a water resource entails:

- Maintenance of the quality 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
- The rehabilitation of the water resource.

In the context of the proposed development and any potential impact on water resources, the definition of pollution and pollution prevention contained within the Act is relevant. 'Pollution', as described by the Act 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.

This definition of pollution is quite wide ranging, and it applies to all types of water resource. 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 Act 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 (inter alia):

- measures to 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.

A surface water assessment has been conducted to explore how the proposed development may impact on water resources as protected by the Act.

1.3.7 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004 as amended)

The overarching aim of the National Environmental Management: Biodiversity Act (NEMBA) No. 10 of 2004, within the framework of NEMA, is to provide for:

- The management and conservation of biological diversity within South Africa, and of the components of such biological diversity;
- The use of indigenous biological resources in a sustainable manner; and
- The fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources.

The South African National Biodiversity Institute (SANBI) was established by the NEMBA, its purpose being (*inter alia*) to report on the status of the country's biodiversity and the conservation status of all listed threatened or protected species and ecosystems.

NEMBA provides for a range of measures to protect ecosystems and for the protection of species that are threatened or in need of protection to ensure their survival in the wild, including a prohibition on carrying out a "restricted activity" involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7. Lists of critically endangered, endangered, vulnerable and protected species have been published and a permit system for listed species has been established.

It is also appropriate to undertake a Faunal and Botanical Impact Assessment where proposed developments, in an area that is considered ecologically sensitive, require an environmental authorisation in terms of NEMA, with such Assessment taking place during the basic assessment or EIA. These two studies will be undertaken during the project.

The NEMBA is relevant to the proposed projects as the construction of the solar PV energy facility and other components (such as power lines and the substations) may impact negatively on biodiversity. The project proponent is therefore required to take appropriate reasonable measures to limit the impacts on biodiversity, to obtain permits if required and to also invite SANBI to provide commentary on any documentation resulting from the proposed development.

1.3.8 National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003 as amended)

The overarching aim of the National Environmental Management: Protected Areas Act (NEMPAA) No. 57 of 2003, within the framework of NEMA, is to provide for:

- provide for the declaration and management of protected areas;

- provide for co-operative governance in the declaration and management of protected areas;
- effect a national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity;
- provide for a representative network of protected areas on state land, private land and communal land;
- promote sustainable utilisation of protected areas for the benefit of people, in a manner that would preserve the ecological character of such areas;
- promote participation of local communities in the management of protected areas, where appropriate; and
- provide for the continued existence of South African National Parks.

1.3.9 National Forests Act, 1998 (Act No. 84 of 1998)

The National Forest Act (NFA) was enacted to:

- Provide for the protection, management and utilisation of forests;
- The protection of certain plant and animal life;
- The regulation of trade in forest produce;
- The control and management of a national hiking way system and National Botanic Gardens.

The NFA enforces the necessity for a license to be obtained prior to destroying any indigenous tree in a natural forest and, subject to certain exemptions, cutting, disturbing, damaging, destroying or removing any protected tree. The list of protected trees is currently contained in GN 908 of 21 November 2014. Licenses are issued by the Minister and are subject to periods and conditions as may be stipulated.

The NFA is relevant to the proposed project as the removal and/or disturbance and/or clearance of indigenous vegetation may be required and a license in terms of the NFA may be required for this to be done.

1.3.10 Conservation of Agricultural Resources Act No. 43 of 1983

The Conservation of Agricultural Resources Act (CARA) No. 43 of 1983 controls the utilization of natural agricultural resources in South Africa. The Act promotes the conservation of soil, water sources and vegetation as well as the combating weeds and invader plants. The Act has been amended in part by the Abolition of Racially Based Land Measures Act, No. 108 of 1991.

The primary objective of the Act is to conserve natural agricultural resources by:

- maintaining the production potential of land;
- combating and preventing erosion and weakening or destruction of the water resources;
- protecting vegetation; and
- combating weeds and invaders plants.

The CARA is relevant to the proposed projects as the construction of a solar energy facility as well as other components (such as power lines and the substations) may impact on agricultural resources and vegetation on the site. The Act prohibits the spreading of weeds and prescribes control measures that need to be complied with in order to achieve this. As such, measures will need to be taken to protect agricultural resources and prevent weeds and exotic plants from invading the site as a result of the proposed development.

An agricultural potential assessment has been conducted to explore how the proposed development may impact on the agricultural production potential of the proposed site.

1.3.11 Subdivision of Agricultural Land Act No. 70 of 1970, as amended

The Subdivision of Agricultural Land Act No. 70 of 1970 controls the subdivision of all agricultural land in South Africa; prohibiting certain actions pertaining to agricultural land. Under the Act the owner of agricultural land is required to obtain consent from the Minister of Agriculture in order to subdivide agricultural land.

The purpose of the Act is to prevent uneconomic farming units from being created and degradation of prime agricultural land. To achieve this purpose the act also regulates leasing and selling of agricultural land as well as registration of servitudes.

The Act is of relevance to the proposed development as any land within the study area that is zoned for agricultural purposes will be regulated by this Act.

Although the whole of this Act has been repealed by section 1 of the Subdivision of Agricultural Land Act Repeal Act 64 of 1998, this Repeal Act has not been implemented and no date of coming into operation has been proclaimed.

It is important to note that the implementation of this act is problematic as the Act defines 'Agricultural Land' as being any land, except land situated in the area of jurisdiction of a municipality or town council, and subsequent to the promulgation of this Act uninterrupted Municipalities have been established throughout South Africa.

1.3.12 National Road Traffic Act No. 93 of 1996, as amended

The National Road Traffic Act (NRTA) No. 93 of 1996 provides for all road traffic matters and is applied uniformly throughout South Africa. The Act enforces the necessity of registering and licensing motor vehicles. It also stipulates requirements regarding fitness of drivers and vehicles as well as making provision for the transportation of dangerous goods.

All the requirements stipulated in the NRTA will need to be complied with during the construction and operational phases of the proposed solar PV energy facility.

1.3.13 Civil Aviation Act No. 13 of 2009

The Civil Aviation Act No. 13 of 2009 controls and regulates aviation within South Africa. It provides for the establishment of a South African Civil Aviation Authority and independent Aviation Safety Investigation Board in compliance with Annexure 13 of the Chicago Convention. It gives effect to various conventions related to aircraft offences, civil aviation safety and security, and provides for additional measures directed at more effective control of the safety and security of aircrafts, airports and matters connected thereto.

Although the Act is not directly relevant to the proposed development, it should be considered as the establishment of a photovoltaic energy facility may impact on aviation and air traffic safety if located directly within aircraft flight paths.

Air Traffic and Navigation Services Company Limited (ATNS) and the Civil Aviation Authority (CAA) will be consulted and the required approvals will be obtained.

1.3.14 Additional Relevant Legislation

- Occupational Health and Safety Act No. 85 of 1993
- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008 as amended)
- Development Facilitation (Act No. 67 of 1995)
- The Hazardous Substances Act (Act No. 15 of 1973)
- Water Services Act (Act No. 108 of 1998)
- Electricity Regulation Act (Act No. 4 of 2006 as amended)
- Municipal Systems Act (Act No. 32 of 2000)
- Mineral and Petroleum Resource Development Act (Act No. 28 of 2002 as amended)
- North West Entrepreneurial Development and Sustainable Resources Utilization Act, 2003, as amended
- North West Parks and Tourism Board Act (Act. No. 3 of 1997)

1.4 Key Development Strategies and Guidelines

1.4.1 Integrated Development Plans

An Integrated Development Plan (IDP) is defined in the Local Government: Municipal Systems Act No. 32 of 2000), as an inclusive and strategic plan that:

- Links, integrates and co-ordinates plans and takes into account proposals for the development of the municipality;
- Aligns the resources and capacity of the municipality with the implementation of the plan

- Forms the policy framework on which annual budgets must be based; and
- Is compatible with national and provincial development plans and planning requirements binding on the municipality in terms of legislation.

The main purpose of the IDP is considered the enhancement of service delivery and fighting poverty through an integrated and aligned approach between different role-players and stakeholders.

Each municipality is required to produce an IDP which would address pertinent issues relevant to their municipality. However, common concerns include municipal transformation and development, and service delivery and infrastructural development.

The proposed solar PV energy facility and onsite substation falls within the Ditsobotla Local Municipality (LM), which is located within the greater Ngaka Modiri Molema District Municipality (DM). The Ditsobotla LM IDP for 2011/12 – 2015/16 details the LM's objectives and strategies, among these is the provision of the expansion of the current load supply to the CBD in order to aid the expansion of the property and business markets. Aligned with this is the identification of "low energy resources" as a critical economic factor impacting on the municipality's ability to achieve its growth and development objectives. It is therefore evident that the proposed development is aligned with the goals of the municipal IDP in the study area.

1.4.2 Draft Integrated Energy Plan for the Republic of South Africa, 2013

The Draft Integrated Energy Plan (IEP), developed by the DoE, are anchored in the National Energy Act, 2008 (Act No. 34 of 2008). The IEP was undertaken to determine the best way to meet current and future energy service needs in the most efficient and socially beneficial manner, while:

- Maintaining control over economic costs;
- Serving national imperatives such as job creation and poverty alleviation; and
- Minimising the adverse impacts of the energy sector on the environment.

The IEP takes into consideration the crucial role that energy plays in the entire economy and is informed by the output of analyses founded on a solid fact base. It is a multi-faceted, long-term energy framework which has multiple objectives, some of which include:

- To guide the development of energy policies and, where relevant, set the framework for regulations in the energy sector;
- To guide the selection of appropriate technologies to meet energy demand (i.e. the types and sizes of new power facilities and refineries to be built and the prices that should be charged for fuels);
- To guide investment in and the development of energy infrastructure in South Africa; and
- To propose alternative energy strategies which are informed by testing the potential impacts of various factors such as proposed policies, introduction of new technologies, and effects of exogenous macro-economic factors.

The IEP considers the national supply and demand balance and proposes alternative capacity expansion plans based on varying sets of assumptions and constraints. While infrastructural matters are briefly discussed, the IEP does not explicitly consider supply and demand at specific geographical locations within the country, nor does it take into account infrastructure bottlenecks at specific locations. These are, or will be, covered in detail as follows:

- Electricity infrastructure (transmission and distribution) is dealt with in other plans and the Integrated Resource Plan (IRP) should assess these in detail, taking into consideration the grid planning currently conducted by Eskom;
- Electricity supply is dealt with in the IRP;
- Liquid fuels will be dealt with in the 20-Year Liquid Fuel Infrastructure Roadmap which will cover logistical matters relating to pipelines and storage facilities for petroleum products.
- The Gas Utilisation Master Plan (GUMP) will take into consideration the bottlenecks and capacity constraints of the current natural gas infrastructure. All the above will inform the integrated energy planning process and will enable overall enhancement through ongoing periodic iterations to ensure alignment.

1.4.3 Integrated Resource Plan, 2010 and updated 2016

The Integrated Resource Plan (IRP) was created in order to plan for projected national electricity demand.

The IRP 2010-30 was promulgated in March 2011, and was planned to be a "living plan", as it needs to take into account changes in the macroeconomic environment, developments in new technologies and changes in national priorities and imperatives, amongst other factors. Since the promulgation of the (IRP) 2010-30 there have been a number of developments in the energy sector in South and Southern Africa. In addition the electricity demand outlook has changed from that expected in 2010. As a result the DoE is in the processing of updating the IDP and has recently published Assumptions and Base Cases in November 2016.

While the IRP 2010-30 remains the official government plan for new generation capacity until it is replaced by an updated plan, there are a number of assumptions that have changed and these include:

- The changed landscape over the past years, in particular in electricity demand and the underlying relationship with economic growth;
- New developments in technology and fuel options (locally and globally);
- Scenarios for carbon mitigation strategies and the impact on electricity supply up to 2050; and
- The affordability of electricity and its impact on demand and supply.

The IRP 2010-30 assumed the existing Eskom fleet to have an average availability of 86%, however actual performance has in the recent past declined to less than 70% availability.

The learning rates adopted in IRP 2010-30 are maintained in the 2016 update with PV and Wind learning rates adjusted to reflect the quick fall in prices experienced in South Africa and are reflected in Below

Technology	2015 (R/kW)	2050 (R/kW)
PV (fixed tilt)	16860.6	13425.03408
PV (tracking)	17860.6	14221.26959
Wind	19208.1	17287.405
Nuclear	55260	53768.80047

The new generation capacities called for in the Ministerial Determinations that are not yet committed (no procurement has started) are allowed to lapse. This means that only procurement up to bid window 4.5 for renewables (expedited including smalls) and coal 900MW are considered committed. The Base Case maintains a number of policy positions imposed in the IRP 2010-30 in particular an annual build limit of new capacity for wind (1600 MW) and photovoltaic (1000 MW).

- Based on least cost and moderate emissions reduction trajectory, the model results indicates, 18GW of PV, 37GW of Wind, 20GW of Nuclear, 34GW of Gas, 2500 of Hydro, 15GW of Coal by end of the study horison (year 2050);
- Looking at same study period used in the promulgated IRP 2010-30, the model results indicate 4.7GW of PV ,6.4GW of Wind, 12.7GW of Gas and 5.3GW of Coal by year 2030;
- The first unit of Nuclear appears around year 2037, but this is sensitive to other technology primary fuel costs and their associated emission assumptions. These will be tested as a scenario as indicated in the next section. The 2030 figures in the Base Case are different from those in the IRP 2010-30 because they exclude the capacity already procured/under procurement (6.2GW of renewable energy as well as 900MW of coal). The figures are also different because adjustment based on scenario analysis and policy has not been done.

1.4.4 Renewable Energy Independent Power Producer Procurement Program (REIPPPP)

(The following information was extracted from the Eskom website: **Guide to Independent Power Procurement (IPP) processes in South Africa and Eskom, June 2010** http://www.eskom.co.za/live/content.php?Item_ID=14324)

The objective of this section is to provide an overview of the processes in the country and within Eskom relating to Independent Power Producers (IPPs). It is important that certain enabling policies, rules and regulations are in place to provide certainty and transparency in the introduction of IPPs.

- **Country Process**

South Africa has two acts that direct the planning and development of the country's electricity sector:

i. The National Energy Act of 2008 (No. 34 of 2008)
ii. The Electricity Regulation Act (ERA) of 2006 (No. 4 of 2006).

In August 2009, the Department of Energy (DoE) gazetted the Electricity Regulations on New Generation Capacity under the ERA. The New Generation Regulations establish rules and guidelines that are applicable to the undertaking of an IPP Bid Programme and the procurement of an IPP for new generation capacity. They also facilitate the fair treatment and non-discrimination between IPPs and the buyer of the energy.

- Formal Programmes

In terms of the New Generation Regulations, the Integrated Resource Plan (IRP) developed by the DoE sets out the new generation capacity requirement per technology, taking energy efficiency and the demand-side management projects into account. This required, new generation capacity must be met through the technologies and projects listed in the IRP and all IPP procurement programmes will be executed in accordance with the specified capacities and technologies listed in the IRP. The table below highlights the energy plan that has been proposed until 2050.

Table 4: Government Energy Plans up until 2050 in terms of the updated IRP 2016

New Build Options									
	PV	**Wind**	**Landfill Gas**	**DR**	**Nuclear**	**OCGT**	**CCGT**	**Coal PF wFGD**	**Inga**
2016									
2017									
2018									
2019									
2020									
2021	160								
2022	160								
2023	370	200							
2024	440	500		1000		396			
2025	650	1000	15	1000		2376	732		
2026	580	1000	5	1000		264	1464		
2027	580	1000	230	1000		264	2196		
2028	580	1000		500		396	1464	1500	
2029	580	1100		1000			1464	1500	
2030	580	1200		1000		1716		2250	1000
2031	580	1200		1000		1584		750	
2032	580	1200		500			732	1500	1000
2033	580	100					1464	750	500
2034	580	1200		1000		1452			
2035	580	1600		500			1464	1500	
2036	580	1600		1000				1500	
2037	580	1400		500	1359		732	2250	
2038	580	1600				1848	1464	750	
2039	650	1500			1359		2928		
2040	650	1600		1000		1056	732		

2041	650	1600		1000	4077	792		750	
2042	650	1600		500			2196		
2043	650	1600		500					
2044	650	1800		500	1359				
2045	770	1600			2718		2196		
2046	790	1600		500	1359	924			
2047	720	1800		1000	1359		732		
2048	720	1600		500	2718	264			
2049	660	1500		500	1359				
2050	720	1400		500	2718				
Total (MW)	17600	37400	250	500	20385	13332	21960	15000	2500

A decision that additional capacity be provided by an IPP must be made with the concurrence of the Minister of Finance. Once such a decision is made, a procurement process needs to be embarked upon to procure that capacity in a fair, equitable and transparent process.

The New Generation Regulations set out the procurement process. The stages within a bid programme are prescribed as follows:

i. Request for Qualifications (RFQ)
ii. Request for Proposals (RFP)
iii. Negotiation with the preferred bidder(s).

A successful bidder will be awarded a Power Purchase Agreement (PPA) subject to approval by the Regulator.

1.4.5 Department of Energy White Paper on Renewable Energy, 2003

The Department of Energy (DoE) gazetted its White Paper on Renewable Energy in 2003, and introduced it as a “policy that envisages a range of measures to bring about integration of renewable energies into the mainstream energy economy.” At that time the national target was fixed at 10 000GWh (0.8Mtoe) renewable energy contribution to final energy consumption by 2013. The White Paper proposed that this would be produced mainly from biomass, wind, solar and small-scale hydropower. It went on to recommend that this renewable energy should to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. Since the White Paper was gazetted, South Africa’s primary and secondary energy requirements have remained heavily fossil-fuel dependant, both in terms of indigenous coal production and use, as well as the use of imported oil resources. Alongside this, the projected electricity demand of the country has led the National utility Eskom, to embark upon an intensive build programme to secure South Africa’s longer-term energy needs, together with an adequate reserve margin.

1.4.6 Renewable Energy Strategy for the North West Province

The Renewable Energy Strategy for the North West Province (RES NWP) was released by the Department of Economic Development, Environment, Conservation and Tourism (DEDECT) in December 2012. It was developed in in response to the need of the North West Provinces to participate meaningfully within the renewable energy sector of South Africa. The renewable energy strategy aims to improve the North West Province’s environment, reduce the North West Province’s contribution to climate change, and alleviate energy poverty, whilst promoting economic development and job creation in the province whilst developing its green economy. This strategy attempts to focus the efforts of all stakeholders and provides a foundation to make the North West Province a primary contributor towards the renewable energy sector within South Africa. The RES NWP states that the North West province has a very good solar potential with an average daily solar radiation greater than 8,000 MJ/m^2.

1.4.7 North West Provincial Growth and Development Strategy, 2004 to 2014

The North West Provincial Growth and Development Strategy provides a framework for integrated and sustainable growth and economic development for the province and its people over the next ten years. It addresses the formulation of a common vision, goals and objectives of what should be achieved and how the provincial government and its social partners should achieve its objectives. The Strategy establishes the foundation blocks from where the Provincial Programme of Action is negotiated in partnership with a variety of stakeholders in the province. It forms the benchmark from which progress and achievements are monitored and evaluated. The strategy identifies several growth and economic development pillars, ones of which is Mining and Energy.

1.4.8 North West Provincial Development Plan, 2013

The North West Provincial Development Plan (PDP) is predominantly based on the National Development Plan (NDP) in an attempt to align with the objectives and priorities it identifies as well as with the vision for 2030 of a united South-Africa. In the North West province eight of the priorities identified in the National Development Plan (NDP) were identified as key focus areas for the North West Provincial Development Plan (PDP). The selected focus areas represent the main challenge areas hampering growth in the province. The chosen development priorities with which the North West intends to align to the National Development Plan (NDP) include the following:

1. Economy and employment
2. Economic infrastructure

The PDP encourages diversification of the economic base, including in industries such as renewable energy. Expanding renewable energy, with special reference to solar power, is one of the stated actions aimed at addressing economic infrastructure. The renewable energy sector is also highlighted as having potential to create jobs in the province.

1.4.9 *The Ngaka Modiri Molema DM Integrated Development Plan (2015/16)*

The Ngaka Modiri Molema DM Integrated Development Plan (IDP) (2015/16) states the DM's mission as "To provide a developmental municipal governance system for a better life for all in the Ngaka Modiri Molema DM". The following have been listed as priorities for the IDP (Ngaka Modiri Molema District Municipality, 2012):

- Provision of water and sanitation;
- Improvement of local road infrastructure;
- Local economic development and job creation;
- Environmental health management;
- Promote integration of services;
- Promote intergovernmental coordination and relations; and
- Support local municipalities.

The IDP also finds that the following are the DM's most prominent development challenges:

- In general, the DM is significantly under-serviced in terms of social as well economic infrastructure;
- The area is large, with respect to, any settlements across various municipalities;
- Such dispersed settlement patterns impact on the cost of erecting, operating, and maintaining infrastructure;
- The affordability of infrastructure is further impacted by the level of poverty and human development issues;
- The most economically active and productive individuals are drawn away from the DM;
- The structure of the economy requires an overhaul through targeted and accelerated interventions; and
- Diversification of the economy, while maintaining the triple bottom-line principle, is critical.

In the 2015 adaption of the IDP, the Environmental Management Framework and State of the Environment Report are discussed briefly. The adapted 2015 – 2016 IDP states that the plan is currently under review but will include a comprehensive analysis of key emerging issues, such as the opportunity for alternative energy in the DM, as these issues will impact on the future state of the environment. Also related to the proposed project is the discussion around the DM's Rural Development Strategy, with the objective of facilitating integrated development and social cohesion through participatory approaches in partnership with all sectors of society. The strategy aims to stimulate rural development and food security by creating vibrant, equitable, and sustainable rural communities. Some of the measures that could be used to achieve this may include (Ngaka Modiri Molema District Municipality, 2015):

- Creating business opportunities;
- Decongestion and rehabilitation of overcrowded rural areas;
- Expanding opportunities for youth, women, people with disabilities, and older people from rural areas; and
- Addressing issues such as; creation of decent jobs, as well as the development of road infrastructure. All key factors in achieving economic growth and development.

1.4.10 The Ditsobotla LM Integrated Development Plan (2011/12 – 2015/16)

According to the Ditsobotla LM Integrated Development Plan (IDP) (2011/12 – 2015/16), the municipality's electricity provision is a joint function of the Ditsobotla LM and Eskom, with the DM being licensed to provide electricity to Lichtenburg, Blydeville, and Coligny. It furthermore states that areas without access to electricity is mostly located in the rural regions, such as Grasfontein and Bakerville, and that universal electrification will be addressed by a joint planning programme between the LM and Eskom. The IDP also states that there is a need for renovation and/or replacement of the electrical infrastructure in the Lichtenburg CBD as this infrastructure is old. There is also a requirement for the provision of the expansion of the current load supply to the CBD in order to aid the expansion of the property and business markets. Aligned with this is the identification of "low energy resources" as a critical economic factor impacting on the municipality's ability to achieve its growth and development objectives (Ditsobotla Local Municipality, 2011).

The LM's Spatial Development Framework (SDF) of 2006 is available in a summary format in the IDP document. If required, attempts will be made during the EIA-phase of the project to obtain the full SDF document. Regardless, the IDP does provide some insight into the LM's spatial goals and objectives.

The SDF takes the approach of developmental clusters, referring to a grouping of more than one settlement within the LM. One such cluster is the Lichtenburg cluster, which includes the settlements of Lichtenburg, Boikhutso, and Blydeville. The relatively high percentage of the population residing in rural areas in the region, as well as various land claims is likely to cause a unique service delivery scenario for the LM and all of its developmental clusters, not least the Lichtenburg cluster (Ditsobotla Local Municipality, 2011).

Directly north of Lichtenburg (the proposed project location is located north-west of Lichtenburg) lies the Lichtenburg Game Breeding Centre. The SDF has identified this area as an ideal location for the potential development of the Open Space System in the LM; however, the extensive diamond mining located north of the Lichtenburg Game Breeding Centre in Bakerville, Grasfontein, and Carlsonia, goes against this proposal. Similarly, the area south west of Lichtenburg, where the upper catchment area of the Hartriver is located, has also been earmarked as important for protection. This area is the origin of the Hartsriver, traversing a number of other municipalities in the western parts of the North West Province. Moreover, the Hartsriver feeds into Barperspan, which is an international RAMSAR site (i.e. wetlands of international importance). It is therefore, important that this catchment area, the river, and adjacent areas are protected from undesirable developments. The north western parts of the LM are characterised by abandoned, un-rehabilitated diamond mining activities, or extensive farming activities focused predominantly on livestock grazing. (Ditsobotla Local Municipality, 2011).

The IDP also provides some feedback on the spatial development strategies set out in the 2006 SDF. Urban integration is an important strategy, aimed at moving away from the fragmented urban structure currently prevalent within the Ditsobotla LM. The vision is that a more compact system will lead to more cost-effective municipal services and public transportation infrastructure. It goes on to state that an important factor in achieving a more desirable urban settlement pattern is the provision of bulk infrastructure development in a rationalised manner. Just as important as the extension of the network, is ensuring that the existing infrastructure has sufficient capacity to deal with expected future development pressures. Upgrading of the existing electricity network in Lichtenburg, as the economic core of the municipality, is required to ensure that the expected residential and economic growth can be accommodated.

Although no mention is made of the potential for RE projects in the Ditsobotla LM, the inference is that the implementation and operation of the proposed Tlisitseng Solar PV project will assist in the extension and strengthening of the electrical network in the region and beyond, thereby aiding in ensuring that the LM is able to accommodate the envisioned growth and development.

2 APPROACH TO UNDERTAKING THE STUDY

The Environmental Impact Assessment was undertaken in accordance with the EIA 2014 Regulations listed in Government Gazette No. 10328 of 4 December 2014 (GN 982, 983, 984 and 985 of 4 December 2014, as amended), in terms of Section 24 and 44 of the National Environmental Management Act, (No 107 of 1998) (NEMA) as amended; the World Bank Standards (IFC Guidelines) and the Equator Principles, as well as with the relevant legislation and guidelines mentioned above.

2.1 Environmental Scoping Study

The Scoping Study identified the potential positive and negative impacts associated with the proposed development as well as the studies which were required to be undertaken as part of the EIA-phase of the project.

It is important to note that on the 18th of January 2016 an application for EA and the DSR for the proposed Tlisitseng 2 Solar PV energy facility were received by the DEA and a reference number was allocated to the proposed development (**DEA reference number: 14/12/16/3/3/2/890**). The original DSR was made available for public review from the 11th of January 2016 to the 9th of February 2016. The DSR was thereafter updated and the Final Scoping Report (FSR) was submitted to the DEA on the 19th of February 2016. After evaluating the FSR the DEA issued a letter indicating that the documents complied with the minimum requirements of the EIA Regulations, 2014 and that SiVEST could proceed with the EIA process (i.e. DEIAr and FEIAr). The original FSR was therefore accepted by the DEA. It should however be noted that due to a change in the layout of the proposed Tlisitseng 2 Solar PV energy facility, SiVEST was not able to submit the FEIAr within the legislated timeframes. On the 20th of June 2016, SiVEST therefore sent the DEA a letter requesting a sixty (60) day extension in terms of Regulation 3 (7) of the EIA Regulations, 2014, in order to provide the specialists with the opportunity to update their specialist reports in-line with the revised layouts. On the 20th of July 2016, the DEA issued a letter refusing the extension request. For this reason the application for EA lapsed in accordance with Regulation 45 of the EIA Regulations, 2014 and the departmental file was closed for the project.

In order to reapply for EA for the proposed Tlisitseng 2 Solar PV energy facility BioTherm has appointed SiVEST to recommence with the EIA process. It should however be noted that all comments received by Interested and Affected Parties (I&APs) during the Public Participation Process (PPP) which was undertaken for the original EIA process (including those received during meetings) will form part of this EIA process. The public participation process isb being re-conducted in accordance with the EIA Regulations, 2014 and all I&APs, Stakeholders and Organs of State were afforded an extra opportunity to review the DSR and to provide comments. As such, the second version of the DSR and application form for the Tlisitseng 2 Solar PV energy facility, was submitted to the DEA and made available for public comment from the 29th of September 2016 to the 31st of October 2016. On the 3rd of October 2016, the DEA acknowledged having received the application for EA and the DSR for the proposed Tlisitseng 2 Solar PV energy facility on the 30th of September 2016 and a new reference number was allocated to the proposed development **(DEA reference number: 14/12/16/3/3/2/975).** The DSR was thereafter updated and the Final Scoping Report (FSR) was submitted to the DEA on the 11th November 2016. After evaluating the FSR the DEA issued a letter on the 12 December 2016, indicating that the documents complied with the minimum requirements of the EIA Regulations, 2014 and that SiVEST could proceed with the EIA process (i.e. DEIAr and FEIAr). The FSR was therefore accepted by the DEA

The following studies were taken through into the EIA Phase:

- Biodiversity Assessment;
- Avifauna Assessment (including preconstruction monitoring);
- Surface Water Impact Assessment;
- Soils and Agricultural Potential Assessment;
- Visual Impact Assessment;
- Heritage and Palaeontological Assessment;
- Socio-economic Assessment;
- Traffic Assessment; and
- Geotechnical Assessment.

2.2 Authority Consultation

The National Department of Environmental Affairs (DEA) are the determining authority on this application. The following consultation took place with DEA:

- An Application and the original DSR were submitted to the DEA on the 13th of January 2016.
- The Department confirmed receipt of the Application and original DSR on the 18th of January 2016.and the following reference number was allocated to Tlisitseng 2 - DEA reference number: 14/12/16/3/3/2/890.
- Comments on the DSR were received on the 4th of February 2016

- The original Final Scoping Report (FSR) was submitted to the DEA on the 19th February 2016 and the Department confirmed receipt of the FSR on the 26th of February 2016.
- Acceptance of the FSR and the Plan of Study (PoS) for the EIA was received on the 5th of April 2016.

It should however be noted that due to a change in the layout of the proposed Tlisitseng 2 Solar PV energy facility, SiVEST was not able to submit the FEIAr within the legislated timeframes. On the 20th of June 2016, SiVEST therefore sent the DEA a letter requesting a sixty (60) day extension in terms of Regulation 3 (7) of the EIA Regulations, 2014, in order to provide the specialists with the opportunity to update their specialist reports in-line with the revised layouts. On the 20th of July 2016, the DEA issued a letter refusing the extension request. For this reason the application for EA lapsed in accordance with Regulation 45 of the EIA Regulations, 2014 and the departmental file was closed for the project.

- A second version of the DSR and application form for the Tlisitseng 2 Solar PV energy facility, was submitted to the DEA on 30th of September 2016
- On the 3rd of October 2016, the DEA acknowledged having received the application for EA and the DSR for the proposed Tlisitseng 2 Solar PV energy facility on the 30th of September 2016 and a new reference number was allocated to the proposed development **(DEA reference number: 14/12/16/3/3/2/975).** Comments on the second version of the DSR were received on the 14th of October 2016
- The second versions of the Final Scoping Report (FSR) was submitted to the DEA on the 11th of November 2016, and the Department confirmed receipt of the FSR on the 22nd of November 2016.
- Acceptance of the FSR and the Plan of Study (PoS) for the EIA was received on the 12th of December 2016.

As part of the letter from the DEA accepting the original and second version of the FSR, it was requested that additional information be included in the DEIAr. The table below provides details as to how this DEIAr fulfils the main information requested by the DEA in the original and second version FSR acceptance letter (Comments received from the DEA on the second version of the FSR are in itallics). For a further details, refer to Appendix 3 for the FSR Acceptance Letters.

Table 5: Compliance with the DEA requirements detailed in the FSR acceptance letter

Additional Information Required by the DEA	**Notes / Comments**
Comments and recommendations made by all stakeholders and I&APs in the scoping report and submitted as part of the scoping report must be taken into consideration when preparing an EIAr in respect of the proposed development.	The Comments and Response Report is included in Appendix 5E. All correspondence between authorities and I&APs is included in Appendix 5D. A record of distribution to Organs of States, including attempts made to obtain comments, is included in Appendix 5I.

All mitigation measures and recommendations in the specialist studies must be addressed in the FEIAr and EMPr.	Specialist recommendations and mitigation measures are included in Chapters 9 and 10, as well as in Chapter 15.1, the summary of findings. All mitigation measures are detailed in the EMPr, included as Appendix 8.
Comments from all relevant stakeholders, including additional stakeholders identified by the DEA in the FSR acceptance letter, must be submitted to the DEA with the FEIAr. This includes but is not limited to: ▪ *North West Department of Rural Environmental and Agriculture Development;* ▪ *The department of Agriculture, Forestry and Fisheries (DAFF);* ▪ *South African Civil Aviation Authority (SACAA);* ▪ *The department of Transport;* ▪ *The Ditsobotla Local Municipality;* ▪ *The Ngaka Modiri Molema District Municipality;* ▪ *The department of Water and Sanitation (DWS);* ▪ *The South African National Roads Agency Limited (SANRAL),* ▪ *The South African Heritage Resources Agency (SAHRA);* ▪ *Endangered Wildlife trust (EWT);* ▪ *Birdlife SA;* ▪ *The Department of Mineral Resources;* ▪ *The department of Rural Development and Land Reform; and* ▪ *The department of Environmental Affairs: Directorate Biodiversity and Conservation.* The EAP is required to address all issues raised by Organs of State and I&APs prior to the submission of the FEIAr to the DEA.	All comments from stakeholders are included in the comments and response report. See Appendix 5E. *A list of Organs of State are included in Section 7.9 of this report. Please See Appendix 5I.* All issues raised by stakeholders are addressed in the comments and response report. See Appendix 5E.
The DEIAr and EMPr must comply with Appendix 3 and Appendix 4 of the EIA Regulations of 2014, before submission to the department.	The DEIAr will comply with the requirements listed in Appendix 3 of the EIA Regulations of 2014, as detailed in the table in Section 2.3 of this report. The EMPr will comply with the requirements listed in Appendix 4 of the EIA Regulations of 2014.
Proof of correspondence with the various stakeholders must be included in the DEIAr. If the EAP is not able to obtain comments, proof should be	Proof of correspondence with stakeholders is included in Appendix 5B and 5D. Proof of attempts made to obtain comments in

submitted to the DEA of the attempts that were made to obtain comments.	included will be included in the Chapter 7 of the FEIAr and in Appendix 5B of the FEIAr.
The EAP must, in order to give effect to Regulation 56(2), give registered I&APs access to, and an opportunity to comment on the report in writing within 30 days before submitting the FEIAr to the DEA.	The EAP will give I&APs opportunity to comment within 30 days before submitting the FEIAr. See Chapter 7 for a description of the PPP followed.
The DEIAr must provide an assessment of the impacts and mitigation measures for each of the listed activities applied for.	The listed activities that are being applied for as part of this project are detailed in Chapter 1. Impacts and mitigation measures identified by the specialists are included in Chapter 9, and mitigation measures are also detailed in Chapter 10.
The listed activities represented in the DEIAr and the application form must be the same and correct.	The listed activities in the DEIAr and application form will be identical and correct.
It is imperative that the relevant authorities are continuously involved throughout the EIA process as the development property possibly falls within geographically designated areas in terms of GN R. 985 Activities 4; 12; 14; 15; and 18. Written comments must be obtained and submitted to the DEA. In addition, a graphical representation of the proposed development within the respective geographical areas must be provided.	All relevant provincial authorities will be involved in the EIA process and given the opportunity to comment on the project, particularly as it pertains to the relevant GN R 546 listed activities. All correspondence is included in Appendix 5D and the comments and response report is included in Appendix 5E. All applicable A3 maps are included in Appendix 7.
All issues raised and comments received during the circulation of the EIAr from registered I&APs and organs of state which have jurisdiction (including the department of Environmental Affairs: Directorate Biodiversity and Conservation) in respect of the proposed activity are adequately addressed and included in the FEIAr. *Proof of correspondence with the various stakeholders must be included in the FEIAr. Should comments be unable to be obtained, proof should be submitted to the DEA of proof of attempts made to obtain stakeholder comments.* *The public participation process must be conducted in terms of Regulations 39, 40, 41, 42, 43 and 44 of the EIA Regulations 2014.*	*A list of Organs of State are included in Section 7.9 of this report. Please See Appendix 5I. Proof of correspondence with stakeholders is included in Appendix 5B and 5D. Proof of attempts made to obtain comments in included will be included in the Chapter 7 of the FEIAr and in Appendix 5B of the FEIAr.* Chapter 7 includes a detailed breakdown of the Public Participation Process followed, and all public participation documents are included in Appendix 5.

All comments and responses trail report (C&R) must be included with the FEIAr. The C&R report must include all historical comment for the proposed development. The C&R must be a separate document from the main report and the format must be in the table format as indicated in Annexure 1 of the FSR acceptance letter.	*All issues raised by stakeholders are addressed in the comments and response report. See Appendix 5E.*
Should the appointed specialist specify contradictory recommendations, the EAP must clearly indicate the most reasonable recommendation and substantiate this with defendable reasons, and where necessary, include further expertise advice.	*Taking all the specialists preferences into consideration, overall; the Tlisitseng PV 2 Substation Alternative 2, O&M building Alternative 2 and Laydown area alternative 2 are considered the preferred alternative for the proposed development.* *Please refer to Chapter 12 for a detailed assessment of the alternatives.* *The surface water specialist recommended the following mitigation measure: **"Seasonal Scheduling of the Construction Process** – It is important that construction activities must be scheduled to take place over the dry winter season when rainfall and flows are low (June/July/August/September) as far as practically possible."* *However, considering that there is only one wetland feature identified on site this mitigation measure has been removed after consultation with the specialist.* *The socio-economic specialist recommended the following mitigation measure: "Develop a water supply plan that would illustrate the facilities water supply options; this plan will need to be shared discussed with the interested and affected parties in the area prior the operations ..."* *As this mitigation measure could be problematic to implement, the mitigation measure as been amended to state the following: "The water supply options will need*

	to be considered and discussed with the interested and affected parties in the area prior the operations …"
Where specialist studies have been conducted in house or by a specialist other than a suitable qualified specialist in the relevant field, such specialist reports must be peer reviewed by a suitable qualified external specialist in the relevant field. The terms of reference for the peer review must include: ▪ *A CV clearly showing expertise of the peer reviewer;* ▪ *Acceptability of the terms of reference;* ▪ *Is the methodology clearly explained and acceptable;* ▪ *Evaluate the validity of the findings* ▪ *Discuss the suitability of the mitigation measures and recommendations;* ▪ *Identify any short comings and mitigation measures to address short comings;* ▪ *Evaluate the appropriateness of the reference;* ▪ *Indicate whether a site-inspection was carried out as part of the peer review; and* ▪ *Indicate whether the article is well-written and easy to understand.*	*The two (2) specialist studies which were undertaken by in-house specialists, namely the Surface Water Impact Assessment and Visual Impact Assessment, were peer-reviewed by external specialists. The peer-reviewed versions of these specialist studies and confirmation from the peer reviewers are included in this DEIAr within* ***Appendix 6C and 6E****.*
Due to the number of similar applications in the area, all specialist recommendations must include a cumulative environmental impact assessment for all identified and assessed impacts. The cumulative impact assessment must include the following: ▪ *Identified cumulative impacts must be clearly defined, and where possible the size of the impact must be quantified and indicated i.e. hectares of cumulatively transformed land.* ▪ *Detailed process flow and proof must be provided, to indicate how the specialist's recommendations, mitigation measures and conclusions from the various similar developments in the area were taken into consideration in the assessment of the cumulative impacts and when the conclusions and mitigation measures were drafted for this project.*	*Detailed cumulative impact assessments have been provided in the DEIAr for all the specialist studies conducted. The cumulative impact assessments were conducted to include all the information which was requested by the DEA.* **Section 11** *provides a detailed summary of all of the cumulative impacts potentially associated with the proposed project.*

▪ *The cumulative impacts significance rating must also inform the need and desirability of the proposed development.* ▪ *A cumulative impact environmental statement on whether the proposed development must proceed.*	
The DEIAr must provide technical details of the proposed facility in a table format as well as their description and/or dimensions. A sample for the minimum information required is listed under point 2 of the EIA information required for solar energy facilities below (see Appendix 3).	Technical details of the project are provided in table format on from page ii to page v of the report.
The DEIAr must provide the four corner coordinate points for the proposed development site (note that if the site has numerous bend points, at each bend point coordinates must be provided) as well as the start, middle and end point of all linear activities.	Coordinates are included on pages iii and iv of the report and in Chapter 6, and also included in further detail in Appendix 9.

The DEIAr must provide the following:
▪ Clear indication of the envisioned area for the proposed solar energy facility
▪ Clear description of all associated infrastructure. This description must include, but it not limited to the following:
  ▪ Power lines;
  ▪ Internal roads infrastructure; and
  ▪ All supporting onsite infrastructure such as laydown area, guard house and control room
  ▪ All necessary details regarding all possible locations and sizes of the proposed satellite substation and the main substation
	Technical details of the project are included in Chapter 5 and from page ii to page v of the report. The receiving environment is discussed in Chapter 6. The final preferred layout, including all related infrastructure, is shown on the map included in Chapter 12 and in Appendix 7.

The DEIAr must include a comments and response report in accordance with regulation 2 h (iii) of the EIA regulations 2014	The comments and response report is included in Appendix 5E.
The DEIAr must the include detail inclusive of the PPP in accordance with Regulation 41 of the EIA Regulation.	Chapter 7 includes a detailed breakdown of the Public Participation Process followed, and all public participation documents are included in Appendix 5.
Details of the future plans for the site and infrastructure after decommissioning in 20–30 years and the possibility of upgrading the proposed infrastructure to more advanced technologies should be included in the report.	The site will either be upgraded with more advance technology or returned to the previous land use.

Information on services required on the site should be included including proof of agreements if applicable.	Information on services provision and availability is included in Appendix 10.
The DEIAr must provide a detailed description of need and desirability, not only providing motivation on the need for clean energy in South Africa of the proposed activity. The need and desirability must also indicate if proposed development is needed in the region and if the current proposed location is desirable for the proposed activity compared to other sites.	Project need and desirability is provided in Chapter 4, and in the discussion of alternatives in Chapter 5.2.
A copy of the final site layout map and alternatives must be included in the final report. All available biodiversity information must be used in the finalisation of the layout map. Existing infrastructure must be used as far as possible. The layout map requirements are included in the FSR acceptance letter. (See Appendix 3 for the FSR acceptance letter).	The project description (Chapter 5) details all of the project components shown on various maps throughout the report. Specific technical details may not be available at this stage as they will be determined by the EPC during the detailed design phase. All applicable A3 maps are included in Appendix 7.
An environmental sensitivity map, indicating environmental sensitive areas and features identified during the EIA process, must be included in the DEIAr.	The environmental sensitivity map is included in Chapter 12 and in A3 in Appendix 7.
A map should be provided that combines the final layout map superimposed on the environmental sensitivity map.	The environmental sensitivity map including layouts is included in Chapter 12 and in A3 in Appendix 7.
A shapefile of the preferred development layout/footprint must be submitted to the DEA. Shapefiles must be created using the methodology detailed in the FSR acceptance letter.	Project shapefiles will be submitted to the DEA with the FEIAr.
An EMPr must be submitted as part of the DEIAr, including specialist mitigation measures, recommendations, the final site layout map and sensitivity map, management plans, monitoring systems, and measures to protect hydrological features. The EAP must provide detailed motivation if any of the above requirements is not required by the proposed development and not included in the EMPr. Detailed specifications for the EMPr, including details of all required management plans, are included in the FSR acceptance letter, shown in Appendix 3.	The EMPr, prepared according to the specifications of the FSR acceptance letter, is included in Appendix 8.
The DEIAr must include a cumulative impact assessment of the facility since there are other	Each of the specialist reports addresses the cumulative impact of renewable energy

similar facilities in the region. The specialist studies as outlined in the EIA plan of study which was included in the FSR, must also assess the facility in terms of potential cumulative impacts.	projects in the area. These are included in Appendix 6. Chapter 11 provides a detailed summary of all of the cumulative impacts potentially associated with the proposed project.
All relevant listed activities should be applied for, these should be specific and should be able to be linked to the development activity or infrastructure in the project description.	A description of listed activities applied for is included in Chapter 1.3.
The EAP is reminded that should the EIAr fail to comply with the requirements of the FSR acceptance letter, the project will be refused in accordance with Regulation 24(1)(b) of the EIA Regulations, 2014.	The comment is noted, the EIAr will comply with the requirements of the FSR acceptance letter, as detailed in this table.
The applicant must comply with the requirements of Regulation 45 with regard to the time period allowed for complying with the requirements of the Regulations, and Regulations 43 and 44 with regard to the allowance of a comment period for interested and affected parties on all reports submitted to the DEA. The reports referred are listed in Regulation 43(1).	All regulated timeframes will be complied with. A description of the public participation process to be followed is included in Chapter 7.
Should the application for Environmental Authorisation be subject to the provisions of Chapter II, Section 38 of the National Heritage Resources Act, Act 25 of 1999, then the DEA will not be able to make nor issue a decision in terms of the application for Environmental Authorisation pending a letter from the pertinent heritage authority categorically stating that the application fulfils the requirements of the relevant heritage resources authority as described in Chapter II, Section 38(8) of the National Heritage Resources Act, Act 25 of 1999. Comments from SAHRA and/or the provincial department of heritage must be provided in the DEIAr.	The relevant officials from the SAHRA have been included on the project database, notified of the project progress and sent copies of the Scoping phase Heritage Report and DSR. Comments from SAHRA on the impact phase Heritage Report and the DEIAr will be included in the FEIAr.
Two (2) hard copies and two (2) electronic copies of the DEIAr and FEIAr must be submitted to the department.	Two hard copies and 2 electronic copies of the report will be submitted to the DEA.
The EAP is referred to the information attached to the acceptance letter that must be used in the preparation of the EIAr. This will enable the DEA to speedily review the EIAr and make a decision on the application. See Appendix 3 for the FSR acceptance letter.	The information attached to the FSR acceptance letter was used in the preparation of the DEIAr as noted in the pointes below.

The EAP is reminded of Section 24F of the National Environmental Management Act, Act No 107 of 1998, as amended, which stipulates that no activity may commence prior to an Environmental Authorisation being granted by the DEA.	The comment is noted, and no activity will commence prior to the Environmental Authorisation being granted by the DEA.
General site information as per point 1 and 2 in the EIA information required for solar facilities must be included in the DEIAr (See Appendix 3 for the FSR acceptance letter detailing EIA information required for solar facilities).	General site information as per point 1 of the FSR acceptance letter is included on pages ii to v of the report.
Maps as per point 3 and 4 in the EIA information required for solar facilities must be included in the DEIAr (See Appendix 3 for the FSR acceptance letter)	All applicable A3 maps are included in Appendix 7.
Important stakeholders as per point 5 in the EIA information required for solar facilities must provide comment on the proposed project (See Appendix 3 for the FSR acceptance letter)	All listed important stakeholders will be included as Organs of State and efforts will be made to obtain comments from them. A record of distribution to Organs of States, including attempts made to obtain comments, is included in Appendix 5I.
An agricultural potential study must form part of the EIA process, as per section B in the FSR acceptance letter (see Appendix 3).	Different sections of the agricultural potential study are included in Chapters 6.9, 8.4, 9.2.4, and 10.1.4. The full agricultural potential report is also included in Appendix 6D.

A record of all authority consultation is included within **Appendix 3.**

Consultation with other relevant authorities was and is also being undertaken via meetings and telephonic consultation in order to actively engage them and provide them with information and gain their feedback.

Authorities and key stakeholders consulted include the following:

- National Authorities;
- Provincial Authorities;
- Ditsobotla LM;
- Ngaka Modiri Molema DM;
- Government Structures such as SAHRA, SANRAL, Telkom, etc.;
- Agriculture Associations;
- Regional and local media (advertisements and public documents e.g. BID);
- Business and commerce;
- Environmental bodies / NGOs;
- Community representatives, CBOs, development bodies;
- Landowners; and

- Civil Aviation Authority (CAA).

The full list of authorities and key stakeholders that have been consulted is included in Appendix 5I.

2.3 Environmental Impact Assessment Report

The EIA phase of the project has focused on consulting with Interested and / or Affected Parties as well as conducting specialist studies to address the potential impacts identified during the scoping phase.

The NEMA EIA Regulations (GN. R. 982) state that the objective of the environmental impact assessment process is to, through a consultative process:

(a) determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
(b) describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
(c) identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
(d) determine the--
    (i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
    (ii) degree to which these impacts-
        (aa) can be reversed;
        (bb) may cause irreplaceable loss of resources, and
        (cc) can be avoided, managed or mitigated;
(e) identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
(f) identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
(g) identify suitable measures to avoid, manage or mitigate identified impacts; and
(h) identify residual risks that need to be managed and monitored.

The content requirements for an Environmental Impact Assessment Report, as well as details of which section of the report fulfils these requirements, are shown in **Table 6** below.

Table 6: Content requirements for an Environmental Impact Assessment Report

Content Requirements	Applicable Section
(a) details of- (i) the EAP who prepared the report; and (ii) the expertise of the EAP, including a curriculum vitae;	Details of the EAP and full project team are included in section 1.2. The expertise (including curriculum

	vitae) of the EAP and full project team are include in Appendix 2.
(b) the location of the activity, including- (i) the 21 digit Surveyor General code of each cadastral land parcel; (ii) where available, the physical address and farm name; (iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	The location of the proposed project is detailed in on page *iii* of the report, as well as in section 6.1.
(c) a plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is- (i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or (ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken;	A map of the regional locality is shown in section 6.1, and the site locality is shown in section 5.1. Additionally, all project maps are included in Appendix 7. Coordinates are shown on page *iii* of the report, as well as in section 6.1.
(d) a description of the scope of the proposed activity, including- (i) all listed and specified activities triggered; (ii) a description of the activities to be undertaken, including associated structures and infrastructure;	The listed and specified activities triggered as per NEMA are detailed in section 1.3.2. The technical project description is included in section 5. This includes a description of activities to be undertaken, including associated structures and infrastructure.
(e) a description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context;	A description of all key legal and administrative requirements is provided in section 1.3, this includes an explanation of how the proposed development complies with the requirements. Key development strategies and guidelines and their applicability to the proposed project are detailed in section 1.4.
(f) a motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;	The need and desirability of the proposed project is discussed in section 4.
(g) a motivation for the preferred development footprint within the approved site;	The site specific suitability is discussed in section 4.4
(h) a full description of the process followed to reach the proposed development footprint within the approved site, including:	A description of the alternatives considered in terms of the Regulations is included in section 5.2 and a full description and

(i) details of the development footprint alternatives considered; (ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; (iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them; (iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; (v) the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts- (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated; (vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks; (vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; (viii) the possible mitigation measures that could be applied and level of residual risk; (ix) if no alternative development locations for the activity were investigated, the motivation for not considering such; and (x) a concluding statement indicating the preferred alternative development location within the approved site;	comparative assessment of the alternatives considered is included in section 12. The public participation process followed is detailed in section 7. Additionally, all public participation documents are included in Appendix 5. This includes a summary of issues raised by I&APs, and the responses to their comments. A full description of the environmental attributes within the application site is included in section 6 and 8. The impacts and risks associated with each alternative are assessed in section 9.2. The methodology used in identifying the impacts and risks associated with each alternative is included in section 9.1. The positive and negative impacts that the proposed activity will have on the environment are discussed in 9.2. Potential mitigation measures are included in section 10. The inclusion of alternatives is discussed in section 5.2 and in section 12. A concluding statement indicating the preferred alternatives is contained in section 12.
(i) a full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred location through the life of the activity, including (i) a description of all environmental issues and risks that were identified during the environmental impact assessment process; and (ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and	The process undertaken to assess the impacts as well as the assessment of impacts by each specialist are shown in section 9. Each environmental issue and risk is tabulated in section 9.2 and an assessment of the significance of each issue before and after mitigation measures is included.

risk could be avoided or addressed by the adoption of mitigation measures;	
(j) an assessment of each identified potentially significant impact and risk, including- (i) cumulative impacts; (ii) the nature, significance and consequences of the impact and risk; (iii) the extent and duration of the impact and risk; (iv) the probability of the impact and risk occurring; (v) the degree to which the impact and risk can be reversed; (vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and (vii) the degree to which the impact and risk can be avoided, managed or mitigated;	The impact rating system contained in section 9.1.2 details the methodology for determining the significance of an impact. This includes the points (j) (i to vii) of Appendix 3.The assessment of each risk identified by the specialists is contained in section 9.2.
(k) where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;	All relevant specialist findings are included in section 8, with all recommended mitigation measures detailed in section 10. The mitigation measures have been incorporated into the EMPr which is contained in Appendix 8. The tabulated summary of key specialist findings and recommendations is included in section 15.1 and in the executive summary.
(I) an environmental impact statement which contains- (i) a summary of the key findings of the environmental impact assessment: (ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and (iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	Section 15 contains a tabulated summary of the key findings in each specialist assessment, it also contains a map showing the final preferred layout superimposed with sensitive areas and buffers where required. The positive and negative impacts associated with the activity, which were identified by each specialist, are also summarised in table form in the section.
(m) based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;	The recommended mitigation measures associated with each impact are included in section 9, and overall specialist recommendations and mitigation

	measures are included in section 10. These measures are contained in the EMPr which can be found in Appendix 8.
(n) the final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;	The final proposed alternatives are included in section 12, including a comparative assessment by the specialists.
(o) any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Any aspects identified by specialists or the EAP that should be included as conditions of the authorisation are identified in section 15 and in the executive summary.
(p) a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	All assumptions and limitations are highlighted in section 3.
(q) a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	A reasoned opionion as to whether of not the proposed activity should be authorised, including conditions if required, is included in section 15 and in the executive summary.
(r) where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	The period required for the environmental authorisation, as well as the date on which the activity and post construction monitoring will be concluded is dicussed in section 15 and the executive summary.
(s) an undertaking under oath or affirmation by the EAP in relation to- (i) the correctness of the information provided in the reports; (ii) the inclusion of comments and inputs from stakeholders and I&APs; (iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and (iv) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	The EAP affirmation is included in Appendix 2.
(t) where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	If applicable, details of any financial provisions for the management of negative environmental impacts

	are included in section 10, section 15 and the executive summary.
(u) an indication of any deviation from the approved scoping report, including the plan of study, including- (i) any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and (ii) a motivation for the deviation;	If required, the details of, and motivation for, any deviation from the FSR plan of study will be detailed in section 2.1.
(v) any specific information that may be required by the competent authority; and	As part of the letter of acceptance for the FSR the DEA detailed specific information requirements. These requirements are tabulated in section 2.2, along with an explanation of how the requirements are met. All correspondence from the DEA is included in Appendix 3.
(w) any other matter required in terms of section 24(4)(a) and (b) of the Act.	All requirements in terms of section 24(4)(a) and (b) of the Act have been met in this report.

3 ASSUMPTIONS AND LIMITATIONS

- It is assumed that all information provided by the Applicant to the Environmental Team was correct and valid at the time it was provided.
- It is not always possible to involve all Interested and / or Affected Parties (I&APs) individually, however, every effort has / is been made to involve as many interested parties as possible. It is also assumed that individuals representing various associations or parties convey the necessary information to these associations / parties.
- It is assumed that the information provided by the various specialists is unbiased and accurate.
- The following assumptions, uncertainties and gaps in knowledge were encountered by the various specialists:

- Biodiversity:
    - Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be unexpectedly located in an area.
    - This study excludes invertebrates and avifauna.

- Avifauna:
  - A total of 62 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 PV2 lay-out alternatives.

- Surface Water:
  - This study focuses solely on the Tlisitseng 2 PV facility and not on the other components of the greater Tlisitseng PV development (including Tlisitseng 1 PV facility and the power line and substation connections for Tlisitseng 1 and 2 PV facilities).
  - This study has only focused on the identification and in-field delineation of surface water resources 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 is included in the avi-faunal assessment.

- Agricultural Potential and Soils:
  - No specific assumptions and limitations were identified by the Soils and Agricultural potential specialist.

- Visual:
  - 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.
    - The feedback regarding the visual environment received from the public participation process and as part of the social impact assessment to date has been incorporated into this report. Any additional 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 switching 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.

- Heritage:
    - 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 Tlisitseng solar PV application site is an area of 10.3 square kilometres.
    - A total of 8 heritage sites were marked within the application site over the extent of the fieldwork.

- Palaeontology:
    - Not detracting in any way from the fieldwork undertaken, it is necessary to realise that the palaeontological heritage sites located during the fieldwork do not necessarily represent all the heritage sites present within the area. Should any heritage features 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 exposing of stromatolites structures as well as cave breccias.

- The survey was conducted over 1 day over the extent of the total footprint area by Dr Gideon Groenewald and David Groenewald on 17 February 2016. It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the palaeontological heritage character of the area.
- The fieldwork that covered the Tlisitseng Solar site as well as the proposed power line corridors covered the whole area by vehicle and on foot, with specific observations recorded as a photographic database. Detailed observation of outcrops were considered as highly important whereas loose gravel and boulders were recorded as representative examples of stromatolites structures which were out of situ observations. No obvious cave breccias or sink holes were observed and the presence of these highly sensitive structures need to be confirmed during detailed geophysical investigations for possible sink hole structures on dolomitic terrains or karts topography.

- Socio-Economic:
  - 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:
    i. Questions asked during the interviews were answered accurately.
    ii. The degree of the perceived possible significance of the concerns raised by some of the respondents were rated by them truthfully.
    iii. That the attitudes of the respondents towards the project will remain reasonably stable.
  - The land owner of Portion 4 of Farm Talene 25 may have concerns but was not willing to raise these concerns until a community meeting has taken place. There is, therefore, an information gap on the activities taking place on this farm portion. Google Earth

imagery was used to determine the current activity on the farm; however, there cannot be certainty of the impact on the specific land user.
- The assumption is that no significant concern exists for those land owners who refused/declined consultation, 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 the relevant farm portions to aid in 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 who did not provide their feedback for whatever reasons.

- Geotechnical
  - No specific assumptions and limitations were identified by the Geotechnical specialist.

- Traffic
  - 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.

4 PROJECT NEED AND DESIRABILITY

4.1 National Renewable Energy Requirement

In 2010 South Africa (SA) had 44, 157MW of power generation capacity installed. Current forecasts indicate that by 2025, the expected growth in demand will require the current installed power generation capacity to be almost doubled to approximately 74,000MW (SAWEA: 2010).

This growing demand, fuelled by increasing economic growth and social development within Southern Africa, is placing increasing pressure on South Africa's existing power generation capacity. Coupled with this, is the growing awareness of environmental impact, climate change and the need for sustainable development. Despite the worldwide concern regarding GHG emissions and climate change, South Africa continues to rely heavily on coal as its primary source of energy, while most of the country's renewable energy resources remain largely untapped (DME, 2003). There is therefore an increasing need to establish a new source of generating power in SA within the next decade.

The use of renewable energy technologies, as one of a mix of technologies needed to meet future energy consumption requirements is being investigated as part of Eskom's long-term strategic planning and research process. It must be remembered that solar energy is plentiful, renewable, widely distributed, clean and reduces greenhouse gas emissions when it displaces fossil-fuel derived from electricity. In this light, renewable solar energy can be seen as desirable.

4.2 National Renewable Energy Commitment

In support of the need to find solutions for the current electricity shortages, the increasing demand for energy, as well as the need to find more sustainable and environmentally friendly energy resources, South Africa has embarked on an infrastructure growth programme supported by various government initiatives. These include; the National Development Plan (NDP), the Presidential Infrastructure Coordinating Commission (PICC), the Department of Energy's Integrated Resource Plan, the National Strategy for Sustainable Development, the National Climate Change Response White Paper, the Presidency of the Republic of South Africa's Medium-Term Framework, and the National Treasury's Carbon Tax Policy Paper.

The Government's commitment to growing the renewable energy industry in South Africa is also supported by the *White Paper on Renewable Energy* (2003) which sets out the Government's principals, goals and objectives for promoting and implementing renewable energy in South Africa. In order to achieve the long term goal of achieving a sustainable renewable energy industry, the Department of Energy has set a target of contributing 17,8*GW* of renewable energy to the final energy consumption by 2030. This target is to be produced mainly through, wind and solar; but also through biomass and small scale hydro (DME, 2003; IRP, 2010).

4.3 Solar PV Power Potential in South Africa and Internationally

Internationally, PV is the fastest-growing power generation technology, South Africa has some of the highest levels of solar radiation in the world and as much as 8GW PV could potentially be installed by 2020 (DEA Guideline for Renewable Energy, 2013). Between 2000 and 2009 the installed capacity globally grew on average by 60% per year. Worldwide more than 35GW of PVs are installed and operating, and in South Africa as much as 8GW PV could potentially be installed by 2020.

4.4 Site Specific Suitability

According to the solar map (**Figure 1**) the North West Province of South Africa has a solar energy concentration of between 8001 and 9000 MJ/m^2. The North West is the province in South Africa with the second highest solar potential. The project site falls within the range of 8501 – 9000 MJ/m^2 and is thus suitable for the establishment of the solar PV energy facility. Based on an estimation of the solar energy resource as well as weather, dust, dirt, and surface albedo, pre-feasibility studies conducted by BioTherm have identified the site as optimal for the proposed Tlisitseng solar PV project.

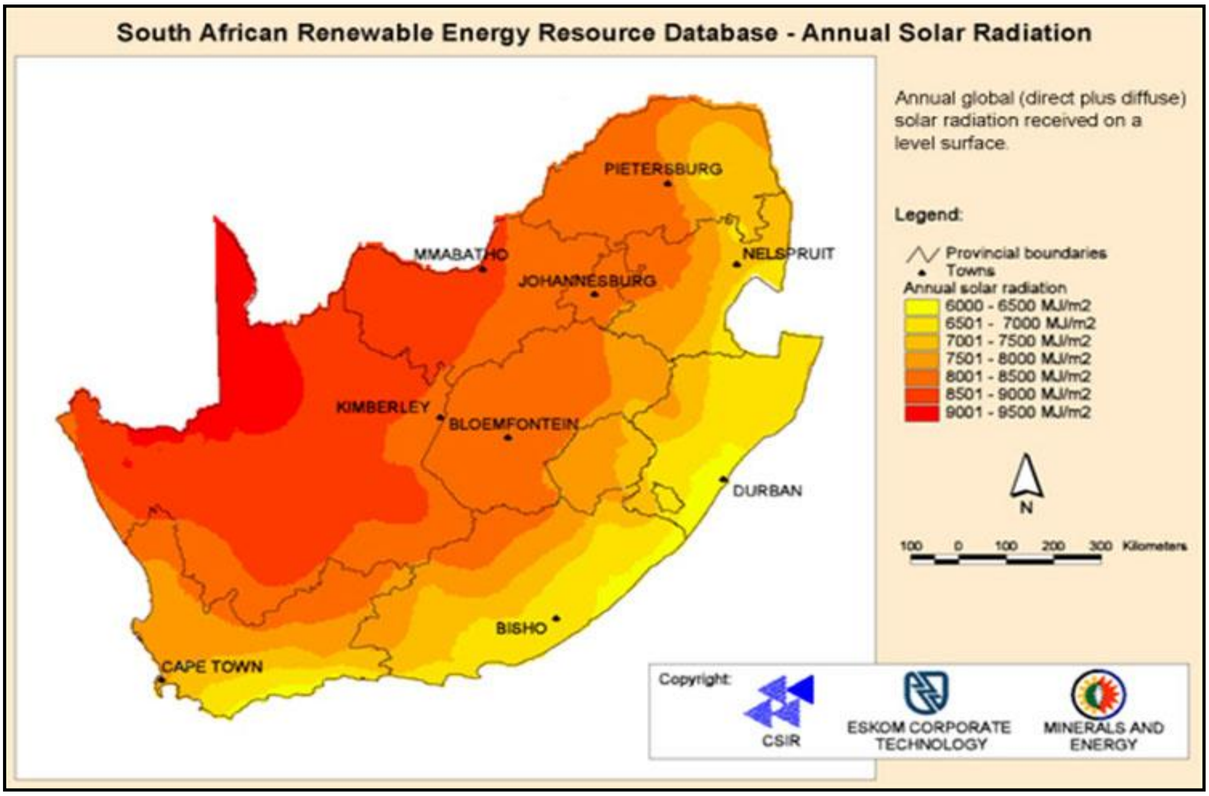


Figure 1: National Solar Resource Map (Source: Solar Vision, 2010)

The proposed solar PV energy facility is situated on the farm Portion 25 of the Farm Houthaalboomen No 31. Portion 25 of the Farm Houthaalboomen No 31 is used for cattle farming and irrigated agricultural activities such as maize farming. In addition, irrigated agricultural activities are also taking place on surrounding farm portions as well as scattered farm houses. Four (4) workers currently reside in two (2) houses on the farm. It is expected that the land under maize (86ha) will be unaffected by the proposed project. The cattle's grazing area will however be affected as the farmer plans to use the rental payment from BioTherm to acquire land elsewhere so that the scale of his cattle farm does not have to be reduced. Land is regularly available in the area. The two (2) permanent houses within the development area will need to be moved. BioTherm will however reimburse the individuals affected by this. Some infrastructure changes may also need to take place and once again the farmer understands that BioTherm will offer reimbursements. It must also be noted that the landowner is in support of the project as he understands the importance of building generation capacity. The site is therefore considered to be suitable from a land use perspective.

The project site near Lichtenburg has been identified through pre-feasibility studies based on the solar resource. Grid connection and land availability were also important initial considerations. The project site has a relatively flat topography that is suitable for facilities of this kind. The project site also has advantageous grid connection potential, with the existing Watershed MTS which is located adjacent to the affected farm. The project site is easily accessible as the tarred R505 road transects the farm and connects to the N14 national road which leads to the R503, Lichtenburg.

Additionally, cumulative impact assessments of similar development in the area was undertaken by the specialist for this proposed devlopment. Based on their findings the cumulative impacts associated with the proposed development will be low. Considering that there are relatively few similar project in the area and the low cumulative impacts associated with the proposed development, the site location is ideal for the proposed development of the PV facility.

4.5 Local Need

The Renewable Energy Policy for the North West Province acknowledges that the province is the country's fourth biggest electricity user, with the bulk of this usage taking place in the mining sector. In addition to the job creation opportunities that could ensue from the creation of an RE industry in the province, the RE Policy recognises the impact that this would have on the province's contribution towards a green South Africa. More specifically, the North West RE Policy mentions the opportunities for the province in the solar energy sphere, making specific reference of the fact that the Ngaka Modiri Molema DM represents one of the best regions in the province for the exploration of the possibility of a solar energy industry (Department of Economic Development, Environment, Conservation, and Tourism, 2012).

Concerning spatial planning policy, the NSDP identifies the Mafikeng-Lichtenburg area as one of South Africa's key economic centres, highlighting the fact that the area is characterised by an undiversified economy, high migration towards certain areas, and marginalisation of the poor. Policy makers believe that coordinated government interaction is required to address the challenges facing the country's municipalities. It specifically recommends exploring the possibilities of using natural resources to generate economic growth and address poverty, as well as seeking out new areas of comparative advantage (The Presidency of the Republic of South Africa, 2006); these are all aligned to exploration and the establishment of a solar energy industry in the North West Province. The North West PSDF – EMP highlights the fact that large parts of the Province are still underdeveloped, under-resourced, and under-serviced. It follows the NSDP in stating that the Province's natural resources must be effectively used to address this and other developmental challenges, such as high illiteracy levels and rapid urbanisation, for example, in a sustainable manner.

The review of applicable socio-economic development policies state the importance of the RE sector, as well as solar electricity in addressing climate change issues while achieving job growth and economic development. The NDP identifies the expansion and acceleration of a commercial RE sector as a key intervention strategy in order to ultimately eliminate poverty and reduce inequality (National Planning

Commission, 2011). The North West PDP focusses on the rural economy and the transformation of human settlements. It identifies the RE sector, specifically solar and biomass initiatives, as becoming increasingly important in the province, especially since its contribution to the province's consumption will become increasingly important over the next two decades (North West Planning Commission, 2013).

Local level policy documents reveal that some of the biggest socio-economic challenges faced by the study community include: an under-serviced region in terms of social as well as economic infrastructure, undesirable settlement patterns, and a relatively undiversified economy (Ngaka Modiri Molema District Municipality, 2015). The Ditsobotla LM states that the identification of low energy resources is a critical factor of the LM's ability to achieve its growth and development objectives.

5 TECHNICAL PROJECT DESCRIPTION

5.1 Project Description

The proposed project will encompass the installation of a solar PV field and associated components, which includes a 132kV onsite substation (Tlisitseng 2 Substation), in order to generate and feed electricity into the national grid. The PV energy facility will have a maximum export capacity of 75MW while the proposed Tlisitseng onsite substation will have a voltage capacity of up to 132kV. The total area of the application site is approximately 1024 hectares, with the proposed Tlisitseng 2 development taking up a total area of approximately 345 hectares. Within the development area a smaller area will be required for the solar PV arrays. The proposed Tlisitseng 132kV onsite substation will cover an area of up to approximately 2.25 hectare. The footprint of the Operations and Maintenance (O&M) buildings will be approximately 225m^2. The final design details are yet to be confirmed. These details will become available during the detailed design phase of the project. During the scoping phase the entire application site was assessed in order to inform the preliminary comparison of layout alternatives for the solar PV energy facility. These layout alternatives have been discussed in the FSR and were presented in the Plan of Study for the EIA Phase. Based on the findings of the FSR and due to constraints in terms of the available area, only one (1) alternative was considered for the PV array area. In the FSR the sensitive areas used to assess the layouts were based on desktop studies. Specialist studies in the EIA phase will provide a more detailed assessment of sensitive areas. If necessary, the layout will be amended at this stage to more accurately avoid highly sensitive or no-go areas. The voltage of the connection lines from the solar PV energy facility's onsite substation (Tlisitseng 2 Substation) to the grid is likely to be 132kV. As mentioned above, this power line will be assessed as part of a separate BA process.

BioTherm is proposing the establishment of a solar PV energy facility and associated infrastructure, which includes a 132kV onsite substation on the development site near Lichtenburg (**Figure 2**). As mentioned, the objective of the solar project is to generate and feed electricity into the national grid. The solar PV energy facility will have a maximum export capacity of 75MW while the proposed Tlisitseng onsite substation will have a voltage capacity of up to 132kV.

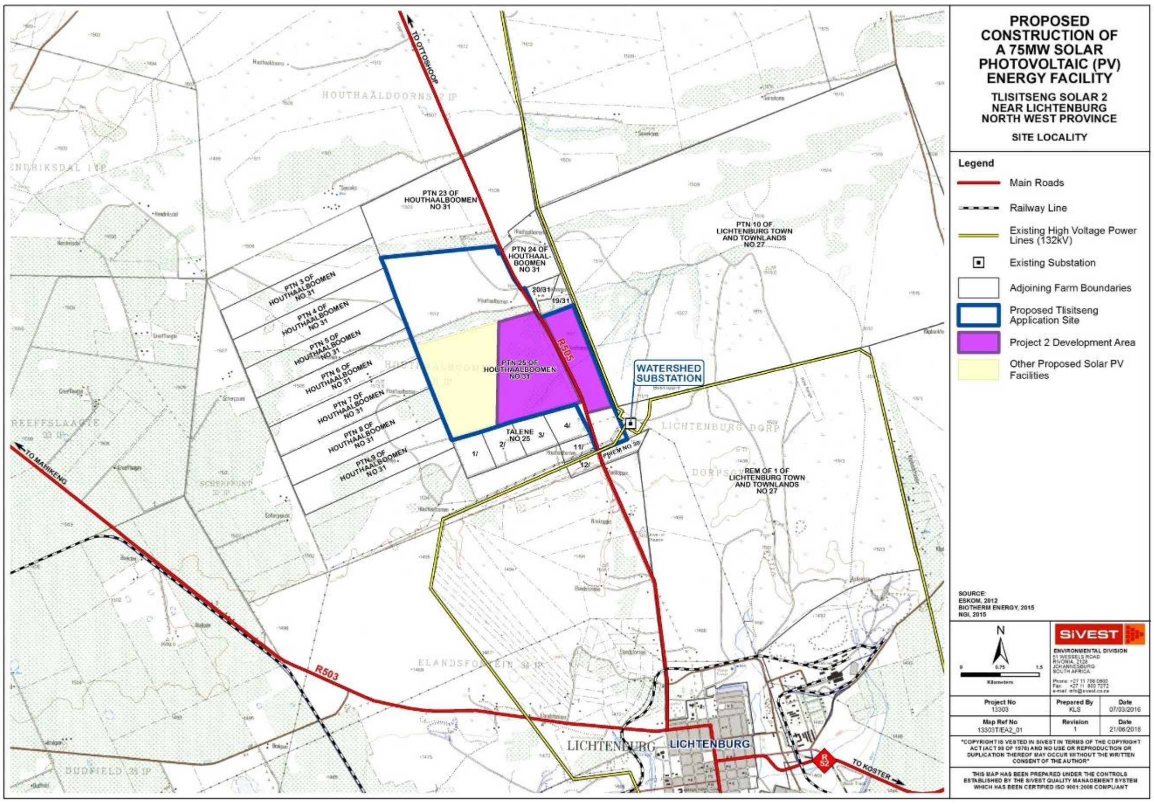


Figure 2: Proposed solar PV energy facility study area

The key technical details and infrastructure required is presented in the table below (Table 7).

Table 7: Tlisitseng 2 technical summary

Project Name	Farm name and area	Technical details and infrastructure necessary for each phase
Tlisitseng 2	Portion 25 of the Farm Houthaalboomen No 31 PV Site Area: Tlisitseng 2 between approximately 345 ha Onsite Substation Site Area: 2.25 ha	▪ Approximately 275 000 **solar PV panels** with a total export capacity of 75MW; ▪ The technology used will be either **fixed tilt mounting or single axis tracking mounting**, and the modules will be either crystalline silicon or thin film technology; ▪ Onsite **substation**, with the transformers for voltage step up from medium voltage to high voltage; ▪ The **onsite** switching **substation** will occupy an area of approximately 2.25ha ▪ The modules will be connected in strings to inverters. Inverter stations will typically house several inverters and a transformer; ▪ DC power from the panels will be converted into AC power in the inverters and the voltage will be stepped up to 22 or 33kV (medium voltage) in the transformers.

		▪ The **medium voltage 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 132kV. ▪ **Onsite substation** (Tlisitseng 2 Substation) with a voltage capacity of up to 132kV; ▪ The **Tlisitseng 2 onsite substation** will occupy an area of approximately 2.25ha; ▪ Grid connection is from the proposed Tlisitseng 2 onsite substation to Watershed Main Transmission Station (MTS) via a **power line** with a voltage capacity of 132kV. ▪ The **power line** pylons will be suspension / strain / steel monopole structures, which may be self-support or guyed suspension. The height will vary based on the terrain, but will ensure minimum Overhead Line (OHL) line clearances with buildings and surrounding infrastructure. The minimum vertical clearances will be 3.8m with building and 6.7m between conductors and ground ▪ A **lay-down area** of approximately 10ha for the temporary storage of materials during the construction; ▪ **Construction of access roads and internal roads**; ▪ Construction of a **car park and fencing** around the project; and ▪ **Administration, control and warehouse buildings.**

As previously mentioned, this proposed solar PV energy facility forms one (1) of two (2) PV energy facilities with a 75MW export capacity that BioTherm is to developing on Portion 25 of the Farm Houthaalboomen No 31. In addition, BioTherm are proposing to construct two (2) 132kV onsite substations namely Tlisitseng 1 and Tlisitseng 2 Substations, and two (2) 132kV power lines from each onsite substation, which will feed the electricity generated by the proposed PV energy facility into the national grid. Each PV energy facility will be developed under a separate Special Purpose Vehicle (SPV) and therefore each requires a separate Environmental Authorisation. Additionally, the two (2) 132kV power lines which will connect each of the proposed Tlisitseng 2 onsite Substations to the existing Eskom Watershed MTS will also require a separate Environmental Authorisations. It must however be noted that the proposed 132kV power lines will require a Basic Assessment (BA) process and not an Environmental Impact Assessment (EIA).

The key components of the project are detailed below.

5.1.1 Solar Array

Solar PV panels are usually arranged in rows consisting of a number of PV modules. The area required for the PV arrays will likely need to be entirely cleared or graded.

Approximately 275 000 solar PV panels will be required for the facility for a total export capacity of 75MW. Support structures will either be fixed tilt mounting or single axis tracking solutions and the modules will be either crystalline silicon or thin film technology. The solar PV modules are variable in size, and are dependent on by advances in technology between project inception and project realisation. At this stage crystalline PV modules solar panels will be 1956mm x 992mm x 40mm. The actual size of the PV modules to be used will be determined in the final design stages of the project. The PV modules are mounted on metal frames. Rammed steel piles are commonly used for the support of such structures (Figure 3).

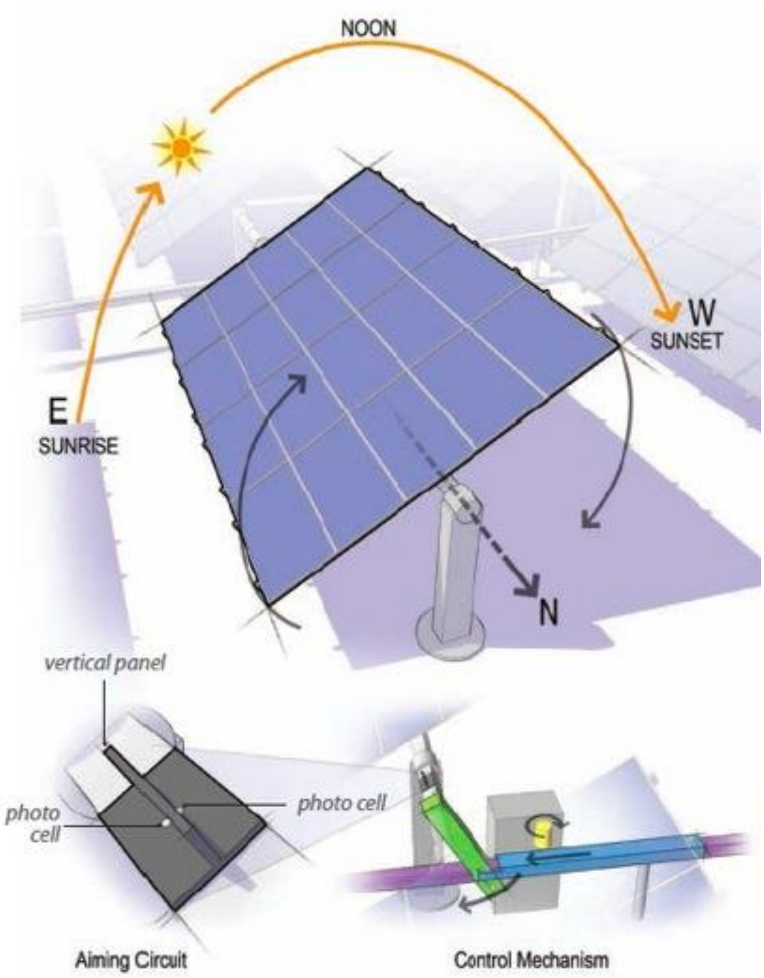


Figure 3: Example of a Photovoltaic Panel with tracking capability.
(**Source: http://solartoday.org/2009/07/single-axis-solar-tracking/)**

5.1.2 Electrical Infrastructure

The solar arrays are connected in strings, which are in turn connected to inverters. For a 75MW size facility, typically 2-4MW inverter stations which are containerised stations housing inverters and transformers will be used (**Figure 4**). DC power from the panels will be converted into AC power in the inverters and the voltage will be typically stepped up to 22 or 33kV (medium voltage) in the transformers.

The medium voltage cables will be run underground in the facility before being fed to the onsite switching substation where the voltage will typically be stepped up to 132kV. An onsite power line with a voltage capacity of 132kV will run from the onsite substation to the proposed connection point at the Eskom Watershed MTS. The power line PYLON will be a tower (suspension / strain) / Steel monopole structure, which may be self-support or guyed suspension. The height will vary based on the terrain, but will ensure minimum OHL line clearances with buildings and surrounding infrastructure.

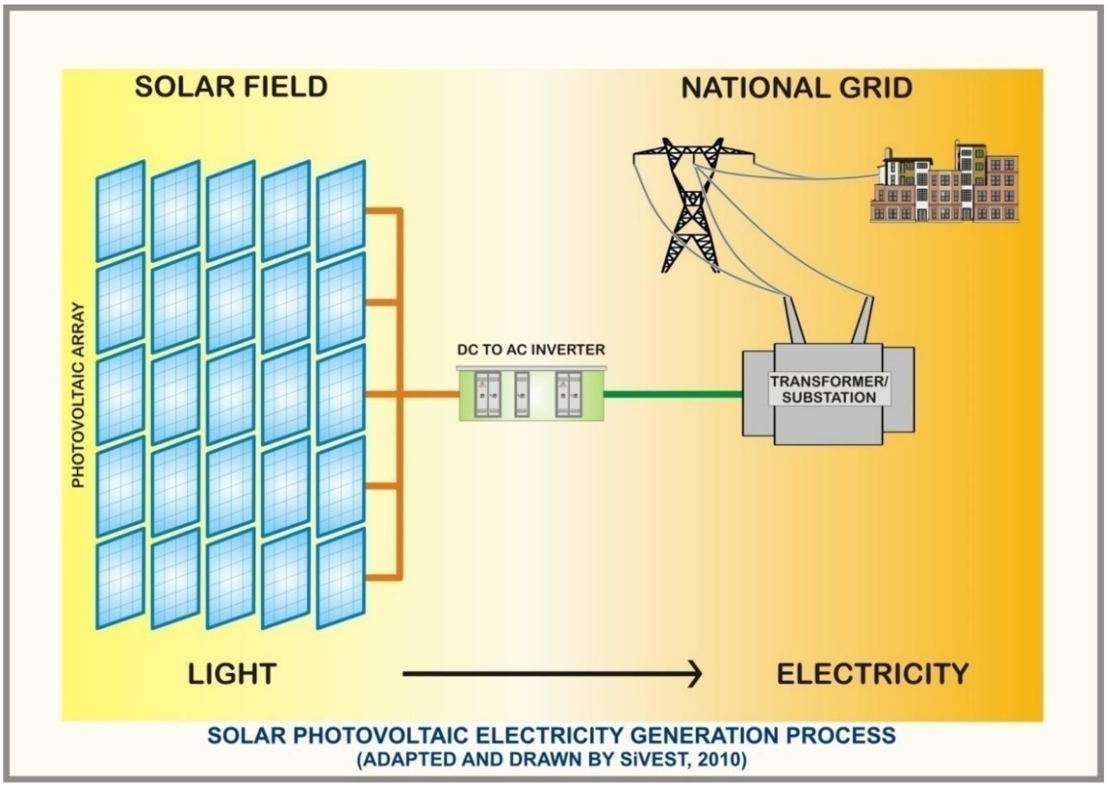


Figure 4: PV process

5.1.3 Buildings

The solar field will require onsite buildings which will be used in the daily operation of the energy facility and includes an administration building (office). Potential locations for the administration building will be determined during the EIA process based on any environmental constraints identified and design factors that need to be considered. The buildings will likely be single storey buildings which will be required to accommodate the following:

- Control room;
- Workshop;
- Kitchen;
- Toilets;
- Storage; and
- Car park and fencing around the project.

5.1.4 Construction Lay-down Area

A general construction lay-down area will be required for the construction phase of the proposed solar PV energy facility. The size of this area is yet to be determined, but 10 hectares is likely. A permanent storage area will be required for the storage of spares, which is to be located close to the O&M building.

5.1.5 Other Associated Infrastructure

Other associated infrastructure includes the following:

- Access roads and internal roads;
- A car park; and
- Fencing around the project which is likely to be galvanized steel type at approximately 2m high.

5.2 Alternatives

As per Chapter 1 of the EIA regulations (2014), feasible and reasonable alternatives are required to be considered during the EIA process. Alternatives are defined at “different means of meeting the general purpose and requirements of the activity” These alternatives may include:

(a) The property on which or location where it is proposed to undertake the activity;
(b) The type of activity to be undertaken;
(c) The design or layout of the activity;
(d) The technology to be used in the activity;
(e) The operational aspects of the activity; and
(f) The option of not implementing the activity.

Each of this alternatives is discussed in relation to the proposed project in the sections below.

5.2.1 The property on which or location where it is proposed to undertake the activity

The project site has been identified by BioTherm through a pre-feasibility desktop analysis based on the estimation of the solar energy resource as well as other factors including; weather, dust and dirt effects. Prior to the EIA process, as part of this analysis, BioTherm considered other site locations for the proposed construction of the solar PV energy facilities. These sites were ruled out for various reasons as indicated in **Table 8** below.

Table 8: Site Location Alternatives Considered Prior to the EIA Process

Project Name	Project Location	Province	Resource	Size of area considered	Feasibility Fatal Flaws Identified
Kathu	Kathu	Northern Cape	2256	12,000 ha	Site was excluded for development due to environmental sensitivity.

Virginia	Virginia	Free State	2149	5,000 ha	No grid capacity on 132kV for loop -in loop-out. Grid costs too high to connect facility.
Bloemfontein	Bloemfontein	Free State	2166	7,000 ha	From land perspective due to the amount of landowners to sign up.
Viljoenskroon	Viljoenskroon	Free State	2109	3,000 ha	Resource too low, grid cost too high.
Petrusville	Petrusville	Free State	2197	5,000 ha	Located 50km from closest grid connection point.
Kimberly	Kimberly	Northern Cape	2108	5,000 ha	Lease not extended due to low resource.

No other site alternatives for this project are being considered because the placement of solar PV installations is dependent on several factors, all of which are favourable at the proposed site location. These include solar resource, climate, topography, grid connections and access to the site. The North West Province in South Africa has favourable solar irradiation potential. The project site receives an annual global horizontal irradiation of approximately 2120 kWh/ m^2/year. The project site has access to the national grid via the existing Watershed MTS located approximately 2.4 km from the site. There are no operational projects which surround the site. The project site has a relatively flat topography which is suitable for the development of a solar PV facility. The project site is easily accessible as the tarred R505 road transects the farm and connects to the N14 national road which leads to the R503, Lichtenburg. The site is therefore considered highly suitable for the proposed development and no other locations are being considered as part of the EIA process.

5.2.2 The type of activity to be undertaken

No other activity alternatives are being considered. Renewable energy development in South Africa is highly desirable from a social, environmental and development point of view. Wind energy installations are not feasible on the site as there is not enough of a wind resource. Concentrated solar power (CSP) installations are also not feasible because they have a high water requirement and the project site is located in an arid area. Therefore solar PV is the only activity being considered for the proposed site.

5.2.3 The design or layout of the activity

Design or layout alternatives are being considered in the EIA process. Various environmental specialists assessed the site during the scoping phase. Their assessments encompassed the entire proposed development site and included the identification of sensitive areas. These sensitive areas were used during the scoping phase to perform a preliminary comparison of layout alternatives (**Figure 5**).

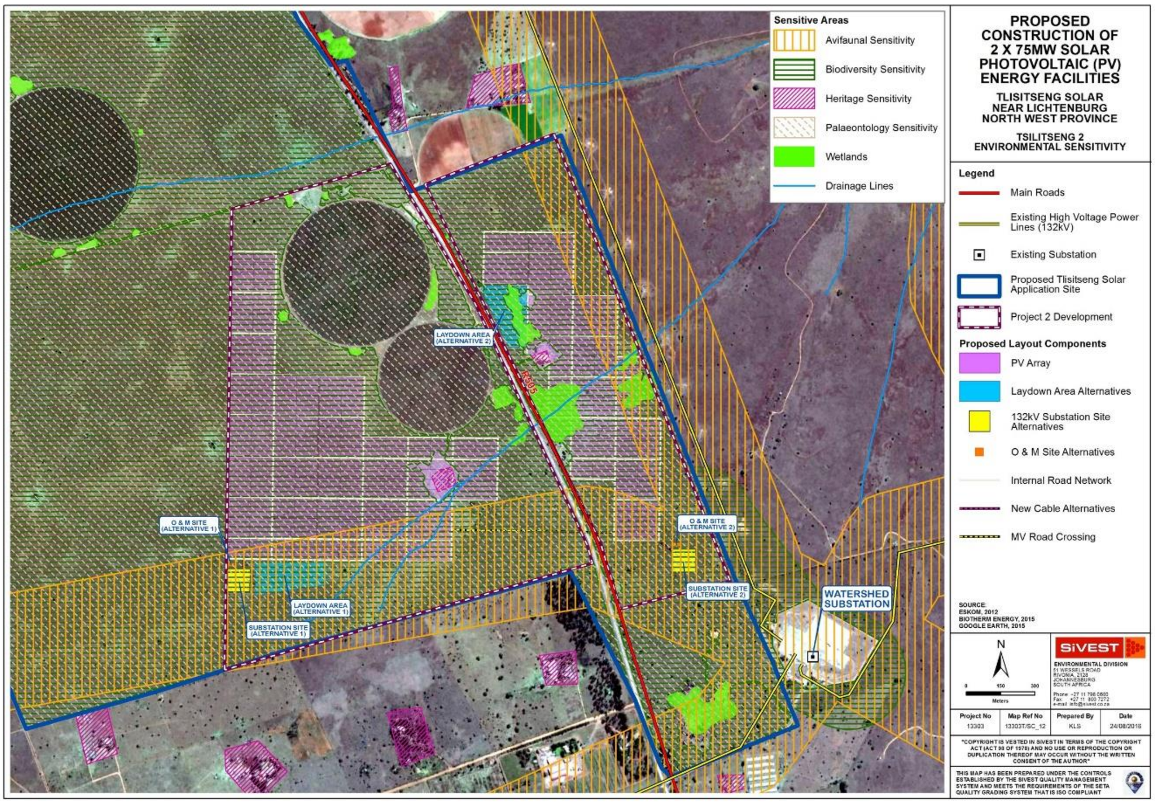


Figure 5: Proposed Scoping Phase Layout Alternatives with Scoping Phase sensitivity

Following the comparative assessment of alternatives in the scoping phase, it was deemed unnessessary to amend the layouts alternatives and all alternatives for the associated infrastructure identified within this FSR have been described and comparatively assessed in the EIA phase (**Figure 6**). The design and layout alternatives will include; alternative locations for the laydown area, onsite substation, and O&M building. The EIA phase layout alternatives, including maps, are presented in **Section 12.** The proposed layouts were constrained in terms of the area available and it was therefore not possible to have two layout alternatives for the PV array area. The selected preferred layout alternative will be based on both environmental constraints and design factors.

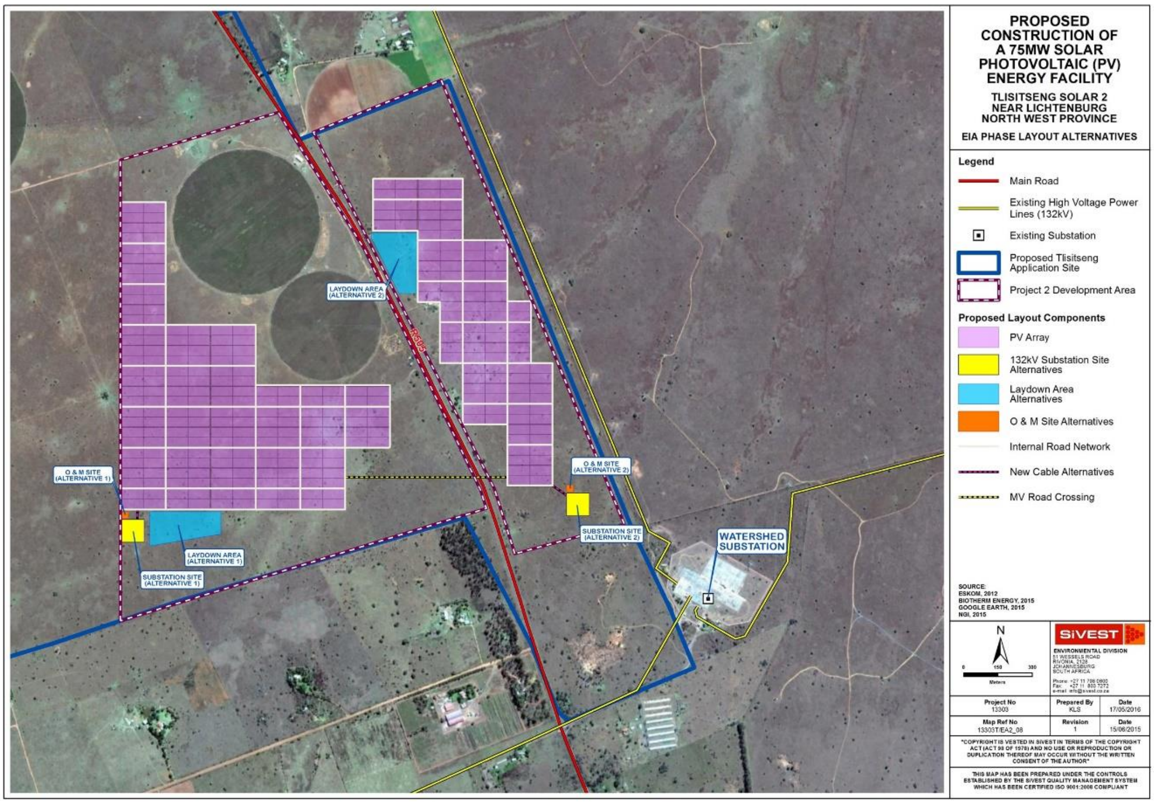


Figure 6: Proposed EIA Phase Layout Alternatives

5.2.4 The technology to be used in the activity

There are very few technological alternatives for PV technology. For the Tlisitseng 2 solar energy facility the mounting structures will be either fixed tilt mounting or single axis tracking solutions, and the modules will be either crystalline silicon or thin film technology. The impacts on the environment of the different types of PV technology are the same during construction, operation and decommissioning. Therefore no technology alternatives will be considered during the EIA. The choice of technology used will ultimately be determined by technological and economic factors at a later stage.

5.2.5 The operational aspects of the activity

No operational alternatives were assessed in the EIA, as none are available for solar PV installations.

5.2.6 The option of not implementing the activity

The option of not implementing the activity, or **the 'no-go' alternative, is considered in the EIA**. South Africa is under immense pressure to provide electricity generating capacity in order to reduce the current electricity demand in the country. With the global focus on climate change, the government is under severe pressure to explore alternative energy sources in addition to coal-fired power stations. Although solar power is not the only solution to solving the energy crisis in South Africa, not establishing the proposed solar PV energy facility and 132kV onsite substation would be detrimental to the mandate that the government has set to promote the implementation of renewable energy. It is a suitable sustainable solution to the energy crisis and this project could contribute to addressing the problem. This project will aid in achieving South Africa's goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

6 DESCRIPTION OF THE RECEIVING ENVIRONMENT

The North West Province is considered to be a suitable region for the establishment of a solar PV energy facility. Accordingly, a land portion located near Lichtenburg has been identified as a potential site. A general description of the study area is outlined in the section below. The receiving environment in relation to each specialists study is also provided.

6.1 Locality

The proposed project is located within the North West Province approximately 8km north-west of Lichtenburg. It falls within the Ditsobotla Local Municipality that forms part of the Ngaka Modiri Molema District Municipality (**Figure 7** and **Figure 8**). The proposed solar PV energy facility and 132kV onsite substation will be accessed by the R505 which traverses the site. The centre point co-ordinates for the development site and the substation assessment area as well as the start and end point coordinates for the power line alternatives, are included in **Table 9** and **Figure 10**.

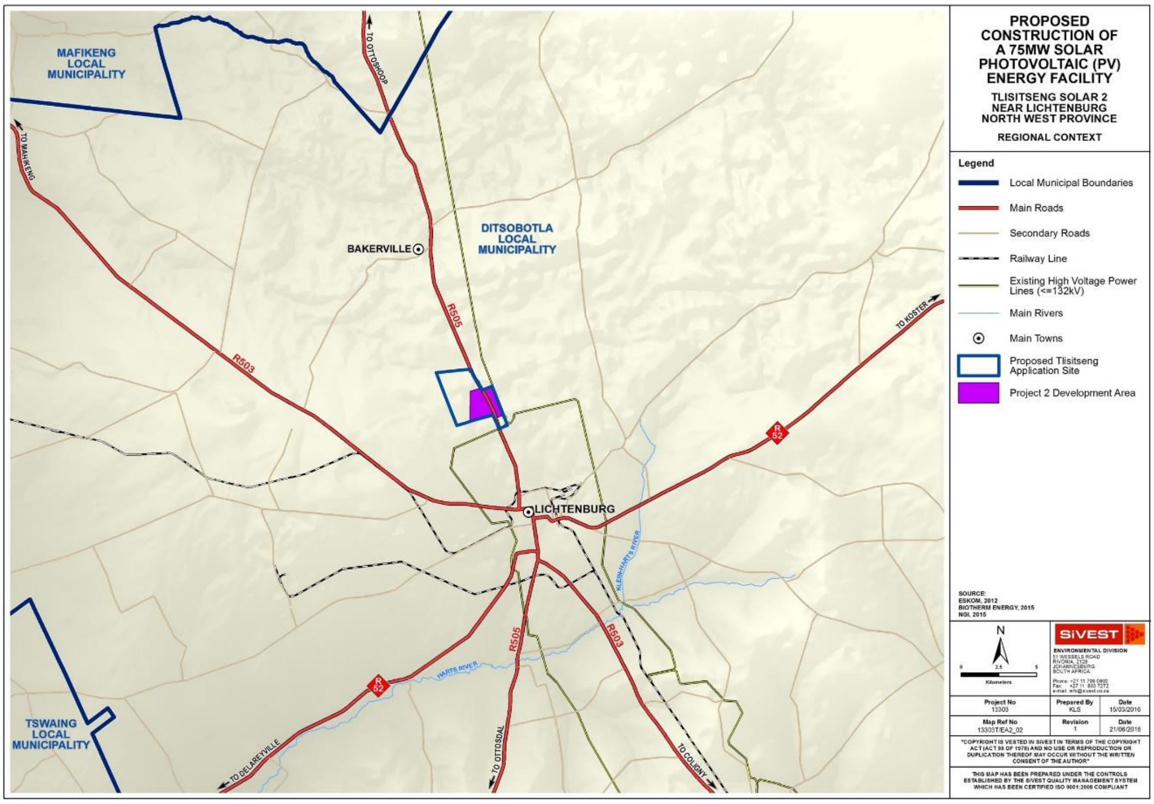


Figure 7: Regional Study Area.

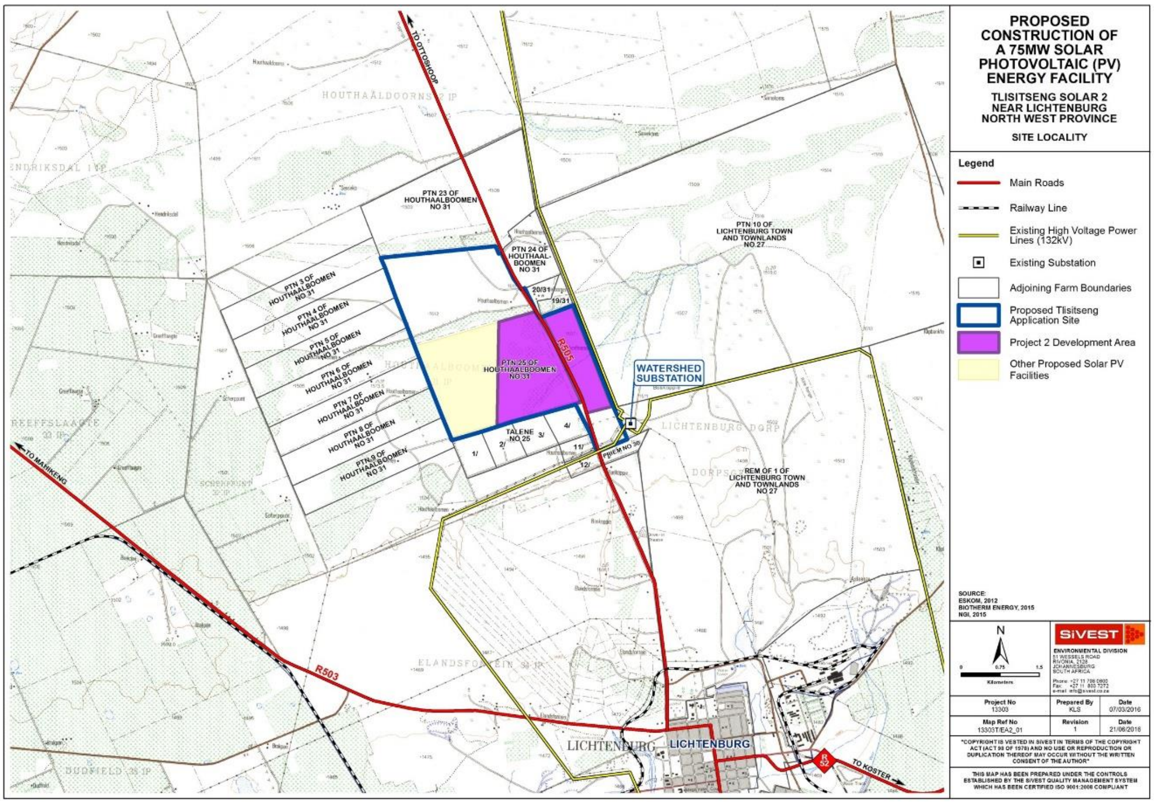


Figure 8: Site Locality

The site that is proposed for the Tlisitseng 2 solar PV energy facility near Lichtenburg is located on the following farm:

- Portion 25 of the Farm Houthaalboomen No 31, cadastral number: T0IP00000000003100025

Table 9: Application Site Location

TLISITSENG PV APPLICATION SITE				
NORTH-WEST CORNER	**NORTH-WEST CORNER**	**NORTH-WEST CORNER**	**NORTH-WEST CORNER**	**NORTH-WEST CORNER**
S26° 3' 46.260"	S26° 3' 46.260"	S26° 3' 46.260"	S26° 3' 46.260"	S26° 3' 46.260"
E26° 5' 42.756"	E26° 5' 42.756"	E26° 5' 42.756"	E26° 5' 42.756"	E26° 5' 42.756"

Table 10: PV Array and Onsite Substation Development Area

DEVELOPMENT AREA			
PHASE	**AREA (HECTARES)**	**CENTRE POINT COORDINATES (DD MM SS.sss)**	
		SOUTH	**EAST**

TLISITSENG SOLAR 2 DEVELOPMENT AREA - WESTERN PORTION	235.870	S26°4' 56.625"	E26° 7' 26.484"
TLISITSENG SOLAR 2 DEVELOPMENT AREA - EASTERN PORTION	108.552	S26°4' 47.604"	E26° 7' 59.539"

PV ARRAYS		
PHASE	**CENTRE POINT COORDINATES (DD MM SS.sss)**	
	SOUTH	**EAST**
TLISITSENG SOLAR 2 PV ARRAY AREA - WESTERN PORTION	S26°4' 57.159"	E26° 7' 22.844"
TLISITSENG SOLAR 2 PV ARRAY AREA - EASTERN PORTION	S26°4' 49.642"	E26° 7' 59.254"

The application site as shown on the locality map below comprises Portion 25 of the Farm Houthaalboomen No 31 which is approximately 1024ha in extent. It should however be noted that the proposed Tlisitseng 2 development area has been split into two (2) portions, namely the Western Portion and the Eastern Portion. The Western Portion will occupy an area of approximately 236 ha, while the Eastern Portion will occupy an area of approximately 109 ha. As such, the proposed Tlisitseng 2 development will occupy a total area of approximately 345 ha. In addition, the proposed 132kV onsite substation occupying approximately 2.25ha (**Figure 9**). The entire development area has been assessed during the EIA phase. The description and comparative assessment of alternatives is included in section 12. Portion 25 of the Farm Houthaalboomen No 31 is used for cattle breeding and irrigated agricultural activities such as maize farming. In addition, irrigated agricultural activities also take place on surrounding farm portions as well as scattered farm houses. The land under maize will be unaffected while the cattle's grazing area will be affected. However, the farmer plans to use the rental payment once construction begins from BioTherm. Between preferred bidder and financial close the farmer will be able to acquire land elsewhere so that the scale of his cattle farm does not have to be reduced. Land is regularly available in the area. There are four (4) workers that reside in two (2) houses on the farm. The two (2) permanent houses on the farm will need to be moved and some infrastructure changes will need to take place. BioTherm will however offer reimbursements for this. The land owner is in support of the project. The proposed development will therefore have very little impact on current land use on the affected farm.

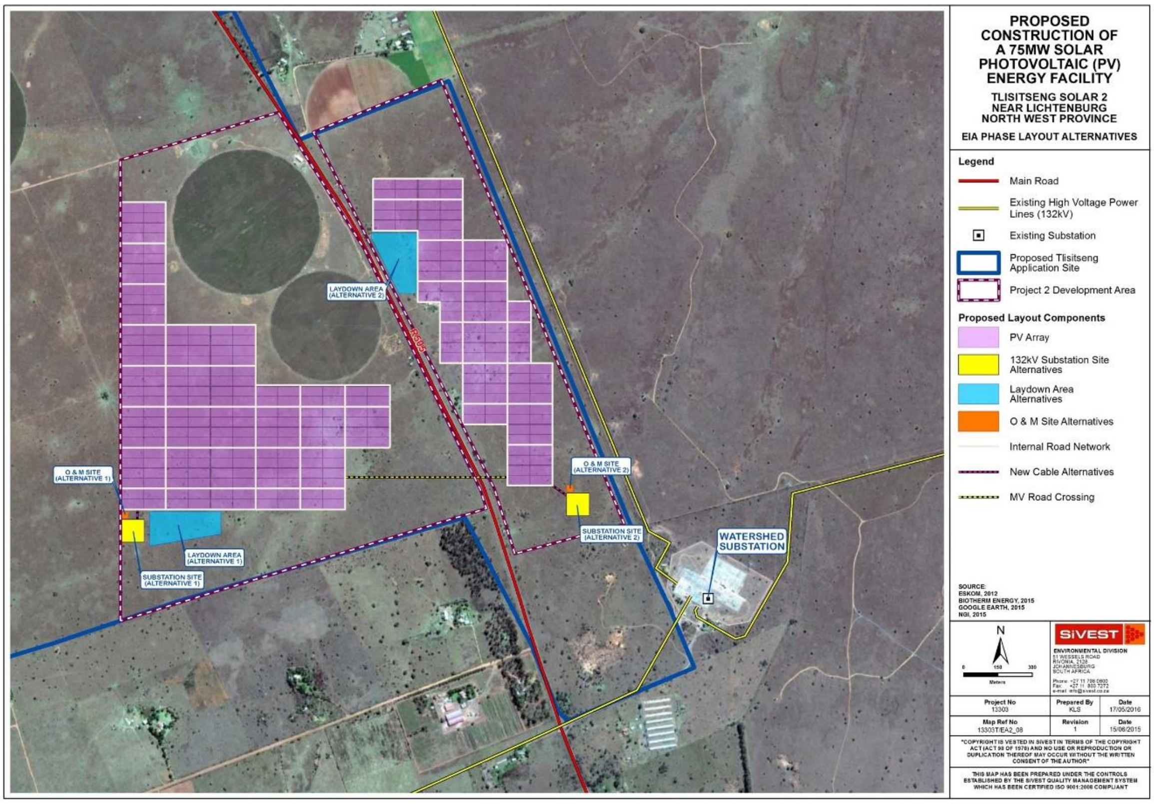


Figure 9: Site Layout

Please note that all maps within the report are included in Appendix 7 and are in A3 format.

6.2 Land Use

The entire site is covered by the Carlton Dolomite Grassland vegetation type, which is characterised by low shrubland with an open tree layer and species rich grasslands. 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 area however is still characterised by natural low shrubland and grassland with transformation present in the form of cultivated fields in the surrounding area and within site boundary (**Figure 10**).

The surrounding land use within the direct proximity of the development site comprises predominantly of vacant land, existing cultivations (agriculture) and mining.
Maize is the main crop produced in the area with both dryland and irrigated farming practises evident.

Built form in the surrounding area, in areas where cultivation 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**).

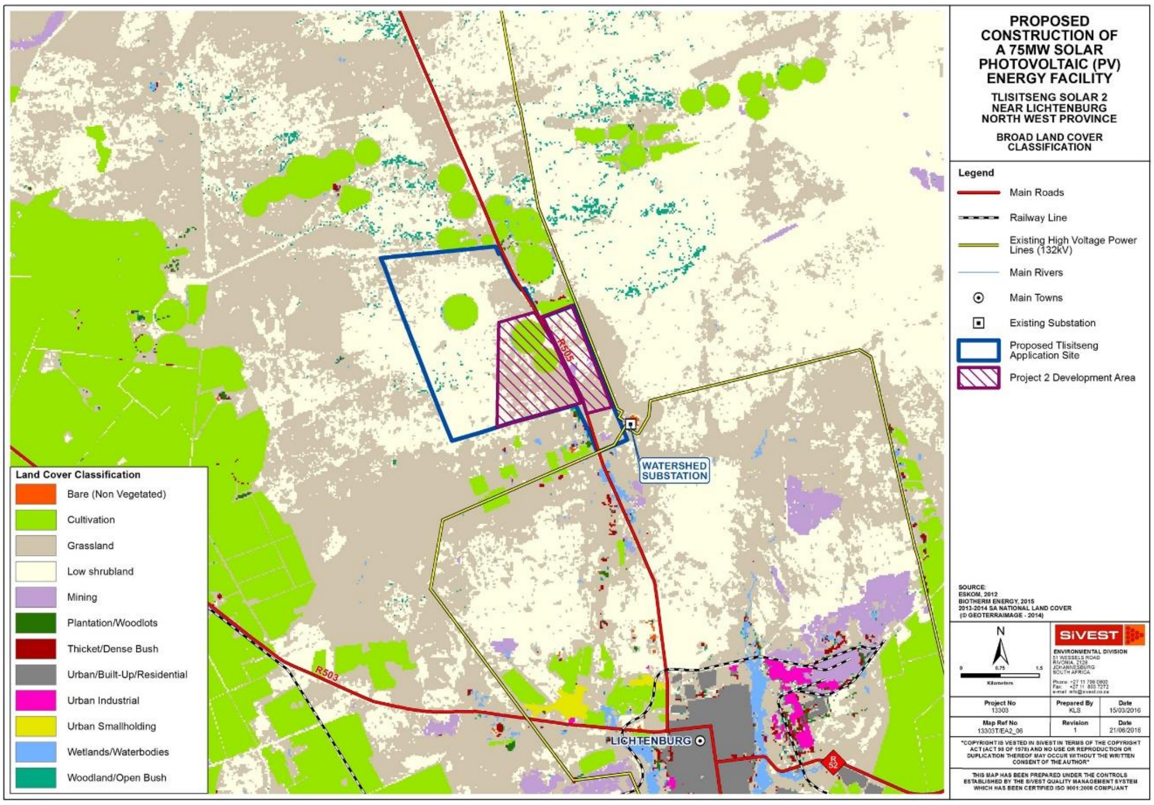


Figure 10: Land Use of the Study Area

Figure 11: Typical built form present within the study area

Human influence is also visible in the form of the R505 main road which traverses the area in a north-west to south-east direction (**Figure 12**) as well as electrical infrastructure comprising of three (3) 132kV power lines feeding into the Watershed MTS. It must be noted that the tall steel structures that make up the Watershed MTS, as well as the tall steel towers of the existing 132kV power lines, are visible from various parts of the site (Figure 13). In addition, there are some relatively small scale mining/quarrying activities in the surrounding area outside of the site footprint.

Figure 12: R505 main road which traverses the study area in a north-west to south-east direction

Figure 13: Tall steel structures that make up the Watershed MTS, as well as the tall steel towers of the existing 132kV power lines that run to the Watershed MTS, which can be seen from various parts of the study area.

The closest built-up area is the agricultural town of Lichtenburg, which is located approximately 5km to the south of the site. Urban development on the outskirts of Lichtenburg comprises of a mix of commercial, light/service industrial and residential development (**Figure 14**) as well as road and rail infrastructure largely concentrated on the eastern side of the R505 main road.

Figure 14: Outskirts of the town of Lichtenburg which comprises of a mix of commercial, light/service industrial and residential development

A large portion of the surrounding area to the east of the R505 has been demarcated as the Lichtenburg Game Breeding Centre, a largely untransformed area which was previously operated by the National Zoological Gardens of South Africa. This game breeding centre was mainly aimed at furthering the breeding programmes of endangered species already in place by the National Zoo, as well as supplementing the populations of local and international zoos. It must however be noted that at this stage, the game breeding centre is no longer operated by the National Zoological Gardens of South Africa and is currently not operational.

6.3 Topography and Slope

The topography within and in the immediate vicinity of the proposed application site is characterised by a flat to gently undulating landscape.

A representation of the typical views from the application site has been provided in Figure 15 below.

Figure 15: View from the Tlisitseng PV application site showing the typically flat to gently undulating terrain within the site

The topography in the wider area is largely characterised by level plains with little noticeable relief and very gradual slopes (**Figure 16**). In general, the area slopes down in a southerly direction towards the town of Lichtenburg (**Figure 17**).

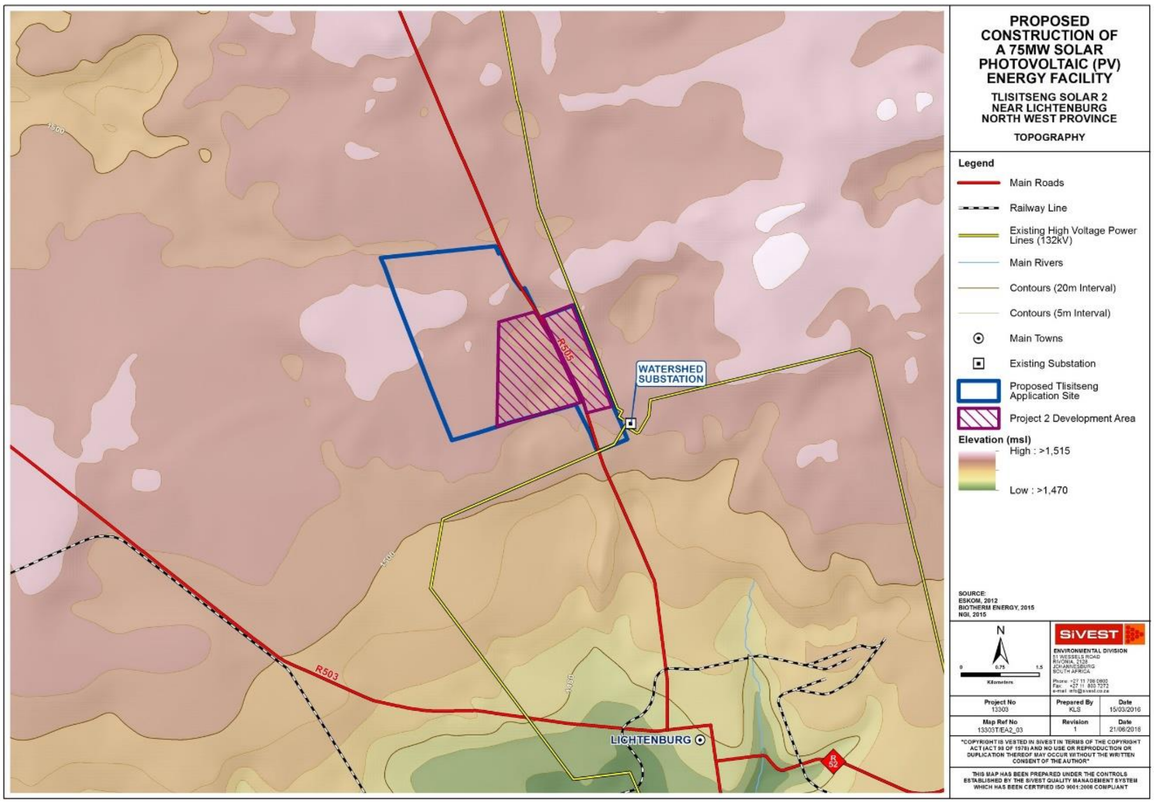


Figure 16: Topography within the study area

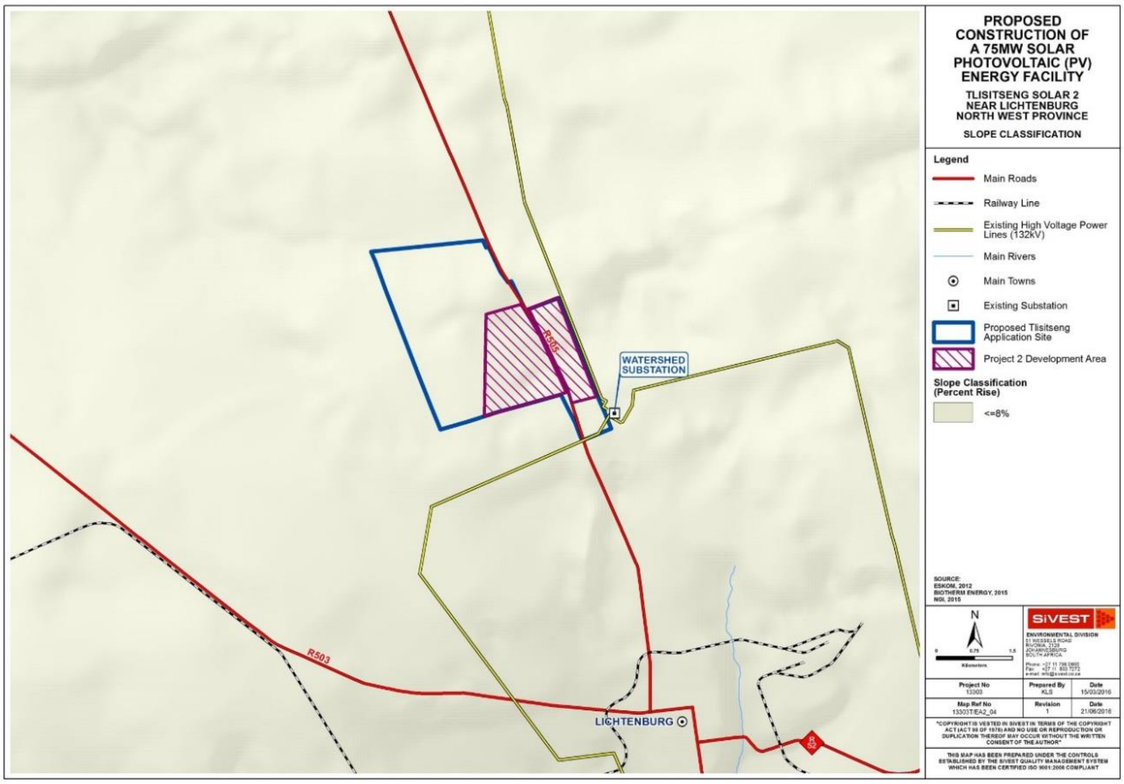


Figure 17: Slope of the study area

6.4 Climate

The climate of the study area (Kotze & Lonergan, 1984) can be regarded as warm to hot with moist summers and dry winters. The long-term average annual rainfall is 545 mm, of which 452 mm, or 83%, falls from October to March. The average evaporation over the same period is 2 335 mm. Temperatures vary from an average monthly maximum and minimum of 31.1ºC and 16.2ºC for January to 17.6ºC and 2.0°C for July respectively. The extreme high temperature that has been recorded is 36.0°C and the extreme low –4.1ºC.

6.5 Geology

The geology of the area comprises dolomite of the Malmani Formation (Geological Survey, 1984).

The distribution of the geological units in the area is shown in **Figure 18**.

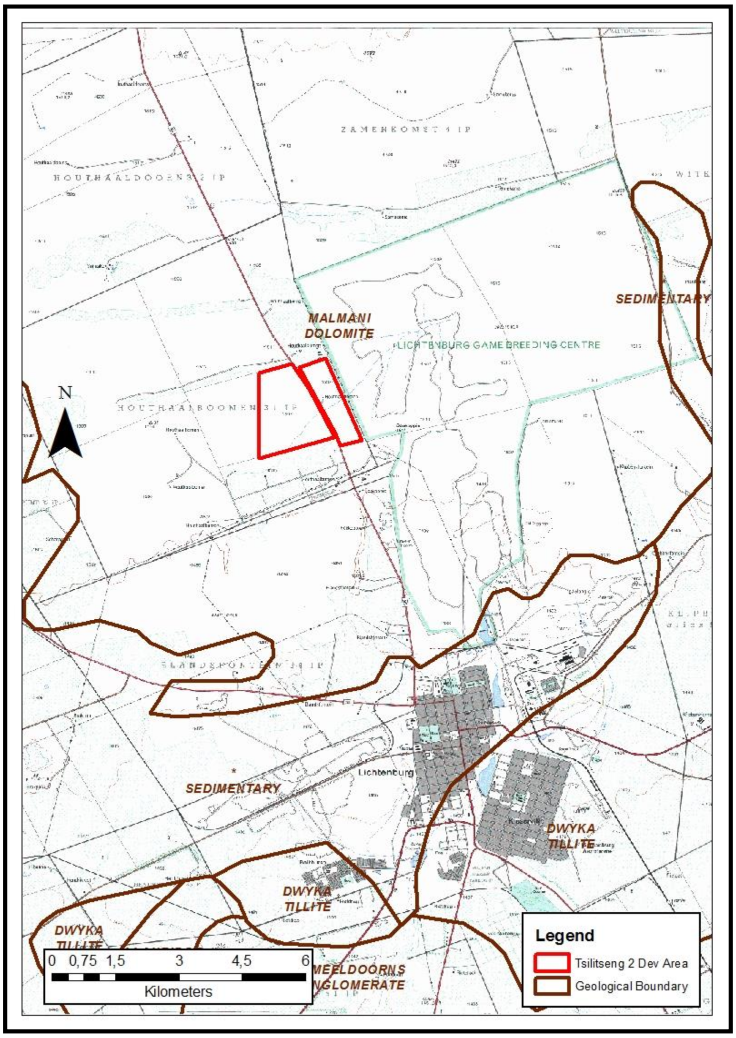


Figure 18: Geology

6.6 Biodiversity (Flora and Fauna)

The Biodiversity Assessment was conducted by David Hoare (**Appendix 6A**). The environmental baseline from a biodiversity perspective is presented below.

6.6.1 Broad vegetation types of the region

The sites fall within the Grassland Biome (Rutherford & Westfall 1986, Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina *et al*. 2006). **Figure 19** below shows one vegetation type occurring within the area of interest, Carletonville Dolomite Grassland. This vegetation type is described in more detail below.

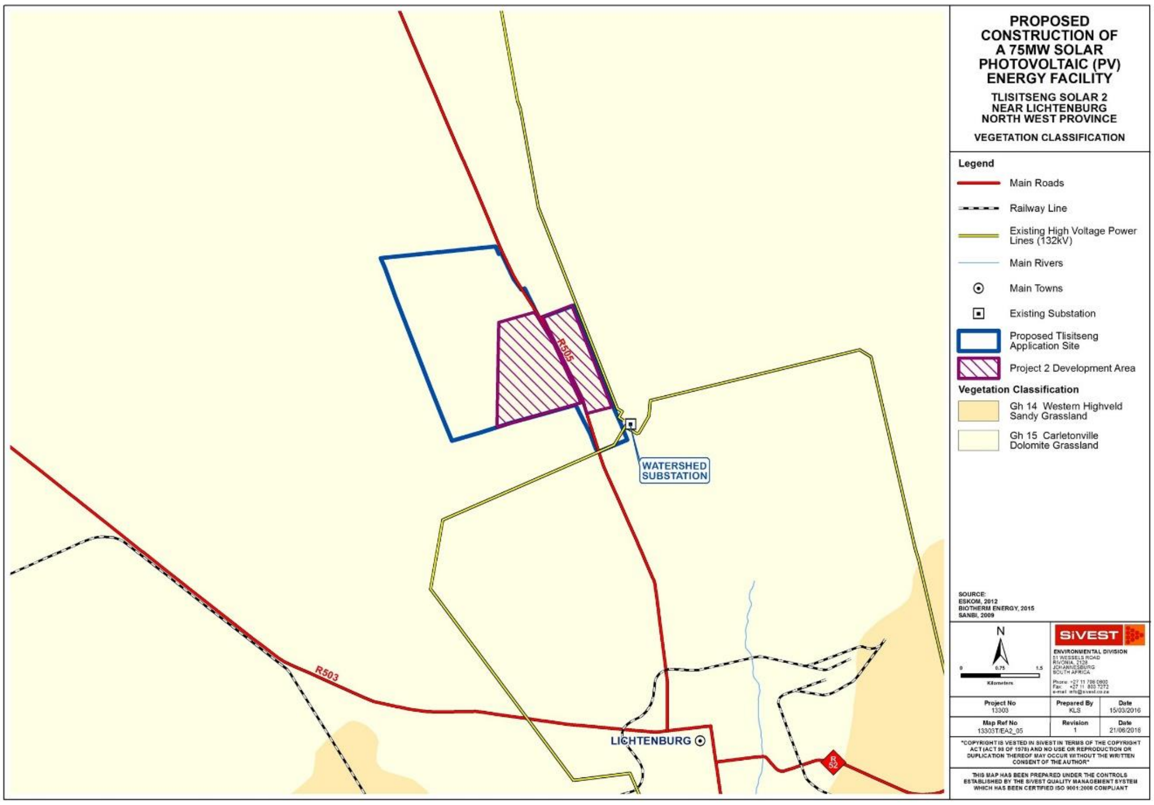


Figure 19: Vegetation of the Study Area.

6.6.2 Carletonville Dolomite Grassland

Carletonville Dolomite Grassland is found mainly in the North-West Province but also in Gauteng and marginally in the Free State Province. It is found in the region of Potchefstroom, Ventersdorp and Carletonville, extending westwards to the vicinity of Ottoshoop, but also occurring as far east as Centurion and Bapsfontein in Gauteng Province. Carletonville Dolomite Grassland is characterised by slightly undulating plains dissected by prominent rocky chert ridges. Species-rich grasslands form a complex mosaic pattern dominated by many species.

6.7 Avifauna

The Avifauna Assessment was conducted by Chris van Rooyen (**Appendix 6B**). The environmental baseline from an avifaunal perspective is presented below.

The proposed site is situated in the grassland biome approximately 9km north-west of the town of Lichtenburg in the North-West Province (Harrison *et al.* 1997). The habitat in the core study area is highly homogenous and consists of extensive grassy plains, with scattered, stunted mostly *Vachellia* trees and a variety of shrubs. The closest Important Bird Areas (IBAs), the Baberspan and Leeupan SA026, and the Botsalano Nature Reserve SA024 are located approximately 70km away to the south-west and north-west respectively (Barnes 1998, Marnewick *et al.* 2015). The development is too far away from these IBAs to have any direct impact on them. The core study area is situated directly adjacent to the 6000ha Lichtenburg Game Breeding Centre which contains an important vulture restaurant. The centre contains good grassland habitat and is a refuge for many grassland avifauna. Directly south of the Game Breeding Centre is an extensive network of dams and wetland areas, which is situated approximately 5km from the core study area at its closest point (see **Figure 20**). When filled with water, the dams and wetlands area attract an abundance of waterbirds.

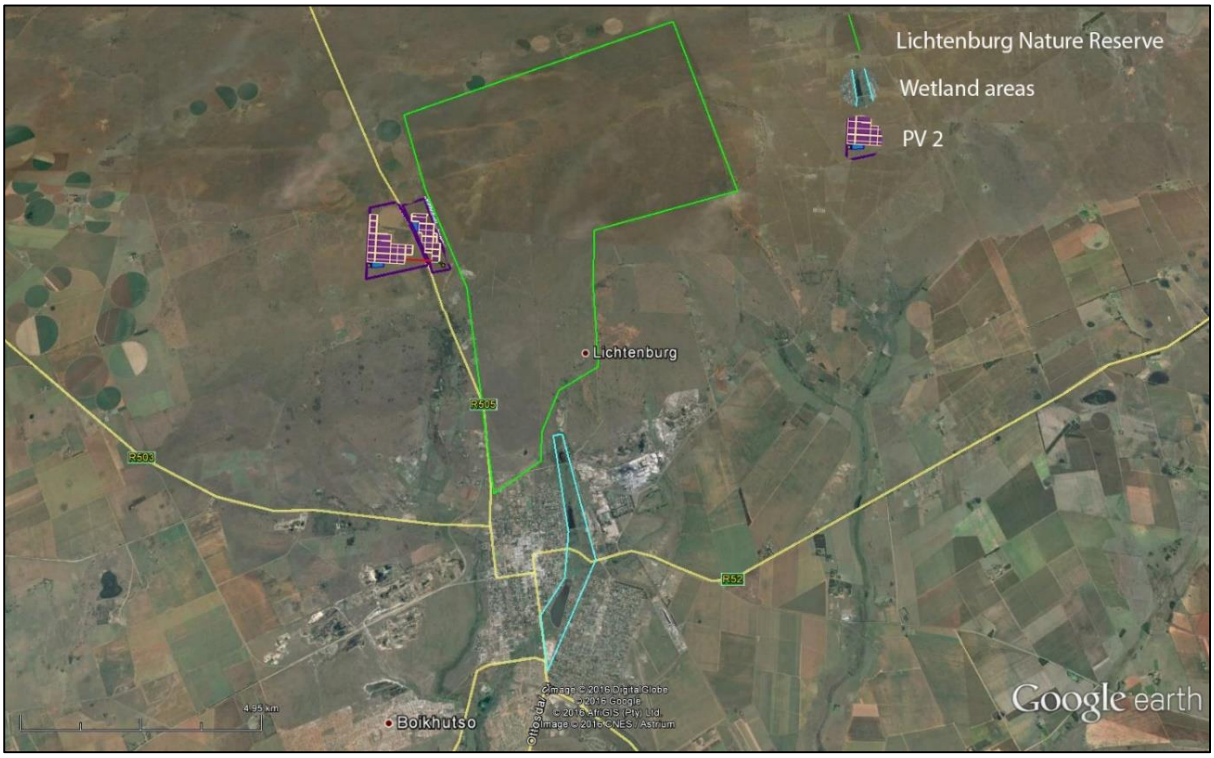


Figure 20: The location of the Lichtenburg Game Breeding Centre and the wetlands relative to the core study area.

6.7.1 Habitat classes and avifauna

Whilst much of the distribution and abundance of the bird species in the core study area and immediate surrounds can be linked to 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 surrounds.

- **Grassland**

The dominant natural vegetation type in the core study area and immediate surrounds is Carltonville Dolomite Grassland. Carltonville Dolomite Grassland occurs on slightly undulating plains dissected by chert ridges. In the study area, small, mostly Vachellia trees, and a variety of shrubs are scattered across the landscape. Species-rich grassland forms a complex mosaic pattern dominated by many grass species. Rainfall is in summer with an overall mean annual precipitation of 593 mm, with temperatures ranging from very cold with frost in winter to very hot in summer (Mucina & Rutherford 2006).

Based on the SABAP2 data, priority species that could potentially be found in natural grassland vegetation in the core study area are Cape Sparrow, Scaly-feathered Finch, Yellow Canary, Kalahari Scrub-robin, Red-headed Finch, Black-chested Prinia, Crimson-breasted Shrike, Cape Penduline-Tit, Bokmakierie, Eastern Clapper Lark, Lark-like Bunting, Fiscal Flycatcher, Northern Black Korhaan, White-backed Mousebird, Ant-eating Chat, South African Cliff-swallow, Pied Starling, Orange River White-eye, African Red-eyed Bulbul, Sabota Lark and Spike-heeled Lark. Occasional priority visitors to the study area could include Lanner Falcon, Martial Eagle, Tawny Eagle, Secretarybird, Kori Bustard, Blue Crane, Fairy Flycatcher, Namaqua Sandgrouse, Burchell's Sandgrouse, Southern Pale Chanting Goshawk, Grey-backed Sparrowlark, White-backed Vulture, Lappet-faced Vulture and Cape Vulture.

Pre-construction monitoring conducted over six months revealed fewer than expected priority species in the grassland habitat at the core site, 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 may also have contributed to the low bird counts.

Figure 21: Typical grassland habitat in the core study area (Carltonville Dolomite Grassland)

- **Surface water**

Surface water is of specific importance to avifauna in this relatively arid study area. The core study area contains two boreholes with water troughs for livestock (see **Figure 24**). Boreholes with open water troughs are important sources of surface water and are used extensively by various species, including large raptors, to drink and bath. Smaller priority species such as Cape Sparrow, Red-headed Finch, Scaly-feathered Finch, Yellow Canary, Namaqua Sandgrouse, Pied Starling and Lark-like Bunting congregate in large numbers around water troughs which in turn could attract priority predators such as Southern Pale Chanting Goshawk and Lanner Falcon. If the mortality is significant, Marabou Stork could also scavenge between the panels. The habitat around boreholes (shrubs and trees) often attract other priority species such as Bokmakierie, Kalahari Scrub-robin, Crimson-breasted Shrike, Fiscal Flycatcher, Karoo Thrush, African Red-eyed Bulbul, Orange River White-eye, Fairy Flycatcher and White-backed Mousebird. The water troughs and reservoirs are also attractive to large raptors and vultures, and could attract Martial Eagle, Tawny Eagle, White-backed Vulture, Lappet-faced Vulture and Cape Vulture. Despite the potential attraction that surface water holds for priority species, the two boreholes at the core study area were not focal points of bird activity during the six months of pre-construction monitoring. This may be due to the very dry and hot conditions which prevailed, which resulted in lower bird activity overall, and the size of the water troughs, which are quite small.

The wetland areas indicated in **Figure 24** might become relevant in that the waterbirds flying over the study area on their way to the wetlands area might mistake the PV area for surface water and attempt to land on the PV panels (the so-called lake effect), which could expose them to collision risk. Priority species that could occur at the wetlands and dams when they are full are South African Shelduck, Black Stork, Yellow-billed Stork, Greater Flamingo, Lesser Flamingo, Great White Pelican and Marabou Stork. Pre-construction monitoring conducted over six months recorded very few waterbirds in the wetland areas, again due to the very dry conditions at the time. The dams were all dry, except one dam that had about 15% water. However, the situation could change significantly if the dams were to fill up e.g. at a small water filled depression in an industrial part of the town the following priority species were recorded incidentally in February 2016: Hamerkop, Caspian Tern, White-faced Duck, Yellow-billed Duck, Red-billed Teal, Ruff, Black-winged Stilt, Blacksmith Lapwing, Little Egret, Glossy Ibis and Hadeda Ibis (K. Lavery pers.comm 2016).

- **Agriculture**

The core study area is bordered by several pivots, where a variety of agricultural crops are cultivated. Although agricultural lands completely destroy the structure of the original vegetation, some birds do benefit from this transformation. Blue Crane, Abdim's Stork and Black-winged Pratincole are the priority species most likely to utilise agricultural clearings adjacent to the core study area. Abdim's Stork and Black-winged Pratincole can occur in flocks of several hundred on irrigated fields, although the species apparently do not occur in large numbers in the area. The clearings could also be utilised by Secretarybirds, but the species is likely to occur sparsely. However, none of the above priority species were recorded during the pre-construction monitoring at the core study area itself, probably due to the lack of agricultural clearings in the core study area itself. This may be due to the rocky nature of the terrain which may have made the development area less viable for cultivation.

Figure 22: Irrigated lands in the core study area

- **High voltage lines**

High voltage lines are an important potential roosting and breeding substrate for large raptors and vultures. Existing high-voltage lines are used extensively by large raptors, especially Martial Eagles, but also Tawny Eagles for breeding purposes (Jenkins et al. 2006). The core study area is located less than 3km from the Watershed Transmission Substation, where many high voltage lines converge.

Several high-voltage lines run to the south and east of the core study area (see **Figure 24** below). While the lines in the Lichtenburg Game Breeding Centre are used extensively by Cape, White-backed and Lappet-faced Vultures which are attracted to the vulture restaurant, for roosting (pers. obs), inspection of the lines directly adjacent to the core study area during the pre-construction monitoring did not reveal any roosting vultures or raptor nests.

Figure 23: The vulture restaurant in the Lichtenburg Game Breeding Centre with the Watershed MTS in the background.

See **Figure 24** below for the location of boreholes and high voltage lines relative to the core study area.

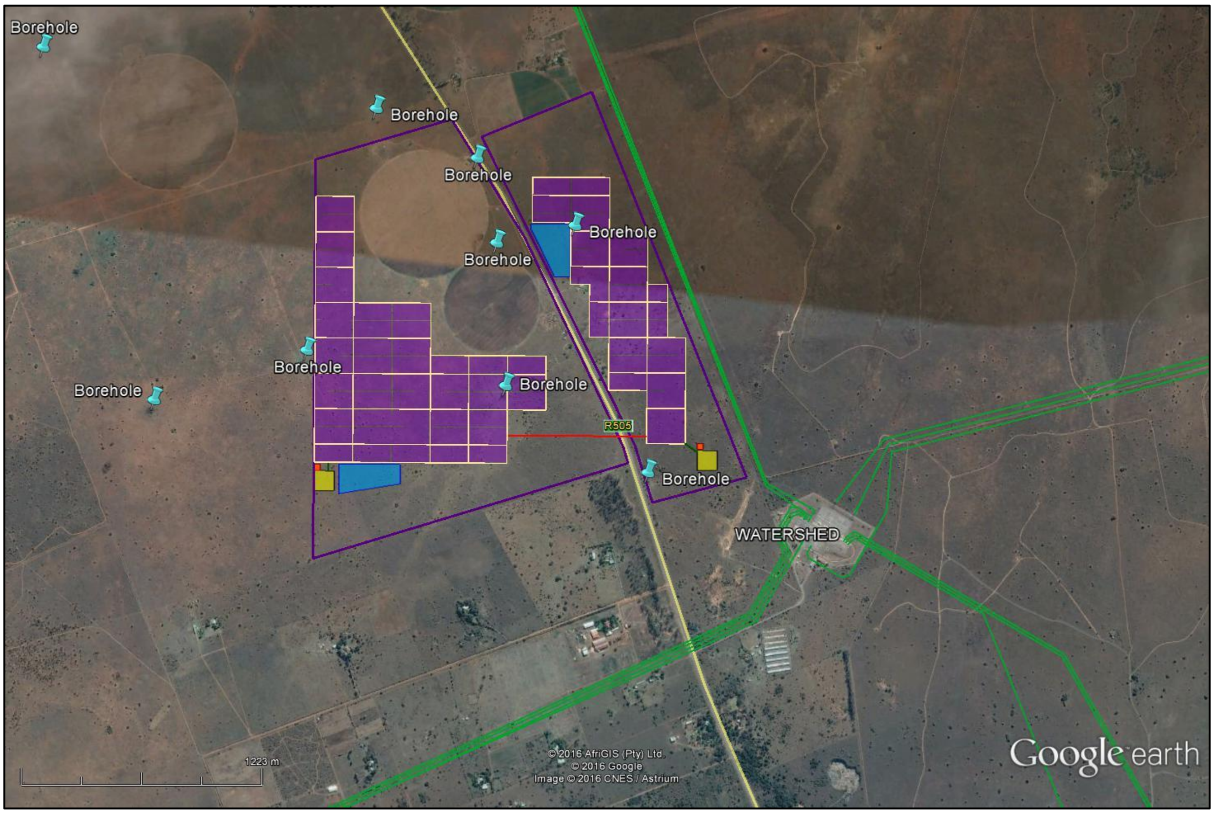


Figure 24: The location of boreholes (blue placemarks) and HV lines (green) relative to the core study area.

6.8 Surface Water

The Surface Water Assessment was conducted by Shaun Taylor of SiVEST (**Appendix 6C**) and the environmental findings from a Surface Water perspective are presented below.

6.8.1 Desktop Findings

In terms of the National and North West ENPAT (2000) databases, the proposed development is found within the Lower Vaal Water Management Area (WMA) which is situated within the Vaal Primary Catchment. More specifically, the proposed development is located within the C31A quaternary catchment.

In terms of surface water resources within the Tlisitseng 2 PV facility site, it was found that there are no wetlands within these areas (**Figure 25**) from a database perspective. However, a small potential watercourse was identified. This feature was investigated in the fieldwork component of the assessment below in **Section 8.4**.

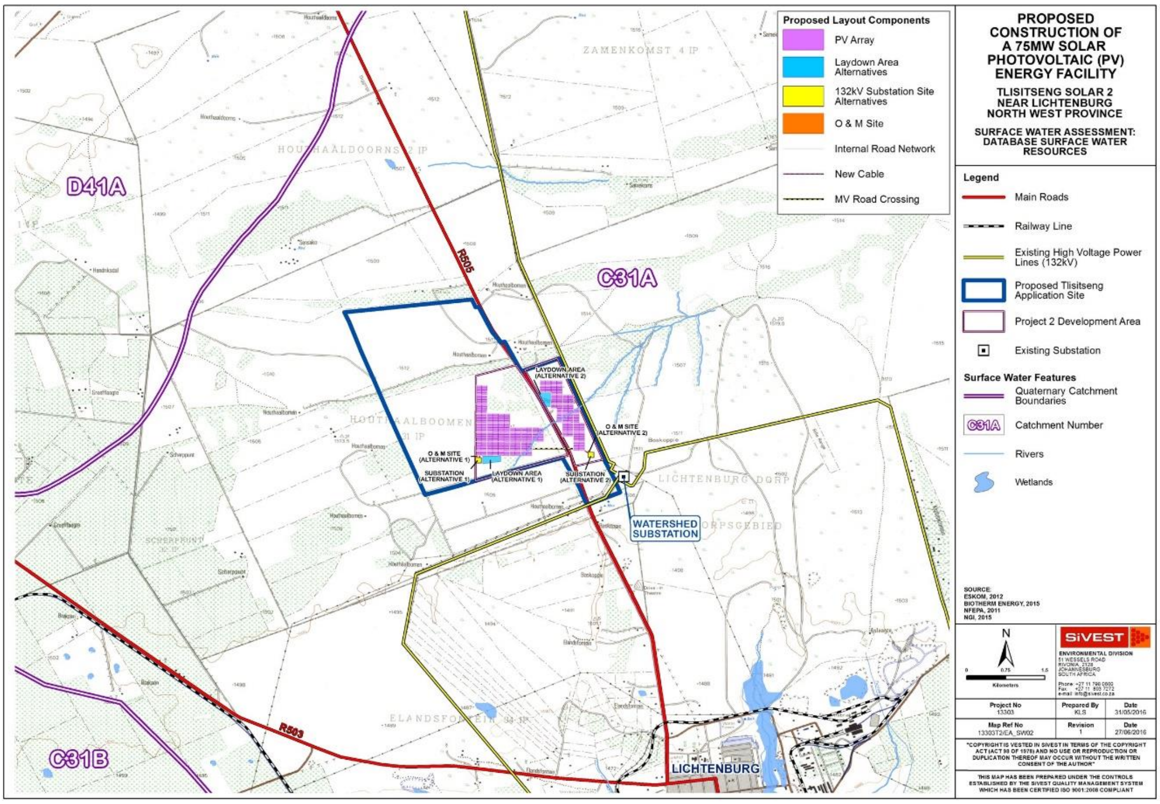


Figure 25. Tlisitseng 2 PV Facility Database Surface Water Map

6.9 Agricultural Potential and Soils

The Agricultural Potential Assessment was conducted by Garry Patterson (**Appendix 6D**) and the environmental findings from an Agricultural Potential perspective are presented below.

For the scoping report, existing soil information was obtained from the map sheet 2626 West Rand (Bruce & Schoeman, 1978) from the national Land Type Survey, published at 1:250 000 scale. A land type is defined as an area with a uniform terrain type, macroclimate and broad soil pattern. The soils are classified according to MacVicar et al (1977).

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).

6.9.1 Terrain

The area lies at a height of approximately 1 500 metres above sea level. The area slopes very gently (<2%) to the south-west). No permanent drainageways are present in the vicinity.

6.9.2 Climate

The climate of the study area (Kotze & Lonergan, 1984) can be regarded as warm to hot with moist summers and dry winters. The long-term average annual rainfall is 545 mm, of which 452 mm, or 83%, falls from October to March. The average evaporation over the same period is 2 335 mm. Temperatures vary from an average monthly maximum and minimum of 31.1ºC and 16.2ºC for January to 17.6ºC and 2.0ºC for July respectively. The extreme high temperature that has been recorded is 36.0ºC and the extreme low –4.1ºC.

6.9.3 Land Use

The land use in the area is dominantly grazing, but with areas of cultivation, some under irrigation as classified by the National Land Cover (Thompson, 1999).

6.10 Visual

The Visual Assessment was conducted by Andrea Gibb and Stephan Jacobs of SiVEST (**Appendix 6E**) and the findings are presented below.

6.10.1 Visual baseline

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. As a result, typically wide-ranging vistas are experienced within the study area, especially from locally higher elevations.

6.10.2 Visual Implications

The predominant very low shrub layer and open areas of cultivated fields / grasslands 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 26**). The relatively low density of human habitation and the presence of natural vegetation cover across large portions of the study area would give the viewer the general impression of a largely natural rural setting (**Figure 27**). There are however significant patches of cultivation in the study area which have transformed the natural characteristics of the area. High levels of human transformation and visual degradation only become evident in the southern sector of the study area where urban/peri-urban development has taken place on the outskirts of Lichtenburg.

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

Figure 26: Example of tall trees that have been established around a farmhouse in order to provide visual screening

Figure 27: Typical natural rural visual character found within larger portions of the study area

6.10.3 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 maize cultivation 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 grasslands. The most prominent anthropogenic elements in these areas include the R505 main road, 132kV power lines, a 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 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 a west-east aligned railway line on the northern perimeter of

Lichtenburg. 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 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.

6.10.4 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 shrubland and grassland interspersed with farmsteads, windmills, livestock holding pens and agricultural land. Livestock farming and other forms of agriculture, such as maize production, are evident within the surrounding area. This can be attributed to the fact that the nearby town of Lichtenburg is situated in the heart of the maize triangle, which is the main maize growing area in South Africa. Today the town is the centre of a huge farming district where maize, groundnuts and sunflower seeds are the main crops (http://www.places.co.za/html/lichtenburg.html).

The town of Lichtenburg was established in 1873 and is situated in the very western corner of South Africa's maize triangle. In addition, Lichtenburg is a farming and industrial town known for the manufacture of cement. (http://showme.co.za/south-africa/north-west/central-district/lichtenburg/). Apart from the agricultural, mining and quarrying activities taking place in the LM, there exists an opportunity for conservation and tourism. It should also be noted that the area surrounding Lichtenburg has a rich diamond mining history. In 1926 a diamond was found on the farm Elandsputte, resulting in a diamond rush where more than 100 000 diggers streamed to Lichtenburg. In 1927, 25 000 runners took part to peg their claims in one of the biggest diamond rushes in history, which resulted in the biggest pure red diamond ("pigeon blood red") in the world being found there (http://www.sa-venues.com/game-reserves/nwp_lichtenburg.htm). Popular activities in the area include game viewing, fishing and motor car racing.. Lichtenburg is also perfectly positioned to be an ideal stopover for travelers from Johannesburg to Mafikeng and Mmabatho. Tourist attractions situated within the greater area include the Lichtenburg Diggings Museum, Bakerville, Wondergat and the Lichtenburg Game Breeding Centre.

There are several attractions in Lichtenburg that pay homage to the town's rich Boer and prospector history as well as its prosperous farming and manufacturing present. Lichtenburg is the resting place of Anglo-Boer War General Koos de la Rey, and a statue of the General on his horse has been erected in the town square. The town and surrounds feature many heritage homes and a couple of National Monuments. The Lichtenburg Diggings Museum has exhibits of the alluvial diamond diggings which lasted from 1925-1935, then the richest public diggings in the world (http://www.southafrica.com/museums/lichtenburg/). The Ampie Bosman Cultural History Museum can also be found within the town of Lichtenburg and gives an introduction to the history of the town. In addition, a number of historical buildings can also be found within the town of Lichtenburg and include:

- The Dutch Reformed Church in Gerrit Maritz Street erected in 1890 (Declared a National Monument);
- The old magistrate's building which dates from 1895/96;
- The home where General De la Rey lived. This was demolished during the Anglo-Boer War but was rebuilt on the original foundations in 1902;
- The home of the founder of Lichtenburg, H.A. Greeff, built in 1875, which is still standing; and
- An old plantation house, home of the pioneer in dry-land farming, Col. H du Toit, erected in 1910.

The nearest known tourist attraction within the study area is the Lichtenburg Game Breeding Centre, which is situated 2km north-east of Lichtenburg. The Lichtenburg Game Breeding Centre was operated by the National Zoological Gardens of South Africa and was mainly aimed at furthering the breeding programmes of endangered species already in place by the National Zoo, as well as supplementing the populations of local and international zoos. The reserve has maintained a largely natural character and was used to breed animals such as the addax, scimitar horned and Arabian oryx, and the mohrr gazelle. The centre is also characterised by the presence of a wetland area which used to be home to unique animals such as the pygmy hippo and Pere David's deer. White rhino, blue wildebeest, zebra, impala, gemsbok and many other species could also be found within the breeding centre. In addition, part of this wetland area has been honed into a series of dams and pans that function as a haven for water birds. The centre also features one of the largest bird hides in the country and has a network of game drive routes (http://www.sa-venues.com/game-reserves/nwp_lichtenburg.htm).

Approximately 20km north of Lichtenburg lies the world-renowned diamond diggings known as "Bakerville". It was the richest public diggings ever mined and is only one of several "Diggers Towns" developed in Wild West style. Approximately 40km on the Mafikeng road lies “Wondergat”, which is one of the deepest sinkholes in South Africa where deep-freshwater diving can be practiced.

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 1873 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 Lichtenburg, 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 an on-site substation and power line as introducing this type of development could be considered to be a degrading factor in the context of the natural or rural / pastoral character of the study area, as discussed further below.

6.11 Heritage and Palaeontology

The Heritage Assessment was conducted by Wouter Fourie from PGS, with Palaeontological input from Gideon Groenewald, and is included in **Appendix 6F**. The environmental baseline from a heritage perspective is presented below.

During the scoping phase, 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. For the second (EIA) phase of this proposed development, 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. 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. These findings are discussed in more detail in **Section 8.7** of this report.

6.11.1 Previous Studies

A search of the SAHRIS (SA Heritage Resources Information System) database identified the following Heritage Impact Assessment (HIA) and Palaeontological Impact Assessment (PIA) reports for the study area and general surrounding region:

- Heritage Impact Assessment for the proposed rerouting of four existing 132kv power lines at the Eskom Watershed Substation, Lichtenburg, Ditsobotla Local Municipality, Ngaka Modiri Molema District Municipality, North-West Province. PGS Heritage (Pty) Ltd
- Cultural Heritage Resources Impact Assessment of Portion 151 of Lichtenburg Town and Townlands 27 IP (Lichtenburg Extension 10), North West Province. Dr Udo Küsel. African Heritage Consultants CC. Prepared for Lockeport Projects (Pty) Ltd. July 2008
- Heritage Impact Report for the Proposed 88kv Power Line from Watershed Substation, Lichtenburg, to the Mmabatho Substation, North West Province. J van Schalkwyk. Prepared for Arcus Gibb. November 2008.
- Cultural Heritage Resources Impact Assessment of a Feedlot on the Farm Kalkfontein, Lichtenburg District, North West Province. Dr Udo Küsel. African Heritage Consultants CC. Prepared for EkoInfo CC. May 2011.
- Heritage Impact Assessment for the Proposed Lichtenburg Solar Park, North-West Province. Compiled for Africa Geo-Environmental Services (AGES) by Marko Hutten, Hutten Heritage Consultants. May 2012.
- Lichtenburg Solar Park, North West Province - Palaeontological Impact Assessment. Prof. Bruce Rubidge. Prepared for AGES (Pty) Ltd. July 2012.

The above-noted studies identified the following sites:

6.11.1.1 Archaeological and Historical Sites:

- No sites dating to the Stone Age were identified in the region of the study area
- No sites dating to the Iron Age were identified in the region of the study area.
- A number of features dating to the historic period were identified in the region surrounding the study area. This includes the remains of an old house in Bakerville, and a number of cemeteries. However, none of these sites is located within or adjacent to the study area.

6.11.1.2 Palaeontological sites:

The PIA (Groenewald, 2016), for the Watershed Substation upgrade, which is located immediately southeast of the study area, noted the following:

> *"The study area is underlain by Vaalian aged Chert-rich Dolomites of the Monte Christo Formation, Malmani Subgroup, Chuniespoort Group, Transvaal Sequence. The Monte Christo Formation begins with an erosive breccia and continues with stromatolitic and oolitic platformal dolomites.*

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."

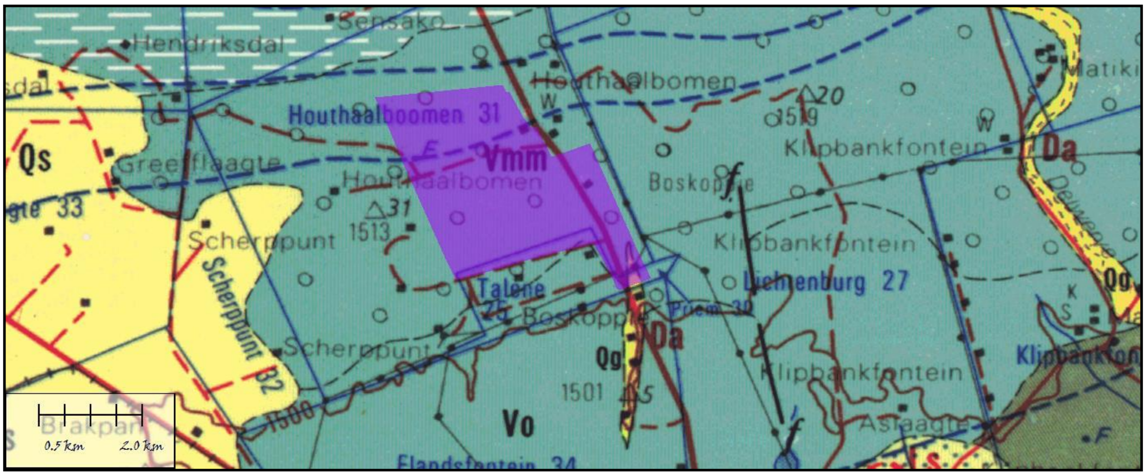


Figure 28: Geology of the study area (in purple)

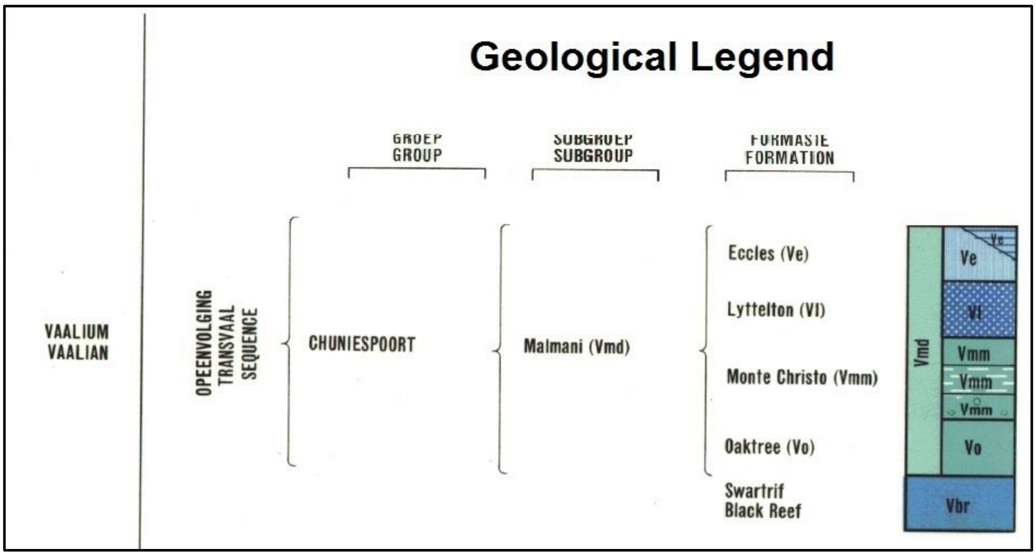


Figure 29: Geological legend for Figure 28

6.11.2 Archival findings

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 11**.

Table 11: Summary of History of Lichtenburg Town and Surrounding Area

DATE	DESCRIPTION
2.5 million to 250 000 years ago	**The Earlier Stone Age (ESA)**. The Earlier Stone Age 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 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. The rock engraving site at Bosworth Farm, near Klerksdorp also contains many stone artefacts (lithics) which date to over one million years ago (http://www.nasmus.co.za/departments/rock-art/public-rock-art-sites). No sites are known in or near the study area.
250 000 to 40 000 years ago	**The Middle Stone Age (MSA)**. 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. No sites are known in the vicinity of the study area.
40 000 years ago to the historic past	The **Later Stone Age (LSA)** is the third phase in South Africa's Stone Age history. It is associated with an abundance of very small stone artefacts (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). See below for two well-known sites in the greater vicinity of the study area (Thaba Sione and Bosworth Farm).
Rock Art	**Thaba Sione**: this site is located in the middle of Thaba Sione town, some 60km south-west of Mmabatho. The site contains over 559 engravings located on rocks and boulders. The engravings are dominated by depictions of rhinoceros – some have been rubbed smooth. There are also buffalo, eland, shamanic human figures, wildebeest and a rare lizard. The site is still important today to local Tswana people and is used by the Zion Christian Church as a rain-making centre. (http://www.nasmus.co.za/departments/rock-art/public-rock-art-sites) **Bosworth Farm**: this site is located some 22km north-west of Klerksdorp on the Bosworth Farm property. It is a large site with over 400 San and Khoe (herder) rock engravings. There many depictions of human figures as well as animals: a charging rhinoceros, a large elephant, a flight of birds. There are also many geometric motifs. The site also has many stone artefacts (lithics) which date to over one million years ago. Bosworth is one of South Africa's 12 Rock Art sites formally protected under the National Heritage Resources Act (25 of 1999). (http://www.nasmus.co.za/departments/rock-art/public-rock-art-sites)

AD 200 - 900	**Early Iron Age (EIA)**. Known sites in the region include Kruger Cave near Rustenburg and Broederstroom near Hartebeespoort Dam. Both sites are located to the east of the study area and date to approximately 460 AD (Mason 1974). No recorded sites were located within the study area during the desktop study.
AD 900 - 1300	**Middle Iron Age (MIA)**. No recorded sites were located during the desktop study.
AD 900 - 1840	**Late Iron Age (LIA)**. Various well-known sites from this period are located in the greater North-West Province, including the stone walled complexes at Buispoort and Braklaagte, the Makgame megasite, the 18th century capital at Kaditshwene and the copper mines at Dwarsberg in the Madikwe Game Reserve. These sites date to between the 15th and 19th centuries and record the arrival and development of the early Moloto Sotho-Tswana speakers (Boeyens, 2003).
	Four groups are of importance in the study area. These are the Bakolobeng, Batloung, Banogeng, and the Barolong. The following information was derived from a study conducted by the Lichtenburg Museum under P. M. Ntamu, 1996. The origins of the tribes of the Lichtenburg area follows (Fourie, 2009). *The Bakolobeng*: Oral sources indicate that the Bakolobeng originated from Tsaong near Silverkrans. Chief Kelly Molete concurs with Breutz's informants that the Bakolobeng were led through the present Kwena-Reserve of Botswana by Chief VI Molete-wa-Modikwagae in about 1769 or 1770, and later moved to Tsaong. Around 1830, they experienced a difficult period, which began with the death of their Chief, Kgosi VIII Molete when the Ndebele Group attacked them. This period of Difagane was also characterised by the Bakolobeng's flight to Thaba 'Nchu (in the Free State) and to Dimawe (Klerksdorp District) were they joined other refugees like the Batloung and Banogeng. After 1837, the Thaba 'Nchu Group of the Bakolobeng returned and settled temporarily at Bodumatau (Lichtenburg District) until they came into contact with Hermannsburg Mission. *Batloung:* They are also known as Batlhako, because they were originally with the Batlhako when they departed from the present Pretoria District and migrated to the areas of Rustenburg in about 1650. Oupa Mogorosi, one of the oldest informants, stated that: "... (they) departed from Mabalstadt along with Baphiring ... who controlled a section of people who were later to settle at Putfontein." Breutz's informants hold that in about 1750, the Batloung became an independent chiefdom and went to settle at Dipakane, in the Klerksdorp area. The Batloung later went to stay in a farm at Gruisfontein, accompanied by Rev Schnell of the Hermannsburg Lutheran Mission. At that time the Tribe was so scattered that one section was at Bodibe (Polfontein) and other places in the district. The idea of buying a farm as their ultimate settlement brought them together. *Banogeng:*

	According to oral sources collected by Breutz, the Banogeng are believed to be an ancient branch of the Digoja, i.e. forerunners of the Batswana Tribes who passed the Mafikeng area in small clan units. They are believed to be related to the Bakubung, Bataung and the Barolong Tribes, who originally shared the same totem; Tholo (Kudu) with them. For reasons better known to themselves; the Banogeng were destroyed and separated even before the period of Mzilikatzi attacks, except for remnants who stayed in the Lichtenburg District. The Ndebele continued to pose a threat to them so that they fled to Dimawe in the District of Klerksdorp. Here they merged with refugees from Baphiring, Batloung and Bakolobeng Tribes. Except for those who were assimilated into the already mentioned tribal groups, Ramosiane attempted to gather the remains of the Banogeng. They stayed at Kolong (Rietfontein) until 1960 when the tribe applied for its recognition and the re-establishment of the tribe. *The two Barolong tribes:* There are presently so many Barolong Tribes whose origin has been attributed to the first Chief Morolong, and the second Chief Noto. It is interesting to note that the totems, Tholo (Kudu) and Tshipi (Iron), were respectively taken from the names of the Chiefs mentioned. In his book, "History of the Batswana", Natal, 1989, Breutz indicate that "the first Tswana Tribe to come to South Africa under the rule of a Chief were the Barolong who arrived sometime between 1 200 and 1 300 or earlier". These migrations which continued even beyond the years 1450 and 1700 made the divisions of the Batswana Tribes like the Bahurutshe and the Bakwena more conspicuous. From 1823 - 1830, several Barolong Tribes fled from their Tribal land in the Transvaal as a result of Bataung raids and the Mzilikazi raids. Towards the end of the eighteenth century, the Barolong had divided into four groups, under Rratlou, Rrapulana, Seleka and Tshidi. The first two groups, namely the Barolong Boo-Ratlou and the Barolong Boo-Rapulana came to stay in the District of Lichtenburg. The Barolong Boo-Rapulana's residence was Lotlhakane (Rietfontein) in the Lichtenburg District. In 1882 moved to Bodibe (Polfontein) in the District of Lichtenburg. The last of the Barolong Boo-Ratloung, Chief Noto Moswete and his tribe were moved to Kopela.
AD 1873	**Historical period** The town of Lichtenburg: Hendrik Adriaan Greeff was born on the farm Lichtenburg close to Durbanville in the Cape Province. He became a hunter and started to frequent the then ZAR area. Greef settled in the late 1860 on the farms Doornfontein and Kaalplaats. Potchefstroom was the closest trading centre and approximately 150 km or "14 uur rijdens te paarde" away. A need for a town with a church and shops became stronger and Greeff and the Boers in the area saw Doornfontein with its abundant water, firewood and building material as the designated place. In 1865 the first application for town establishment was addressed to the House of Assembly, signed by 132 males in the area, and they started compiling a number of

	town regulations. Greeff wanted to name the town Lichtenburg, a name that he carried from his birth and because he wanted it to be a town whose light would shine over the area, not just with regard to hospitality and prosperity, but also in respect of religion. In 1868 the name "Lichtenberg", (a mistake still commonly made) appeared on the official map of the SAR, but the House of Assembly did not react yet. The men met again to discuss the town regulations and to obtain an appeal on speedy proclamation from the House of Assembly. The well-known Voortrekker savant, JG Bantjes, also established himself in Lichtenburg and signed the regulation as witness. Eventually Lichtenburg was officially proclaimed as town in mid-winter on 25 July 1873 by Pres. TF Burgers. (Lichtenburg Museum, 2009; cited in Fourie 2009).
1900-1902	**Boer War** During the Boer War the town of Lichtenburg was occupied by a British garrison of 620 men under the command of Lieutenant-Colonel CGC Money. The market square was turned into a fortified redoubt and strong pickets and sangars on the outskirts of town. On 3 March 1901, General De la Rey planned to attack the town with the help of General Cilliers and Commandant Lemmer and their followers, amounting to 1200 men. An attacking force of between 300-400 men was to assault the town. Due to the marshy terrain and a premature charge by General Liebenberg, the attack was repulsed with equal loses on both sides (Cloete, 2000).
Diamond Rush 1927	**Diamond Rush 1927** The Lichtenburg area is known for the 1926-27 diamond rush. In December 1924, a diamond of 3 carats was discovered by the Voorendyk family on the farm Elandsputte. Initial prospecting in 1925 produced a high yield of diamonds and the area was proclaimed as a “diggings” in February 1926. By 1945 a total of 104 diggings were proclaimed on 13 farms. It was the richest public diggings in the world, with the biggest gathering of diggers in history. A shanty town rose within a year or two, which housed in the region of 150 000 people, about 5 times as big as Lichtenburg today. Bakers, called after the owner Albert Baker, and later known as Bakerville, was the "main town". Here the houses and shacks stood ‘cheek by jowl’ for several kilometers. In the business centre there were as many as 250 diamond buyers' offices, as well as about 60 cafes, shops, barbers, butcheries and other businesses (Lichtenburg Museum, 2009). Bakerville is situated 10 kilometers to the north of Houthaalboomen, the proposed development farm for this project.

6.11.3 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. The only possible sensitivities identified is related to farmsteads situated outside the study area but within close proximity to the proposed development area. These farmsteads’ experience of the rural cultural landscape could possibly be impacted on by the development. A single small farmstead was also identified inside the study area and will require assessment during the fieldwork component of the HIA. **Figure 30** indicates the possible heritage sensitive areas.

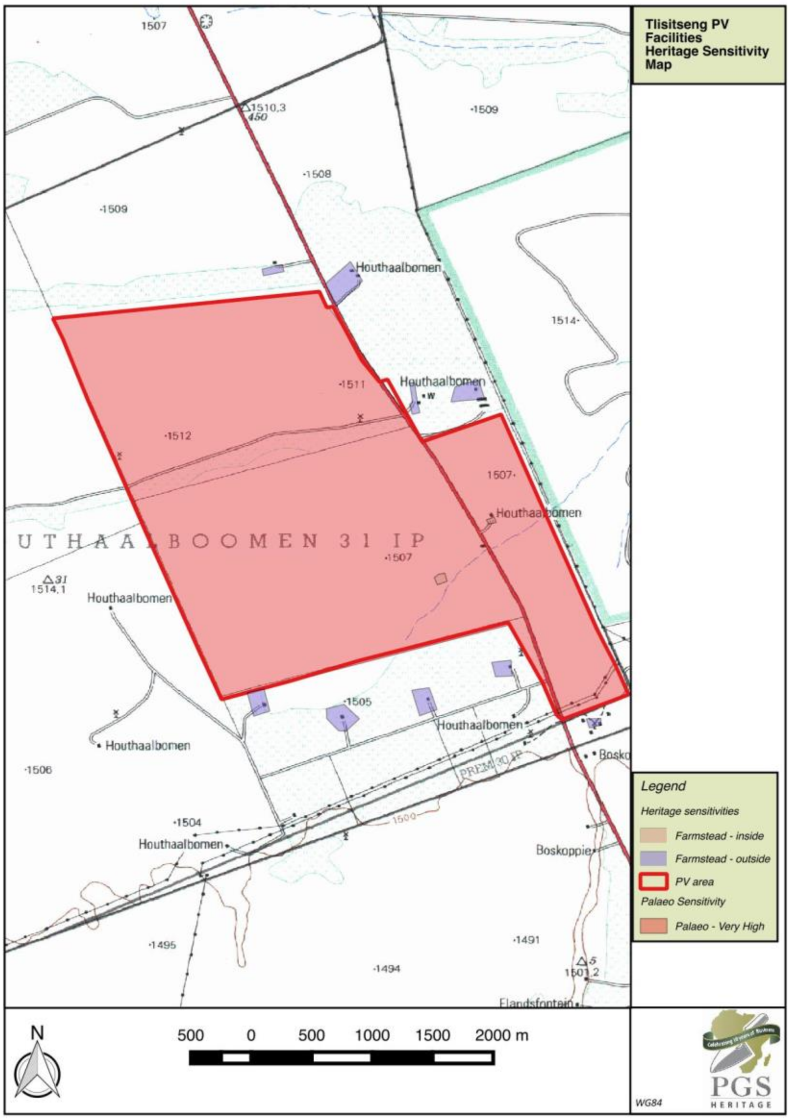


Figure 30: Tlisitseng Solar heritage sensitivity map from map analysis for the total study area during the Scoping phase

6.12 Socio-economic Environment

The Social Assessment was conducted by Mariette Steynberg and Elena Broughton from Urban Econ Development Economists and is included in **Appendix 6G**. The environmental baseline from a socio-economic perspective is presented below.

6.12.1 Study Area Composition

- **Spatial context and regional linkages**

The proposed Tlisitseng 2 Solar PV plant project is located close to Lichtenburg, which is the administrative centre and economic hub of the Ditsobotla LM. The Ditsobotla LM is one of five local municipalities comprising the Ngaka Modiri Molema DM, one of the four districts of the North West Province. **Figure 31** indicates the locality of the LM in relation to the other four LMs as well as key regional linkages.

Figure 31: Locality of the Ditsobotla LM (Ngaka Modiri Molema District Municipality)

The North West Province is mostly rural in nature, comprising 9.7% of the total surface area of South Africa. Four of Botswana's districts border the Province. Domestically, the provinces of Limpopo, Gauteng, Free State, and the Northern Cape border the North West Province. Also located within the Ngaka Modiri Molema DM, is the Mafikeng LM, capital of the district and province.

As can be seen from **Figure 31**, one national road, the N14, traverses the primary study area. A section of the N14, which connects the western parts of Gauteng with the central parts of the North West Province, passes through the south eastern parts of the Ditsobotla LM, through the towns of Coligny and Biesiesvlei. Other important main roads linking the Ditsobotla LM with surrounding LMs include (Ditsobotla LM, 2011):

- Road 52 from Koster to Lichtenburg, and further westwards from Lichtenburg to Mafikeng (R503). This road carries high traffic volumes, and traverses the municipality in an east-west direction.
- The R503 connects Lichtenburg in a south eastern direction with Coligny and ultimately Klerksdorp.
- The R505, traversing the LM in a north-south direction, connects Lichtenburg to Ottoshoop when travelling north and Gerdau and Ottosdal when travelling south.
- The R52 connects Lichtenburg with Itekeng and Biesiesvlei.
- Parts of Route R53, the road that connects Ventersdorp and Swartruggens, transverses the eastern parts of the Ditsobotla LM.

- **Towns and settlements**

The closest major town to the proposed project site is Lichtenburg, the administrative hub of the Ditsobotla LM. Other settlements in close proximity include Bakerville, Boikhutso, and Itsoseng.

Lichtenburg is situated approximately 230 kms from Johannesburg and is located in the middle of the maize triangle, South Africa's main maize growing area. The production of cement is also another main economic activity taking place in close proximity, with three major cement producers operating within an 80 km radius of the town.

As seen on **Figure 32,** Bakerville is located approximately 20 kms north of Lichtenburg. The settlement is a world-renowned diamond site, covering an area of roughly 35 km from east to west. The town originated due to the significant diamond deposit that was found there, and grew at a rate that eventually meant Bakerville was larger than Cape Town at the time. As previously mentioned, today the diamond mining activities are mostly abandoned, leaving the land on which it took place largely un-rehabilitated.

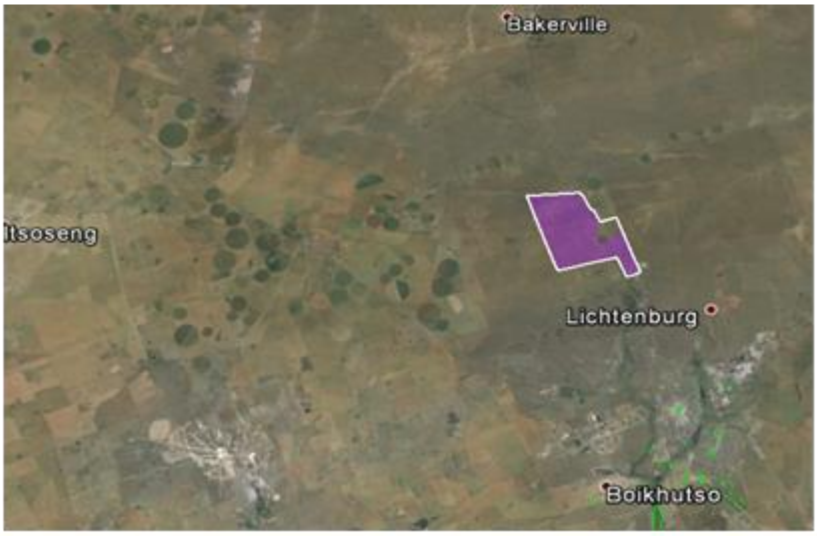


Figure 32: Towns and settlements close to the proposed project site.

The Ditsobotla LM's SDF groups towns within the LM according to certain specific geographical locations. These clusters of towns and settlements are (Ditsobotla LM, 2011):

- The Lichtenburg cluster: including Lichtenburg, Boikhutso, and Blydeville.
- The Coligny cluster: includes Coligny and Tlhabologang.
- The Itsoseng cluster: Comprising of Sheila, Verdwaal 1 and 2, and Itsoseng.
- The Bodibe cluster: Includes Bodipe, Springbokpan, Welverdiend, and Matile / Meetmekaar.

The Lichtenburg cluster is not only considered the core area of the municipality, but is also spatially located in the centre of the Ditsobotla LM. It is within the area between the Lichtenburg and Itsoseng clusters that approximately 60% of the population is located. However, the fact that 28% of the population reside on farms within the LM, comparatively more than other LMs in the district, means that service delivery is required to take consideration of the rural areas.

- **Resources and land capability**

According to the Ditsobotla LM's 2006 SDF, the area of the project site is dominated by agriculture activities. More specifically, cattle and grazing. The entire southern part of the Ditsobotla LM is focused on commercial dry land and irrigated agricultural activities.

The LM has a number of mining and quarrying activities taking place in proximity to Lichtenburg:

- The limestone quarries and operations of Afrisam around Dudfield.
- The limestone quarry of Lafarge between Bodipe and Springbokpan.
- The quarrying areas of Lafarge immediately west of Lichtenburg and in the area north east of the main Lafarge plant situated at the Lichtenburg industrial area.
- The extensive diamond mining activities occurring in the north western parts of the LM, specifically Bakersville, Grasfontein, and Welverdiend.
- The state quarries found in the northern parts of the LM.

Apart from the agricultural, and mining and quarrying activities taking place in the LM, there exists an opportunity for conservation and tourism, with Lichtenburg considered arguably the prettiest town in the North West based on the rich diamond mining history of the area. Aligned with this aim of conservation is the LM's SDF goal of creating an Open Space System by linking all natural elements of value and the "High Environmental Control Zones" in the LM. Elements that may be included into this system in close proximity to the proposed project site include: Molope Eye conservancy and nature reserve, the Malmanies Eye Natural Reserve, the Lichtenburg Game Breeding Centre, and the upper catchment areas of the Hartsriver. The SDF states that the linking of these natural resources in an Open Space System, will create an environment where conservation and environmental protection is considered as a primary factor, making sure no undesirable developments take place there (Ditsobotla LM, 2011).

6.12.2 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.

The Ngaka Modiri Molema DM is home to 842 702 people residing in 227 003 households, with 20% of the DM's total population residing in the Ditsobotla LM. At the same time Lichtenburg's population is estimated as 26 337 (7 540 households), 15.6% and 3.1% of the populations of the LM and DM respectively (Stats SA, 2012).

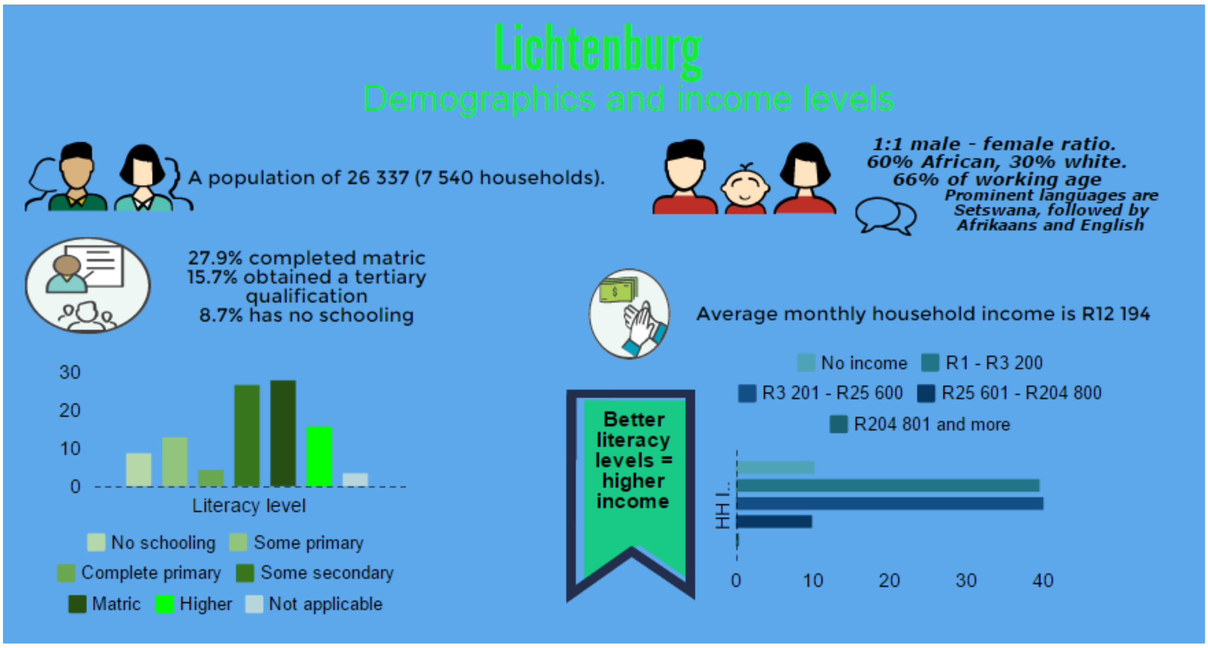


Figure 33: Infographic: Lichtenburg Demographics (Stats SA, 2012)

According to the National Census of 2011, 99.99% of Lichtenburg's population is settled in urban areas, with the remaining 0.01% (3 persons) living on farms. This is markedly different from the scenario in the study area's DM and LM where 61.5% and 24.1% of the respective populations reside on tribal or traditional land; this signifies the relative rural nature of the municipalities being studied. The Ditsobotla LM's IDP, as well as the Ngaka Modiri Molema DM's IDP, takes cognisance of the fact that the high number of its population residing in rural or tribal areas increases the complexity of adequate service delivery, and that service delivery backlogs in the economic as well as social services sphere are present for these rural communities. The fact that nearly all of Lichtenburg's population is staying in the urban area can thus be seen as an indication that this population group enjoys relatively better service delivery; although, the LM's IDP does state that the infrastructure in Lichtenburg, especially the electrical infrastructure, is in need of maintenance or replacement (Ditsobotla LM, 2011).

The majority of the DM's population is African, (94%), with Whites being the next biggest population group at 3.6%; 89% of the LM's population is African, with the African population in Lichtenburg being the smallest of the respective study areas at 60%. Within the LM, 8% of the population is White with a further 1.9% being Coloured. In Lichtenburg the White population is slightly bigger at 30%, with a Coloured population of 7.7% (Stats SA, 2012). According the 2011 Census, the most prominent home language spoken across all of the study areas is Setswana, with Afrikaans and English the preferred home language of the next biggest groups of the population.

Within Lichtenburg the male to female ratio is virtually 1:1, with 49.97% of the town's population being male and 50.03% female. The situation is slightly different in the LM and DM, where the respective populations have slightly more females than males (Stats SA, 2012). In all of the areas being studied, the majority of the population is of working age (15 – 64); however, in some cases the dependency ratio is relatively high when compared to that of the country (Stats SA, 2012):

- In the Ngaka Modiri Molema DM, 60.8% of the population is of working age, with 39.2% being aged 0 – 14 or older than 65. This means that the dependency ratio for the DM is higher than the average for the country (34.5%).
- The Ditsobotla LM's population consists of a slightly higher percentage of working aged individuals – 61.9%, regardless the number of individuals who would be dependent on those of working age is still higher than the country average at 38.1%.
- Lichtenburg is the only study area where the dependency ratio is smaller than that of the country. With a dependency ratio of 33.8%, and 66.2% of the population aged 15 – 64, Lichtenburg has a slightly higher proportion of individuals being economically active than the rest of the study areas. This could be seen as a driver for growth if employment creation is able to provide sufficient opportunities and the work force is suitably skilled.

6.12.3 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.

Based on current prices, the economy of the North West Province is valued at R199 551 million (Quantec, 2014). This is the equivalent of a 6.5% contribution to the national GDP. At the same time, the economy of the Ngaka Modiri Molema DM was valued at R31 007 million in current prices, while the economy of the Ditsobotla LM was estimated to have a GDP of R8 122 million in current prices. The LM comprises more than a quarter (26.2%) of the GDP of the DM, and 4.1% of the North West Province's GDP is attributable to Dibotla LM (Quantec, 2014).

Over a ten-year period ranging from 2003 to 2013, the Ditsobotla LM's economy grew by a Compounded Average Growth Rate (CAGR) of 5%. The growth recorded in the LM is higher than the rate at which the DM and province's respective economies grew. It is estimated that these economies grew by 3.2% and 22% in the DM and province respectively, over the same five-year period. In turn, the growth of 2.2% recorded in the province is below that of the country, which was estimated at 3.3% for the same ten-year period (Quantec, 2014).

The comparatively high growth rate in the LM can be attributed to the growth recorded in the Wholesale, trade, and accommodation, and Finance, insurance, and real estate sectors. Based on current prices, the Wholesale, trade, and accommodation sector comprises 23.9% of the Ditsobotla economy, with the Finance, insurance, and real estate sector accounting for a further 23% of the LM's GDP in current prices (Quantec, 2014). Thus a CAGR of 6.5% in the Wholesale, trade, and accommodation sector, and 8.5% in the Finance, insurance, and real estate sector is likely to have driven the bulk of the LM's economic growth based on the importance and contribution of these sectors to its economy.

In terms of the structure of the economies being studied, and the most significant economic activities taking place within these, the economy of the Ditsobotla LM is not unlike that of the country. Based on current prices, the economy of South Africa is a service economy with the tertiary sector contributing 70.5% of the national GDP. The importance of tertiary activities increases slightly in the LM – here the tertiary sector comprises 77% of the economy's GDP. It can furthermore be stated that wholesale, trade, and accommodation industries are contributing more to the LM's economy when comparing the proportionate contribution to that in the country's economy (16.6%). Other significant structural differences between the Ditsobotla and the South African economies relate to manufacturing industries being a slightly more important contributor to the national GDP. This sector contributes 11.3% to South Africa's economy and 9.4% to the economy of the LM. The importance of the primary economy is also lower in the LM (8%), versus the 11.5% that the primary sector contributes to the country's GDP. In addition, the primary sector is structured differently in the LM, here agriculture is more important (6.8% of the LM's GDP), compared to the 1.2% contribution of the mining sector. In the country, the mining sector contributes 9.2% to the national GDP.

Table 12: Economic structure of the various delineated study areas

Economic Sector	**Ngaka Modiri Molema DM**		**Ditsobotla LM**	
	GDP in current prices (R'm)	% of GDP	GDP in current prices (R'm)	% of GDP
Agriculture	R1 361	4.4%	R553	6.8%
Mining and quarrying	R683	2.2%	R97	1.2%
Manufacturing	R1 871	6.0%	R761	9.4%
Electricity, gas and water	R689	2.2%	R158	1.9%
Construction	R1 005	3.2%	R287	3.5%
Trade	R6 388	20.6%	R1 938	23.9%
Transport and communication	R2 403	7.7%	R649	8.0%
Finance and business services	R6 373	20.6%	R1 867	23.0%
Personal services	R3 187	10.3%	R767	9.4%
General government	R7 045	22.7%	R1 045	12.9%
TOTAL	R31 007	100%	R8 122	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)

6.12.4 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 13: Labour force of the delineated study areas

Indicator	South Africa	North West Province	Ngaka Modiri Molema DM	Ditsobotla LM	Lichtenburg
Working age population	33 928 806	2 273 362	512 630	104 628	17 407
Non-economically active population	13 238 633	907 948	243 945	44 487	6 169
Labour force	18 841 453	1 236 786	226 903	53 005	10 683
Employed	13 254 829	848 107	150 683	37 933	8 495
Unemployed	5 586 624	388 679	76 220	15 072	2 188
Unemployment rate	29.7%	31.4%	33.6%	28.4%	20.5%
Labour force participation rate	55.5%	54.4%	44.3%	50.7%	61.4%
Discouraged work seekers	5.4%	5.7%	8.2%	6.8%	3.2%

(Stats SA, 2012)

The Ngaka Modiri Molema DM has a working age population (15 – 64 years of age) of 512 630 individuals – 60.8% of its total population. According to South Africa's official unemployment definition, it is estimated that 33.6% of the DM's labour force is unemployed, while 8.2% can be classified as discouraged work seekers (Stats SA, 2012). Within the Ditsobotla LM the situation improves slightly since here, according to the Census 2011, there is a working age population of 104 623. Furthermore, the LM has an approximate unemployment rate of 28.4%, while 6.8% of the population are discouraged work seekers.

As expected in the previous section, where it was revealed that the household income levels in Lichtenburg are comparatively, significantly higher than that of the municipalities being studied, and the employment situation in the town is noticeably more positive than that of the DM or LM. In Lichtenburg, where 66% of the population is of working age, unemployment is estimated at 20.5% and discouraged work seekers comprise 3.2% of the town's 17 407 working age population. It follows that Lichtenburg's labour force participation rate is also significantly higher at 61.4%, compared to the 44.3% and 50.7% in the DM and LM.

In the Ditsobotla LM, 11.3% of all employment is created by the agriculture sector - more than the 7.7% in the DM created by the same sector. Nationally the agriculture sector creates an even smaller proportion of total employment opportunities – 5.8%. The economy is predominantly a service economy, though, with practically three quarters of all jobs, in all of the respective study areas, generated by the tertiary sector (Quantec, 2014). More specifically, the tertiary sector created 74.6% of all employment opportunities in the LM. The biggest contributors to this job creation is the wholesale and retail trade sector (38.6%), and the community, social and personal services sector (25.6%) (Quantec, 2014).

6.12.5 Income

According to the 2011 Census, literacy levels in Lichtenburg are relatively on par with the level of literacy recorded in South Africa. The literacy levels in the municipalities being studied are below that of the country though, indicating a community that is relatively less employable than the Lichtenburg community or the broader South Africa. Approximately 17% and 15% of the DM and LM's respective populations, aged 20 years and older, have had no access to formal education, while 8.7% of the population of Lichtenburg has had no schooling. In the DM, only 20.3% of the population aged 20 years and older successfully completed matric, with 8.1% achieving a higher education. The situation is even worse in the LM, where only 19.7% of the population, aged 20 and older, has obtained a matric certificate. In Lichtenburg, 27.7% of the population has completed matric, while 12% successfully completed tertiary studies.

In Lichtenburg the average monthly household income is R12 194, 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 R5 772 and R6 004, 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.

Easier access to employment opportunities can be viewed as the reason why Lichtenburg has a smaller proportion of households living with no income (10.2%), compared to the 15.3% and 12.5% of households in the DM and LM not receiving any monthly income. Furthermore, the fact that fewer (39%) of Lichtenburg's households, versus 58.6% and 59.3% of the households in the DM and LM, earn an income of R3 200 or less per month can be seen as an indication of the relative quality of the employment opportunities offered in Lichtenburg compared to that of the DM and LM

6.12.6 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.

- **Housing**

It is estimated that 86.7% of households in Lichtenburg reside in formal brick structures, be it stand-alone houses, complexes, in a block of flats, or as a second building in a yard. A further 12.6% of Lichtenburg's households reside in informal dwellings, with only 0.1% of the town's households living on tribal or traditional land. Within the Ditsobotla LM the proportions vary significantly, with only 74% of the households of this municipality living in formal brick structures. Proportionally more of the DM's population is living on tribal land, in traditional structures such as huts (8%), with 16.8% living in some kind of informal structure. The situation in the Ngaka Modiri Molema DM mirrors that of Lichtenburg more closely, here 82.7% of households reside in brick structures of some sort, with 12.7% living in informal structures. The number of traditional dwellings is proportionally more however, at 3.5%.

It must be noted that the LM is in the process of implementing a housing programme, specifically in the towns of Tlhabologang and Boikhutso (Ditsobotla LM, 2011). The objective of the housing programme is to address the sanitation backlog; regardless, the result will be that fewer households will reside in informal settlements in the LM.

- **Access to water**

It is estimated that 91% of all households in Lichtenburg have access to piped water either inside the dwelling or in the yard. The situation is markedly worse in the LM and DM where only 65.9% and 51% of the respective households have access to piped water in the dwelling or yard. This statistic for access to piped water is worse than the national average, where 73% of households have access to piped water in their dwelling or yard. The dire situation in these municipalities is further reflected in the fact that 14% of households in the DM, and 10.9% of households in the LM, have no access to water. According to the Ngaka Modiri Molema DM's IDP, the proportion of households with no access to water have declined from 2000 to 2010. This backlog remains a service delivery issue in the DM however (Ngaka Modiri Molema District Municipality).

The 205/2016 revision of the DM's IDP states that the DM was declared a Water Services Authority (WSA) in 2003, giving the district authority to perform water and sanitation services in its jurisdiction.

The Department of Water Affairs bulk infrastructure systems operational within the DM, are concentrated in the Mafikeng, Ditsobotla, and Ramotshere Moiloa LMs. Other infrastructure systems in the DM include (Ngaka Modiri Molema District Municipality):

- 30 reservoirs,
- Five pump stations and eight water purification works, and
- 12 waste water treatment works.

The revised IDP also states that the surface water in the area is generally insufficient, leading to rural water supply often relying on ground water sources, and that the WSA is in the process of developing a Water Services Development Plan (WSDP) and Water Services Master Plan. The WSDP will provide a backlog study and identify projects than need to be implemented, while the master plan will reconcile the available water sources with the demand for water supply (Ngaka Modiri Molema District Municipality).

The Ditsobeng LM's IDP (2011/12 – 2015/16), states that a services backlog study commissioned in 2007 by the Department of Developmental Local Government, revealed that 18 023 households receive water connection services below RDP standards, while a further 20 559 of the municipality's households receive services within the RDP standards. It was estimated that upgrades for these households, to either be within the RDP standards or for yard connection, would require a total budget of R214 million. The IDP furthermore makes mention of the fact that two major bulk water infrastructure projects, aimed at addressing water shortages in Tlhabologang and Itsoseng were being implemented (Ditsobotla LM, 2011).

As far as water infrastructure is concerned, the IDP states that; the Lichtenburg water treatment plant is more than fifty years old, but well maintained, and the pump station in Itsoseng requires overhaul maintenance. Of the 30 reservoirs within the DM, 16 are located within the LM's boundaries. According to the IDP, the municipal infrastructure audit revealed that 9 of these reservoirs are in good condition, while one is in average condition, and three more in poor condition. The reservoirs in poor condition provide bulk water to Itsoseng and Verdwaal (Ditsobotla LM, 2011).

- **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 Lichtenburg, 90% of the households had access to a flushing toilet, while almost 2% of the households had no access to toilet facilities. At the same time, 4% of the town's households were using pit latrines while 0.12% were still reliant on the bucket system.

The situation is markedly worse in the municipalities being studied. In the Ngaka Modiri Molema DM only 38.5% of households had access to a flushing toilet, while 7.5% of the households had no access. The bulk of the households (57%) in the DM were using pit latrine systems, with 1.2% of households using the bucket system. More households had access to a flushing toilet in the LM (47%); however, 4.9% of the Ditsobotla 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. 35% of households in the LM were using pit latrines while 0.3% had no access to toilet facilities.

As mentioned in the previous section, the Ngaka Modiri Molema DM has been awarded WSA status. The WSA is in the process of developing the WSDP and master plan, which will provide guidance on addressing these services backlogs with the limited water resources in the DM.

The findings discussed here can be somewhat verified by the fact that the Ditsobotla LM's IDP states that the largest sanitation backlogs are prevalent in rural areas and urban based informal settlements, explaining the comparatively high level of sanitation in Lichtenburg when compared to the rest of the LM. The IDP estimated that it would cost R80.9 million to upgrade the 10 274 households in the municipality (with sanitation systems below RDP standard), to pit latrine systems. To address the large number of households still making use of the bucket toilet system, the LM has implemented a housing programme involving the construction of low cost houses in Tlhabologang and Boikhutso (Ditsobotla LM, 2011).

- **Access to electricity**

The indicator "electricity for lighting", was used as a proxy for measuring households' access to electricity. In Lichtenburg 86% of households had access to electricity; this is only slightly more than the national average proportion with access of 84.8%. The situation is somewhat worse in the municipalities studied, with 80.5% and 74% of households in the DM and LM respectively having access to the grid.

The main alternative source for lighting in the study areas was candles; 12% of households in Lichtenberg utilised this lighting method, while 17.7% of households in the DM did the same. In the Ditsobotla LM, nearly a quarter of all households were reliant on candles for lighting. Of interest to this project is the fact that 18 households in Lichtenburg (0.2% of all households), were using solar power for lighting.

According to the Ditsobotla LM's IDP, the LM is licensed to provide electricity to Lichtenburg, Blydeville and Coligny, with the remainder of the LM serviced by Eskom. The IDP furthermore reveals that areas without electricity are mainly located in rural areas such as Grasfontein and Bakerville for example. Based on the IDP, the electrical infrastructure in Lichtenburg is old, requires maintenance, and is in need of upgrades. Moreover, load supply to Lichtenburg needs to be increased to provide for the demand associated with the growing property and business markets in the town. The IDP states that, based on preliminary business plans and estimates, the cost of the new infrastructure is approximately R29 million.

- **Refuse removal service**

It is estimated that 62% of households nationally have their refuse removed by a local authority on a weekly basis. This national estimate is substantially below the number of households in Lichtenburg (87.8%), with regular weekly refuse removal services. At the same time, only slightly more than a third of households in both the LM and DM have regular refuse removal services. It is more common for households in these municipalities to have their own refuse dump, with 54% of homes in the DM, and 48.9% in the LM using this method of waste disposal. Also noteworthy is the fact that the LM has the highest proportion of households within the study areas with no means of refuse disposal (6.6%), compared to the DM (6.1%), and Lichtenburg where 2.7% of households have no access to refuse removal services.

Based on the findings of the Ditsobotla LM's IDP, the municipality recognises the serious health issues posed by the non-collection and improper disposal of refuse. However, in order for the LM to address these service backlogs it is required that the organisational structure of the LM be reviewed in order to align with the challenges highlighted in the Strategic Environmental Assessment Report (Ditsobotla LM, 2011).

- **Internet access**

Internet access has become increasingly important for 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.
In Lichtenburg, 58.6% of households have no access to internet. These are fewer households than the national average of 64.5%; regardless, it still excludes more than half of the town's population from the potential that could be associated with internet access. The situation is significantly worse in the studied municipalities, where almost three quarters of all households have no access. For those with access, a cell phone is the most common method of access, followed by home internet access or access at work.

- **Health services –** There are two hospitals and nine clinics within the Ditsobotla jurisdiction.
    - General de la Rey Hospital: located on the Thabo Mbeki Drive. The hospital provides in-patient care and maternity services. The outpatient unit provides emergency care until a patient can be transferred to the Thusong Hospital.
    - Thusong Hospital: situated roughly 25 km from Lichtenburg, on the Mafikeng road at the turn off to Itsoseng. The hospital has the following facilities available: theatres, male and female medical wards, a gynaecology ward, a paediatric ward, a maternity ward, a tuberculosis ward, out-patients, and casualties.
    - Nine community clinics in the following towns: Lichtenburg, Boikhutso, Blydeville, Coligny, Tlhabologang, Itekeng, Bodibe, and Itsoseng.
    - The IDP estimates that about 31 health facilities are required to provide adequately. However, considering the current population (168 904) and the planning norm of one clinic per 5 000 community members, the requirement is more likely to be approximately 20 clinics in the LM.
    - There is one formal old age home located in the LM, the Lichthuis Old Age Home, situated in Lichtenburg.

- **Community facilities and services (sport fields etc.)**

- Most of the existing community facilities, including sports grounds, are located in urban areas, excluding most of the LM's rural population.
- Facilities located in rural areas are of poor standards compared to the facilities available in Lichtenburg.
- The challenge facing the LM in this regard is therefore, considered to be not only access to existing facilities, but also ensuring that available facilities are tailored to the social circumstances and conditions of the communities they target.
- According to the IDP, the sport fields in Ga-Motlatla, Verdwaal, and Bodibe are in various stages of completion. Projects were initiated to finalise them for handover to the respective communities for utilisation.

- **Cemeteries**
  - Additional land for cemeteries is required in the communities of Itekeng, Coligny, and Itsoseng.
  - Maintenance of cemetery yards in all areas of the LM remains a challenge. There is also a need for all cemeteries to be fenced, and ablution facilities to be constructed at all cemeteries in the LM.
  - The IDP believes that the challenges with regards to the provision of adequate cemeteries will rely on a focus on the following aspects:
    - Providing cemeteries that meet sustainable, technical, and environmental criteria.
    - Accommodating diverse cultural requirements and the function of cemeteries as public spaces in each to ensure a dignified municipality.
    - Fostering civil and private sector partnerships in cemetery development and management.
    - Special attention must be given to those in need, respecting the bereaved at burial. It is also important to protect and properly maintain cemeteries as public property and create a safe working space for cemetery employees.

- **Community halls**
  - All community halls within the LM require renovation. The towns in which these renovations will take place are: Lichtenburg, Boikhutso, Itekeng, Itsoseng, Sonop, and Tlhabologang.
  - Bakerville, Grasfontein, Bodibe, and Verdwaal are all areas that require new community hall facilities.
- **Traffic and licensing services**
  - Generally, traffic law enforcement is concentrated in urban areas such as Lichtenburg and Coligny.
  - This is mainly due to a lack of human resources as well as below par traffic infrastructure in rural or former township areas.

- **Disaster management**
  - An Emergency Services Unit exist within the Ditsobotla LM for fire and rescue services as well as disaster management.

- The unit is functional; however, it is not up to standard and under-resourced, with only temporary employees and insufficient equipment.
- The Ngaka Modiri Molema DM commissioned the drafting of a Disaster Management Framework and Disaster Risk Management Plan. The Draft Gap Analysis Report found that the LM does not conform to legislative requirements. The DM will address these gaps through a comprehensive disaster management plan incorporating the needs of category-B municipalities.
- Moreover, the provision of services in the LM is hampered by problems surrounding powers and functions. According to the IDP, the LM has not yet entered into a service level agreement with the DM for provision of these services.

6.13 Traffic

The Traffic Assessment was conducted by Hermanus Steyn of Aurecon. The full report is included in **Appendix 6H**. The environmental baseline from a traffic perspective is presented below.

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 Lichtenburg or Bakerville 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 operational and maintenance support, with only a few light vehicles per day.

Access to the site will be from the R505. No traffic data is available for the roads in the area around the proposed site. However it can be assumed that traffic on the R505 to be reasonably low (<1500 AADT,

<200 Veh/h). These assumptions are based on the current road cross section and the general associated road class characteristics as well as data interpolated from SANRAL traffic counts in the greater Lichtenburg area for similar class regional roads.

It can therefore be stated that the construction traffic of less than 20 vehicles during the peak hour and the post construction traffic of less than 5 vehicles per day would have almost no noticeable impact on the existing traffic service levels.

6.1 Geotechnical

The Geotechnical Assessment was conducted by Thanduxolo Maengana of Geopractica. The full report is included in **Appendix 6I**. The environmental baseline from a traffic perspective is presented below.

6.1.1 Climate and Weather Conditions

According to the Climatic N value map of South Africa compiled by Weinert, Lichtenburg falls into the transition zone between Sub Humid and Sub Arid having an N value marginally greater than 5. This would indicate that the most likely method of weathering of the bedrock would be due to mechanical disintegration, as opposed to chemical weathering in the areas of the country having a higher annual rainfall.

The weathering profile in these more arid regions of the country, should therefore favour the generation of a thinner residual soil horizon, than would be the case in the more humid, wetter coastal regions.
The average annual rainfall in this area is between 566mm and 620mm, most of which occurs in heavy isolated falls between November and March.

The average maximum summer temperature of approximately 28,0°C occurs in January with an average maximum of 18°C in June. Frost in winter is relatively common.

6.1.2 Local Geology

From available literature, it is evident that the site is underlain by dolomite belonging to the Malmani Subgroup within the Transvaal Sequence. This blue/grey, hard rock dolomite is typically interbedded with of very hard, grey chert, and the upper surface usually weathers insitu to form a dark brown, silty sand with abundant, close packed gravels, cobbles and boulders of both fresh and leached chert and dolomite (residuum).

The bedrock profile within the dolomites is highly variable with hard, steep, dolomite pinnacles with deeply weathered slots (grykes) in between. These hard rock dolomite pinnacle can occur close to surface or at a significant depth, and can be widely separated or closely spaced. These features are due to the fact that dolomites can be easily dissolved by slightly acid ground water, percolating downward from surface, into the underlying formation.

Typically these slots can be filled with wad (a very soft, silt and clay derived from the insitu decomposition of dolomite) and other alluvial debris (dolomite residuum). The collapse of these cavities can result in the formation of sinkholes or doline depressions at the surface. On the West Rand, most sinkhole and doline formation was related to the drawdown of the local watertable, due to underground mining operations. Human development could also be the triggering mechanism for the formation of sinkholes and dolines, due to the ingress of surface water into the underlying formation due to leaking sewers, water storage ponds, water taps, stormwater drains as well as water services to residential and commercial buildings.

The Malmani Subgroup is subdivided into the Oaktree (lower), Monte Christo (lower middle), Lytleton (upper middle) and Eccles (upper) formations. The Oaktree and Lytleton are chert poor while the Monte Christo and Eccles are generally chert rich. According to the geological map, the site is located within the lower middle Monte Christo (chert rich) Formation. Typically the chert rich formations tend to be less problematic as the insoluble chert lenses within the dolomite bedrock tend to provide stability to the surrounding soluble dolomite.

A further factor which reduces the risk profile of dolomite terrains, is the presence of a thick and non-erodible blanketing soil layer, over the underlying dolomite formation. The Malmani Subgroup is inturn overlain by quaternary sandy gravel and pedogenic soils in the form of calcrete.

A site geological map is shown below (**Figure 34**) of this report.

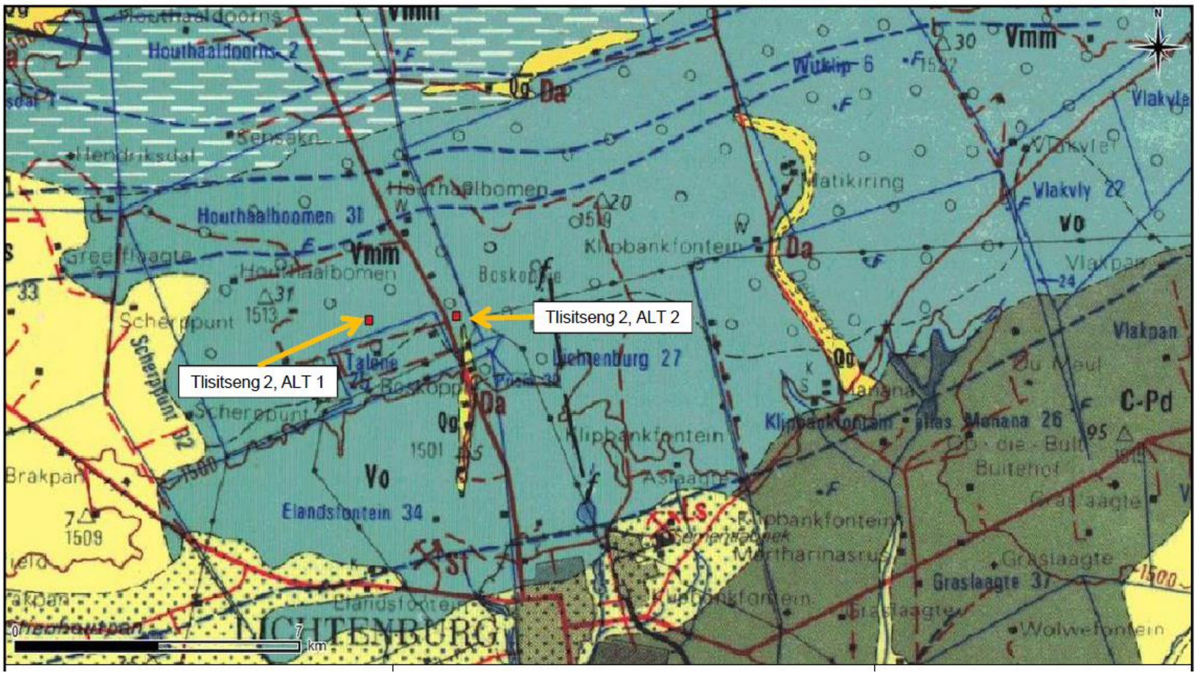


Figure 34: Site Geology Map for Tlistseng 2.

7 PUBLIC PARTICIPATION PROCESS

Public participation is the cornerstone of any EIA. The principles of NEMA as well as the EIA Regulations govern the EIA process, including public participation. The Public Participation Process (PPP) for the proposed development has been conducted according to regulation 41 of the 2014 EIA Regulations. These include provision of sufficient and transparent information on an ongoing basis to stakeholders to allow them to comment, and ensuring the participation of previously disadvantaged people, women and the youth.

The public participation process is primarily based on two factors; firstly, ongoing interaction with the environmental specialists and the technical teams in order to achieve integration of technical assessment and public participation throughout. Secondly, to obtain the bulk of the issues to be addressed early on in the process, with the latter half of the process designed to provide environmental and technical evaluation of these issues. These findings are presented to stakeholders for verification that their issues have been captured and for further comment.

Input into the public participation process by members of the public and stakeholders can be given at various stages of the EIA process. Registration on the project can take place at any time during the EIA process up until the FEIAr is submitted to DEA. There are however set periods in which comments are required from Interested and / or Affected Parties (I&APs) in order to ensure that these are captured in time for the submission of the various reports. The comment periods during the EIA phase will be implemented according to regulation 41 of the 2014 EIA Regulations

The EIA regulations emphasise the importance of public participation. In terms of the EIA regulations, registered interested and/or affected parties –

- may participate in the application process;
- may comment on any written communication submitted to the competent authority by the applicant or environmental consultant;
- must comment within the timeframes as stipulated by the EIA Regulations;
- must send a copy of any comments to the applicant or Environmental Assessment Practitioner (EAP) if the comments were submitted directly to the competent authority; and
- Must disclose any direct business, financial, personal or other interests that the person has in the application being granted or refused.

The following actions were taken upon receiving comments/queries/issues:

- The contact details provided were entered into the project database for use in future notifications.
- Confirmation receipts were sent to those submitting comments.
- Comments were addressed in the Comments & Response Report.

7.1 Overview of the Public Participation Process to date

The public participation process was initiated in early December 2015 with the issuing of the BID and initial landowner consultation. Many site notices (as per regulations) were placed near the study area during a site visit on Tuesday and Wednesday the 1st and 2nd of December 2015. On the 18th of January 2016 an application for EA and the DSR for the proposed Tlisitseng 2 Solar PV energy facility were received by the DEA and a reference number was allocated to the proposed development (**DEA reference number: 14/12/16/3/3/2/890**). The original DSR was released for review on the 11th of January 2016 and the EIA process advert was publicised on the 15th of January 2016 in the Noordwester newspaper. The original DSR comment period ran from the 11th of January 2016 to the 9th of February 2016. I&APs were notified at the start of the comment period. The DSR was thereafter updated and the original Final Scoping Report (FSR) was submitted was submitted to the DEA on the 19th of February 2016, and I&APs were notified of this submission on the same day. Prior to the release of the original DEIAr, public and focus group meetings were held on the 14th of March 2016.

After evaluating the FSR the DEA issued a letter indicating that the documents complied with the minimum requirements of the EIA Regulations, 2014 and that SiVEST could proceed with the EIA process (i.e. DEIAr and FEIAr). The original FSR was therefore accepted by the DEA. Following the acceptance of the FSR and Plan of Study for EIA, the public was notified of the DEA's decision through the EIA Newsletter which was sent out in the 23rd May 2016, prior to the planned DEIAr comment period.

It should however be noted that due to a change in the layout of the proposed Tlisitseng 2 Solar PV energy facility, SiVEST was not able to submit the FEIAr within the legislated timeframes. On the 20th of June 2016, SiVEST therefore sent the DEA a letter requesting a sixty (60) day extension in terms of Regulation 3 (7) of the EIA Regulations, 2014, in order to provide the specialists with the opportunity to update their specialist reports in-line with the revised layouts. On the 20th of July 2016, the DEA issued a letter refusing the extension request. For this reason the application for EA lapsed in accordance with Regulation 45 of the EIA Regulations, 2014 and the departmental file was closed for the project.

In order to reapply for EA for the proposed Tlisitseng 2 Solar PV energy facility BioTherm appointed SiVEST to recommence with the EIA process. It should however be noted that all comments received by Interested and Affected Parties (I&APs) during the Public Participation Process (PPP) which was undertaken for the original EIA process (including those received during meetings) will form part of this EIA process. The public participation process is beinge-conducted in accordance with the EIA Regulations, 2014 and all I&APs.

The second round of public participation was reinitiated in September 2016. Many site notices (as per regulations) were replaced near the study area during a site visit on in September. On the 29th September 2016 the second version of the DSR was released for public comment from the 29th of September 2016 to the 31st of October 2016 and an updated EIA process advert was publicised on the 30th of September 2016. 2016 in the Noordwester newspaper notifying I&Aps that the second version of the DSR and application form for the Tlisitseng 2 Solar PV energy facility, was submitted to the DEA. On the 3rd of October 2016, the DEA acknowledged having received the application for EA and the DSR for the proposed Tlisitseng 2 Solar PV energy facility on the 30th of September 2016 and a new reference number was allocated to the proposed development **(DEA reference number: 14/12/16/3/3/2/975).** The DSR was thereafter updated and the Final Scoping Report (FSR) was submitted to the DEA on the 11th November 2016 and I&APs were notified of this submission on the same day.

After evaluating the FSR the DEA issued a letter on the 12 December 2016, indicating that the documents complied with the minimum requirements of the EIA Regulations, 2014 and that SiVEST could proceed with the EIA process (i.e. DEIAr and FEIAr). The FSR was therefore accepted by the DEA.

The stages that typically form part of the public participation process during the EIA phase are reflected in **Figure 35** below.

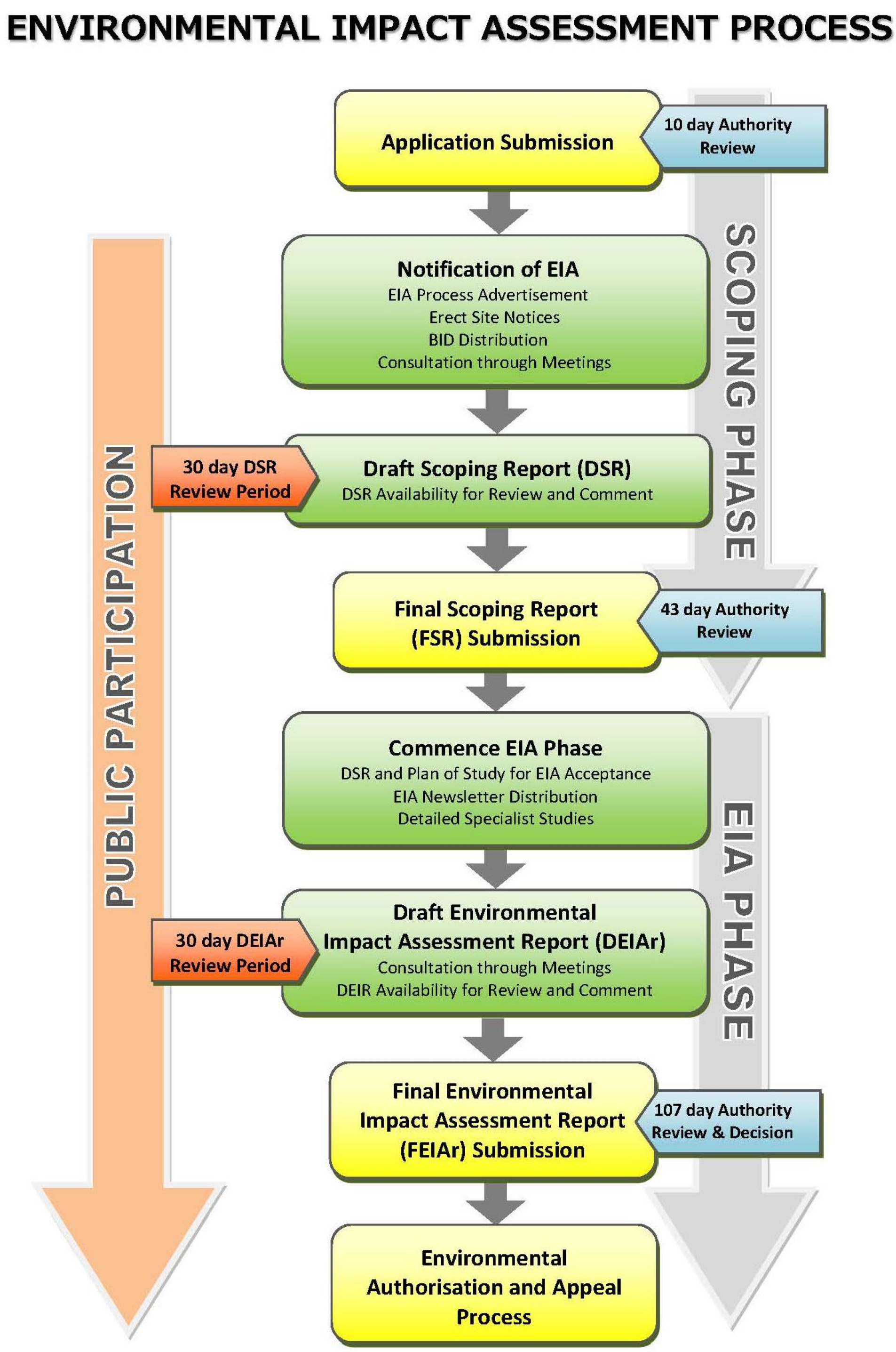


Figure 35: EIA and Public Participation Process

Members of the public who wished to be registered on the database as an I&AP were able to do so via telephone, fax, email, mail or SiVEST's website (www.sivest.co.za).

During the EIA phase, consultations will be held with individuals, businesses, institutions and organisations, and the following sectors of society have been identified and will be afforded the opportunity to comment (the full stakeholder database list is included in **Appendix 7F**):

- National Authorities;
- Provincial Authorities;
- Ditsobotla LM;
- Ngaka Modiri Molema DM;
- Government Structures such as SAHRA, SANRAL, Telkom, etc.;
- Agriculture Associations;
- Regional and local media (advertisements and public documents e.g. BID);
- Business and commerce;
- Environmental bodies / NGOs;
- Community representatives, CBOs, development bodies;
- SENTEC;
- Landowners; and
- Civil Aviation Authority (CAA).

As mentioned above, all comments received by Interested and Affected Parties (I&APs) during the Public Participation Process (PPP) which was undertaken for the original EIA process (including those received during meetings) will form part of this EIA process. No further public or focus group meetings will however be held as the meetings which have already been undertaken for the original EIA process have been deemed sufficient. The minutes of all the meetings which have already taken place for the original EIA process will be included in this process and all comments received for the original DSR and FSR, as well as the second version of the DSR and FSR have been incorporated into this DEIAr.

7.2 Consultation and Public Involvement

Through the consultation process, issues for inclusion within this DEIAr were identified and confirmed. Telephonic discussions and one-on-one consultation were undertaken where relevant. Meetings with landowners took place after the release of the original FSR (prior to the release of the DEIAr) in order to identify key issues, needs and priorities for input into the proposed project. Special attention was paid to the consultation with possibly affected landowners and communities within the study area to try and address their main concerns.

As in the scoping phase, consultation will continue to be held with key stakeholders and other relevant I&APs in order to identify key issues, needs and priorities for input into the proposed project. Special attention will be paid to the consultation with possibly affected landowners and communities within the study area to try address their main concerns.

Notifications will be sent via email, sms, fax and post to inform I&APs of the availability of the DEIAr.

7.3 Comments Received during the Scoping Phase

All comments and recommendations made by stakeholders and I&APs during the scoping phase and submitted as part of the FSR have been taken into consideration when preparing the DEIAr.

All comments received during the scoping phase, including at public and focus group meetings which took place during the original public participation process, are addressed and included in **Appendix 5E**.

7.4 Proof of Notification

Appendix 5 includes all proof of notification to Interested and Affected Parties;

- Proof of process advertisements in the newspapers (**Appendix 5C**)
- EIA Newsletter (**Appendix 5A**)
- Correspondence to registered I&APs and key stakeholders (**Appendix 5B**)

7.5 Focus Group Meetings

Focus Group Meetings (FGMs) are smaller meetings with specific groups or organisations who have similar interests in or concerns about the project.

Two FGMs took place prior to the release of the original DEIAr. The meetings took place on the 14th of March 2016 and affected landowners and authorities were invited to the respective FGMs.

Table 14: Focus Group meeting

Venue	Interested Parties	Date	Time
Rafters Bushpub & Sports Bar	Landowners	Monday, 14 March 2016	11h00
Auditorium of the Ditsobotla Local Municipality Library, Civic Centre, Cnr Nelson Mandela and Transvaal Streets, Lichtenburg	Councillors and Officials	Monday, 14 March 2016	14h00

As previously mentioned, no additional focus group meetings will be held for this EIA process as the meetings which have already been undertaken for the original EIA process have been deemed sufficient. All comments and recommendations made by stakeholders and I&APs during the original scoping phase and submitted as part of the original DSR and FSR as well as the second version of the DSR and FSR have been taken into consideration when preparing this DEIAr. The minutes of all the meetings which have already taken place for the original EIA process will be included in this EIA process.

Minutes of the FGMs were compiled and forwarded to all attendees for their review and comment. The primary aim of the meetings was to:

- Disseminate information regarding the proposed development to I&APs.
- Provide I&APs with an opportunity to interact with the EIA team and the BioTherm representatives present.
- Supply more information regarding the EIA process.
- Answer questions regarding the project and the EIA process.
- Receive input regarding the public participation process and the proposed development.
- Present I&APs with an overview of EIA phae specialist findings.

Minutes of the meetings are included in **Appendix 5G.**

7.6 Public Meeting

A Public Meeting was held prior to the review of the original DEIAr.

Invitation letters were sent out via post and e-mail to all registered I&APs on the project's database.

Table 15: Focus Group meeting

Venue	Interested Parties	Date	Time
Lichtenburg Town Hall / Soepee Hall, on Nelson Mandela Drive, Lichtenburg	I&APs	Monday, 14 March 2016	18h00

The Public Meeting was held in order to provide I&APs with information regarding the proposed development, present the EIA phase environmental findings and invite I&APs to raise any further comments and/or concerns that they may have.

Except for the representatives from SiVEST, Zitholele and BioTherm Energy, no one attended the public meeting. The meeting feedback document is included in **Appendix 5G**.

As previously mentioned, no additional public meetings will be held for the new EIA process as the public meeting undertaken for the original EIA process is deemed sufficient. All comments and recommendations made by stakeholders and I&APs during the original scoping phase and submitted as part of the original DSR and FSR as well as the second version of the DSR and FSR have been taken into consideration when preparing this DEIAr. The minutes of the public meeting which has already taken place for the original EIA process will be included in this EIA process and all comments received for the original DSR, FSR and the second version of DSR and FSR were incorporated into this DEIAr.

7.7 Public review of Draft Environmental Impact Assessment Report

The DEIAr will be made available for review at the following venue for a period of 30 calendar days, excluding public holidays:

Table 16: Venues where the DEIAr will be publically available

Venue	Street Address	Hours	Contact No.
Lichtenburg Public Library	Nelson Mandela Drive, Lichtenburg	Mondays- Thursdays 09h00 – 17h30 Fridays 09h00 – 17h00 Saturdays 09h00 – 12h00	018 633 3904

All comments received on this report will be incorporated into the Comments and Response Report, which will be attached to the FEIAr as **Appendix 5E**.

7.8 Comments and response report

Issues, comments and concerns raised during the public participation process to date (including the origical public participation process) are captured in the Comments and Response Report (C&RR) – **Appendix 5E**. This C&RR provides a summary of the issues raised, as well as responses which were provided to I&APs. This information will be used to feed into the evaluation of social impacts.

7.9 Authority review of Draft Environmental Impact Assessment Report

Table 17 below includes all the key stakeholders and organs of state who were e-mailed the DEIAr and sent electronic copies (on CD) of the full report including all appendices.

Table 17: List of Organs of State

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF THE TWO TLISITSENG 75MW SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITIES NEAR LICHTENBURG, NORTH WEST PROVINCE					
DISTRIBUTION OF THE DRAFT IMPACT ASSESSMENT REPORT (DEIAR) TO ORGANS OF STATE FOR COMMENT					
TITLE	SURNAME	NAME	POSITION	POSTAL ADDRESS	EMAIL ADDRESS
DITSOBOTLA LOCAL MUNICIPALITY					

Mr	Molefe	J	Municipal Manager	PO Box 7 LICHTENBURG 2740	digoamajel@ditsobotla.co.za
Ms	Zandamela	KRJ	Environmental Health Practitioner	PO Box 7 LICHTENBURG 2740	info@ditsobotla.gov.za
NGAKA MODIRI MOLEMA DISTRICT MUNICIPALITY					
Ms	Dince	Nono	Municipal Manager	Private Bag X2165 MAHIKENG 2765	municipalmanager@nmmdm.gov.za
Ms	March	Lehlohonolo	Environmental Manager	Private Bag X2165 MAHIKENG 2765	matsosel@nmmdm.gov.za
DEPARTMENT OF ENERGY					
Provincial - NORTH WEST					
Mr	Sethosa	Tebogo		Pvt Bag X2075 MMABATHO 2745	Tebogo.sethosa@energy.gov.za
Ms	Mahlaku	Matshediso		Pvt Bag X2075 MMABATHO 2745	Matshediso.mahlaku@energy.gov.za
National					
Ms	April	Lerato		Private Bag x96 Pretoria 0001	lerato.april@energy.gov.za
Mr	Masipa	Pheladi		Private Bag x96 Pretoria 0001	Pheladi.Masipa@energy.gov.za
DEPARTMENT OF WATER AND SANITATION					
Ms	Matsheka	SM		Private Bag X5 MMABATHO 2735	MatshekaS@dwa.gov.za
Mr	Bogopa	L		Private Bag X5 MMABATHO 2735	-
Ms	Maumela	Doris		Private Bag X5 MMABATHO 2735	MaumelaD@dws.gov.za
NORTH WEST DEPARTMENT OF RURAL, ENVIRONMENTAL AND AGRICULTURAL DEVELOPMENT					

Ms	Dintwe	Tsholofelo	Acting Director	Private Bag X2039 MMABATHO 2735	tsholofelodintwe@nwpg.gov.za
DEAPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES					
Mrs	Collett	Anneliza		Private Bag X120 PRETORIA 0001	annelizac@nda.agric.za
Ms	Buthelezi	Thoko	Directorate Land Use and Soil Management	Private Bag X120 PRETORIA 0001	ThokoB@nda.agric.za
Ms	Marubini	Mashudu	Assistant Director	Private Bag X120 PRETORIA 0001	mashuduma@daff.gov.za
DEPARTMENT OF MINERAL RESOURCES (DMR)					
Mr	Swart	Pieter		Private bag a1 KLERKSDORP 2570	Pieter.Swart@dmr.gov.za
SANRAL					
	Oliver	Jan	Statutory Control Section	Private Bag X17 Lynnwood Ridge 0040	oliverj@nra.co.za
Mr	Dyers	Shaun	Manager: Statutory Control	Private Bag X19 BELLVILLE 7535	Dyerss@nra.co.za
Ms	Bota	Victoria			BotaV@nra.co.za
NORTH WEST DEPARTMENT OF ROADS AND TRANSPORT					
Mr	Thamae	M	Head of Department	Private Bag x2080 MMABATHO 2735	-
SAHRA: HEAD OFFICE					
Ms	Higgitt	Natasha	Heritage Officer: Archaeology, Palaeontology and Meteorites Unit	PO Box 4637 CAPE TOWN 8000	nhiggitt@sahra.org.za
	Khumalo	Nokukhanya	Heritage Officer	PO Box 4637 CAPE TOWN 8000	nkhumalo@sahra.or.za

ESKOM					
Mr	Geeringh	John	Chief Planner	PO Box 1091 JOHANNESBURG 2000	GeerinJH@eskom.co.za
SA CIVIL AVIATION AUTHORITY (SA CAA)					
Mr	Roberts	Harry		Private Bag X73 HALFWAY HOUSE 1685	Robertsh@caa.za
Ms	Stoh	Lizell	Obstacle Specialist	Private Bag X73 HALFWAY HOUSE 1685	strohl@caa.co.za
AIR TRAFFIC AND NAVIGATION SERVICES (ATNS)					
Ms	Morobane	Johanna	Manager: Corporate Sustainability and Environment	Private Bag X15 KEMPTON PARK 1620	JohannaM@atns.co.za
Mr	Masilela	Simphiwe	Obstacle Evaluator		SimphiweM@atns.co.za
TRANSNET FREIGHT RAIL					
Mr	Fiff	Sam	Environmental Manager: Freight Rail	PO Box 255 BLOEMFONTEIN 9300	sam.fiff@transnet.net
SENTECH					
Mr	Koegelenberg	Johan	Renewable Projects	Private Bag X06 Honeydew 2040	koegelenbergj@sentech.co.za
TELKOM					
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8 SPECIALIST STUDIES

The following specialist studies were undertaken as per the Plan of Study for EIA:

- Biodiversity (flora and fauna)
- Avifauna
- Surface Water
- Soils and Agricultural Potential
- Visual Impact
- Heritage and Palaeontology
- Socio-economic Impact
- Traffic
- Geotechnical

Each specialist assessed the impact of the solar PV energy facility and associated infrastructure that BioTherm are proposing to develop near Lichtenburg and the results are presented below.

8.1 Biodiversity

The full Biodiversity Assessment was conducted by David Hoare and is included in **Appendix 6A.**

8.1.1 Conservation status of broad vegetation types

On the basis of a recently established approach used at national level by SANBI (Driver et al. 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 18, as determined by best available scientific approaches (Driver *et al*. 2005).

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

All of the vegetation types occurring in the study area (**Table 19**) is classified as Vulnerable (Driver et al. 2005; Mucina et al., 2006) and is therefore flagged as being of potential conservation concern.

Table 18: Determining ecosystem status (from Driver et al. 2005)

*BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)			
	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

Table 19: Conservation status of different vegetation types occurring in the study area, according to Driver et al. 2005 and Mucina et al. 2005.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver *et al.* 2005; Mucina *et al*., 2006	Draft Ecosystem List (NEMBA)
Carletonville Dolomite Grassland	24	3	24	Vulnerable	Not listed

The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature. Carletonville Dolomite Grassland is not listed in the "National List of Ecosystems that are Threatened and need of protection" (GN1002 of 2011).

8.1.2 Biodiversity Conservation Plans

The North-West Province Biodiversity Conservation Assessment (obtained from bgis.sanbi.org) provides maps that show Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), corridors and hills. This shows a single feature within the study area (**Figure 36**), as follows:

- Protected
- CBA1
- CBA2
- ESA1
- ESA2
- Other natural
- Degraded

The proposed infrastructure therefore falls within areas defined as of biodiversity significance for a number of reasons.

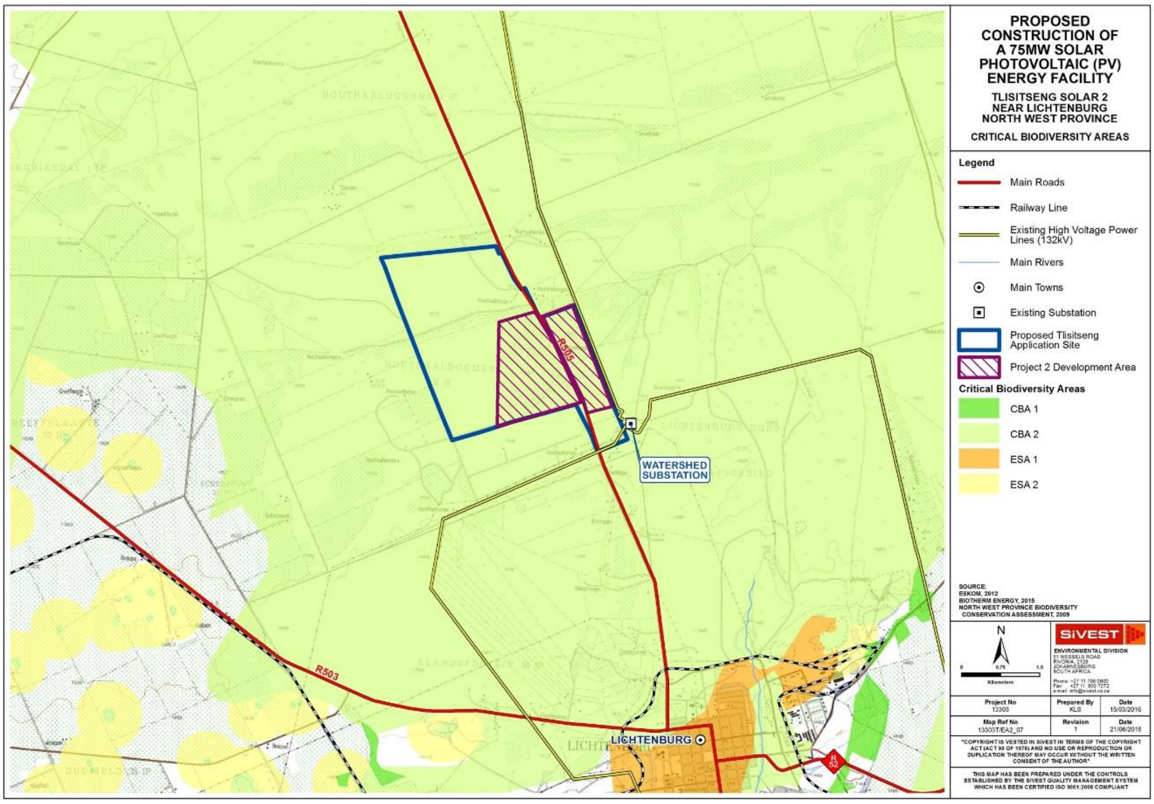


Figure 36: Critical Biodiversity Areas

8.1.3 Proposed protected areas

According to the National Parks Area Expansion Strategy (NPAES), there is an area 20 km to the north-west of the project study area that has been identified as priority areas for inclusion in future protected areas. This particular component of the landscape is considered to be of high biodiversity value by National Parks, but the proposed project does not affect this area at all.

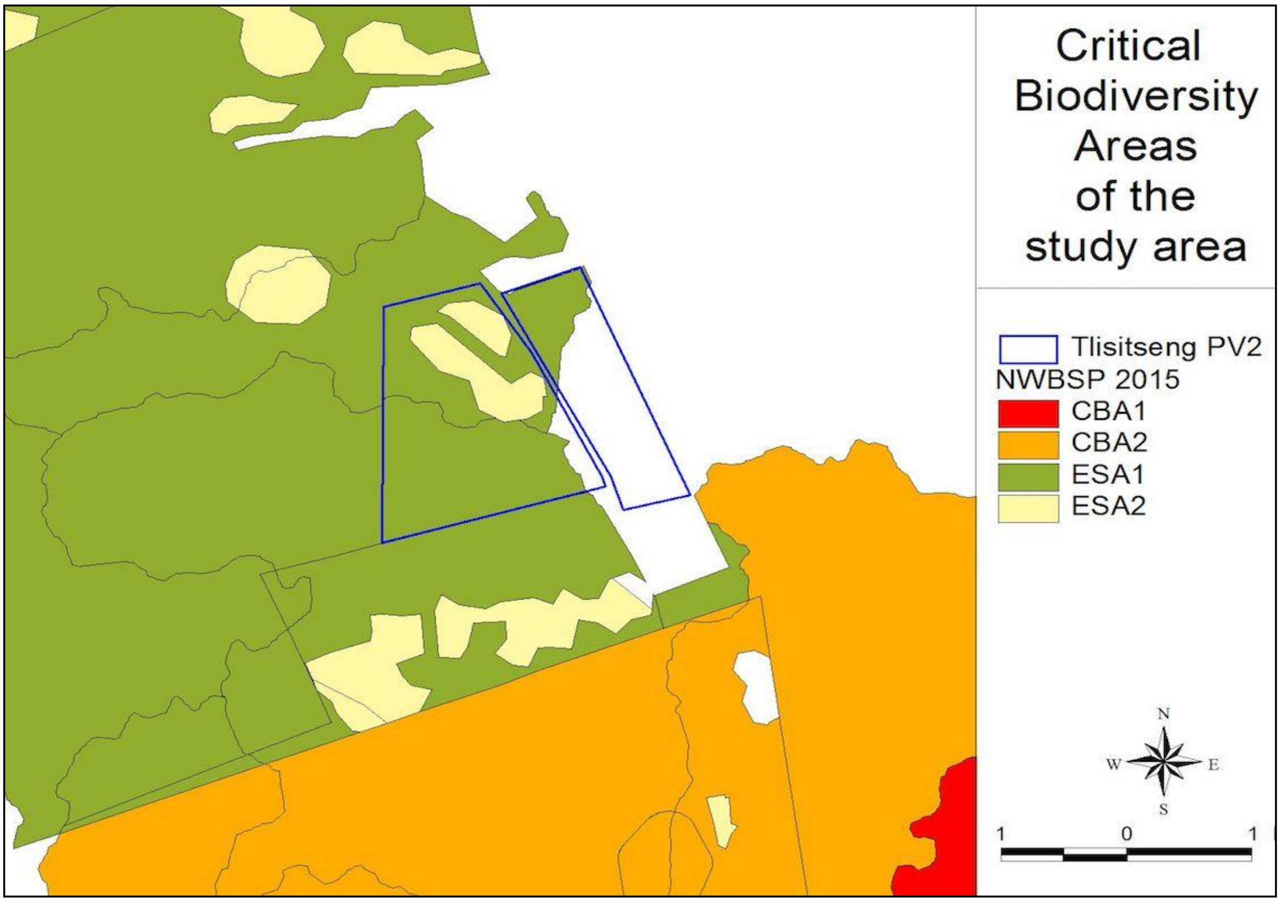


Figure 37: Biodiversity Conservation Assessment for the Tlisitseng 2 Solar PV energy facility study area.

8.1.4 Red List plant species of the study area

Lists of plant species of conservation concern previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in the Biodiversity Specialist Report. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in these grids, are also listed.

There are four species that may occur in the study area, the bulb, *Boophone disticha*, listed as Declining, the bulb, *Crinum macowanii*, listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened (see **Table 20** for explanation of categories). *Boophone disticha* is found in dry grassland and rocky areas. The species has been recorded in grid in which the site is located in the type of habitat that is found on site. One individual was found on site, but based on the habitat present on site there is a probability that more individuals occur there. *Crinum macowanii* is found in mountain grassland and stony slopes in hard dry shale, gravely soil or sandy flats. The species has been recorded in grid in which the site is located in the type of habitat that is probably found on site and the possibility of it occurring in the study area is therefore considered to be high. A species of *Crinum* was recorded in nearby areas, but it is unknown whether tit occurs on this site or not. *Brachystelma incanum* is found in sandy loam soils in bushveld. Such habitat does not strictly occur on site, although there are occasional bush-clumps that may be suitable. The species has been previously recorded in the grid to the north of the site and there is therefore the possibility that it occurs on site. *Cleome conrathii* is found in stony quartzite slopes, usually in red sandy soil, in grassland or deciduous woodland, at all aspects. It is possible that it could also occur on site, but was not seen there.

Table 20: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well-known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

8.1.5 Red List animal species of the study area

All Red List vertebrates (mammals, birds, reptiles, amphibians) that could occur in the study area are listed in the Biodiversity Specialist Report.

There are 93 mammal species that have a geographical distribution that includes the study area, of which nine are listed in a conservation category of some level (see Biodiversity Specialist Report). Of the listed species, there are three of low conservation concern and one of high conservation concern that could occur in available habitats in the study area. These are the Brown Hyaena, the Honey Badger and Southern African Hedgehog. All of these species are classified nationally as near threatened (NT), but globally as Least Concern. They are, therefore, of relatively low conservation concern in comparison to more threatened species found in other parts of the country. The Honey Badger and the Hedgehog are protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit. The species of high conservation concern that could occur on site is the White-tailed Rat (*Mystromys* *albicaudatus*), listed as Endangered. The White-tailed Rat is restricted to savannas and grasslands of South Africa and Swaziland. They tend to inhabit burrows of meerkats and cracks in the soil during the day and venture out at night. They apparently require black loam soils with good cover (Coetzee & Monadjem 2008). It has been previously recorded in the grid in which the study area is located (Friedmann & Daly 2004, http://vmus.adu.org.za). The survey capture rate for this species is very low, suggesting that there are low numbers of the species (Coetzee & Monadjem 2008). Information sources suggest that there is a likelihood of this species occurring on site, although, if it does occur there, it is likely to be at a low density.

There are a total of 17 frog species with a geographical distribution that includes the study area. The Giant Bullfrog is the only amphibian species with a distribution that includes the study area and which could occur on site. This species is listed as Least Concern globally and Near threatened in South Africa. It is, however, protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit.

There are a total of 58 reptile species with a geographical distribution that includes the study area. There is one reptile species of conservation concern that has a distribution that includes the study area, the Southern African Python. This species is not listed in a threat category, but is protected under the National Environmental Management: Biodiversity Act.

8.1.6 Protected plants (National Environmental Management: Biodiversity Act)

Plant species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) are listed in the Biodiversity Specialist Report. One plant species that appears on this list that could potentially occur in the general region, although thay have not previously been recorded in the grids of the study area, is *Harpagophytum procumbens*.

Harpagophytum procumbens occurs in Angola, Botswana, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe. Within South Africa this species occurs in the Northern Cape, North West, Free State, and Limpopo Provinces and the largest populations are found in the communally owned areas of the North West Province and the north eastern parts of the Northern Cape. The species is found in well drained sandy habitats in open savanna and woodlands. It has not been previously recorded in this grid in which the site is located and may be outside the scattered geographic range of the species. However, it is considered possible, but unlikely that this species could occur on site due to habitat conditions found there relative to the species requirements.

8.1.7 Protected trees

Tree species protected under the National Forest Act are listed in the Biodiversity Specialist Report. There are three that have a geographical distribution that includes the study site, *Acacia erioloba, Combretum imberbe* and *Boscia albitrunca*. There are a number of others that have a geographical distribution that ends close to the study site, including *Sclerocarya birrea* subsp. *caffra, Prunus africana,* *Pittosporum viridiflorum* and *Erythrophysa transvaalensis*. There is therefore a small possibility that they could also occur on site if suitable habitat occurs there.

Acacia erioloba (Camelthorn / Kameeldoring) is found in savanna, semi-desert and desert areas with deep, sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops. This species occurs in relatively large numbers on site in areas affected by the proposed project. At least 50 individuals were seen on site without specifically looking for them. There is therefore probably a much greater number that occurs there.

Boscia albitrunca (Shepherd's Tree / Witgatboom / !Xhi) occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. This species could potentially occur on site in areas affected by the proposed project. No individuals were seen on site, but one individual was recorded nearby.

Combretum imberbe (Leadwood / Hardekool / Motswere) is found in bushveld and mixed woodland, often in alluvial soils along dry and active river beds. This species could potentially occur on site in areas affected by the proposed project, although the habitat on site does not appear from the desktop assessment to be suitable. No individuals were seen during the field survey.

Erythrophysa transvaalensis (Transvaal Red Balloon / Rooiklapperboom / Mofalatsane) grows on the rocky slopes of hills, often amongst boulders. This species has a limited distribution in South Africa occurring in Gauteng, Limpopo and the North West Province. It was first thought to be endemic to syenite hills in the Pilanesburg National Park, but is found in a wider area. It is considered unlikely that it occurs on site. No individuals were seen there.

Pittosporum viridiflorum (Cheesewood / Bosboekenhout / Mosetlela) is widely distributed in the eastern half of South Africa, occuring from the Western Cape up into tropical Africa and beyond to Arabia and India. It grows over a wide range of altitudes and varies in form from one location to another. *Pittosporum viridiflorum* grows in tall forest and in scrub on the forest margin, kloofs and on stream banks. No such habitat occurs on site and it is considered unlikely that this species occurs there. No individuals were seen there.

Prunus africana (Bitter Almond / Bitteralmandelhout / Mogohloro) is found in evergreen forests near the coast, inland mistbelt forests and afromontane forests up to 2100 m. The species is listed as Vulnerable in the Red List of South African plants. Based on habitat requirements, it is not expected that it occurs there. No individuals were seen there.

Sclerocarya birrea subsp. *caffra* (Marula / Maroela / Morula) is widespread in Africa from Ethiopia in the north to KwaZulu-Natal in the south. In South Africa it is more dominant in the Baphalaborwa area in Limpopo. It occurs naturally in various types of woodland, on sandy soil or occasionally sandy loam. No individuals were seen there and the habitat on site is considered to not be typical of the habitat in which the species usually occurs.

8.1.8 Protected animals

There are a number of animal species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). According to this Act, "*a person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7*". Such activities include any that are "*of a nature that may negatively impact on the survival of a listed threatened or protected species*". This implies that any negative impacts on habitats in which populations of protected species occur or are dependent upon would be restricted according to this Act.

Those species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) that have a geographical distribution that includes the site are listed in the Biodiversity Specialist Report, marked with the letter "N". This includes the following species: Roan Antelope, Black Wildebeest, Reedbuck, Cape Clawless Otter, Brown Hyaena, Spotted-necked Otter, Honey Badger, Leopard, Cape Fox, Southern African Hedgehog, Southern African Python, Giant Bullfrog, Blue Crane, Martial Eagle, Lesser Kestrel, Black Stork, Cape Vulture, Lappet-faced Vulture and White-backed Vulture.

Due to habitat and forage requirements and the fact that some species are restricted to game farms and/or conservation areas, only the Brown Hyaena, Black-footed Cat, Honey Badger, Leopard, Cape Fox and the Giant Bullfrog have a likelihood of occurring on site. All of these species are mobile animals that are likely to move away in the event of any activities on site disturbing them. They are therefore unlikely to be affected by the proposed development of the solar power facility and associated infrastructure.

8.1.9 Habitats on site

Aerial imagery indicates that most of the site consists of natural vegetation (grassland called Carletonville Dolomite Grassland). This was confirmed from the field survey, but with the addition of scattered trees and bushclumps. The distribution of main habitats on site, as identifiable from aerial imagery, is shown in **Figure 38**.

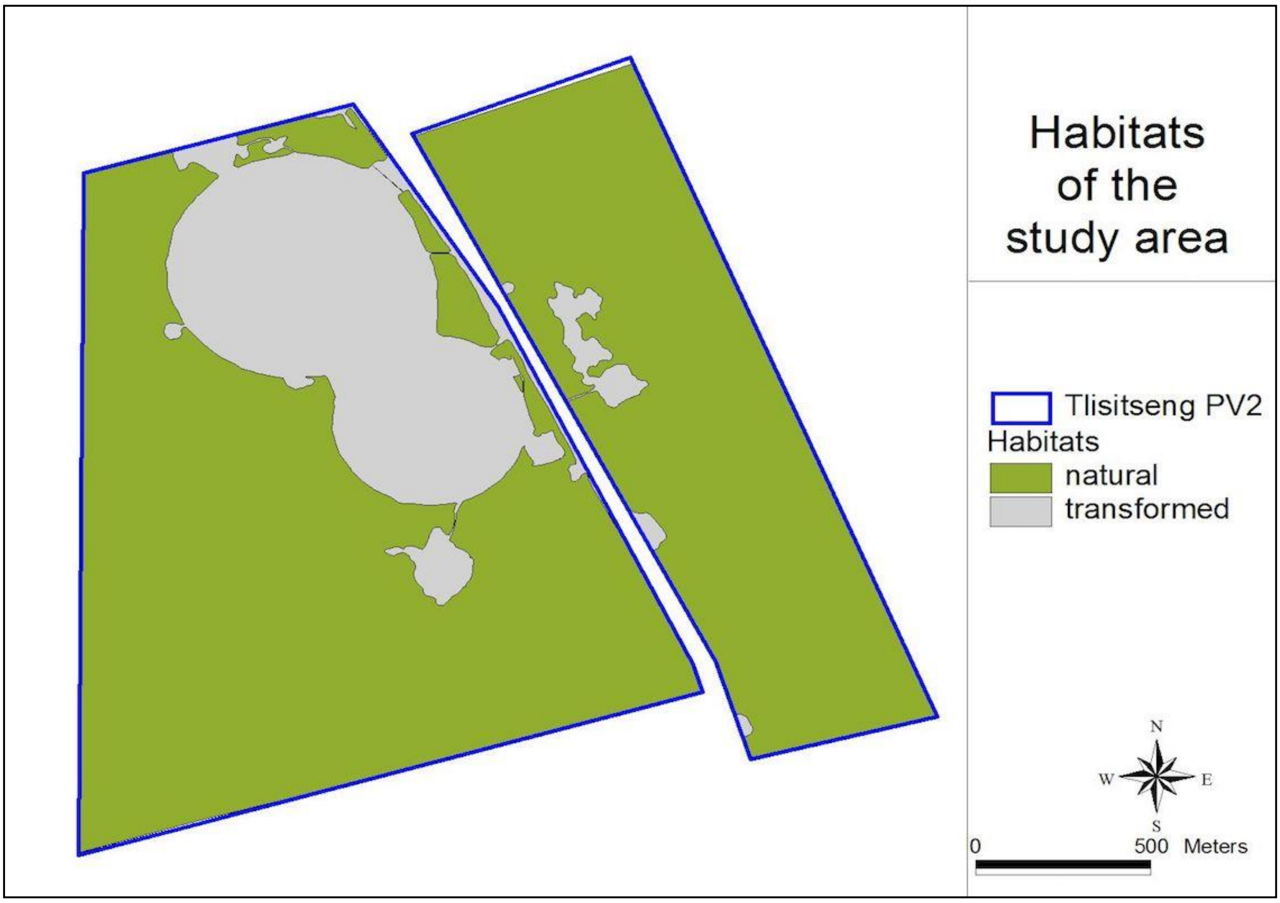


Figure 38: Main habitats of the study area

8.1.10 Watercourses

From a biodiversity assessment the study area contains no watercourses / drainage lines that are visible from aerial imagery or from the Surveyor-General's 1:50 000 topocadastral map. No drainage areas or water features were observed on site during the field survey. However a Surface water impact assessment was conducted and is discussed in **Section 8.3** of this report.

8.1.11 Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas of potentially high sensitivity are shown in **Figure 39**. The information provided in the preceding sections was used to compile a map of remaining natural habitats and areas important for maintaining ecological processes in the study area.

These factors have been taken into account in evaluating sensitivity within the study area. Watercourses are considered to be the most sensitive features on site. The sensitivity classification is as follows:

1. MEDIUM-HIGH: The majority of the study area is classified as having medium sensitivity (see **Figure 39**). These are areas of natural vegetation which may harbour features of conservation concern (listed or protected plants and/or animals), as well as falling within C-Plan Ecological Support Areas and being part of a vegetation type classified as Vulnerable.
2. LOW: Transformed areas are classified as having low sensitivity (see **Figure 39**). These are areas in which no intact natural habitat still remains.

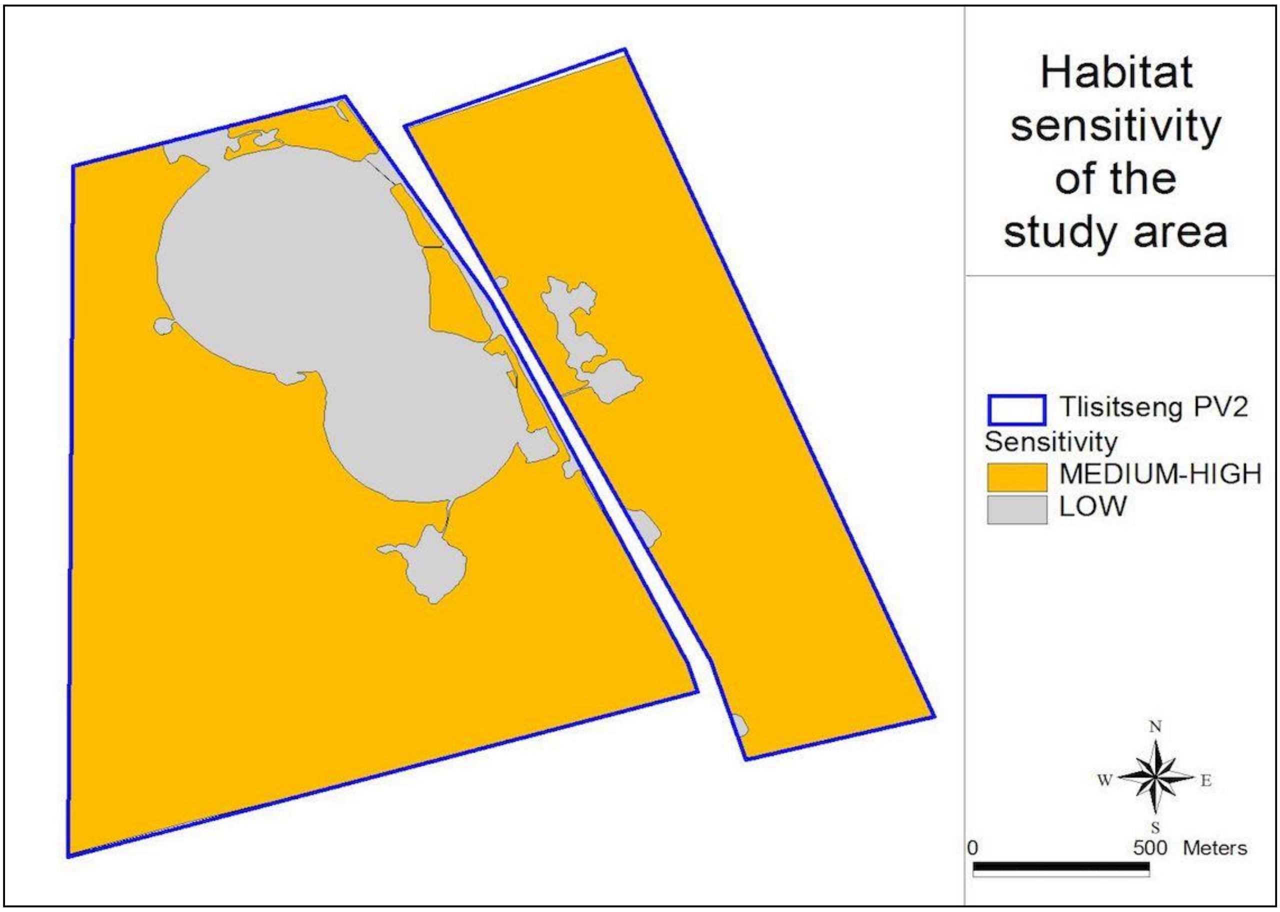


Figure 39: Potentially sensitive areas of the study area

8.1.12 Description of potential impacts

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous forest and/or woodland and wetland vegetation that leads to direct or

indirect loss of such habitat.

- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
    - disruption to nutrient-flow dynamics;
    - impedance of movement of material or water;
    - habitat fragmentation;
    - changes to abiotic environmental conditions;
    - changes to disturbance regimes, e.g. increased or decreased incidence of fire;
    - changes to successional processes;
    - effects on pollinators;
    - increased invasion by alien plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems that would result from construction of the proposed PV facility are as follows:

- Clearing of land for construction.
- Construction of access roads.
- Placement of power lines.
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

There are also risks associated with operation of the proposed facility, as follows:

- Maintenance of surrounding vegetation as part of management of the power line.
- Animal collisions with infrastructure, especially flying animals.
- Invasion of habitats by alien plants as a consequence of disturbance.

Potential issues for the general study area

A summary of the potential ecological issues for the study area is as follows:

- Presence of natural vegetation on site, some of which is included in Provincial CBA areas and is therefore of potentially high conservation priority.
- Potential presence of four plant species of concern, the bulb, *Boophone disticha* (occurs on site), listed as Declining, the bulb, *Crinum macowanii* (probably occurs on site), listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened.
- Potential presence of one protected plant species, *Harpagophytum procumbens*.
- Potential presence of three protected tree species, *Acacia erioloba* (occurs in large numbers on site), *Combretum imberbe* and *Boscia albitrunca* (occurs in adjacent habitats).
- Potential presence of some animals of potential conservation concern:
    - Brown Hyaena (NT)
    - Honey badger (NT)
    - Southern African Hedgehog (NT)
    - White-tailed Rat (EN)
    - Giant Bullfrog (NT/LC).
- Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.

Potential risks to the ecological receiving environment are therefore the following:

1. Loss of indigenous natural vegetation during construction;
2. Impacts on two listed plant species;
3. Impacts on protected plant species;
4. Impacts on two protected tree species;
5. Mortality of populations of sedentary species during construction (terrestrial and aquatic);
6. Displacement of populations of mobile species (terrestrial);
7. Introduction and/or spread of declared weeds and alien invasive plants in terrestrial habitats.

8.2 Avifauna

The full Avifauna Assessment was conducted by Chris van Rooyen and is included in **Appendix 6B.**

An estimated 282 species could potentially occur at times in the core study area and immediate surroundings (which includes the Lichtenburg Game Breeding Centre and wetland areas south-east of the core study area). Of these, 21 are South African Red Data species, 12 are southern African endemics and 21 are near-endemics. This means that 7.4% of the species that could potentially occur at the core study area and immediate surroundings are Red Data species, and 11.7% 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 could potentially at times host a total of 30 endemics and near-endemics, which is 18% of the 167 southern African endemics and near-endemics (Hockey et al. 2005).

See the Avifaunal Specialist Report 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 21** below.

Table 21: Priority species potentially occurring at the core study area and immediate surroundings.

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 core study area
Barbet, Acacia Pied	*Tricholaema leucomelas*	-	-	x	x	x	High
Bittern, Little	*Ixobrychus minutus*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Bokmakierie	*Telophorus zeylonus*	N-end	-	x	x	x	High
Bulbul, African Red-eyed	*Pycnonotus nigricans*	N-end	-	x	x	x	High
Bunting, Cape	*Emberiza capensis*	N-end	-	x	x	x	Low
Bunting, Lark-like	*Emberiza impetuani*	N-end	-	x	x	x	Low
Buzzard, Steppe	*Buteo vulpinus*		-	x			
Canary, Yellow	*Crithagra flaviventris*	N-end	-	x	x	x	High

Chanting Goshawk, Southern Pale	*Melierax canorus*	N-end	-	x	x	x	Medium
Chat, Ant-eating	*Myrmecocichla formicivora*	End	-	x	x	x	High
Clapper-Lark, Eastern	*Mirafra fasciolata*	N-end	-	x	x	x	High
Cliff-swallow, South African	*Hirundo spilodera*	End	-	x	x	x	High
Coot, Red-knobbed	*Fulica cristata*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Cormorant, Reed	*Phalacrocorax africanus*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Cormorant, White-breasted	*Phalacrocorax carbo*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Courser, Double-banded	*Rhinoptilus africanus*	NT	LC	x	x	x	Low

Crake, Black	*Amaurornis flavirostris*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Crane, Blue	*Anthropoides paradiseus*	NT	VU		x	x	Low
Darter, African	*Anhinga rufa*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Duck, African Black	*Anas sparsa*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Duck, Fulvous	*Dendrocygna bicolor*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Duck, White-faced	*Dendrocygna viduata*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction

Duck, Yellow-billed	*Anas undulata*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Eagle, Martial	*Polemaetus bellicosus*	EN	VU	-	x	x	Low
Eagle, Tawny	*Aquila rapax*	EN	LC		x	x	Low
Egret, Cattle	*Bubulcus ibis*			x	x	x	High
Falcon, Amur	*Falco amurensis*			x	x	x	High
Falcon, Lanner	*Falco biarmicus*	VU	LC	x	x	x	High
Falcon, Peregrine	*Falco peregrinus*			x			Low
Falcon, Red-footed	*Falco vespertinus*	NT	NT	x	x	x	Low
Finch, Red-headed	*Amadina erythrocephala*	N-end	-	x	x	x	High
Finch, Scaly-feathered	*Sporopipes squamifrons*	N-end	-	x	x	x	High
Flamingo, Greater	*Phoenicopterus ruber*	NT	NT	x	-	-	Very low, but could be attracted by the lake effect after construction

Flamingo, Lesser	*Phoenicopterus minor*	NT	NT	x	-	-	Very low, but could be attracted by the lake effect after construction
Flycatcher, Fairy	*Stenostira scita*	End	-	x	x	x	Low
Flycatcher, Fiscal	*Sigelus silens*	End	-	x	x	x	High
Goose, Egyptian	*Alopochen aegyptiacus*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Goose, Spur-winged	*Plectropterus gambensis*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Grebe, Little	*Tachybaptus ruficollis*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Greenshank, Common	*Tringa nebularia*	-	-	x	-	-	Very low, but could be attracted by the

							lake effect after construction
Gull, Grey-headed	*Larus cirrocephalus*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Hamerkop	*Scopus umbretta*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Harrier-Hawk, African	*Polyboroides typus*	-	-	x	x	x	Low
Heron, Black	*Egretta ardesiaca*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Heron, Black-headed	*Ardea melanocephala*	-	-	x	--	-	Very low, but could be attracted by the lake effect after construction

Heron, Goliath	*Ardea goliath*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Heron, Green-backed	*Butorides striata*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Heron, Grey	*Ardea cinerea*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Heron, Purple	*Ardea purpurea*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Ibis, African Sacred	*Threskiornis aethiopicus*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction

Ibis, Glossy	*Plegadis falcinellus*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Kestrel, Greater	*Falco rupicoloides*	-	-	x	x	x	Low
Kestrel, Lesser	*Falco naumanni*	-	-	x	x	x	Medium
Kingfisher, Giant	*Megaceryle maximus*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Kingfisher, Malachite	*Alcedo cristata*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Kingfisher, Pied	*Ceryle rudis*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Kite, Black-shouldered	*Elanus caeruleus*	-	-	x	x	x	High
Kite, Yellow-billed	*Milvus aegyptius*	-	-	x	x	x	High

Korhaan, Northern Black	*Afrotis afraoides*	End	-	x	x	x	High
Lark, Eastern Clapper	*Mirafra fasciolata*	-	Near endemic	x	x	x	High
Lark, Sabota	*Calendulauda sabota*	N-end	-	x	x	x	Low
Lark, Spike-heeled	*Chersomanes albofasciata*	N-end	-	x	x	x	Medium
Moorhen, Common	*Gallinula chloropus*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Mousebird, White-backed	*Colius colius*	End		x	x	x	High
Night-Heron, Black-crowned	*Nycticorax nycticorax*	--	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Owl, Barn	*Tyto alba*	-	-	x	x	x	High
Painted-snipe, Greater	*Rostratula benghalensis*	VU	LC	x	-	-	Very low, but could be attracted by the lake effect after construction

Pelican, Great White	*Pelecanus onocrotalus*	VU	LC	x	-	--	Very low, but could be attracted by the lake effect after construction
Penduline-tit, Cape	*Anthoscopus minutus*	-	Near endemic	x	x	x	Low
Pratincole, Black-winged	*Glareola nordmanni*	NT	NT	x	x	x	Low
Prinia, Black-chested	*Prinia flavicans*	N-end	-	x	x	x	High
Roller, European	*Coracias garrulus*	NT	NT	x	x	x	Very low
Sandgrouse, Burchell's	*Pterocles burchelli*	N-end	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Sandgrouse, Namaqua	*Pterocles namaqua*	N-end	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Scrub-Robin, Kalahari	*Cercotrichas paena*	N-end	-	x	x	x	High
Secretarybird	*Sagittarius serpentarius*	VU	VU	x	x	x	Low

Shelduck, South African	*Tadorna cana*	End	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Shelduck, South African	*Tadorna cana*	End	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Shoveler, Cape	*Anas smithii*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Shrike, Crimson-breasted	*Laniarius atrococcineus*	N-end	-	x	x	x	Medium
Snake-eagle, Brown	*Circaetus cinereus*				x	x	Low
Snipe, African	*Gallinago nigripennis*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Sparrow, Cape	*Passer melanurus*	N-end	-	x	x	x	High

Starling, Pied	*Spreo bicolor*	End		x	x	x	Medium
Stilt, Black-winged	*Himantopus himantopus*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Stint, Little	*Calidris minuta*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Stork, Abdim's	*Ciconia abdimii*	NT	LC	x	x	x	Low
Stork, Black	*Ciconia nigra*	VU	LC	x	-	-	Very low, but could be attracted by the lake effect after construction
Stork, Marabou	*Leptoptilos crumeniferus*	NT	LC	x	-	-	Low
Stork, Yellow-billed	*Mycteria ibis*	EN	LC	x	-	-	Very low, but could be attracted by the lake effect after construction
Swamphen, African Purple	*Porphyrio madagascariensis*	-	-	x	-	-	Very low, but could be attracted by the

							lake effect after construction
Teal, Hottentot	*Anas hottentota*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Teal, Red-billed	*Anas erythrorhyncha*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Tern, Whiskered	*Chlidonias hybrida*	-	-	x	-	-	Very low, but could be attracted by the lake effect after construction
Thrush, Karoo	*Turdus smithi*	End		x	x	x	Low
Thrush, Karoo	*Turdus smithi*	End		x	x	x	Medium
Vulture, Cape	*Gyps coprotheres*	EN	VU		x		Low
Vulture, Lappet-faced	*Torgos tracheliotus*	EN	VU	-	x	-	Low
Vulture, White-backed	*Gyps africanus*	EN	VU	-	x	-	Low
White-eye, Cape	*Zosterops virens*	End	-	x	x	x	Low

White-eye, Orange River	*Zosterops pallidus*	End	-	x	x	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 core study area revealed fewer than expected priority species. Two walk transects of 1km each were identified at the site and each surveyed 24 times through the course of the monitoring, to record the diversity and abundance of avifauna. **Table 22** 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 the majority 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 22: Priority species recorded during pre-construction monitoring at the core study area.

Priority species	Mean individuals per survey	Individuals per kilometre
Amur Falcon	0.04	0.02
Barn Owl	0.04	0.02
Cattle Egret	0.92	0.46
Lanner Falcon	0.13	0.06
Acacia Pied Barbet	0.04	0.02
African Red-eyed Bulbul	0.13	0.06
Black-chested Prinia	0.21	0.10
Bokmakierie	0.54	0.27
Cape Sparrow	0.04	0.02
Chestnut-vented Tit-babbler	0.08	0.04
Eastern Clapper Lark	0.42	0.21
Kalahari Scrub-Robin	0.08	0.04
Marico Flycatcher	0.04	0.02
Northern Black Korhaan	2.21	1.10
Scaly-feathered Finch	0.46	0.23
White-backed Mousebird	1.04	0.52
Anteating Chat	0.50	2.0
Yellow Canary	0.21	2.0
Total	7.13	7.19

As can be seen in **Table 22** 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 due to the characteristics of the site itself, which, does 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 an absolutely representative snapshot of the typical avifaunal dynamics at the core study area under all conditions.

8.2.1 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).

8.2.2 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 Tlisitseng PV 2 facility, the results of the Solar Two 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 Tlisitseng 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 23**:

Table 23: 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.

<u>Tlisitseng PV 2</u>

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 **Tlisitseng PV 2** site is tabled in **Table 21**. The so-called "lake effect" could act as an attraction to some species and it is expected that flocking species such as Pied Starling, and mixed flocks of seed-eaters including Cape Sparrow, Red-headed Finch, Scaly-feathered Finch, Yellow Canary, Grey-backed Sparrow-lark and several species of doves would be most susceptible to this impact as they habitually arrive in flocks at surface water to drink. Multiple mortalities could potentially result from this, which in turn could attract raptors e.g. Lanner Falcon 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" may draw various water birds to the area, including endemics e.g. the South African Shelduck and possibly even the Red Data Black Stork, Greater Flamingo, Lesser Flamingo, Greater Painted-snipe and Great White Pelican. The proximity of the wetland areas may act as an aggravating factor as it already holds an attraction for waterbirds when full.

8.2.3 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.

Tlisitseng PV 2

See **Table 21** 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 and scavengers (e.g. Southern Pale Chanting Goshawk, Lanner Falcon, Tawny Eagle and Marabou Stork) 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.

8.3 Surface Water

The full Surface Water Assessment was conducted by Shaun Taylor of SiVEST and is included in **Appendix 6C.**

The in-field wetland delineation assessment took place from the 1st to 2nd of December 2015. 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 40**.

Following the fieldwork, no watercourses were identified on the study site. Only one small pan wetland was identified in the field. This wetland was not contained in the consulted databases. Aside from this wetland, no other wetlands nor watercourses were identified within the alternative substation sites as well as the power line corridor. The physical characteristics of the various indicators for the pan wetland is provided in more detail below.

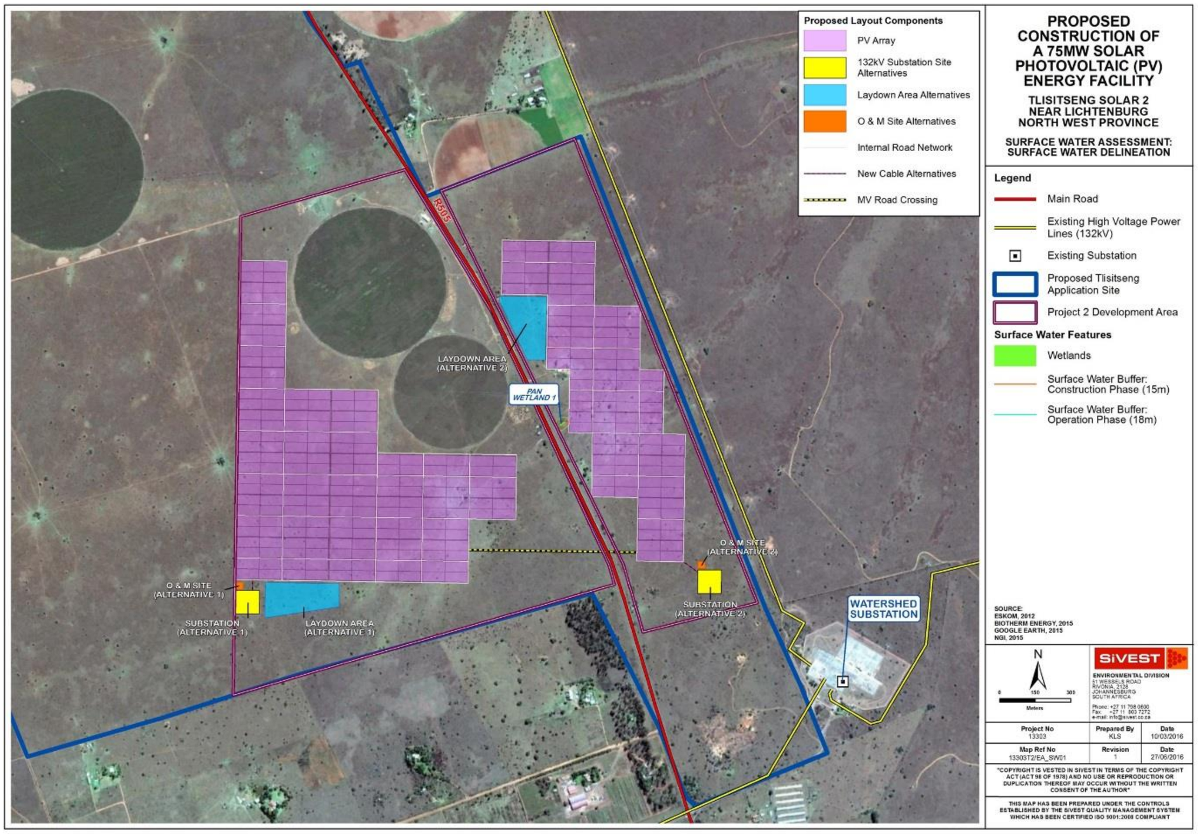


Figure 40: Tlisitseng 2 PV Facility Surface Water Delineation Map

8.3.1 Pan Wetland 1

8.3.1.1 Terrain and Wetland Soil Characteristics

The general terrain is mostly flat on the eastern portion of Portion 25 of the Farm Houthaalboom 31. However, multiple excavation pits around the property on the eastern portion, particularly to the south, have been undertaken. There are multiple micro-topographical modifications that have taken place which influence the drainage on this portion of the study site. As a result, one such excavation extended deep enough to the water table, where a wetland has formed.

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.

Figure 41: Pan Wetland identified in the proposed PV field

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 wetlands. In this instance however, one soil form was identified in the pan wetland located within the power line corridor. The soils within the pan wetland were found to have a fair amount of clay material in the soil samples drawn along with mottling in the form of orange, brown, red and black precipitations beneath the surface (Figure 42). An Orthic A horizon could be attributed to the thin surface soil horizon. Overall, the sub-soil samples were of a low chroma colour to that of the surrounding landscape indicating reduction of ferric oxides thereby indicating a G horizon. The combination of the Orthic A over a G horizon indicates that the Katspruit Soil Form could be attributed to the pan wetland.

Figure 42: Iron Mottling and Depleted Soils within the Pan Wetland.

8.3.1.2 Wetland Vegetation

The pan wetland was mainly vegetated with graminoid species within and around the fringes of the wetland. However, small rush species were also noted within the core of the wetland presumably where inundation last longer (**Figure 43**). The limited species identified included *Cymbopogon caesius*, *Cynodon dactylon, Hyparrhenia hirta* and *Schoenoplectus* sp (ow).

Figure 43: Pan Wetland with mainly Graminoid Species (left) but also including Rush Species in the Core of the Wetland (right)

8.3.2 Surface Water Buffer Zones

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 also contribute to increased run-off and sediment inputs, as well as turbidity. Again, the terrain and climate a factors that will have a bearing on potential impacts. However, with the implementation of mitigation measures, potential impacts can be avoided. Therefore, the operation phase buffers in this instance can be of limited extent once more.

Based on the above as well as the suggested mitigation measures stipulated in Section 10, 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

8.4 Agricultural Potential and Soils

The full Agricultural Potential Assessment was conducted by Garry Paterson and is included in **Appendix 6D.**

8.4.1 Soil pattern

The desk-top study indicated that the soils in the vicinity of the project were generally shallow to very shallow (<500 mm), usually sandy loam and calcareous, overlying either rock or cemented hardpan calcrete. Some rock outcrops occur in places in the landscape. However, some areas of deeper red soils, which will have a higher agricultural potential, can also occur.

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).

At several observation points, the soil was seen to be deep (>750 mm), but these points were generally isolated, and surrounded by shallow soils, so that a relatively large, homogeneous area of deep soils does not occur (this is quite typical of various areas of dolomite-derived soils). Only at adjoining points L64, L65 and L47 was there a significant area of deep soils, but no cultivation was observed in this area, so it can be surmised that this area does not extend for any distance. The location of the points in the vicinity of Tsilitseng PV 2 (shown by the yellow boundary) that were visited during the field trip is shown in **Figure 44**

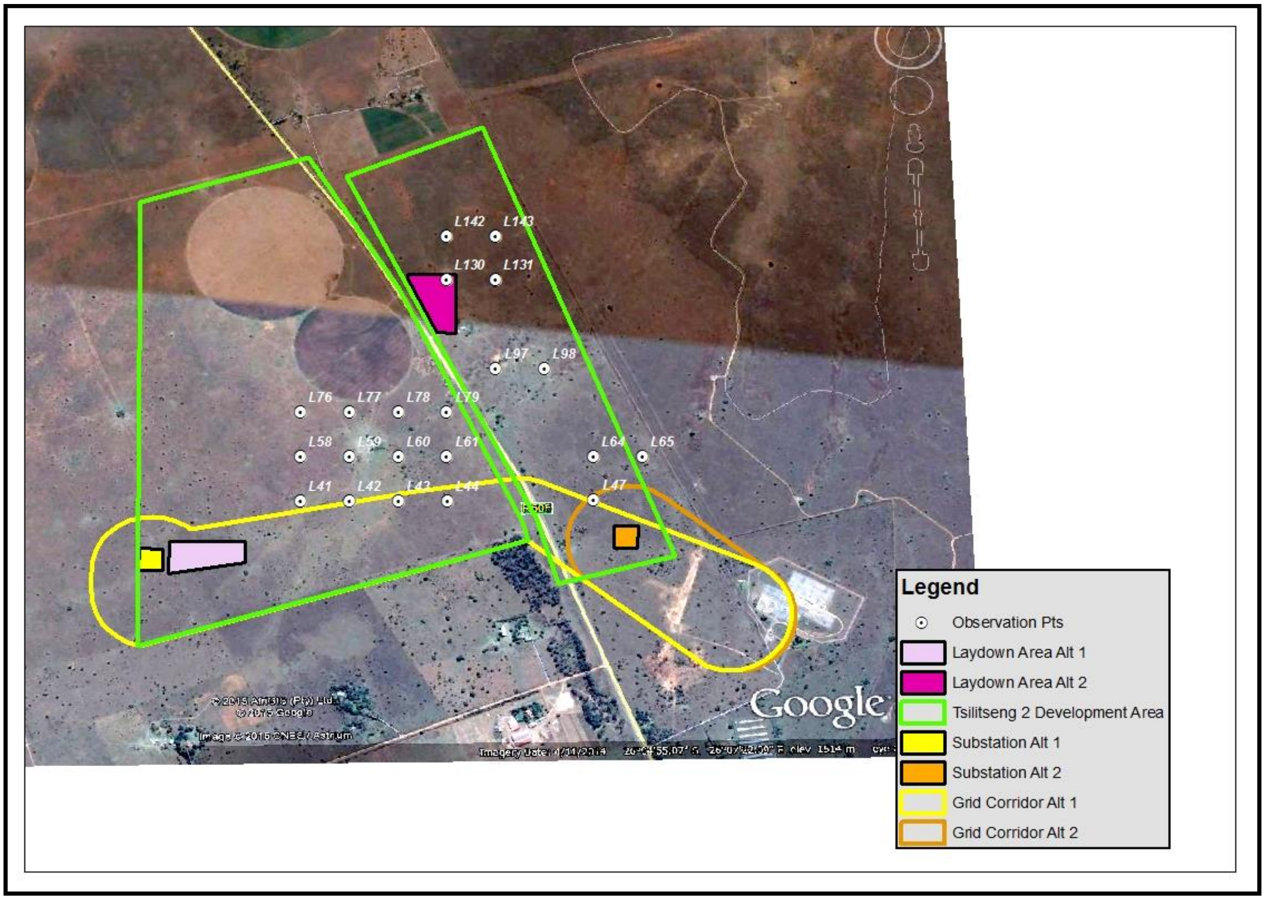


Figure 44: Soil observed points

8.4.2 Agricultural Potential

Despite the dominance of shallow soils in the area, areas of cultivation on the deeper soils can be seen in the vicinity. These include the various centre pivot fields, two of which occur in or close to the north-west corner of the part of the PV 2 site occurring to the west of the R505 road. The rainfall in the area is adequate for rain-fed cultivation, but due to the unreliability of the distribution, irrigation is a viable means of supplementing the rainfall in times of shortage, especially in the areas where deeper soils occur.

The climatic parameters 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).

8.4.3 Land Use

The land use in the area is dominantly grazing, but with areas of cultivation, some under irrigation as classified by the National Land Cover (Thompson, 1999).

8.5 Visual

The full The Visual Assessment was conducted by Andrea Gibb and Stephan Jacobs of SiVEST and is included in **Appendix 6E.**

8.5.1 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 24**), 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 24: 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.

8.5.2 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 52** below and each receptor is identified by a specific number (e.g. VR 1 = Visual Receptor 1). Of the potentially sensitive visual receptors identified, only three (3) receptor locations were identified as being sensitive within the study area due to their current and potential tourism significance, namely Rafters Pub, the Lichtenburg Vakansie Oord and the Lichtenburg Game Breeding Centre (VR 14, VR 69 and VR 71 respectively). The Lichtenburg Vakansie Oord is situated approximately 4km south-east of the proposed PV application site, adjacent to the Lichtenburg Game Breeding Centre, and is an ideal place for relaxation, adventure and scenic beauty. This holiday resort is an attractive destination for tourists and people on vacation and offers accommodation in the form of equipped chalets (**Figure 45**) and camping facilities. Other facilities that can be found within the holiday resort include lapa facilities with a boma, an in-house warm pool, an outside pool with slides (**Figure 46**), a day resort with 90m “Supertube” and 45m “Lane-Racer”, and an Olympic swimming pool with shaded island (http://lichtenburgvakansieoord.co.za/index2.htm).

Figure 45: The tiled roof chalets that are found within the Lichtenburg Vakansie Oord

Figure 46: The outside swimming pool area with slides which is found within the Lichtenburg Vakansie Oord

In addition, a tower which looks out over the adjacent Lichtenburg Game Breeding Centre can also be found within the resort (**Figure 47**). Due to the relatively tall nature of this structure, it is likely that individuals standing on the lookout tower might have views of the proposed project site. The area surrounding the holiday resort has maintained a relatively natural or scenic character, with transformation limited mainly to the holiday resort area itself. This is most likely due to the fact that the Lichtenburg Vakansie Oord is situated adjacent to the largely natural area of the Lichtenburg Game Breeding Centre. It should however be noted that certain anthropogenic elements, such as telephone poles and a large cement factory (**Figure 48**), can be seen from within the holiday resort and are expected to lessen the visual impact sensitivity of the surrounding area. Although the above-mentioned cement factory is situated outside of the visual assessment zone, it is still expected to alter the visual character of the views from the Lichtenburg Vakansie Oord and will ultimately lessen the visual impact associated with the proposed development.

Figure 47: Lookout Tower found in the Lichtenburg Vakansie Oord which looks out over the adjacent Lichtenburg Game Breeding Centre

Figure 48: Large cement factory which can be seen from inside the Lichtenburg Vakansie Oord

The Lichtenburg Game Breeding Centre (VR 71) has maintained a largely natural character (**Figure 49**). It should however be noted that a series of telephone poles can be found throughout the game breeding centre. In addition, other existing linear elements, such as a large cement factory and the tall steel structures that make up the Watersed MTS, are also visible from certain areas of the game breeding centre (**Figure 50**). The game breeding centre is also characterised by the presence of a wetland area which used to be home to unique animals such as the pygmy hippo and Pere David's deer.

Figure 49: View from one of the game drive routes in the Lichtenburg Game Breeding Centre showing the largely natural character of the area.

Figure 50: The tall steel structures of the Watershed MTS which can be seen from certain parts of the Lichtenburg Game Breeding Centre.

Part of the wetland area has been honed into a series of dams and pans that function as a haven for water birds. The centre also features one of the largest bird hides in the country and a network of game drive routes (http://www.sa-venues.com/game-reserves/nwp_lichtenburg.htm). The Lichtenburg Game Breeding Centre was therefore considered to be an attractive tourist destination and would be adversely affected by the visual intrusion of the proposed development should it be visible from this location. It is however important to note that at this stage, the game breeding centre is no longer operated by the National Zoological Gardens of South Africa and is currently not operational. During the site visit it was also noted that all wetland areas, dams and pans were completely dry and burning had taken place within these areas (**Figure 51**). It is estimated that the restoration and construction process of the game breeding centre will last another year, however there is currently no definite decision on whether or not the centre will be opened for tourists (Steynberg, 2016). Despite this, the Lichtenburg Game Breeding Centre has still been regarded as a sensitive visual receptor for the purpose of this study as the game breeding centre will be re-opened and could be operated as a tourism facility in the future.

Figure 51: View of one of the dried up wetland/dam/pan areas within the Lichtenburg Game Breeding Centre where burning has taken place.

The Rafters Pub (referred to as plots locally) has been operating on Portion 1 of the Farm Talene 25 for approximately eight years. It is estimated that the pub receives between 300 and 340 visitors per month and when special events (i.e. pool tournaments etc.) are hosted, the visitor numbers are higher. The owner of the farm has expressed his intention to start a bird breeding programme focused on African Greys on the farm. It is also the intention of the owner to offer overnight accommodation and build four chalets on the property (Steynberg, 2016). The owner of the farm has expressed his concern about the possible negative visual impact and the effect that the project could have on the potential for tourism development as well as the sense of place on his farm (Steynberg, 2016). In addition at the Landowner Focus Group Meeting held in March 2016, the owner expressed his concern regarding the possible impact that the proposed development would have on their existing business. Patrons visit their establishment to escape the town in order to experience the calm atmosphere and nature on the farm. As such, the farm is regarded as a sensitive visual receptor due to its current economic activities which in part rely on the scenic nature of the surrounding area and due to the future potential of the farm as a tourism facility.

During the EIA Phase site visit, several scattered farmsteads / homesteads 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 <u>potentially</u> 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 three (3) sensitive visual receptor locations were identified within the rural parts of the study area, these being Rafters Pub (VR 14) which is located south-west of the Tlisitseng Solar PV 2 development area, the Lichtenburg Game Breeding Centre (VR 71) which occupies a large tract of land directly east of the application site and the Lichtenburg Vakansie Oord (VR 69) which can be found to the south-east of the application site, adjacent to the game breeding centre. This is mainly due to low levels of leisure-based or nature based tourism activities in the assessment area. In addition, the only significant concentration of human habitation in the study area is the agricultural town of Lichtenburg, most of which lies outside the 5km assessment area. The northern sector of Lichtenburg which lies just inside the assessment area largely comprises of a mix of land uses with some receptors present. 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 the visual impact report.

In many cases, roads, along which people travel, are considered to be sensitive receptor locations.
The R505 main road which traverses the study area is considered to be a visually sensitive road as it is the main access road between Lichtenburg and the N18 national route to the north. This road can be used to access tourism attractions to the north of the study area such as the diamond diggings at Bakerville and the Wondergat sinkhole (http://www.tourismnorthwest.co.za). The relatively high volumes of motorists travelling along this road would therefore be visually exposed to the proposed PV facility as the road traverses the application site.

Table 25 below provides details of the sensitive visual receptor locations and roads that were identified within the study area.

Table 25: Visual receptor locations sensitive to the proposed Tlisitseng Solar 2 PV energy facility

Name	Distance from the proposed PV development area or associated infrastructure	Visual Impact Zone
VR 14 – Rafters Pub	Approximately 1.5km	Moderate
VR 69 – Lichtenburg Vakansie Oord	Approximately 3.7km	Low
VR 71 – Lichtenburg Game Breeding Centre	Approximately 1.8km	Moderate
R505 Secondary Road	Varies (traverses the PV array alernatives)	Varies (High, Moderate and Low)

Other thoroughfares in the study area are primarily used by local farmers travelling to and from Lichtenburg. 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 52** below.

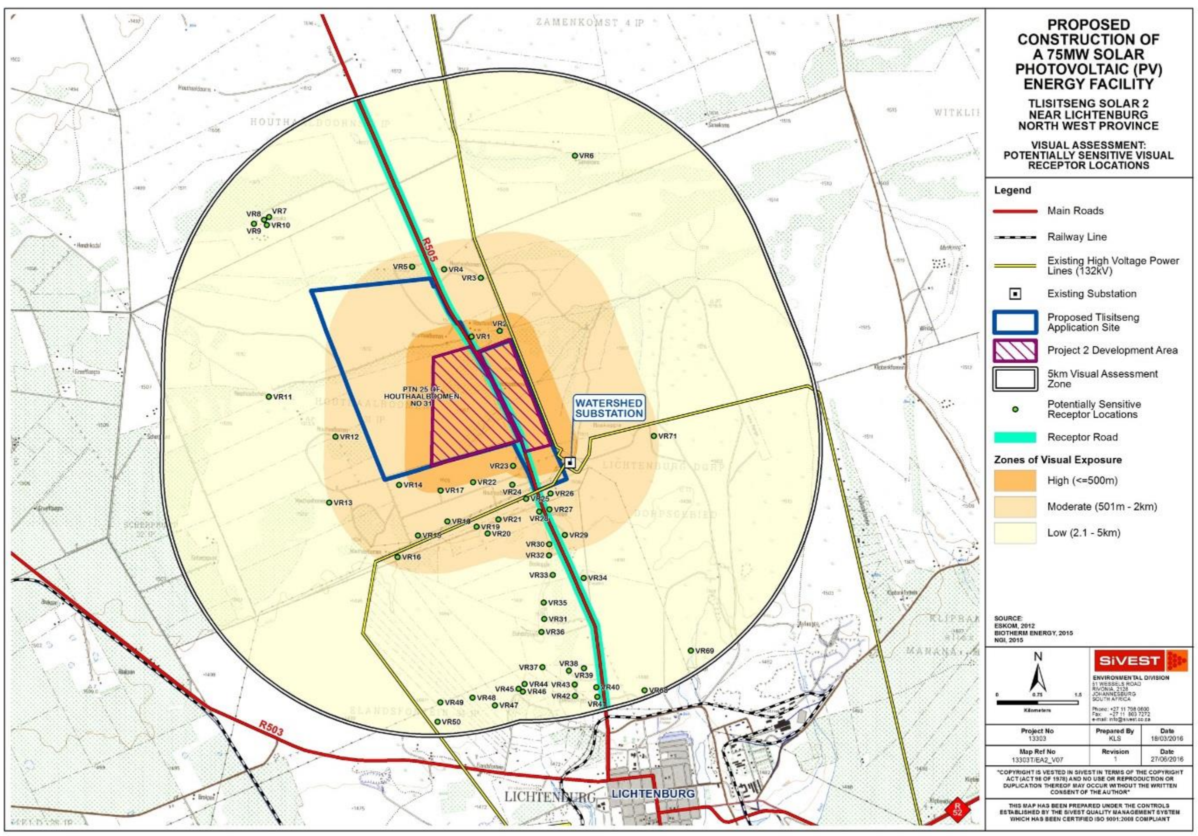


Figure 52: Potentially sensitive visual receptors within the study area

8.5.3 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 53**).

Figure 53: 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 54**). 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 54: 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.

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.

8.5.4 Impact Assessment

- **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. In addition, the level of visual contrast would depend on the height, density and colour of the proposed development. As a whole the proposed development would contrast with the natural earthly tones of the prevailing shrubs and grassland 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.

- **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 26**), 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 26: 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**	

- **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.

As previously mentioned, distance bands were used to assign zones of visual impact from the proposed development site. Based on the height and scale of the project, as well as the investigations undertaken during the fieldwork, the radii chosen to assign the zones of visual impact are as follows:

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

- **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.

- **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 to contrast 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 55** below.

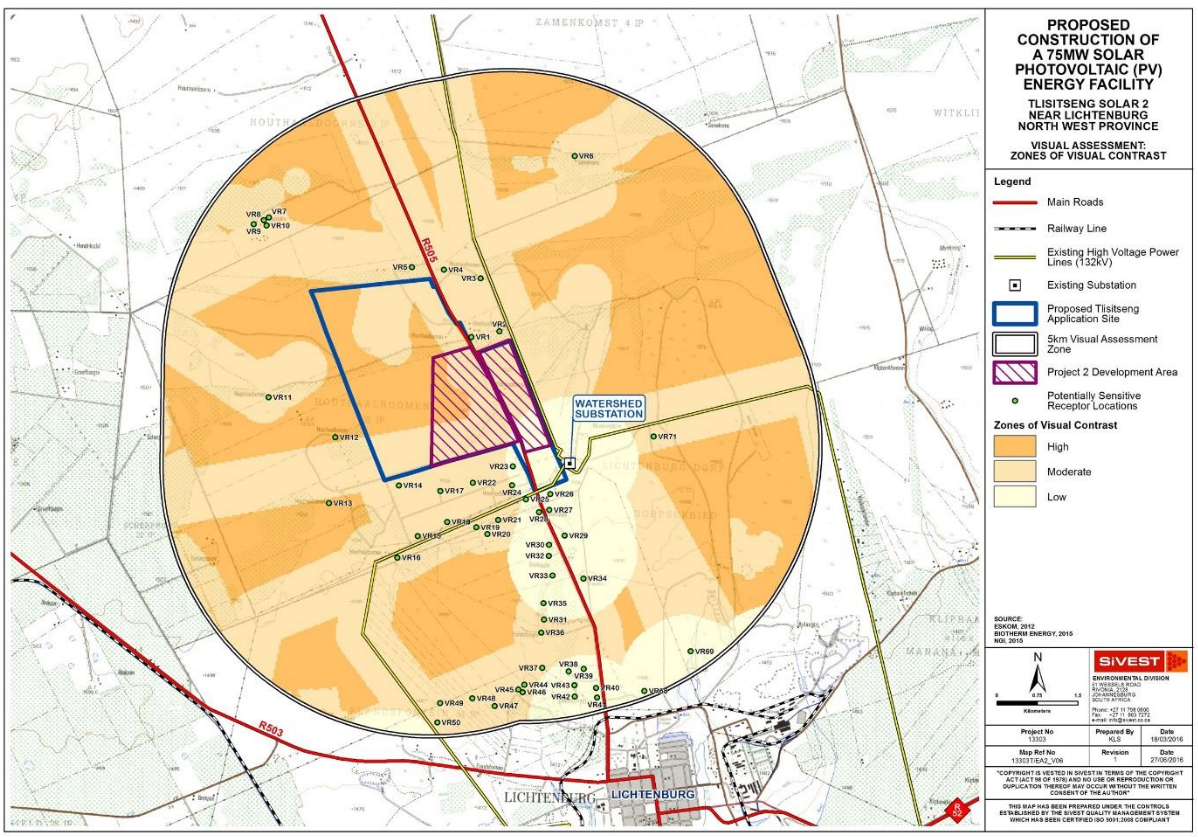


Figure 55: Zones of visual contrast

Table 27 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 27: Visual impact of the proposed development on sensitive / potentially sensitive visual receptors within the study area

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
VR 1	Moderate (2)	High (3)	Moderate (2)	**MODERATE**
VR 2	Moderate (2)	Moderate (2)	Moderate (2)	**MODERATE**
VR 3	Moderate (2)	High (3)	Moderate (2)	**MODERATE**
VR 4	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 5	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 6	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 7	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 8	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 9	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 10	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 11	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 12	Moderate (2)	Moderate (2)	High (3)	**MODERATE**
VR 13	Low (1)	Moderate (2)	High (3)	**MODERATE**
VR 14 – Rafters Pub	Moderate (2)	Moderate (2)	Moderate (2)	**MODERATE**
VR 15	Moderate (2)	Moderate (2)	Moderate (2)	**MODERATE**
VR 16	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 17	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 18	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 19	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 20	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 21	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 22	Moderate (2)	Low (1)	Moderate (2)	**MODERATE**
VR 23	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 24	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 25	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 26	Moderate (2)	Moderate (2)	Low (1)	**MODERATE**

Receptor Location	Distance	Screening	Contrast	OVERALL IMPACT RATING
VR 27	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 28	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 29	Moderate (2)	Negligible	Low (1)	**NEGLIGIBLE**
VR 30	Moderate (2)	Low (1)	Low (1)	**LOW**
VR 31	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 32	Low (1)	Low (1)	Low (1)	**LOW**
VR 33	Low (1)	Low (1)	Low (1)	**LOW**
VR 34 – Lichtenburg Drive-in Theatre	Low (1)	High (3)	Low (1)	**MODERATE**
VR 35	Low (1)	Low (1)	Low (1)	**LOW**
VR 36	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 37	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 38	Low (1)	High (3)	Low (1)	**MODERATE**
VR 39	Low (1)	High (3)	Low (1)	**MODERATE**
VR 40	Low (1)	Low (1)	Low (1)	**LOW**
VR 41	Low (1)	High (3)	Low (1)	**MODERATE**
VR 42	Low (1)	Low (1)	Low (1)	**LOW**
VR 43	Low (1)	Moderate (2)	Low (1)	**LOW**
VR 44	Low (1)	Moderate (2)	Moderate (2)	**MODERATE**
VR 45	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 46	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 47	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 48	Low (1)	Low (1)	Moderate (2)	**LOW**
VR 49	Low (1)	High (3)	Moderate (2)	**MODERATE**
VR 50	Negligible	High (3)	Moderate (2)	**NEGLIGIBLE**
VR 68	Low (1)	High (3)	Low (1)	**MODERATE**
VR 69 – Lichtenburg Vakansie Oord	Low (1)	Moderate (2)	Low (1)	**LOW**
VR 71 – Lichtenburg Game Breeding Centre	Moderate (2)	Moderate (2)	Moderate (2)	**MODERATE**

As indicated above, the proposed development would result in a moderate visual impact on majority of the potentially sensitive visual receptor locations with the study area (29 in total). The proposed development would not result in a high visual impact on any of the potentially sensitive visual receptors. In addition, the development is expected to have a negligible visual impact on two (2) of the potentially sensitive visual receptors, namely VR 29 and VR 50. The proposed development would therefore not be visible from these locations. The development is likely to exert a low visual impact on twenty two (22) of the potentially sensitive visual receptor locations. It should be noted that the proposed development would result in a moderate visual impact on Rafters Pub (VR 14) as well as the Lichtenburg Game Breeding Centre (VR 71). The proposed development would however result in a low visual impact on the Lichtenburg Vakansie Oord (VR 69).

- **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 Lichtenburg is the main source of light within the surrounding area, however it is located more than 6km away and are therefore expected to have a limited impact on the night scene. It must be noted that the Lichtenburg Game Breeding Centre, Lichtenburg Vakansie Oord and Lichtenburg Drive-in Theatre can be found within relatively close proximity to the application site and will most likely require some form of lighting for security reasons. At this stage, it is uncertain whether the Lichtenburg Drive-in Theatre is still operational and the impact of it on the night scene. It should also be noted that majority of the Lichtenburg Game Breeding Centre has maintained a largely natural / undisturbed character as it was used to breed animals for local and international zoos. The natural / undisturbed areas within the breeding centre are therefore not expected to be characterised by a large amount of lighting. The Lichtenburg Vakansie Oord is however expected to to be illuminated at night and require lighting for security reasons as it is used as a holiday resort and offers accommodation and recreational facilities. In addition, another prominent light source within the study area at night is the security lighting at the Eskom Watershed MTS which the power lines are proposed to connect to. According to local farmers, the Watershed MTS can be seen at night from relatively far away. Other sources of light are limited to, isolated lighting from the surrounding farmsteads and residential dwellings. In general the study area is characterised by a picturesque dark starry sky and the visual character of the night environment is considered to be generally 'unpolluted' and pristine.

Due to the fact that the larger area is 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 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 Watershed MTS and Lichtenburg Vakansie Oord, as a result lighting impacts from the proposed substation will increase the existing light pollution in the surrounding area.

8.5.5 Visual Impacts of Associated Infrastructure

- **Internal Roads**

A network of gravel access roads will also be constructed to provide access to the PV panels. As mentioned above, 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.

- **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 that existed in the area prior to development with shallow root systems, in order to reduce the potential for creating unnatural linear features in the environment.

- **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.

8.6 Heritage and Palaeontology

The full Heritage Assessment was conducted by Wouter Fourie and Gideon Groenewald from PGS and is included in **Appendix 6F.**

Field work was conducted on the application site of the Tlisitseng 2 Solar PV Project from 1st to 2nd of December 2015. The methodology focused of a tracked walkthrough of the foot print areas of proposed PV project application area. 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 Tlisitseng 2 solar PV application site is an area of 10.3 square kilometers.

A total of 8 heritage related sites were marked within the application site over the extent of the fieldwork.

8.6.1 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 56: View of general area of Tlisitseng 2 solar PV area

Figure 57: General view of the area of Tlisitseng 2 solar PV area

8.6.2 Finds

3 structures were located, **TS02**, **TS05**, and **TS06** of which the age of these has not been determined. TS02 and TS06 is not older than 60 years and not of heritage significance.

Figure 58: TS02 - farmhouse

Figure 59: Structures for Livestock at TS06

Figure 60: Stone foundation at Site TS05

8.6.3 PV footprint – Mitigation:

TS02 – No further mitigation required
TS05 –It is recommended that the site be documented before destruction can take place.
TS06 – No further mitigation

8.6.4 Sites – summary

During the fieldwork 3 heritage resources were identified in and close to the proposed project footprint (**Table 28**). Refer to **Appendix D** for distribution map.

Table 28: Sites – Application footprint

Site number	Type	Longitude	Latitude	Description	Heritage Significance
TS02	Structure	26.131316°	-26.079524°	Old structure which occurs on a 1972 Topographic map but is not older than 60 years. The structure occurs to the east of the R505.	Grade 4C
TS05	Historic stone foundation	26.118161°	26.118161°	The foundation remains of a historic structure.	Grade 4B
TS06	Structure	26.126358°	-26.084879°	This structure was mentioned in the scoping level assessment as possible heritage, the structures however are in relation to watering and feeding of livestock and of little significance	Grade 4C

8.6.5 Palaeontological findings

During the fieldwork period several arbitrary finds of dolomite and chert with significantly well-defined stromatolites as well as a few potential sites with either associated sinkholes or cave breccias were recorded (**Table 29**). Confirmation of the significance of these sites will only be possible after completion of the geotechnical surveys.

Table 29: Photographic observations during fieldwork session

Photo	GPS station no and coordinates	Description	Picture

1	(0122) -26° 04' 50.4" 26° 08' 09.1"	Outcrop of pseudo cave breccia with not enough geotechnical information to prove sinkhole exisitence. No fossils observed during field inspection but site should be seen as highly sensitive for possible fossils	
2	(0132) -26° 04' 47.4" 26° 07' 58.6"	Brick field with blocks of stromatolitic dolomite not in situ. Dolomite rippled surfaces with stromatolitic growth on rippled surfaces. Stromatolites not in situ	
3	(0142) -26° 04' 39.0" 26° 07' 51.1"	Deep sandy soils. No outcrop, no fossils observed	
4	(0152) -26° 04' 30.4" 26° 07' 44.7"	Stromatolitic dolomite and chert boulders on areas away from brick fields. No outcrop and geotechnical reports might indicate exposure of in situ stromatolites where foundations will be deeper than 1.5m.	

5	(0212) -26° 04' 54.4" 26° 07' 19.3"	Shallow soils on stromatolitic dolomites and chert. No significant fossils observed	

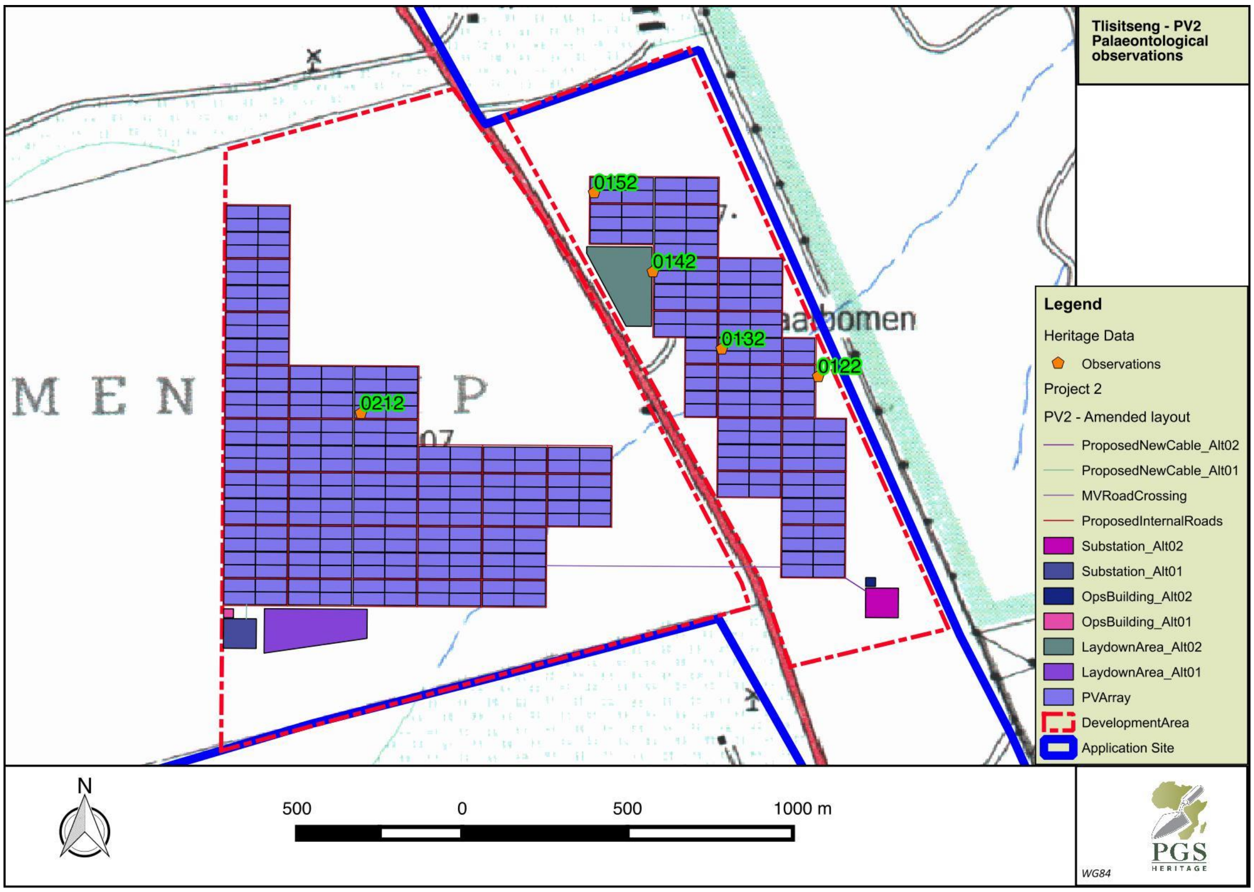


Figure 61: Palaeontological find spots

8.7 Socio Economic

The full Social Assessment was conducted by Mariette Steynberg and Elena Broughton from Urban Econ Development Economists and is included in **Appendix 6G**.

The following paragraphs provide the socio-economic profiles of the farm portions where the proposed project is planned to be constructed.

8.7.1 Land-use profile

Figure 62 shows the farm portion earmarked for development of the proposed Tlisitseng PV facilities, with the Tlisitseng 2 PV array highlighted. The primary data gathered from the site visit that took place in December 2015 and updated with the information received from selected property owners over e-mails/letters in July 2016 are provided below.

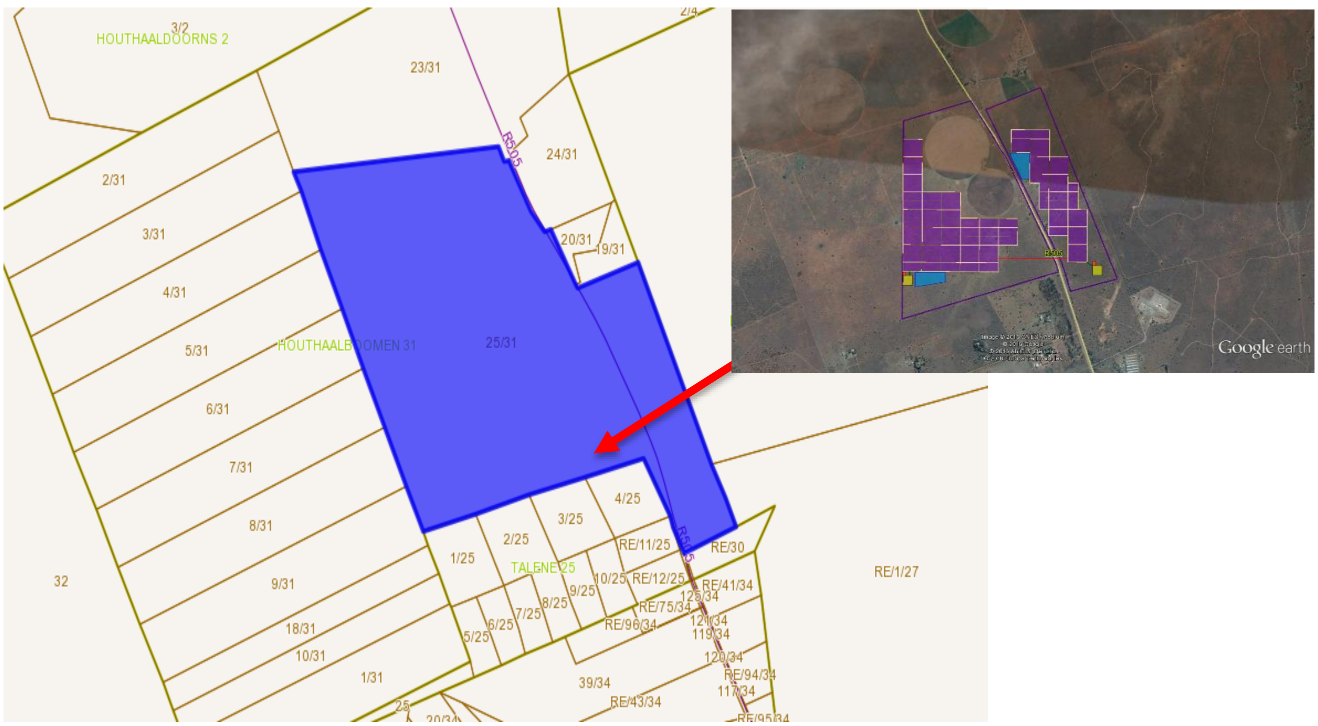


Figure 62: Farms directly and indirectly impacted by the proposed Tlisitseng 1 PV facility project (Chief Surveyor-General, 2016)

- **Portion 25 of Farm Houthaalboomen 31**

Mr Hertzenberg is the owner of the directly impacted farm, i.e Portion 25 of Farm Houthaalboomen 31. He views the commercial agriculture activities taking place on the farm as “up and coming”, indicating that the operations are not yet well established. He has indicated that the rental income that he would derive from leasing the land for the proposed PV facility will be used to acquire land to continue the operations elsewhere in the area.

- **Economic activities:**

- Roughly 86 ha is currently under irrigation, producing maize. This will not be affected by the Tlisitseng PV facilities.
    - Grazing : 150 cows and 120 calves. These will have to be relocated to a different farm to make way for the project.
    - Estimated profit for the total operations on Portion 25 of Farm Houthaalboomen is R5 000 per ha.
    - The rental received from the PV project will be used to lease land, where commercial farming can be continued.
    - Four permanent workers are employed on the farm, who receive minimum wage.
- **Services:** The farm uses borehole water and has a grid connection.
- **Residency:** The land owner resides in town. Four workers have lodging on the farm but go home over weekends. The workers therefore, are not perceived to have a cultural connection with the boarding as they do not consider this their homes.
- **Concerns raised:** The land owner mentioned that he would require an advancement from the developer to ensure that he is able to acquire alternative farming land, from which to continue his livestock farming operations.
- **Community observations:** The land owner could make the following observations about the broader community:
    - High unemployment and related to that high crime rate are the biggest socio-economic ills facing the broader community.

- **Portions 23 and 24 of Farm Houthaalboomen 31**

Mr. Nel is the land owner of the farm. The consultation revealed the following:

- **Economic activities:**
    - The farm is approximately 800 ha, with 150 ha used for growing corn, maize, and sunflower.
    - The farm is also used for commercial livestock farming with 150 heads of cattle.
    - Nine full-time employees and ten seasonal workers (used as needed) are employed by the farm; all are paid a minimum wage.
- **Services:** The farm uses borehole water and has access to the electricity grid.
- **Residency:**
    - The farm has two homesteads where the land owner and his parents reside.
    - There are rooms for farm workers, who stay in these during weekdays and go home on weekends.
- **Concerns raised:** The land owner does not have any objections to the project.
- **Community observations**: The greatest challenges facing the broader community are the lack of decent job opportunities, leading to poverty in the area.

- **Portion 19 of Farm HouthaalBoomen 31**

This portion of land is owned by Mr. Pieterse. The information gathered from consultation with the land owner is as follows:

- The farm is used for commercial agricultural activities.
- The total agricultural holding is about 25 ha, with 12 ha under irrigation (maize and small scale vegetable farming). The rest is used for livestock grazing.
- The property has two homesteads. The land owner resides in one, with the other being rented out.
- The farm has between one and two permanent workers, receiving a minimum wage. They do not reside on the farm.
- The farm uses borehole water; electricity is provided by Eskom.
- The land owner does not have any objections or concerns related to the proposed project.

- **Portion 4 of Farm Talene 25**

The owner of the property, Mr Fazel VarVariawa, stated in the letter submitted on 22 June 2016 that he objects to the development of power lines that would traverse his property. No other issues were raised.

- **Portion 3 of Farm Talene 25**

The farm portion (locally referred to as plots) is owned by Mr. Goedhals. The land owner and his wife have been living on the farm for 32 years. The farm is not used for any commercial activity; it is used as a residence by the land owner.

During a site visit, the land owner objected to the project based on a concern about potential water supply scarcity. There seems to be existing strain between the land owner and Mr. Hertzenberg (directly impacted land owner) regarding the impact of farming operations on Portion 25 of Farm Houthaalboomen 31 on the borehole water at Portion 3 of Talene 25.

In the letter submitted by Mr. Goedhals on 25 June 2016, the owner indicated that he is not objecting to the development of the project, as long as it does not leave any footprint on his property. Some concerns were though raised and these included:

- Change in the sense of place due to the visual impact.
- Decline in property value and limited potential for future development of the farm.
- Threat to personal security and privacy on the farm due to the presence of unwanted individuals and workers (particularly with respect to a power line option that is to traverse the property).
- Workers leaving access gate on the farm open, which could potentially result in the loss of property.
- Possible creation of living quarters on project site and inadequate access to sanitation for workers, as well as the impact thereof on the property values and water availability.

- **Portion 2 of Farm Talene 25**

This portion of land is owned by Mr van Rooyen. In the letter dated 25 July 2016, the property owner raised the following concerns:

- The owner generally approves the development of the project in the area, but objects to any of its components being developed on Portion 2 of Farm Talene 25.
- The major objection lies with the establishment of power lines across the property, which may negatively impact on the value of the property and usability thereof.
- The presence of unwanted individuals and workers in the area is also a concern, as it may pose a risk to their security and privacy.
- The issue of workers leaving an access gate on the farm open is also of a concern, as it could potentially result in the loss of property.

- **Portion 1 of Farm Talene 25**

The portion of land is owned by Mr. and Mrs. Hechter. They have been owners of the land for roughly eight years. The Rafters Pub have been operating on the farm portion (referred to as plots locally) for the same number of years.

- **Economic activities:**
    - Rafters pub is the main economic activity on the farm. It is estimated that the pub receives between 300 and 340 visitors per month. When special events (i.e. pool tournaments etc.) are hosted, the visitor numbers are higher.
    - The owner is actively involved in the management of the pub; two more full time workers are employed at the pub.
    - The land also has some sheep for subsistence farming. The land owner did however, explain that they want to create a petting zoo for the children of the pub patrons.
    - As a side venture, paintball is offered on the farm. This however, makes a very small contribution to the overall business revenue.
    - Future tourism/economic potential:
        - The land owner indicated that they plan to start a bird breeding programme focussed on African Greys.
        - They plan to start offering overnight accommodation and want to start off by building four chalets on the property.
        - No sign of the commencement of these activities were present during the site visit in December 2015, even though the land owner stated that they want to begin with the breeding programme early in the same month.
- **Services**: The farm uses borehole water; electricity is supplied by Eskom.
- **Residency:** The land owners live on the property and plan to use it for retirement. Consultation revealed that peaceful retirement planning was the reason for purchasing the property in the first place. No workers reside on the farm.
- **Concerns raised:**

- The land owners are most concerned about the possible negative visual impact. The effect the project will have on the potential for tourism development as well as their sense of place have been realised as concerns.
- The property owners also raised a concern over the project's potential negative impact on the borehole water supply. The land owner revealed that, like the owner of Portion 3 of Talene 25, their water supply was previously severely affected by the extended and upgraded irrigation system on Portion 25 of Farm Houthaalboomen 31 (i.e. the site where the proposed project is to be established).
- The land owner raised some concern about the influx of workers and the impact this may have on crime in the area. Unwanted visitors to the pub may also become a problem.
- A concern was raised over the effect of construction impacts such as dust, noise, etc., on the proposed African Grey breeding programme.

- **Portion 3, 4, 5, 6, and 7 of Farm Houthaalboomen 31**

The land is owned by Wessel Boerdery (Pty) Ltd and is estimated at 1 034 ha.

- **Economic activities:**
  - The farms are used for commercial livestock.
  - A transport (trucking) company is run separately from the agriculture business.
  - Approximately 30 full time employees are paid minimum wage and work throughout the operations.
- **Services**: The farm uses borehole water; electricity is supplied by Eskom.
- **Residency:** No one resides on the farm portions.
- **Concerns raised:**
  - The biggest concern is the servitude road running across the project site. Should this no longer be available for access to the farm portions, a suitable, viable alternative will need to be provided. Alternatively, the operating costs of the farm would increase due to the need to spend more money on transportation using far longer routes compared to the current route.
  - The access road currently used by the company is a gravel road; concern was raised around the impact of the increased construction-related traffic on the condition of this road.
  - The land owner is concerned about the possibility of veld fires. If the project proponent does not construct fire breaks it could have severe consequences on the adjacent farm portions.
  - The risk of increased soil erosion once vegetation is removed for the proposed development to be implemented has also been raised as a concern.
  - Livestock theft due to the influx of workers into the area is a worry for the owner. The problem is already present at the farm. The land owner indicated that they would expect and demand that adequate rules of conduct for all workers be put in place and enforced by the project proponent.
  - The land owner is also concerned about the risk of reduced borehole water supply to the impacted farms, taking into account the previous experience when the irrigation system on Portion 25 of Farm Houthaalboomen 31 was expanded and upgraded.

- **Portion 10 of Lichtenburg town and townlands 27**

Years ago this piece of land was a wildlife breeding centre that was open to the public. It was abandoned and in a state of disrepair until Mr Steinman and the local municipality formed a joint venture to restore the breeding centre. The following information as gathered from the interview with Mr Steinman:

- The land is approximately 7 000 ha.
- The centre is registered under Oryx Wildlife and Game Trading.
- It is estimated that the restoration and construction process of the game breeding centre will last another year.
- Currently, employment at the centre is high due to the construction activities. Once it becomes operational, four permanent employees and a manager will be employed.
- Currently, there is no definite decision on whether or not the centre will be opened for tourists.

- **Summary and zone of influence of the Tlisitseng 2 PV array**

For the purpose of the study, it will initially be assumed that only Tlisitseng 2 is implemented. The discussion on the possibility and level of the impacts that may ensue should both Tlisitseng developments be approved, will be discussed in length under the section that deals with cumulative impacts. However, considering the fact that the land owner has indicated that he will acquire alternative grazing land, where commercial livestock activity can be relocated, it can be expected that the impact on the agricultural production should be minimal.

Considering the knowledge of the socioeconomic environment present on the adjacent farms, the following land portions are most likely to be the sensitive receptors of any impacts generated by Tlisitseng 2:

- Portions 20 of Farm Houthaalboomen 31
- Portion 10 of Lichtenburg town and townlands 27
- Portion 3 of Farm Talene 25
- Portion 4 of Farm Talene 25

8.7.2 Resources and land capability

The proposed study area and surrounding land is predominantly non-arable grazing land with marginal potential agriculture soil becoming more common closer to the R52 and R503.

8.7.3 Access to infrastructure

Consultation with the land owner revealed that Portion 25 of Farm Houthaalboomen 31 is connected to the national Eskom grid and makes use of borehole water for its irrigation. A concern has been raised by most of the indirectly affected land owners of the possibility of disruption to their own borehole water supply as a result of the needs of the proposed development.

8.7.4 Impact on natural capital

Currently the land proposed for the development of Tlisitseng 2 is being used primarily of commercial livestock farming. About 86 ha is under irrigation, which will remain unaffected by the proposed Tlisitseng development. The land owner has, however, indicated that alternative grazing land will be acquired with the rental income derived from the project proponent. The direct impact on loss of agricultural land due to the construction of Tlisitseng 2 can, thus, be expected to be marginal assuming the conditions and requests of the land owner are adhered to (paying rental in advance so that land can be acquired)

The **cumulative** impact of the various solar PV facilities (Tlisitseng1, 2, and others) could result in a notable **loss of agricultural land used for livestock farming** in the region as a whole. The potential loss of agricultural land due to the possibility of establishment of Tlisitseng 1 and Tlisitseng 2 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 Tlisitseng project (20 years). The cumulative impact of the loss of agricultural land across the region and North West Province may last even longer as a result of the fact that the projects proposed to be built on other farms 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 commercial livestock farming over the long term across the North West Province.

The Tlisitseng 2 development in itself may not negatively impact on food security of the region, however, as more grazing land is neutralised due to the development of the solar PV sector food security may be under threat.

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.

8.7.5 Impact on human capital

- **Impact on employment**

The project proponent estimates that the proposed Tlisitseng 2 development will create an average of approximately 68 opportunities for skilled individuals and 62 opportunities for unskilled individuals during the construction period. Thus, an average total of 130 jobs will be created on site during the construction phase. Of these opportunities, between 40% and 50% will be made available to local labour. At peak periods, the total jobs can however be up to 400, however this will not be sustained.

Literacy levels in the Ditsobotla LM can be considered to be low. It is estimated that only 19.7% of the Ditsobotla LM population older than 20 has achieved a matric qualification while 15% has had no formal education. The argument can therefore be made that the 40% - 50% of local labour that will be procured locally by the project proponent will most likely only be unskilled jobs. 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 Tlisitseng 2.

Once the Tlisitseng 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. Since the majority of these positions are for unskilled and semi-skilled laboured, they will be possible to fill by people from the local communities.

It is estimated that unemployment in the Ditsobotla LM is 28.4% of the labour force, which equates to 15 072 individuals looking for work who are unable to find any opportunities. In Lichtenburg the number of hopeful individuals unable to find employment is 2 188. The magnitude of the impact on employment creation that is envisaged to be generated by the Tlisitseng 2 development is therefore relatively low. This is, however, limited to the individual impact of the development of Tlisitseng 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 visible 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 25 of Farm Houthaalboomen 31 create four permanent employment positions. The jobs are not expected to be lost as a result of the development of the proposed project; moreover, the project will absorb an additional 43 workers, many of whom will be from the local community.

Should both Tlisitseng projects receive environmental authorisation and be approved for development, the **cumulative** impact will be more noticeable:

- An average of up to 260 temporary job opportunities could be created during the construction phase with up to 800 people working on site at peak periods, of which half could be filled by locals.
- Up to 86 sustainable jobs could be created during operations, of which the majority could be filled by people residing in the local community.

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 support industries would create additional job opportunities.

- **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 that 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 Tlisitseng 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 Tlisitseng 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 two-fold.

- 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.

- **Impact on health (and nutrition) of the community**

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 Tlisitseng 2 development would lead to improved nutrition levels for benefitting local community members. Currently 59.3% of households within the LM have to survive on less that R3 200 per month. As higher and importantly more sustainable 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, ability to improve living conditions, 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 Tlisitseng 2 development.

One negative effect of the proposed development of health that may ensue 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.

8.7.6 Impact on social capital

- **Impact on community ties**

Consultation with the surrounding land owners revealed that there is existing strain on the neighbourly relationship between some of the indirectly impacted land owners and the directly impacted land owner. The strain seemingly stems from a water use license that the owner of Portion 25 of Houthaalboomen 31 obtained to expand and upgrade the farm's irrigation system. The indirectly affected land owners reported that with the expansion of the irrigation system, water the drop in water levels in some of the boreholes in the area were experienced.

Since the proposed project will require access to water for cleaning of panels and some small uses, there is a risk of further break in community ties in the area and exacerbation of existing strained relations between the owners of the adjacent farms and the owner of the farm where the proposed project is to be located. The adjacent land owners may experience severe unhappiness and may perceive to be significantly disadvantaged as a result of the project. The project could therefore result in severing of community ties during the construction phase of the proposed development, which may extend over the operational phase.

- **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 Tlisitseng 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 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. These include the owners of Portion 1, 2, and 3 of Farm Talene. 25.

- **Impact on safety**

Some of the land owners 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 Tlisitseng 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 increase 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 Ngaka Modiri Molema DM (33.6%) and the Ditsobotla LM (28.4%), 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 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 medium- to long-term impact.

8.7.7 Impact on cultural and spiritual capital

- **Impact on sense of place**

The effects on 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 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 Lichtenburg revealed that local community members and especially the previously disadvantaged community of the Ditsobotla LM are in dire need of job creation as joblessness is the biggest socio-economic ill facing the community. At the same time, the various consultations with directly and indirectly affected land owners revealed that the farms are providing a limited number of jobs, while the broader community is faced with extreme poverty and joblessness. It could be argued that the local community may see the existing land uses of the proposed development site and its adjacent farms as 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 Tlisitseng 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.

Only the land owners of Portion 1 of Talene 25 expressed a concern related to the visual impact and its effect on the sense of place experienced by them and the visitors to their farm. This land owner plans to retire on this piece of land and acquired it specifically for its rural nature and peaceful surroundings. 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 Tlisitseng 2 development is therefore expected to be related to the visual zone of influence only.

As illustrated in the following figure, which was extracted from the Visual Impact Assessment study for the project (SiVEST, 2016), a northern quarter of the Portion 1 of Farm Talene 25 falls within the high impact visual exposure zone. However, considering various parameters, Portion 1 of Farm Talene 25 falls within the medium contrast zone (SiVEST, 2016). The overall visual impact on the property is determined to be of moderate significance. The same can be said about Portion 3 of Farm Talene 25.

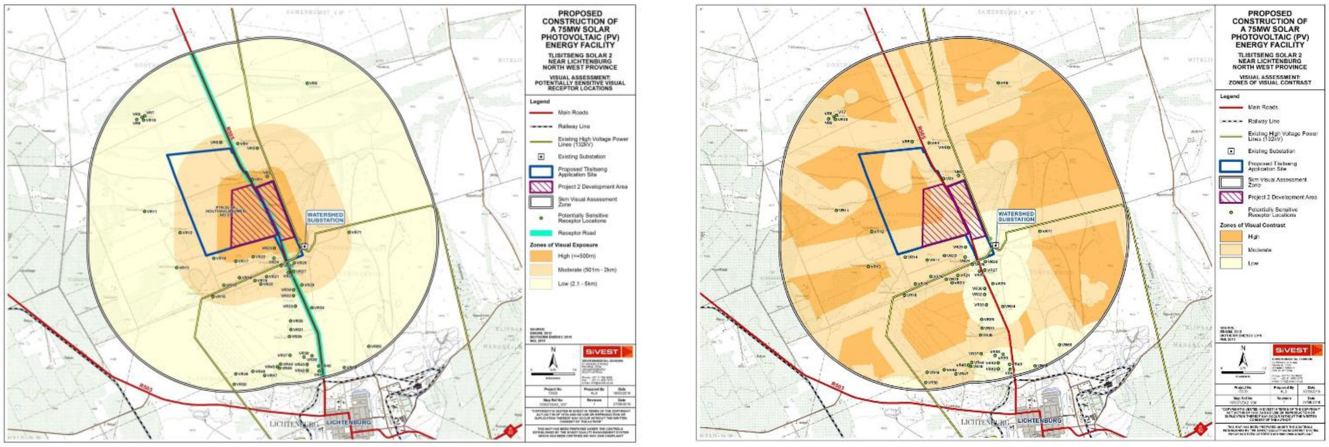


Figure 63: Visual exposure zone (left) and visual impact (right) of the Tlisitseng 2 Solar PV facility (SiVEST, 2016)

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.

Considering the sensitivities identified, if projects proposed to be developed in the area are approved, Portion 1 and Portion 3 of Farm Talene 25 will then be exposed to an even greater visual impact, as it may be surrounded by solar PV plants to the left of its property (refer to Watershed Solar Energy Facility that is under investigation) and possibly Matrigenix Renewable Energy Project (to the north-east of the farm). From a community perspective, though, the cumulative impact is 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.

8.7.8 Impact on physical capital

- **Impact on production**

The project proponent estimates that the construction of the proposed Tlisitseng 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 even the Province.

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 Tlisitseng 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.

Tlisitseng 2 will require R1.75 million in in annual operating expenditure (OPEX) over the 20-year lifespan of the development. Based on current economic structure of the Ditsobotla 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 likely to be a significant, sustained, long-term impact.

- **Impact on road infrastructure**

Details on the design and layout of infrastructure associated with Tlisitseng 2 is 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 roads 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 Tlisitseng 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 more of a nuisance, which can be effectively managed through the correct mitigation measures. The impact associated with only Tlisitseng 2 is 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 deterioration of local road infrastructure.

- **Impact on social facilities**

Based on a review of the LM's most recent IDP, the LM requires 31 more health facilities to adequately cater for the local population. In general, social infrastructure in the LM, especially the more rural areas, require significant renovation and upgrading.

With an influx of migrant job seekers, especially during the construction period of the proposed Tlisitseng 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 the local government to deliver the required social services. The impact directly associated with Tlisitseng 2 can be expected to be low-medium and short-term as it should dissipate as construction of Tlisitseng 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 Tlisitseng PV development 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 of a 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.

- **Impact on service delivery**

The local municipality suffers from a housing backlog, where 12.6% of households reside in informal dwellings. In addition, the municipality is also struggling to provide adequate water, electricity, and sewerage services to the local population.

Should the proposed Tlisitseng 2 development be approved, it can be expected that construction and operation of the PV facility will 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 Tlisitseng 1 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 Tlisitseng facility 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 in 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 Tlisitseng 2 alone.

8.7.9 Impacts on financial capital

- **Impact on household income and financial resources**

It is estimated that 59.3% of households in the Ditsobotla LM earn less than R3 200 per month. In Lichtenburg the situation is better with 39% of households earning only 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 Tlisitseng 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 unskilled positons, it can be argued that the benefit that will accrue to local community members will be limited. However, the benefitting households (an estimated 62 temporary opportunities over the construction period and 29 long-term permanent opportunities once Tlisitseng 2 is operational) 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, and improved ability to make economic choices among others.

To maximise the benefit from the Tlisitseng 2 development for the local procurement practices can be devised to ensure that, where feasible, local labour, goods, and services are used. Should the other Tlisitseng project 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 able to consume more, creating jobs through their consumption patterns.

- **Impact on realisation of nearby properties' tourism business potential**
-

The farms located on or near to the proposed development site are mainly used for a mix of commercial agriculture activities, residential purposes and community entertainment (i.e. pub and paintball facility). There was no indication from any of the land owners consulted that their existing economic activities would cease should Tlisitseng 2 be approved and constructed, although some concerns were indeed raised and related to the issue of unrealised businesses opportunities related to the local tourism potential that the proposed project may create (with a specific reference to plans to develop chalets and expand the existing pub on Portion 1 of Farm Talene 25).

The owner of Portion 1 of Farm Talene 25 raised a concern that the visual impact that will be created from the proposed solar PV plant will change the sense of place to such an extent that it would prevent them from further expanding the local tourism and entertainment spot on the same farm. The activities that are undertaken on the farm and that are planned to be developed largely target the local community (i.e. pub and a pool club) and are envisaged to attract outside (mainly domestic) tourists that would like to stay for a few days or that pass through the area, once accommodation is developed.

There is no empirical evidence that can be used to suggest that the proposed solar PV project will negatively impact on these activities. Although it will change the sense of place as discussed earlier in the report, the solar PV plants are green technologies and do not create the same negative perceptions as, for example, heavy industry factories or coal-fired power stations do. Furthermore, due to the relatively new nature of these type of facilities in the country and associated benefits thereof in terms of carbon emission reduction for electricity generation, such facilities may also be used to attract tourists.

Eco-tourism has proven to be one of the fastest growing segments of the global industry (Hill, 2009) and green energy areas are seen as an important attraction to visit tourism regions (Terradis, 2007). This statement was emphasised at the World Summit on Sustainable Development, presented in Johannesburg in 2002. In addition to this, tourism is also emphasised as being one of the major energy incentive sectors and environmental action in tourism has gained a lot of attention over the past couple of years (Pace, 2016).

In his essay, Prinsloo (2015) states that renewable energy structures may seem to have a negative effect from a tourist perspective, but in general these installations are beneficial to the field of tourism. For example, one facility where the response to tourism and renewable energy farms was exceptionally positive is that of ‘Scroby Sands’ (a wind farm) in the United Kingdom (Prinsloo, 2015). Educational facilities were built at the site, and in the first six months since the opening of the facility around 30 000 visitors were welcomed (Prinsloo, 2015). This illustrative example shows that renewable energy structures may actually help grow the tourism industry at a particular location and may become an important tourist attraction to that area, village, town or region, especially in a country such as South Africa where Green Tourism (or Eco-tourism) is still fairly unknown.

In the Annapurna region of Nepal, there was a definite impact on tourism levels at guesthouses where renewable energy farms were used to supply energy (Prinsloo, 2015). The results indicate that the use of renewable energy and locally developed energy-saving technologies helped to increase tourist numbers. The renewable structures such as solar panels and wind turbines further provide the necessary energy in remote areas, meaning the areas attract more tourists than before. Remote areas are now regarded as more luxurious than before, while tourists see renewable energy as a cleaner alternative to burning paraffin or wood for heat.

In a study done on visitors to test the impact of renewable energy farms on visitors to Cornwall, it was found that they have a positive attitude towards renewable energy (80%) and just 6% perceived it negatively (The South West Research Company Ltd, 2014). It was also found that many people are used to seeing these developments close to where they live and as such are not troubled by similar sights while on holiday. Seventy-five percent (75%) of visitors were in favour of solar farms as a means of generating power and on the whole thought they were a good idea. They therefore didn’t mind that it formed part of the landscape where they were accommodated. Only nine percent (9%) had a negative attitude towards it and the remaining sixteen percent (16%) were indecisive.

Despite various case studies which prove that tourists perceive renewable energy developments positively, the probability that the proposed project may negatively impact on the realisation of the identified tourist potential on Portion 1 of Farm Talene 25 and concerns raised by the owner of that property cannot be negated and needs to be adequately addressed. In order to accommodate the local land owner and residents, it is advised that various incentives and compromises are negotiated. One of these incentives should include educational tours to the proposed solar farm, to be packaged and sold by the businesses surrounding the solar farm (for example, by the owner of the tourist attraction facility on Portion 1 of Farm Talene 25). Security is a big concern to local residents and tourists; therefore, measures need to be put in place to ensure that establishments surrounding the solar PV farm are kept safe. The aesthetic value of the solar farms need to resemble a green imprint by keeping the appearance as natural as possible. This can be done by including greenery between the solar panels and implementing other mitigations measures suggested by the visual specialist to reduce the visual impact on the sensitive receptors (refer to SiVEST, 2016).

A unique opportunity for local establishments located around the solar farm close to Talene small holdings is to champion Eco- or Green Tourism in South Africa. The North West visitor numbers are slowly gaining momentum and a unique solar experience combined with local offerings will play a major role in attracting more eco-feet to the area.

- **Impact on property values**

Many of the owners of farm portions south of the proposed facility have raised the concerns over the property values if the proposed project is to be approved. Most of these concerns were largely related to the possible development of power lines on their properties and not to the effects of the solar PV facility. However, it should be noted that concerns and perceptions relating to possible shortages of water in boreholes and the change in the sense of place may negatively impact the attractiveness of the nearby properties. The latter specifically refers to the owner of Portion 1 of Farm Talene 25, who has raised a concern that the visual impact of the proposed solar PV facility will negatively impact on his property values as it will have a negative impact on the entertainment and tourism business that is operated on the property. 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 some small possibility exists that the nearby farms may experience shortages with the water supply in their boreholes when the proposed Tsitsileng 2 reaches operations or a perception may be developed that such problem may be present, the potential property values of the farms to the west of the proposed project may be negatively affected. The water supply options will need to be considered and discussed with the interested and affected parties in the area prior the operations to discard any of the above-mentioned concerns.

As for the visual impact that may be exerted on Portion 1 of Farm Talene 25, which hosts a local entertainment hotspot, the effects on their property values are difficult to determine. However, it should be noted that the proposed solar facility, with appropriate marketing campaign, could also become a tourist hotspot and could result in the area attracting more people (locals or tourists passing through the area) interested in green technologies. Furthermore, solar PV sites are frequented by businesses tourists (project developers, project owners, technology owners, etc.) and as mentioned earlier, if properly marketed, can attract a greater number of visitors and leisure tourists passing through the area. This can increase the turnover of the local tourist attractions and therefore increase the value of these businesses and subsequently the properties themselves.

8.7.10 Impacts on political and institutional capital

The local communities and the municipality at large suffer from poor service delivery due to limited funding available to provide these and expand their coverage. Should the proposed Tlisitseng 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 Tlisitseng 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.

8.8 Geotechnical

The Geotechnical Impact Assessment was conducted by Colin Dalton of Geopractica and is included in **Appendix 6H**.

8.8.1 Database and Literary Review

- This literary review was conducted on data obtained from the following sources:-
- Previous investigations in the area undertaken by Geopractica (Pty) Ltd and Geostrategies c.c.
- Previous published investigations in the area undertaken by other consultants.
- The 1:250 000 geological map, “No 2626 West Rand” was consulted in order to determine the regional geology in the vicinity of the site.
- The 1:50,000 topo-cadastral map “2626 AA Lichtenburg” was assessed for topography and drainage of the site.
- Google Earth imagery both current and historical.
- Seismic hazard map of South Africa.
- Internet.

8.8.2 Local Geology

From available literature, it is evident that the site is underlain by dolomite belonging to the Malmani Subgroup within the Transvaal Sequence.

This blue/grey, hard rock dolomite is typically interbedded with of very hard, grey chert, and the upper surface usually weathers insitu to form a dark brown, silty sand with abundant, close packed gravels, cobbles and boulders of both fresh and leached chert and dolomite (residuum).

The bedrock profile within the dolomites is highly variable with hard, steep, dolomite pinnacles with deeply weathered slots (grykes) in between. These hard rock dolomite pinnacle can occur close to surface or at a significant depth, and can be widely separated or closely spaced. These features are due to the fact that dolomites can be easily dissolved by slightly acid ground water, percolating downward from surface, into the underlying formation.

Typically these slots can be filled with wad (a very soft, silt and clay derived from the insitu decomposition of dolomite) and other alluvial debris (dolomite residuum). The collapse of these cavities can result in the formation of sinkholes or doline depressions at the surface.

On the West Rand, most sinkhole and doline formation was related to the drawdown of the local watertable, due to underground mining operations. Human development could also be the triggering mechanism for the formation of sinkholes and dolines, due to the ingress of surface water into the underlying formation due to leaking sewers, water storage ponds, water taps, stormwater drains as well as water services to residential and commercial buildings.

The Malmani Subgroup is subdivided into the Oaktree (lower), Monte Christo (lower middle), Lytleton (upper middle) and Eccles (upper) formations. The Oaktree and Lytleton are chert poor while the Monte Christo and Eccles are generally chert rich. According to the geological map, the site is located within the lower middle Monte Christo (chert rich) Formation.

Typically the chert rich formations tend to be less problematic as the insoluble chert lenses within the dolomite bedrock tend to provide stability to the surrounding soluble dolomite.

A further factor which reduces the risk profile of dolomite terrains, is the presence of a thick and non-erodible blanketing soil layer, over the underlying dolomite formation.

The Malmani Subgroup is in turn overlain by quaternary sandy gravel and pedogenic soils in the form of calcrete.

A site geological map is shown below in **Figure 64** below.

Figure 64: Regional Geology Plan for the Tlisitseng 2 PV Facility.

8.8.3 Topography and Drainage

Proposed Substation Alternative 1

Substation alternative 1 is generally flat with minor depression and has no preferential drainage channels. Google Earth imagery suggests that this site may be underlain by well developed, shallow calcrete, which is typically impermeable and thus stormwater ponding could be an issue in this area.

Proposed Substation Alternative 2

Substation alternative 2 generally slopes gently towards the east at a gradient of between 1% and 2%, which should be sufficient for stormwater runoff, in the form of sheet wash towards the east, after periods of heavy prolonged rainfall. Google Earth imagery also suggests that this site may be overlain by Aeolian sand which is typically free draining, and should accommodate “normal” rainfall via natural percolation.

8.8.4 Seismicity

According to the seismic hazard map of South Africa, the site is situated in the area where peak ground acceleration with a 10% probability of being exceeded in a 50 year period falls between 0.12g and 0.16g as seen on the seismic hazard map of South Africa (**Figure 65**).

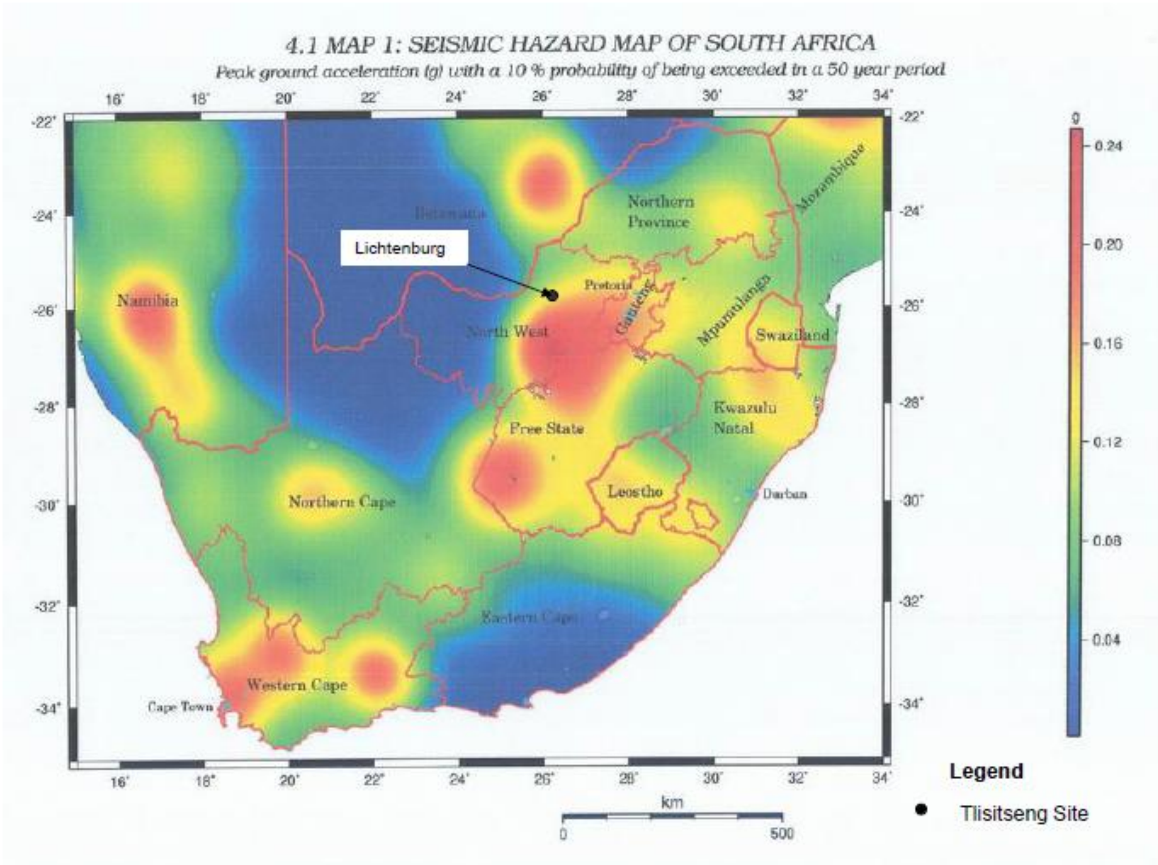


Figure 65: Seismic Hazard Map

8.8.5 Anticipated Soil Profile

Each typical soil type will be discussed below, considering the potential problems which can be generally anticipated, as well as possible geotechnical solution.

Recently Transported Soil Types

It can be anticipated that the entire site will have a surface cover of recently transported soils. The thickness of this cover can be expected to vary, according to the recent geological depositional processes that were active at the time. Main critical factors will be the general topography of the areas at the time of the sedimentation cycle as well as the presence of large rivers and lakes.

As these transported sediments were laid down in recent geological times, they will not have undergone any significant consolidation. They can therefore be considered to be of a loose consistency, and could experience settlement under applied foundation loading.

Most structures in this area are therefore typically founded at the base of these recently transported materials, on the more competent residual soil horizons.

Alternatively, these loose, potentially collapsible and consolidating soils are removed down to a specified depth, and replaced with well compacted, inert, granular fill materials, which provide a competent base for the proposed structures.

- **Wind Blown Aeolian Sands**

These soils have been transported under the action of wind. They usually form relatively deep horizons, and at surface display characteristic undulating sand dune features. Due to their method of deposition, these sandy soils are generally of low cohesion and consistency, and can be expected to settle under foundation loading. Where this sandy surface horizons is thick, the most appropriate geotechnical solution would be to excavate to a specified depth, and re-compact the removed soils back up to foundation level. This solution is referred to as constructing and engineered soil mattress. If the horizon is thin, structures could be founded on competent underlying pedogenic (calcrete) or residual soil horizons. This material is also popularly used as plaster sand in building constructions.

- **Water Transported Hillwash**

These hillwash soils have been transported by water, generally over fairly short distances, from higher ground down to lower lying areas. They usually form more cohesive soils than the aeolian sands, but are also of generally low consistency. A further characteristic of these soils is that over time, downward percolating of rain water carrying dissolved cementing solutions, can create bridges between the individual soil particles. On saturation and loading of these soils, the soil bridges can break down, resulting in collapse settlement. The geotechnical solution to founding in such soils is to place the foundation on an engineered soil mattress.

- **Water Transported Alluvium**

Alluvium are sediments that have been deposited from rivers, either after overflowing their banks in periods of flooding, or as alluvial fans entering lakes and lagoons, as well as bottom sediments dropped as the velocity of the river was impeded and reduced. These sediments can include boulders, gravels and sands, as well as fine silts and clays. The coarse gravel and sandy soils are often suitable as a founding medium, provided they are not immediately underlain by very soft silt or clayey soils. The alluvial clays can however be problematic, as they could exhibit settlement or expansive behaviour. Where materials of high plasticity are present at founding elevation, it is recommended that they be excavated out, and replaced with well compacted, inert, granular materials.

<u>Pedogenic Formations</u>

- **Ferricrete and Calcrete**

Where a fluctuating perched water table occurs, the near surface permeable soils can become cemented by iron or lime (calcium) rich solutions, to form well cemented ferricrete or calcrete horizons. Due to the increase consistency and competence of these soils, they provide a potentially good founding medium for light to medium loaded structures, depending upon the thickness and degree of cementation. This material may be prominent in areas around alternative 1 of the site.

Monte Christo Formation (Residual Soils and Bedrock Geology)

- **Dolomites**

These rocks are formed due to biological synthesis and inorganic precipitation, in an ancient inland sea. As these rocks are highly soluble by slightly acidic ground waters, under these conditions the possibility exists for the formation of sinkholes and doline depressions. These features generally only occur where static or flowing water is present, such as human settlements, dams, commercial farming using intensive irrigation and poor stormwater facilitation. Large scale dewatering processes also escalates the formation of these features. Where none of these are present, the risk of sinkholes are considerably reduced. The sandy and gravelly composition of soils derived from the weathering of dolomite and chert, are typically suitable as a founding medium for light to medium loaded structures. Only if the area has been classified as a suitably stable dolomite environment.

8.8.6 Comments

The comments made below are general, and based on anticipated geological and geotechnical conditions. In terms of SANS 1936:2012 parts 1 to 4 “Development on Dolomite Land” a two phase (feasibility and design level) geotechnical and dolomite stability investigation will be needed to be undertaken on the chosen site.

General Anticipated Founding Solutions

Proposed Alternative 1 of Tlisitseng Solar 2

Alternative 1 is possibly underlain by shallow dense pedogenic material or chert residuum. These material are likely to be suitable as founding medium for lightly to medium loaded structures.

Proposed Alternative 2 of Tlisitseng Solar 2

Alternative 1 is possibly underlain by deeper Aeolian sands which may be possibly collapsible and loose in consistency as discussed above. This material is generally not considered suitable as a founding medium and thus the structures in this area would probably need to be founded on an engineered soil matrass.

General

Due to fact that this entire site is underlain at depth by dolomite, it is a legal requirement that a Dolomite Stability Investigation (DSI) be undertaken in accordance with the South African National Standards SANS 1936-Parts 1 to 4 Development of Dolomitic Land. For the substation, built on a 1 hectare property, this DSI will comprise a gravity survey and the drilling of a minimum of 3 boreholes for a feasibility level (Phase 1) investigation. It is also evident from the Topographical maps and Google Images that a water boreholes are present near the both Alternative 1 and 2 - sites. These borehole are probably used for irrigation purpose and as mentioned above, dewatering has a significant effect on the underlying dolomite stability.

Construction Problems

The removal of large hard rock chert boulders and or hardpan calcrete, could be problematic, on both sites, when undertaking the bulk excavation or deep trenches for the installation of services.

Construction Materials

It is likely that relatively competent construction materials will be available on both site (calcrete gravels), whilst a dolomite aggregate quarry is located some 5km south of the site.

Geotechnical Site Classification

Proposed Alternative 1 of Tlisitseng Solar 2

The site is likely to be allocated a Geotechnical Site Classification Designation of P/R, in terms of the NHBRC requirements.

Proposed Alternative 2 of Tlisitseng Solar 2

The site is likely to be allocated a Geotechnical Site Classification Designation of P/C1, in terms of the NHBRC requirements.

Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.

8.9 Traffic

The Traffic Assessment was conducted by Aurecon and is included in Appendix 6I.

8.9.1 General Freight Requirements

- **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.
- Abnormal permits are required for vehicles exceeding these limits.

- **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.

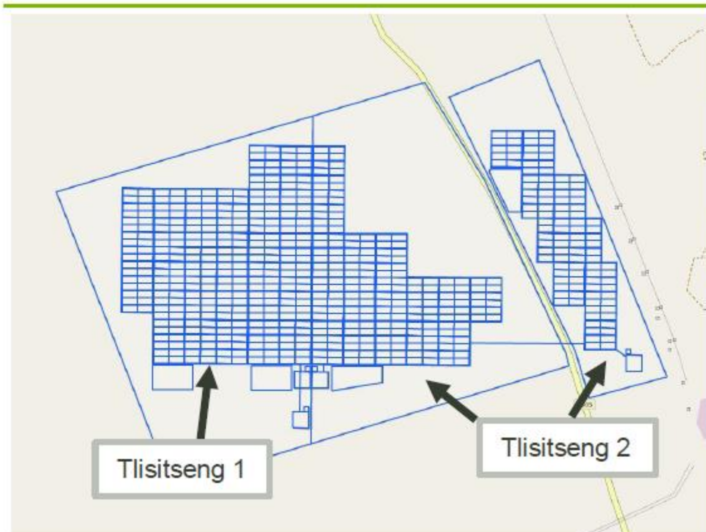
The following is anticipated:

(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.

8.9.2 Tlisitseng Solar PV Energy Facilities - Access Route

- **Site Description**

The site description is as follows:



Location	26°04'54.53"S 26°07'15.84"E
Distance from Lichtenburg **Distance from Mahikeng**	7.8 km 70 km
Generation Capacity	2x75MW
Distance from Ports **Durban** **Port Elizabeth/Coega** **Saldanha**	 765 km 1035 km 1388 km
Farm	Portion 25 of Farm Houthaalbomen 31

Figure 66: Site Description for Tlisitseng Solar PV Energy Facilities

The site is proposed to be developed in two separate phases as seen in **Figure 66** above. These will however be assessed separately as they may or may not be implemented at the same time.

- **Route Alternative 1 – Durban Port to the Tlisiteng 1 Tlisitseng 2 Solar PV Energy facility (765km)**

The route for transportation of imported equipment is either from Durban with a travelling distance of only 765 km. The preferred route follows National Roads for a significant distance and due to the good condition of these National Roads and the fact that the route avoids busy towns, it served as enough justification to be 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 Bethlehem, Kroonstad and Klerksdorp. It should be noted that the Ports Authority also has preferences on freight import, which should be considered.

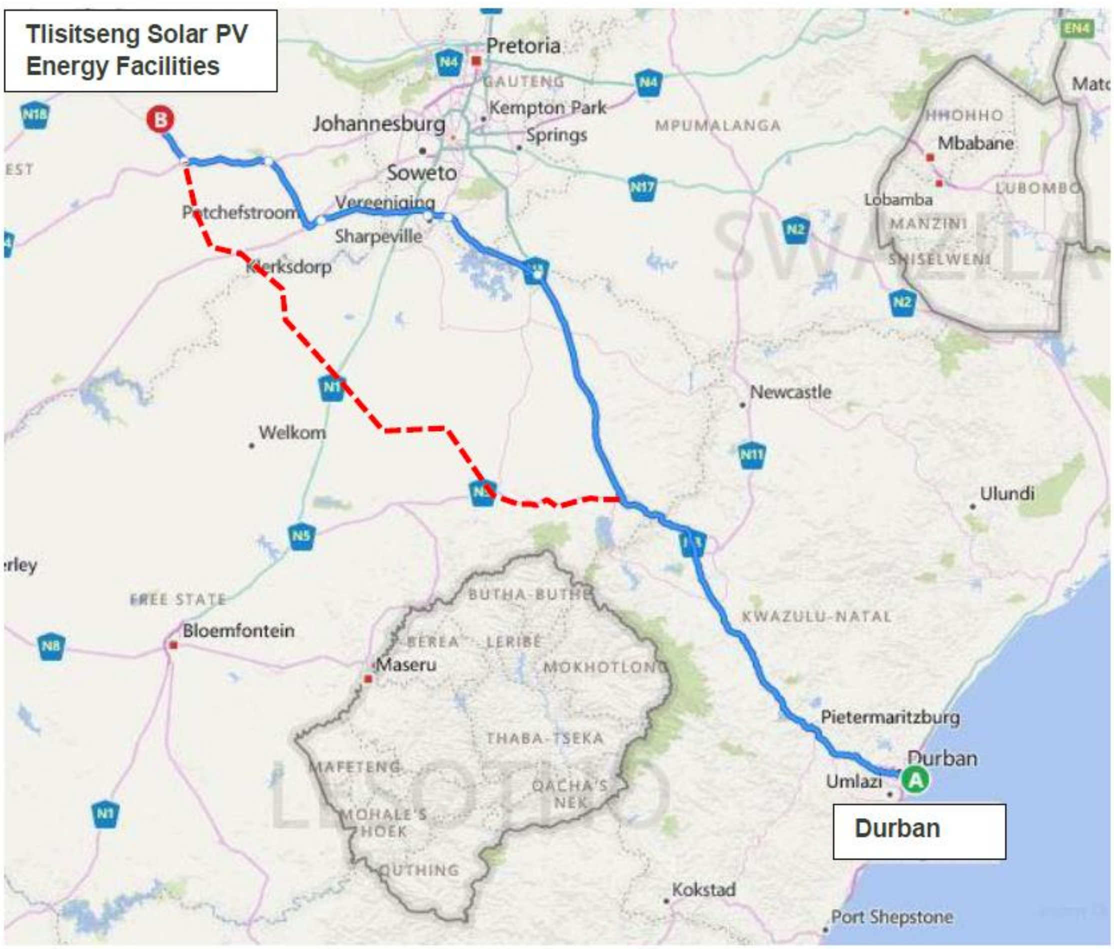


Figure 67: Preferred route from Durban Port to the Tlisitseng 2 Solar PV Energy facility (765km).

The Preferred Route's elements are shown in **Table 30** below.

Table 30: Elements of the preferred route.

Section	Route Name	From	To	Distance [km]	Type
1	N3	Durban	Villiers	456	Surfaced National
				The N3 is a dual carriageway two lane road with surfaced shoulders for most parts.	
2	R54	Villiers	Potchefstroom	168	Surfaced Regional Road
				The R54 is a single carriageway two lane road with gravel shoulders.	
3	R53	Potchefstroom	Ventersdorp	52.5	Surfaced Regional Road

				The R53 is a single carriageway two lane road with surfaced shoulders.	
4	N14	Ventersdorp	Coligny	58.4	Surfaced National Road
				The N14 is a single carriageway two lane road with surfaced shoulders.	
5	R503	Coligny	Lichtenburg	23.7	Surfaced Regional Road
				The R503 is a single carriageway two lane road with surfaced shoulders.	
6	R505	Lichtenburg	Site	7.8	Surfaced Regional Road

	The R505 is a single carriageway two lane road with gravel shoulders.

- **Route Alternative 1 – Port Elizabeth/Coega Port to the Tlisiteng 1 Tlisitseng 2 Solar PV Energy facility (1035km)**

The route for transportation of imported equipment is either from Port Elizabeth/Coega with a travelling distance of 1035km.

Figure 68: Preferred route from Port Elizabeth/Coega to the Tlisitseng 2 Solar PV Energy facility (1035km).

- **Route for Construction Materials**

Material sources for road building and concrete works is available in Lichtenburg 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 below.

- **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.

- **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 R650 per heavy vehicle with 5+ axles for a single one-way trip. If the alternative route as indicated is used, the total toll fees will be reduced by approximately R60.
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.

- **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 R505 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.

- **Site Access Road**

- <u>Access to Road Network</u>

The possible access roads for Tlisitseng 2 Solar PV Energy Facility of the proposed development as indicated in the image below are off the Regional Road R505. Both entrances should be allowed by SANRAL as sufficient sight distances (stopping and shoulder) are present. The proposed access positions are as follows:

- <u>Tlisitseng 2 Access Road Option 1</u>: For Tlisitseng 2 Solar PV Facility, the first access road alternative is situated at the most southern part of the facility. An access is required for Phase 2.1 and Phase 2.2 on both sides of the R505. It is proposed that an access for Phase 2.1 is constructed off Tlisitseng 1 Access Road Option 1, as this will potentially reduce construction costs. A road has to be constructed directly opposite Phase 2.1's entrance. The proposed access position to Phase 2.2 is shown in **Figure 69** below.

Figure 69: Tlisitseng 2 Solar PV Energy Facilities - Access Option 1

- Tlisitseng 2 Access Road Option 2: On the northern side of the site, there exists another proposed access point to Phase 2.2's site. There is an existing access road, however an additional short section of road will have to be constructed to gain access to the site from this point. This option only caters for access to Phase 2.2's site. The proposed access location to Phase 2.2 is show in **Figure 70**.

Figure 70: Tlisitseng 2 Solar PV Energy Facilities - Access Option 2

The different access road options and their respective locations are indicated in the following figure:

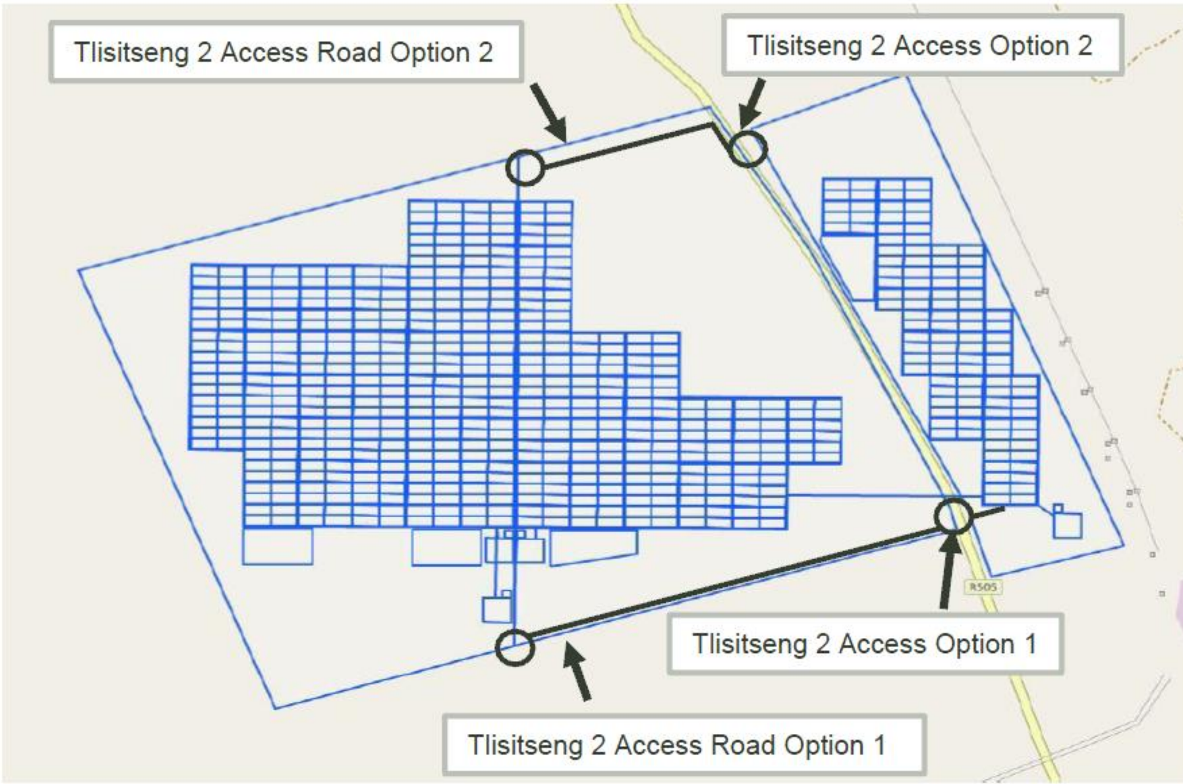


Figure 71: Tlisitseng Solar PV Energy Facilities - Access Options and Access Roads

The internal access roads will be confirmed once the final positioning of the solar panels are available and a more detailed design is required. These roads will obviously have to be constructed before any components are delivered to site.

- **Preferred Access Route**

Both of the access options illustrated above are considered to be viable from environment and technical viewpoints, however access road Option 1 is preferred for Phase 2.2. In both cases, the additional road length that has to be constructed is minimal. 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) and finished with a gravel wearing course layer.

- **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.

- **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.

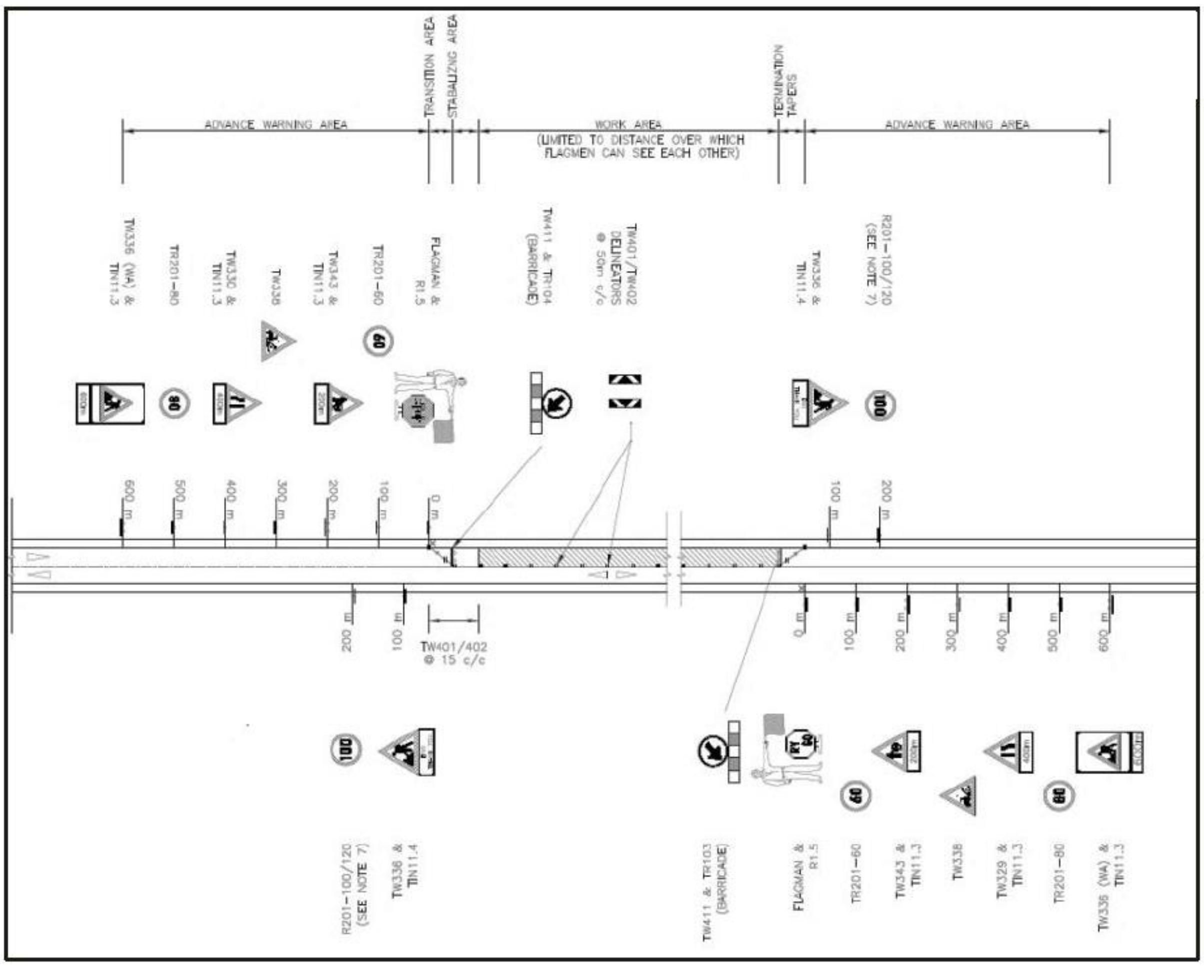


Figure 72: Accommodation of Traffic - Typical Layout

9 ENVIRONMENTAL IMPACT ASSESSMENT

9.1 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.

9.1.1 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 calculated as shown in **Table 32**.

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.

9.1.2 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.

- 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 31: 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.

Table 32: Rating of impacts

IMPACT TABLE FORMAT	
Environmental Parameter	A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water.
Issue/Impact/Environmental Effect/Nature	A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water.
Extent	A brief description indicating the chances of the impact occurring.
Probability	A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity.
Reversibility	A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water.
Irreplaceable loss of resources	A brief description of the degree in which irreplaceable resources are likely to be lost.
Duration	A brief description of the amount of time the proposed activity is likely to take to its completion.
Cumulative effect	A brief description of whether the impact will be exacerbated as a result of the proposed activity.

IMPACT TABLE FORMAT		
Intensity/magnitude	A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily.	
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**
	Pre-mitigation impact rating	
Extent	1	4
Probability	1	4
Reversibility	1	4
Irreplaceable loss	1	4
Duration	1	4
Cumulative effect	1	4
Intensity/magnitude	2	2
Significance rating	-12 (low negative)	-48 (medium negative)
Mitigation measures	*Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analysing the significance. These measures will be detailed in the EMP.*	

The 2014 regulations also specify that alternatives must be compared in terms of impact assessment.

9.2 Environmental Impact Assessment

9.2.1 Biodiversity

- Planning

There are no impacts that are likely to be created as a result of project planning.

- Construction

<u>Impact 1: Impacts on indigenous natural vegetation</u>

The regional terrestrial vegetation type in the broad study area is Carletonville Dolomite Grassland, listed as Vulnerable in the scientific literature. However, natural habitat on site has been identified as being of importance in the Provincial Conservation Assessment. Loss of habitat will definitely occur, but this will be a small area in comparison to the total area of the vegetation type concerned.

Table 33: Rating of impacts on indigenous natural vegetation.

LOSS OF INDIGENOUS NATURAL VEGETATION		
Environmental parameter	Indigenous natural vegetation.	
Issue/Impact/Environmental Effect/Nature	Loss, degradation or fragmentation of vegetation.	
Extent	The impact will affect natural vegetation on site and possibly in immediately surrounding areas.	
Probability	The impact will definitely happen.	
Reversibility	Irreversible in human timeframes, since natural successional processes cannot compensate for complete local loss of habitat and diversity. Secondary vegetation will probably never resemble the original vegetation found on site.	
Irreplaceable loss of resources	Significant loss of resources will occur.	
Duration	The impact will be permanent (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.).	
Cumulative effect	Medium cumulative impact. Added to existing impacts on natural habitat, the current project will cause additional loss of vegetation.	
Intensity/magnitude	Medium. Regional vegetation will continue to function.	
Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	3	3
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	**-38 (medium negative)**	**-38 (medium negative)**
Mitigation measures	The following mitigation measures would help to limit impacts, but will not affect the extent, probability, reversibility, irreplaceable loss of resources, duration, cumulative effect or intensity: 1. Compile a rehabilitation programme.	

	2. Compile an Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas.

Impact 2: Impacts on listed plant species

There are four species that may occur in the study area, the bulb, *Boophone disticha*, listed as Declining, the bulb, *Crinum macowanii*, listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened

Table 34: Rating of impacts on listed plant species

LOSS OF INDIVIDUALS OF LISTED PLANTS		
Environmental parameter	Listed plants, as per Red & Orange List.	
Issue/Impact/Environmental Effect/Nature	Loss of individuals.	
Extent	The impact will affect local populations or individuals of the affected species.	
Probability	The impact will probably happen.	
Reversibility	Partly reversible. Individuals can be rescued or else cultivated to replace lost specimens.	
Irreplaceable loss of resources	Marginal loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range.	
Duration	The impact will be medium-term.	
Cumulative effect	Low cumulative impact. Cumulative effects will not be significant.	
Intensity/magnitude	Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	**-12 (low negative)**	**-10 (low negative)**
Mitigation measures	The following mitigation measures would help to limit impacts:	

	1. It is a legal requirement to obtain permits for specimens that will be lost. 2. A pre-construction walk-through survey will be required to locate any listed plants. 3. Near threatened and Declining plants lost to the development can be rescued and planted in appropriate places in surrounding areas. This will reduce the probability as well as the cumulative effect. 4. If any listed plants are located during the pre-construction survey, a Plant Rescue Plan would be required to manage the process of attempting to rescue such individuals. 5. If any threatened species are found (only *Brachystelma incanum* listed for this area), the infrastructure layout would need to be adjusted to allow in situ conservation of affected plants as well as a suitable buffer zone. An Ecological Management Plan would need to be compiled to manage the locality where it occurs.

Impact 3: Impacts on protected plant species

There is one species protected according to the National Environmental Management: Biodiversity Act, *Harpagophytum procumbens*, which may potentially occur on site. No individuals were found on site during the field survey and, based on an assessment of available habitat on site, it is considered unlikely that any occur there. This potential impact will therefore not occur and is not assessed further.

There are a number of species that may be protected according to provincial legislation. The possible presence of these on site is unknown due to the dry conditions at the time of the survey. There is therefore a possibility that additional protected species may occur there and that they may be detected at a later stage of the project. The assessment below is therefore based on this possibility.

Table 35: Rating of impacts on protected plant species

LOSS OF INDIVIDUALS OF PROTECTED PLANTS	
Environmental parameter	Protected plants, as per NEM:BA and provincial legislation.
Issue/Impact/Environmental Effect/Nature	Loss of individuals.
Extent	The impact will affect local populations or individuals of the affected species.
Probability	The impact may possibly happen.
Reversibility	Partly reversible. Individuals can be rescued or else cultivated to replace lost specimens.

Irreplaceable loss of resources	Marginal loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range.	
Duration	The impact will be medium-term.	
Cumulative effect	Low cumulative impact. Cumulative effects will not be significant.	
Intensity/magnitude	Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	**-11 (low negative)**	**-9 (low negative)**
Mitigation measures	The following mitigation measures would help to limit impacts: 1. It is a legal requirement to obtain permits for specimens that will be lost. 2. A pre-construction walk-through survey will be required to locate any protected plants. 3. Plants lost to the development can be rescued and planted in appropriate places in surrounding areas. This will reduce the irreplaceable loss of resources as well as the cumulative effect. 4. If any protected plants are located during the pre-construction survey, a Plant Rescue Plan would be required to manage the process of attempting to rescue such individuals.	

Impact 4: Loss of individuals of protected trees

There are three protected tree species that could occur on site, *Acacia erioloba, Combretum imberbe* and *Boscia albitrunca.* Whether these species occur on site or not is unknown until a site evaluation has been undertaken**.**

Table 36: Rating of impacts of loss of individuals of protected trees

LOSS OF INDIVIDUALS OF PROTECTED TREES		
Environmental parameter	Protected trees, as per National Forests Act.	
Issue/Impact/Environmental Effect/Nature	Loss of individuals.	
Extent	The impact will affect local populations or individuals of the affected species.	
Probability	The impact will definitely happen.	
Reversibility	Irreversible. Individuals are not possible to be rescued.	
Irreplaceable loss of resources	Marginal loss of resources could occur. The species that occurs on site is relatively common throughout its range although a large number of individuals were seen to occur on site.	
Duration	The impact will be permanent.	
Cumulative effect	Low cumulative impact. Cumulative effects will not be significant.	
Intensity/magnitude	Low. Loss of some individuals will be insignificant compared to the number that probably occur in surrounding areas.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2	2
Duration	4	5
Cumulative effect	2	2
Intensity/magnitude	1	1
Significance rating	**-17 (low negative)**	**-9 (low negative)**
Mitigation measures	The following mitigation measures would help to limit impacts: 1. It is a legal requirement to obtain permits for specimens that will be lost. 2. A pre-construction walk-through survey will be required to locate any protected trees and record information about each specimen.	

There are five animal species of conservation concern that could potentially be affected by the proposed project:

- Brown Hyaena (NT),
- Honey badger (NT),
- Southern African Hedgehog (NT),
- White-tailed Rat (EN),
- Giant Bullfrog (NT/LC).

Three of these species, the Southern African Hedgehog, the White-tailed Rat and the Giant Bullfrog, are relatively sedentary and therefore considered to be potentially vulnerable to habitat loss, as related to this project.

Table 37: Rating of impacts of mortality of populations of sedentary species.

LOSS OF POPULATIONS OF SEDENTARY ANIMALS		
Environmental parameter	Species of conservation concern.	
Issue/Impact/Environmental Effect/Nature	Loss of individuals/populations.	
Extent	The impact will affect local populations or individuals of the affected species.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible. Individuals may be rescued and translocated.	
Irreplaceable loss of resources	Marginal loss of resources could occur. The species that potentially occur on site have very wide geographical ranges.	
Duration	The impact will be short-term.	
Cumulative effect	Low cumulative impact. Cumulative effects will not be significant.	
Intensity/magnitude	Low. Loss of some individuals will be insignificant compared to the number that probably occur throughout their range.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	2
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	**-10 (low negative)**	**-7 (low negative)**
Mitigation measures	The following mitigation measures would help to limit impacts:	

	1. It is a legal requirement to obtain permits for specimens that will be lost. 2. A pre-construction walk-through survey will be required to locate any individuals and move them to surrounding habitats.

Construction activities, loss of habitat, noise, dust and general activity associated with the construction phase of the project are likely to cause all mobile species to move away from the site. Mobile species of conservation concern (two sedentary species are discussed for the previous impact) that could potentially be affected by the proposed project are as follows:

- Brown Hyaena (NT),
- Honey badger (NT).

These are all highly mobile terrestrial species with a large home range and the ability to travel long distances in short periods of time. For these species, they may be locally displaced, but this will have little effect on the overall range of any of these species nor is it expected that any overall impacts will result from local displacement. This potential impact is therefore not assessed further.

- Operation

There is a moderate possibility that alien plants could be introduced to areas within the footprint of the proposed infrastructure from surrounding areas in the absence of control measures. The potential consequences may be of moderate seriousness for surrounding natural habitats due to the fact that a lot of natural vegetation still remains on site. Control measures could prevent the impact from occurring.

Table 38: Rating of impacts of the establishment and spread of declared weeds and alien invader plants

ESTABLISHMENT AND SPREAD OF DECLARED WEEDS	
Environmental parameter	Vegetation and habitat.
Issue/Impact/Environmental Effect/Nature	Loss of habitat due to invasion by alien plants.
Extent	The impact will affect habitat on site and possibly in immediately surrounding areas.
Probability	The impact will probably happen in the absence of control measures.
Reversibility	Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.
Irreplaceable loss of resources	Marginal to significant loss of resources will occur. Uncontrolled invasion can affect all nearby natural habitats.
Duration	The impact will be long-term.

Cumulative effect	Low cumulative impact. Cumulative effects will not be significant.	
Intensity/magnitude	Medium. Severe invasion can alter the functioning of natural ecosystems.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	1
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	1
Significance rating	**-28 (medium negative)**	**-11 (low negative)**
Mitigation measures	Compile and implement an alien management plan. Undertake regular monitoring to detect alien invasions early so that they can be controlled. Implement control measures.	

- Decommissioning

It is expected that the project will operate for a minimum of twenty years or more (a typical planned life-span for a project of this nature). Decommissioning will probably require a series of steps resulting in the removal of equipment from the site and rehabilitation of footprint areas. It is possible that the site could be returned to a rural nature, but it is unlikely that natural vegetation would become established on site for a very long time. The reality is that it is not possible to determine at this stage whether rehabilitation measures will be implemented or not or what the future plans for the site would be nor is it possible at this stage to determine what surrounding land pressures would be. These uncertainties make it impossible to undertake any assessment to determine possible impacts of decommissioning.

9.2.2 Avifauna

- Planning

No impacts are expected during planning.

- Construction

Table 39: Rating of impacts of displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.

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.	

- Operation

Table 40: Rating of impacts of displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.

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 = 3The 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.	

Table 41: Rating of impacts of mortality of priority species due to collisions with solar panels

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.

- Decommissioning

Table 42: Rating of impacts of displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure.

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.	

9.2.3 Surface Water

- Pre-construction Phase

No impacts are expected during planning.

A construction lay-down area will be required for the proposed development. The location of the construction lay-down area is important, as it is proposed that this could be placed near to the wetland (approx. 260m 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 wetland, clearance/removal of vegetation at the surface can leave the downstream wetland vulnerable to erosion and sedimentation impacts from associated run-off.

Table 43: 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 the wetland.	
Extent	Site.	
Probability	Probable.	
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	3	3
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	**- 24 (low negative)**	**- 8 (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 prevent erosion in susceptible construction areas. All impacted areas are to be adequately sloped to prevent the onset of erosion.	

- Construction Phase

Construction vehicles (heavy and light) are likely to require access to the proposed PV arrays. Potential negative impacts can include the need to travel into or through the wetland, thereby resulting in physical degradation. However, this potential activity is unlikely since the wetland is in a lower topographical position that is difficult and impractical to access. Nonetheless, inward drainage into the wetland for leaks or spills of oils, fluids and/or fuels from vehicles and machinery in general or during re-fuelling or servicing in or near the wetland is a possibility. Should any leakage or spillage occur in and/or near the wetland, potential soil/water contamination/toxication of amphibians frequenting the wetlands can result. Fuels and oils also pose a fire risk not only to the wetland but also neighbouring grazing lands or nearby settlement areas.

Table 44: Impact rating for construction vehicle and machinery degradation impacts to the wetland

IMPACT TABLE		
Environmental Parameter	Wetlands	
Issue/Impact/Environmental Effect/Nature	Vehicle and machinery degradation to the wetland.	
Extent	Site.	
Probability	Possible.	
Reversibility	Partly reversible.	
Irreplaceable loss of resources	Marginal loss of resources.	
Duration	Medium term.	
Cumulative effect	Medium cumulative Impact.	
Intensity/magnitude	Low.	
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	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	**- 24 (low negative)**	**- 6 (low negative)**
Mitigation measures	**Preventing Physical Degradation of the Wetland** – The wetland and the associated buffer zone is to be designated as a "highly sensitive area". Vehicle access is not to be allowed in the highly sensitive area. Access roads are not to be routed through the wetland or the associated buffer zone. Where this cannot be undertaken, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented.	

	Construction workers are only allowed in the designated construction areas of the proposed development and not into the wetland. The highly sensitive area is to be clearly demarcated prior to the commencement of construction and no access into this area is to be allowed. **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.

The possibility of human degradation to the wetland is likely to occur during the construction phase, since construction activities will probably take place in relative close proximity to the wetland given the location of the PV array area (approximately 18m to the east of the wetland) as well as the adjacent existing road of the R505 (approximately 35m to the west of the wetland). Human degradation can take the form of physical / direct degradation such as lighting fires (purposefully or accidentally) in or near to the wetland. Usage of the wetland for sanitation purposes may take place, 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.

Table 45: 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 wetland.	
Extent	Site.	
Probability	Possible.	
Reversibility	Completely reversible.	
Irreplaceable loss of resources	Marginal loss of resources.	
Duration	Short 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	2	1
Reversibility	1	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	**- 18 (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 wetland designated as highly sensitive. The highly sensitive area is to be clearly demarcated and no access into this area is to be allowed unless authorised. 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.

The proposed PV array is to be located within close proximity (to the east, approximately 18m from the edge of the wetland on the edge of the operation phase buffer zone) of the identified wetland and the associated buffer zone. Foundations will need to be laid for the various PV structures and infrastructure. The depth of the foundations may be up to 1m deep. Where the placement of the foundations extend into the wetland area and / or the associated buffer zone, the excavation of potential soils are likely to affect the functionality of these hydrological systems. Functionality may be affected in terms of hydrological functionality as well as pedological functionality. Moreover, the implementation of the foundations are considered a permanent structure, meaning that the area occupied by the foundation will result in a degree of permanent surface water resource habitat (vegetation) loss. Moreover, soil will also need to be removed during this process.

Table 46: Impact rating for construction phase degradation and removal of vegetation and soils associated with the wetland and the associated buffer zone

IMPACT TABLE	
Environmental Parameter	Wetlands.

Issue/Impact/Environmental Effect/Nature	Degradation and removal of soils and vegetation associated with the wetland.	
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	High.	
Significance Rating	Pre-mitigation significance rating is medium 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	1
Reversibility	3	1
Irreplaceable loss	2	1
Duration	3	1
Cumulative effect	3	1
Intensity/magnitude	3	1
Significance rating	**- 42 (medium negative)**	**- 6 (low negative)**
Mitigation measures	**Avoiding Direct Impacts to the Wetland** – The PV layout should be amended to avoid the wetland area as well as the associated buffer zone since the terrain is unsuitable for the placement of PV panels given the microtopographical alterations of the landscape in this vicinity. Additionally, should the PV panels need to be placed partially within the wetland, infilling will be required to adequately slope the terrain. The wetland would therefore be lost which is unacceptable unless a wetland off-set is undertaken and imposed.	

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.

Table 47: 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 wetland.	
Extent	Site.	
Probability	Definite.	
Reversibility	Partly reversible.	
Irreplaceable loss of resources	Marginal loss of resources.	
Duration	Medium 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 further reduced.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	1	1
Significance rating	**- 39 (medium negative)**	**- 6 (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 zone of the wetland.

- Operational Phase

Internal access roads are to be required for access to the proposed PV field during the operation and maintenance phase. Internal access roads can physically affect the identified wetland depending on the final alignment. Therefore, it is important that roads are not planned and constructed within the wetland and/or associated operation phase buffer zone. Regular vehicle movement in the identified wetland 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.

Table 48: 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	Possible.
Reversibility	Partly 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 low and negative. With appropriate mitigation measures, the impact can be further reduced to a lower negative impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	**- 26 (low negative)**	**- 8 (low negative)**
Mitigation measures	**Minimising Vehicle Damage to the Wetland** – Potential impacts can be avoided by the routing of access roads outside of and away from the wetland and the associated buffer zone. Where access through the wetland is unavoidable and is absolutely required, it is recommended that any road plan and associated structures be submitted to the relevant environmental and water departments for approval prior to implementation. Service roads authorised in the highly sensitive area will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month in the rainy season (October to March). Moreover, after short or long periods of heavy rainfall or after long periods of sustained rainfall, the roads will need to be checked 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.	

- Decommissioning

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.

9.2.4 Agricultural Potential and Soils

- Construction and Operation

Table 49: Rating of impacts (loss of potential)

RATING OF IMPACTS (LOSS OF POTENTIAL)		
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

RATING OF IMPACTS (LOSS OF POTENTIAL)		
Intensity/magnitude	2	1
Significance rating	**-22 (negative low)**	**-10 (negative low)**
Mitigation measures	Due to the generally 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 50: Rating of impacts (erosion hazard)

RATING OF IMPACTS (EROSION HAZARD)		
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)**

RATING OF IMPACTS (EROSION HAZARD)	
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 loamy nature of the soils means that if exposed, there is only a small hazard of soil removal by wind erosion, especially in the drier winter months. However, 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.

- Decommissioning

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

9.2.5 Visual

- Planning

No impacts are expected during planning.

- Construction

Table 51: Rating of visual impacts of the proposed Tlisitseng 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 R505 and visitors at Rafters Pub, the Lichtenburg Game Breeding Centre as well as the Lichtenburg Vakansie Oord. 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	▪ If possible, carefully plan to reduce the construction period. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible, in accordance with the recommendations of the biodiversity specialist. ▪ Vegetation clearing should take place in a phased manner. ▪ Make use of nurseries to speed up recovery of vegetation. ▪ 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. ▪ Establish erosion control measures on areas which will be exposed for long periods of time. This is to reduce the potential impact heavy rains may have on the bare soil. ▪ Where possible, laydown areas and temporary construction equipment and camps should be placed in already in disturbed areas in order to minimise vegetation clearing. ▪ Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting. ▪ Where possible, protect existing local trees and maintain natural vegetation outside the development footprint.

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

- Operation

Table 52: Rating of visual impacts of the proposed Tlisitseng Solar 2 PV energy facility during operation

IMPACT TABLE		
Environmental Parameter	Visual Impact.	
Issue/Impact/Environmental Effect/Nature	The proposed Tlisitseng 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 R505 and visitors at Rafters Pub, the Lichtenburg Game Breeding Centre as well as the Lichtenburg Vakansie Oord.	
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. ▪ If possible, light sources should be shielded by physical barriers (walls, vegetation, or the structure itself); ▪ Make use of minimum lumen or wattage in fixtures; ▪ Limiting mounting heights of lighting fixtures, or alternatively using foot-light or bollard level lights; ▪ If possible, make use of motion detectors on security lighting. ▪ 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 gravel access roads, where possible. ▪ Only clear vegetation on site and adjacent to the site which is required to be cleared for the correct operation of the facility. ▪ Ensure that the PV arrays are not located within 500m from any of the surrounding farmhouses, in order to limit the visual impact of the solar facility on these dwellings. ▪ Locally occurring indigenous woody vegetation (trees and shrubs) should be planted along the southern boundary of the site.	

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

Table 53: Rating of visual impacts of the infrastructure associated with the Tlisitseng Solar 2 PV energy facility during operation

IMPACT TABLE	
Environmental Parameter	Visual Impact.
Issue/Impact/Environmental Effect/Nature	The infrastructure associated with the proposed Tlisitseng 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 R505 and visitors at Rafters Pub, the Lichtenburg Game Breeding Centre as well as the Lichtenburg Vakansie Oord.	
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	2
Intensity/magnitude	1	1
Significance rating	**-17 (low negative)**	**-15 (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. ▪ If possible, the O&M buildings should not be illuminated at night. Alternatively, light sources should	

	be shielded by physical barriers (walls, vegetation, or the structure itself); ▪ Make use of minimum lumen or wattage in fixtures; ▪ Limiting mounting heights of lighting fixtures, or alternatively using foot-light or bollard level lights; ▪ If possible, make use of motion detectors on security lighting. ▪ If overhead power lines are required, align power lines to run parallel to other linear elements and the farm boundaries, where possible. ▪ 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 (i.e. Substation and O&M Building Alternative 1 as well as Laydown Area Alternative 2). ▪ Limit the number of maintenance vehicles which are allowed to access the site. ▪ Ensure that dust suppression techniques are implemented on gravel access roads, where possible. ▪ Non-reflective surfaces should be utilised where possible. ▪ Ensure that the associated infrastructure are not located within 500m from any of the surrounding farmhouses, in order to limit the visual impact on these dwellings. ▪ Locally occurring indigenous woody vegetation (trees and shrubs) should be planted along the southern boundary of the site.

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

- Decommissioning

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase. It is however recommended that the following mitigation be implemented during decommissioning:

- All infrastructure that is not required for the post-decommissioning use should be removed;
- Rehabilitate all cleared areas as soon as possible, in accordance with the recommendations of the biodiversity specialist; and
- Monitor rehabilitated areas post-decommissioning and implement remedial actions, as required.

9.2.6 Heritage

- Planning

No impacts are expected during planning.

- Construction

Table 54: 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	2	1
Reversibility	2	1
Irreplaceable loss	3	2
Duration	4	3
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	**-26 (medium negative)**	**-9 (low negative)**
Mitigation measures	Documentation of sites TS04 and TS05. Demarcate TS08 as no-go.	

Table 55: Rating of Impacts and Chance finds

IMPACT TABLE	
Environmental Parameter	Palaeontological Resources.
Issue/Impact/Environmental Effect/Nature	The possibility of encountering previously unidentified 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.
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 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 palaeontological 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 palaeontological sites the cumulative impact is seen as having a medium negative impact.

Intensity/magnitude	The large scale impact on palaeontological sites might require mitigation work.	
Significance Rating	The overall significance rating for the impact on heritage resources is seen as very high pre-mitigation. This can be attributed to 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.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	3	2
Reversibility	4	3
Irreplaceable loss	3	3
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	3	3
Significance rating	**-63 (high negative)**	**57 (high positive)**
Mitigation measures	▪ Mitigation through paleontological excavations and collection if Geotechnical Survey indicates necessity for mitigation. ▪ Monitoring during construction by paleontologist if fossils are exposed during excavation of more than 1.5m of soil cover.	

- Operation

No impacts are expected during operation.

- Decommissioning

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

9.2.7 Socio-economic

- Planning

No impacts are expected during planning.

- Construction

Table 56: Rating of impacts of a loss of productive agriculture land

SOCIO-ECONOMIC		
Environmental Parameter	The current economic activity on the directly impacted farm portion is irrigated maize and cattle grazing. The grazing land will be affected should the proposed development be approved.	
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 marginal 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 agriculture 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	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	4	4

Intensity/magnitude	2	1
Significance rating	**- 34 (medium negative)**	**-17 (low negative)**
Mitigation measures	• Consultation with the directly affected land owner 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.	

Table 57: Rating of impacts of temporary employment creation.

SOCIO-ECONOMIC	
Environmental Parameter	Skills and literature levels in the Ditsobotla 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 between 25 and 31 temporary job opportunities.
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	3	3
Probability	3	4
Reversibility	4	4
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	**16 (low positive)**	**34 (medium positive)**
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.	

Table 58: Rating of skills development.

SKILLS DEVELOPMENT	
Environmental Parameter	Skills and literature levels in the Ditsobotla LM is low with high levels of unemployment.
Issue/Impact/Environmental Effect/Nature	The impact will create between 25 and 31 temporary job opportunities. These 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 resource.
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	3	3
Probability	2	4
Reversibility	2	2
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	**17 (low positive)**	**36 (medium positive)**
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.	

Table 59: Rating of impact on living standard (due to temporary increase in income).

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 59.3% of the households living in the Ditsobotla LM is living on an income of less than R3 200 per month.	
Issue/Impact/Environmental Effect/Nature	The impact will create between 25 and 31 temporary job opportunities. These individuals, 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 are 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	3	3
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1

Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	**13 (low positive)**	**16 (low positive)**
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.	

Table 60: Rating of impact of severing of existing community ties

SEVERING OF EXISTING COMMUNITY TIES		
Environmental Parameter	The relationship between the directly impacted land owner and some adjacent land owners is strained due to a water use license awarded to the directly impacted land owner previously.	
Issue/Impact/Environmental Effect/Nature	Approval of the project may negatively influence the relationship further as indirectly affected land owners may perceive to be unduly negatively impacted.	
Extent	The impact will only affect the site.	
Probability	The impact may occur (between 25% and 50% chance of occurrence).	
Reversibility	The impact is reversible with implementation of minor mitigation measures.	
Irreplaceable loss of resources	The impact will not result in loss of any resources.	
Duration	Long term, the perception will last for as long as the operational life of the project continues.	
Cumulative effect	The impact would result in minor cumulative impacts, especially if the other Tlisitseng development is also approved.	
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:** Negative low impact: the anticipated impact will have negligible negative effects, requiring minor mitigation. **After mitigation measures:** Implementation of the mitigation measures decreases the significance rating, although the impact remains negative low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	2	1
Reversibility	1	1

Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	3	3
Intensity/magnitude	1	1
Significance rating	**-15 (low negative)**	**-14 (low negative)**
Mitigation measures	• Participate in ongoing consultation with directly and indirectly affected land owners to avoid unduly influencing any processes or day to day activities of these individuals. Ensure that all interested and affected parties understand the project and its requirements as far as is feasible, reasonable, and possible.	

Table 61: Rating of impact of temporary increase in social pathologies

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 only affect the site.
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	4	4
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	3
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	**-36 (medium negative)**	**-17 (low negative)**
Mitigation measures	▪ Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers. ▪ Set up a recruitment office in the nearby town of Lichtenburg and adhere to strict labour recruitment practices that would reduce the desire of potential job seekers to loiter around the properties in hope to find temporary employment ▪ Employ locals as far as feasible through the creation of the local skills database and recruitment of suitable candidates. ▪ Set up a gate or access control to site to limit or completely eliminate the possibility of loitering on site and movement of people from site to the adjacent properties. ▪ Movement of workers and vehicles on the roads linked to the construction activities should be limited to working hours and workdays.	

Table 62: Rating of impact on business safety and security

IMPACT ON BUSINESS SAFETY AND SECURITY	
Environmental Parameter	The study area is characterised by rural nature. Most 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 not 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	3	3
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	**-32 (medium negative)**	**-15 (low negative)**
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.

Table 63: Rating of impact of change in the sense of place.

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.	
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	3	3
Probability	4	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	4	4
Cumulative effect	4	4

Intensity/magnitude	1	1
Significance rating	**-19 (low negative)**	**-16 (low negative)**
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.	

Table 64: Rating of impact of temporary increase in production.

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	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	**36 (medium positive)**	**36 (medium positive)**
Mitigation measures	• Where possible and feasible, local procurement of labour, goods, and services must be practiced to maximise the benefit to the local economy.	

Table 65: Rating of impact of upgrading of existing local road infrastructure

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 Tlisitseng 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 irreversible.	
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 Tlisitseng 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	4	4

Probability	2	2
Reversibility	3	3
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	**28 (low positive)**	**28 (low positive)**
Mitigation measures	No mitigation measures exist.	

Table 66: Rating of impact of temporarily increased traffic and the impact on road

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.	
Issue/Impact/Environmental Effect/Nature	The construction of the proposed Tlisitseng 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 site.	
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 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 the rating to negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	2	2
Reversibility	2	2

Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	**-30 (medium negative)**	**-15 (low negative)**
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.	

Table 67: Rating of impact of increased demand for social facilities

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 could decrease the rating to negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	3	3
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	**-30 (medium negative)**	**-14 (low negative)**
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.	

Table 68: Rating of impact on service delivery

IMPACT ON SERVICE DELIVERY	
Environmental Parameter	The Ditsobotla 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 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 the rating to negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	3	3
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	**-30 (medium negative)**	**-14 (low negative)**
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.	

Table 69: Rating of impact of temporary increase in household disposable income

TEMPORARY INCREASE IN HOUSEHOLD DISPOSABLE INCOME	
Environmental Parameter	It is estimated that 59.3% of the households in the Ditsobotla LM earn less than R3 200 per month.
Issue/Impact/Environmental Effect/Nature	An estimated maximum of 31 households in the Ditsobotla 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	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	**24 (medium positive)**	**24 (medium positive)**
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.	

Table 70: Rating of impact of temporary increase in tax revenue for government

TEMPORARY INCREASE IN TAX REVENUE FOR GOVERNMENT	
Environmental Parameter	The government will benefit from an increased local tax base in the Ditsobotla 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	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	**2**	**2**
Significance rating	**24 (medium positive)**	**24 (medium positive)**
Mitigation measures	No mitigation measures exist.	

- Operation

Table 71: Rating of impacts on employment creation

EMPLOYMENT CREATION	
Environmental Parameter	Skills and literature levels in the Ditsobotla 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 between 12 and 15 permanent employment opportunities for local community members.	
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 barely reversible – permanent employment will be created.	
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:** 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	3	3
Probability	3	3
Reversibility	2	2
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	**14 (low positive)**	**28 (medium positive)**
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.

Table 72: Rating of impacts on skills development

SKILLS DEVELOPMENT		
Environmental Parameter	Skills and literature levels in the Ditsobotla LM is low with high levels of unemployment.	
Issue/Impact/Environmental Effect/Nature	The impact will create between 12 and 15 permanent employment opportunities. These 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 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	3	3
Probability	3	4
Reversibility	3	3
Irreplaceable loss	1	1

Duration	4	4
Cumulative effect	4	4
Intensity/magnitude	1	2
Significance rating	**18 (low positive)**	**38 (medium positive)**
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.	

Table 73: Rating of impact on living standard

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 59.3% of the households living in the Ditsobotla LM are living on an income of less than R3 200 per month.
Issue/Impact/Environmental Effect/Nature	The impact will create between 12 and 15 employment opportunities. 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 barely reversible – permanent employment.
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	3	3
Probability	3	3
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	1	1
Significance rating	**16 (low positive)**	**16 (low positive)**
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.	

Table 74: Rating of impact of increased social pathologies

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 only affect the site.
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	4	4
Probability	3	2
Reversibility	2	2
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	**-38 (medium negative)**	**-18 (low negative)**
Mitigation measures	• Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers.	

Table 75: Rating of impact of increase in production

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 Tlisitseng 1 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	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	**26 (low positive)**	**26 (low positive)**
Mitigation measures	• Where possible and feasible, local procurement of labour, goods, and services must be practiced to maximise the benefit to the local economy.	

Table 76: Rating of impact of increased demand for social facilities

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 the rating to negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	3	3
Probability	3	2
Reversibility	3	3
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	**-34 (medium negative)**	**-16 (low negative)**
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.	

Table 77: Rating of impact on service delivery

IMPACT ON SERVICE DELIVERY		
Environmental Parameter	The Ditsobotla LM has a significant housing backlog. 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 the rating to negative low impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	3	3
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	1
Significance rating	**-32 (medium negative)**	**-15 (low negative)**
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.

Table 78: Rating of impact of increased household disposable income

INCREASED HOUSEHOLD DISPOSABLE INCOME		
Environmental Parameter	It is estimated that 59.3% of the households in the Ditsobotla LM earn less than R3 200 per month.	
Issue/Impact/Environmental Effect/Nature	An estimated maximum of 15 households in the Ditsobotla LM 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 country.	
Probability	The impact will certainly occur (greater than 75% chance of occurrence).	
Reversibility	The impact is barely reversible – permanent employment.	
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	1	1
Probability	4	4
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2

Significance rating	**30 (medium positive)**	**30 (medium positive)**
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.	

Table 79: Rating of impact on property values

IMPACT ON PROPERTY VALUES		
Environmental Parameter	Property values.	
Issue/Impact/Environmental Effect/Nature	Concerns over water supply and visual impact may negatively impact on the property value; however, realisation of opportunities presented for the local tourism industry associated with the growth of eco-tourism and green tourism may reverse the situation.	
Extent	The impact will affect the local area.	
Probability	The impact may occur (between a 25% and 50% chance of occurrence).	
Reversibility	The impact is 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 insignificant cumulative impact.	
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 marginal negative effects. **After mitigation measures:** Positive low impact. The proposed mitigation measure may eliminate and reverse the impact from being a negative impact to being a positive impact.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	**-22 (low negative)**	**22 (low positive)**
Mitigation measures	▪ The water supply options will need to be considered and discussed with the interested and affected parties in the	

	area prior the operations to discard any of the above-mentioned concerns. ▪ Engage with the owners of the local tourist attractions (Portion 1 of Farm Talene 25 specifically) and discuss with them the opportunities to establish educational tours in partnership between the two (or more) local parties that could be packaged, advertised and sold by the businesses surrounding the solar farm. ▪ Implement recommendations of the visual specialist.

Table 80: Rating of impact of increased government tax revenue

INCREASED GOVERNMENT TAX REVENUE		
Environmental Parameter	The government will benefit from an increased local tax base in the Ditsobotla 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	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	4	4

Intensity/magnitude	2	2
Significance rating	**28 (medium positive)**	**28 (medium positive)**
Mitigation measures	No mitigation measures exist.	

Table 81: Rating of impact of increased government tax revenue

IMPACT ON REALISATION OF NEARBY PROPERTIES' TOURISM BUSINESS POTENTIAL		
Environmental Parameter	Tourism and related business potential.	
Issue/Impact/Environmental Effect/Nature	Once of the concerns raised by the local property owners is the negative effect of the proposed solar PV facility on its tourist and entertainment spot, and specifically on the ability to realise the local area's potential to develop local accommodation and attract larger number of tourists.	
Extent	The impact will affect the local area.	
Probability	Due to the nature of the tourist attraction existing on Portion 1 of Farm Talene 25 and envisaged future developments on site, the impact is possible.	
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 minor cumulative impact.	
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 marginal negative effects. **After mitigation measures:** Positive low impact. The proposed mitigation measure may eliminate and reverse the impact from being a negative impact to being a positive impact.	
	Pre-mitigation impact rating	Pre-mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	**24 (low negative)**	**24 (low positive)**
Mitigation measures	▪ Engage with the owners of the local tourist attractions (Portion 1 of Farm Talene 25 specifically) and discuss with	

	them the opportunities to establish educational tours in partnership between the two (or more) local parties that could be packaged, advertised and sold by the businesses surrounding the solar farm. ▪ Other opportunities linked to realising the potential for eco-tourism linked to the proposed solar PV project/s need to be examined. This could include the use of Socio-Economic Development and Enterprise Development funding allocated by the project during operations on realising these opportunities and developing the local tourism industry. ▪ Implement recommendations of the visual specialist. ▪ Ensure that the establishments surrounding the farms are kept safe by insetting a stringent access control and proper fencing between the boundaries of properties.

- Decommissioning

Socio-economic impacts stimulated during the decommissioning phase are expected to be similar to those that take place during the construction phase

9.2.8 Traffic

Table 82: Rating of impacts of additional traffic on existing routes during the Construction and De-commission of the proposed Solar Facility

TRAFFIC	
Environmental Parameter	Traffic impact of additional traffic on existing routes during the Construction and De-commission of the proposed Solar Facility
Issue/Impact/Environmental Effect/Nature	The transport of the necessary materials, equipment and personnel for the construction and de-commissioning of the proposed 75MW solar facility using major routes such as the N3, R54, R53, R52 & R505.
Extent	Local
Probability	Probable
Reversibility	Reversible
Irreplaceable loss of resources	Marginal
Duration	Short Term
Cumulative effect	The cumulative impact of other Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) in the area will only have a noticeable impact if the construction timelines as

	well as components, manufacturing centre, importation ports, etc. are exactly aligned, which is highly unlikely. Even in that case the impact will still be considered as negligible.	
Intensity/magnitude	Low	
Significance rating	Prior to mitigation measures: Low Negative After mitigation measures: Low Negative	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	1	1
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	**- 12 (Low negative)**	**-11 (low negative)**
Mitigation measures	▪ Manage traffic volumes by means of the management of delivery volumes and times by distributing it throughout the day. ▪ Implement dust control measures during construction with speed limits and regular watering for gravel roads. ▪ Ensure delivery drivers are licensed and competent, and vehicles are in good road worthy condition.	

Table 83: Rating of impacts of additional traffic on existing routes during operation of the proposed Solar Facility

TRAFFIC	
Environmental Parameter	Traffic impact of additional traffic on existing routes during operation of the proposed Solar Facility
Issue/Impact/Environmental Effect/Nature	The transport of the necessary materials, equipment and personnel for the operation of the proposed 75MW solar facility.
Extent	Local
Probability	Probable
Reversibility	Reversible
Irreplaceable loss of resources	No Loss
Duration	Long Term

Cumulative effect	The cumulative impact of other Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) in the area will only have a noticeable impact if the construction timelines as well as components, manufacturing centre, importation ports, etc. are exactly aligned, which is highly unlikely. Even in that case the impact will still be considered as negligible.	
Intensity/magnitude	Low	
Significance rating	Prior to mitigation measures: Low Negative After mitigation measures: Low Negative	
	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	2	2
Intensity/magnitude	1	1
Significance rating	**- 11 (Low negative)**	**-11 (low negative)**
Mitigation measures	▪ Manage traffic volumes by means of the management of delivery volumes and times by distributing it throughout the day. ▪ Implement dust control measures during construction with speed limits and regular watering for gravel roads. ▪ Ensure delivery drivers are licensed and competent, and vehicles are in good road worthy condition.	

10 SPECIALIST RECOMMENDATIONS AND MITIGATION MEASURES

10.1 Mitigation Measures

10.1.1 Biodiversity

The mitigation hierarchy approach

The mitigation hierarchy consists of a number of sequential steps (avoid, mitigate, restore or rehabilitate and offset). This approach enables an infrastructure development project to work towards “no net loss” of biodiversity, and ideally, a net gain. The mitigation hierarchy is defined as:

- **Avoidance:** measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of biodiversity.
- **Minimisation:** measures taken to reduce the duration, intensity and / or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible.
- **Rehabilitation/restoration:** measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/ or minimised.
- **Offset:** measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, in order to achieve no net loss or a net gain of biodiversity. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risk, protecting areas where there is imminent or projected loss of biodiversity.

Mitigation measures

Surface Runoff and Stormwater Management Plan

The purpose of a Surface Runoff and Stormwater Management Plan is to prevent damage to areas downslope / downstream of the project area. This is an impact avoidance measure. This plan must indicate how all surface runoff generated as a result of the project and associated activities (during both the construction and operational phases) will be managed (e.g. artificial wetlands/stormwater and flood retention ponds) prior to entering any natural drainage system or wetland and how surface water runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions.

Rehabilitation Programme

The purpose of a Rehabilitation Plan is to provide a framework for rehabilitating areas outside of the infrastructure footprint that will be disturbed during the construction of the proposed project. Rehabilitation Programme should be established before operation. The programme must address the rehabilitation of the existing habitats as well as rehabilitation after closure. This Rehabilitation Programme must be approved by the relevant government departments. Rehabilitation can also be undertaken in habitats adjacent to sensitive areas that will not be developed, but that are currently disturbed by existing impacts on site. This will constitute a form of offset. Rehabilitation must include aspects such as undertaking rehabilitation as quickly as possible after disturbance, soil management measures and using native plants during rehabilitation.

Botanical walk-through survey

A preconstruction walk-through survey should be undertaken to list the identity and location of all listed and protected species. The results of the walk-through survey should provide an indication of the number of individuals of each listed species that are likely to be impacted by the proposed development. The botanical walk-through survey is a requirement for various permit applications.

Search and rescue

Search and rescue operation of all listed species within the activity footprint. For each individual plant that is rescued, the plant must be photographed before removal, tagged with a unique number or code and a latitude longitude position recorded using a hand-held GPS device. The plants must be planted into a container to be housed within a temporary nursery on site or immediately planted into the target habitat. If planted into natural habitat, the position must be marked to aid in future monitoring of that plant. Rescued plants housed in temporary nursery may be used in one of two ways: (1) transplanted into suitable natural habitats near to where they were rescued, or (2) used for replanting in rehabilitation areas. Receiver sites must be matched as closely as possible with the origin of the plants and, where possible, be placed as near as possible to where they originated.

Obtain permits for protected plants

It is a legal requirement that permits will be required for any species protected according to National or Provincial legislation. The identity of species affected by such permit requirements can only be identified during the walk-through survey (previous mitigation measure). It is common practice for the authorities that issue the permits to require search and rescue of affected plants. There are a number of individuals of the protected tree, *Acacia erioloba*, that occur on site. The location and condition of each individual tree must be recorded and a permit obtained for the removal of each of these.

Alien plant management plan

It is recommended that a monitoring programme be implemented to enforce continual eradication of alien and invasive species, especially within the riparian habitat. An Alien Invasive Programme is an essential component to the successful conservation of habitats and species. Alien species, especially invasive species are a major threat to the ecological functioning of natural systems and to the productive use of land. In terms of the amendments of the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), landowners are legally responsible for the control of alien species on their properties. The protection of our natural systems from invasive species is further strengthened within Sections 70-77 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). This programme should include monitoring procedures.

Undertake regular monitoring

Monitoring should be undertaken to evaluate the success of mitigation measures. Monitoring methods must be in accordance with features that need to be monitored and can form part of a monitoring programme to be compiled.

Worker education

Educate workers (permanent staff and contractors) regarding the occurrence of important ecological features and resources in the area and the importance of their protection.

Dust control

Use abatement measures to minimise fugitive dust that could have a negative effect on vegetation and habitats, especially adjacent to sensitive areas and in areas adjacent to the project site.

10.1.2 Avifauna

- 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 used should be made of existing access roads and the construction of new roads should be kept to a minimum.
- 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.
- 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.
- 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 used should be made of existing access roads and the construction of new roads should be kept to a minimum.

10.1.3 Surface Water

- Should no direct impacts need to take place to the identified wetland, the need for water use licensing can be avoided where it can be demonstrated to DWS that significant impacts will not take place and/or where other water uses (other than those identified in **Section 8**) are not required.
- Where impacts to surface water resources is not avoidable, the relevant water use license and environmental authorisations are to be applied for before construction is allowed to commence.
- All identified mitigation measures are to be implemented in order to minimise the identified potential impacts.
  - 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 prevent erosion in susceptible construction areas. All impacted areas are to be adequately sloped to prevent the onset of erosion.
  - Preventing Physical Degradation of the Wetland – The wetland and the associated buffer zone is to be designated as a “highly sensitive area”. Vehicle access is not to be allowed in the highly sensitive area. Access roads are not to be routed through the wetland or the associated buffer zone. Where this cannot be undertaken, environmental authorisation and a water use license will be required before construction takes place and all mitigation measures are to be implemented.
  - Construction workers are only allowed in the designated construction areas of the proposed development and not into the wetland. The highly sensitive area is to be clearly demarcated prior to the commencement of construction and no access into this area is to be allowed.
  - 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.
  - Minimising Human Physical Degradation of Sensitive Areas – Construction workers are only allowed in designated construction areas and not into the wetland designated as highly sensitive. The highly sensitive area is to be clearly demarcated and no access into this area is to be allowed unless authorised.

- 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.
- Avoiding Direct Impacts to the Wetland – The PV layout and internal access roads are not to be allowed in the wetland and associated construction and operation phase buffer zone areas. The wetland and buffer zones must be clearly demarcated for the duration of the construction phase, to be avoided by all construction vehicles, machinery, equipment and workers. No ingress into the wetland and the associated buffer zone is allowed.
- 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 zone of the wetland.
- Minimising Vehicle Damage to the Wetland – Potential impacts can be avoided by the routing of access roads outside of and away from the wetland and the associated buffer zone. No access roads are to be allowed into or through the wetland and the associated buffer zone.

- Internal access roads in close proximity to the highly sensitive wetland area will have to be regularly monitored and checked for erosion. Monitoring should be conducted once every month in the rainy season (October to March). Moreover, after short or long periods of heavy rainfall or after long periods of sustained rainfall, the roads will need to be checked 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.
- 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.

10.1.4 Agricultural Potential and Soils

- Due to the generally 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.
- 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 loamy nature of the soils means that if exposed, there is only a small hazard of soil removal by wind erosion, especially in the drier winter months. However, 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.

10.1.5 Visual

- If possible, carefully plan to reduce the construction period.
- Minimise vegetation clearing and rehabilitate cleared areas as soon as possible, in accordance with the recommendations of the biodiversity specialist.
- Vegetation clearing should take place in a phased manner.
- Make use of nurseries to speed up recovery of vegetation.
- 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 gravel access roads, where possible.
- 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.
- Establish erosion control measures on areas which will be exposed for long periods of time. This is to reduce the potential impact heavy rains may have on the bare soil.
- Where possible, laydown areas and temporary construction equipment and camps should be placed in already in disturbed areas in order to minimise vegetation clearing.
- Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
- Where possible, protect existing local trees and maintain natural vegetation outside the development footprint.
- Where possible, laydown areas and temporary construction equipment and camps should be placed in already in disturbed areas in order to minimise vegetation clearing.
- Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
- Where possible, protect existing local trees and maintain natural vegetation outside the development footprint.
- 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.
- If possible, light sources should be shielded by physical barriers (walls, vegetation, or the structure itself);
- Make use of minimum lumen or wattage in fixtures;
- Limiting mounting heights of lighting fixtures, or alternatively using foot-light or bollard level lights;
- If possible, make use of motion detectors on security lighting.
- As far as possible, limit the number of maintenance vehicles which are allowed to access the site.
- Only clear vegetation on site and adjacent to the site which is required to be cleared for the correct operation of the facility.
- Ensure that the PV arrays are not located within 500m from any of the surrounding farmhouses, in order to limit the visual impact of the solar facility on these dwellings.
- Locally occurring indigenous woody vegetation (trees and shrubs) should be planted along the southern boundary of the site.
- If possible, the O&M buildings should not be illuminated at night. Alternatively, light sources should be shielded by physical barriers (walls, vegetation, or the structure itself);
- Make use of minimum lumen or wattage in fixtures;
- Limiting mounting heights of lighting fixtures, or alternatively using foot-light or bollard level lights;
- If possible, make use of motion detectors on security lighting.
- 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 (i.e. Substation and O&M Building Alternative 1 as well as Laydown Area Alternative 2).
- Limit the number of maintenance vehicles which are allowed to access the site.

- Ensure that dust suppression techniques are implemented on gravel access roads, where possible.
- Non-reflective surfaces should be utilised where possible.
- Ensure that the associated infrastructure are not located within 500m from any of the surrounding farmhouses, in order to limit the visual impact on these dwellings.
- Locally occurring indigenous woody vegetation (trees and shrubs) should be planted along the southern boundary of the site.
- If possible, light sources should be shielded by physical barriers (walls, vegetation, or the structure itself);
- Make use of minimum lumen or wattage in fixtures;
- Limiting mounting heights of lighting fixtures, or alternatively using foot-light or bollard level lights;
- If possible, make use of motion detectors on security lighting.
- All infrastructure that is not required for the post-decommissioning use should be removed;
- Rehabilitate all cleared areas as soon as possible, in accordance with the recommendations of the biodiversity specialist; and
- Monitor rehabilitated areas post-decommissioning and implement remedial actions, as required.

10.1.6 Heritage and Palaeontology

- **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 prospecting 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.

3 structures were located **TS02**, **TS05**, **TS06**.

TS02 – No further mitigation required
TS05 – It is recommended that the site be documented before destruction can take place.
TS06 – No further mitigation

- **Palaeontology**

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area. It is essential that the information gathered during the Geotechnical investigations for developments be made available to the Heritage Practitioner and Palaeontologist to assess the possibility of exposing bedrock with fossils where excavations will exceed 1.5m or where gravity surveys indicate possible karst topography in dolomitic terrains.

It is possible that cultural material, including palaeontological finds, 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 prospecting 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 and palaeontological 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 and palaeontological monitoring programme.

In the case where archaeological or palaeontological material is identified during construction the following measures must be taken:

- Upon the accidental discovery of archaeological or palaeontological material, a buffer of at least 20 meters should be implemented.
- If archaeological and palaeontological material is accidentally discovered during construction, activities must cease in the area and a qualified archaeologist or palaeontologist be contacted to evaluate the find. To remove the material a permit must be applied for from SAHRA under Section 35 of the NHRA.

The study area is underlain by Vaalian aged dolomite of the Monte Christo Formation, Chuniespoort Group. Stromatolites are known to occur within these deposits and more modern fossiliferous Caenozoic cave breccias have been recorded associated with carst formation in the dolomite.

During the fieldwork period several arbitrary finds of dolomite and chert with significantly well-defined stromatolites as well as a few potential sites with either associated sinkholes or cave breccias were recorded. Confirmation of the significance of these sites will only be possible after completion of the geotechnical surveys.

- Although no significant fossils were recorded in situ in both PV sites as well as the proposed alternative route corridors for the power lines, several well-defined micro-stromatolites and possible sites with cave breccia have been identified. Depending on the results of the geotechnical investigation and where potential excavations for foundations will exceed 1.5m, the ECO must investigate the possible presence of stromatolites and/or cave breccia and inform the HIA consultants immediately for appropriate action and appointment of a qualified palaeontologist to investigate the site before destruction of fossils occurs.
- Site visits as stipulated in the management tables will include an initial 2 day site visit and then fortnightly during construction.
- 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.

- **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.

10.1.7 Socio-economic

- Consultation with the directly affected land owner 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.
- 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.
- Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community.
- 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.
- Participate in ongoing consultation with directly and indirectly affected land owners to avoid unduly influencing any processes or day to day activities of these individuals. Ensure that all interested and affected parties understand the project and its requirements as far as is feasible, reasonable, and possible.
- 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.
- 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.
- 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
- 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.
- 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.
- 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.

10.1.8 Traffic

- Manage traffic volumes by means of the management of delivery volumes and times by distributing it throughout the day.
- Implement dust control measures during construction with speed limits and regular watering for gravel roads.
- Ensure delivery drivers are licensed and competent, and vehicles are in good road worthy condition.

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11 CUMULATIVE IMPACTS

The area has seen a notable interest from developers of various renewable energy projects, which could be associated with the solar energy resource potential found in the region, proximity to the existing sub-station and its evacuation capacity, as well as other factors. Such developments, whether already approved or only proposed, need to be considered as they have the potential to create numerous cumulative impacts, whether positive or negative, if implemented. Table 84 lists the projects that will need to be considered when examining the cumulative impacts; their location relative to the project under review is illustrated in Figure 73.

Table 84: Proposed renewable energy projects in the area

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Tlisitseng 1	14/12/16/3/3/2/889	EIA ongoing	BioTherm Energy	75MW	Portion 25 of the Farm Houthaalboomen No 31
Lichtenburg Solar Park	14/12/16/3/3/3/270	Project has received environmental authorisation	Matrigenix (Pty) Ltd	70MW	A portion of portion 10 of the Farm Lichtenburg Town and Townlands No. 27
Watershed Solar Energy Facility Phase 1	14/12/16/3/3/2/556	Project has received environmental authorisation	FVR Energy South Africa (Pty) Ltd	75MW	Portions 1, 9, 10 and 18 of the Farm Houthaalboomen No. 31
Watershed Solar Energy Facility Phase 2	14/12/16/3/3/2/557	Project has received environmental authorisation	FVR Energy South Africa (Pty) Ltd	75MW	Portions 1, 9, 10 and 18 of the Farm Houthaalboomen No. 31
Hibernia PV Solar Energy Facility	14/12/16/3/3/2/1062	Project has received environmental authorisation	Megawatt One Photovoltaic (Pty) Ltd	5MW	Portions 9 and 31 of the Farm Hibernia No. 52

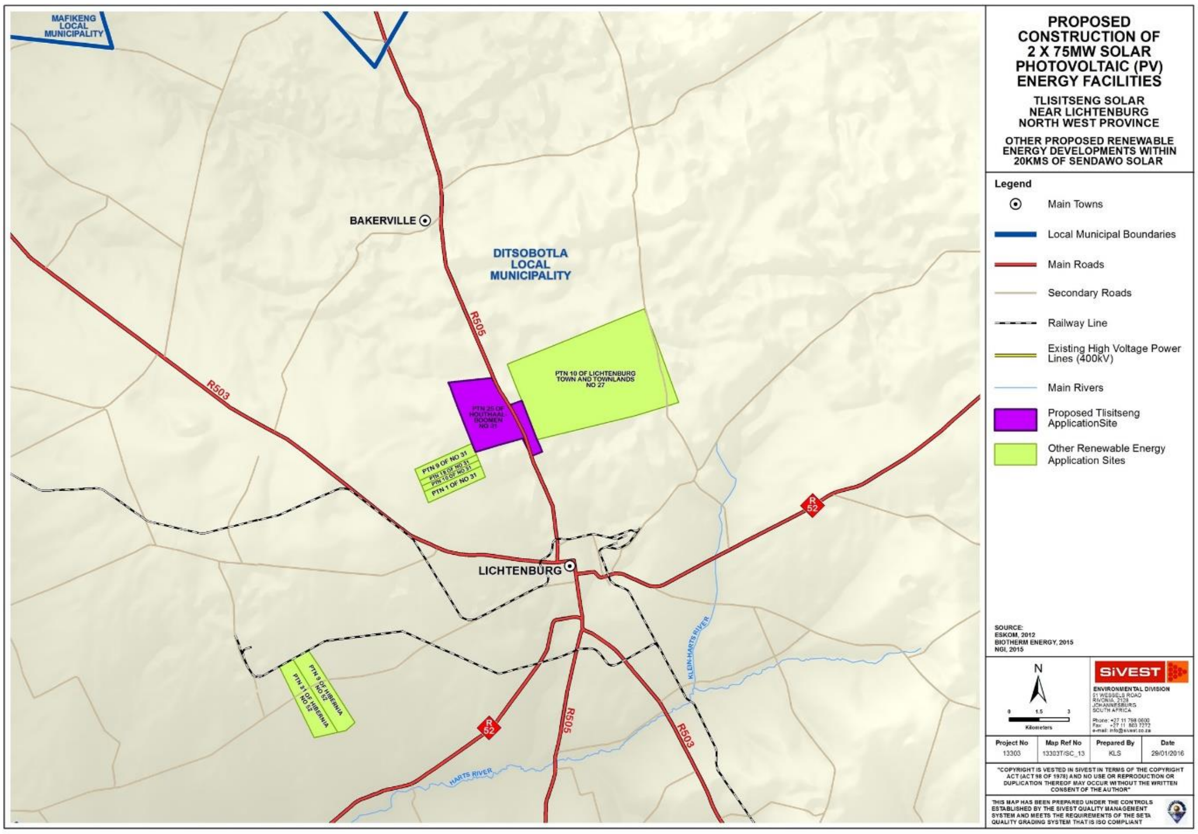

Figure 73: Renewable energy developments proposed within a 25km radius from theTlisitseng Solar 2 PV application site.

Based on the DEA's acceptance of the Final Scoping Report (FSR), the DEA requested that a cumulative environmental impact assessment be conducted including a literature review of other specialist assessments / studies on the neighbouring adjacent properties in order to ascertain any additional cumulative impacts that should be taken into consideration.

In an effort to meet this requirement SiVEST under took every effort to obtain the information (including specialist studies, BA / EIA / Scoping and EMPr Reports) for the above mentioned developments. The steps taken to acquire the relevant documents for the above mentioned projects is detailed below:

Table 85: Proposed renewable energy projects in the area, steps taken to obtain the relevant information and documents obtains.

Proposed Development	EAP	Steps taken to obtain relevant documents	Documents Obtained
Tlisitseng 1	SiVEST SA (Pty) Ltd	SiVEST is the EAP for the proposed development. The proposed development Final Scoping Report (FSR) has been accepted by the DEA. Additionally, the specialist impact assessments have been conducted to form part of the DEIAr. All the relevant documents were therefore available for the cumulative assessment.	▪ Biodiversity Impact Assessment Report; ▪ Avifaunal Impact Assessment Report; ▪ Surface Water Impact Assessment Report; ▪ Soils and Agricultural potential Impact Assessment Report; ▪ Visual Impact Assessment Report; ▪ Heritage Impact Assessment Report; ▪ Socio-economic Impact Assessment Report; ▪ Geotechnical Impact Assessment Report; and ▪ Traffic Impact Assessment Report
Lichtenburg Solar Park	Africa Geo-Environmental Services (AGES)	▪ Google Search for PV facilities near Lichtenberg North West Province; ▪ Proposed Development was found on Leads 2 Business website (www.l2b.co.za/project-region/North-West). ▪ Google search of the proposed development project name was undertaken. ▪ Consulted the SAHRA Website for Heritage and PIA Report (http://sahra.org.za/sahris/cases/lichtenburg-solar-park). ▪ Attempted to download reports from the AGES Website (http://ages-group.com/)	▪ Archaeological Impact Assessment Report ▪ Heritage Impact Assessment Report

		○ Reports were not available for publically available to download ▪ Contacted AGES in an effort to obtain outstanding specialist reports that were not available for public download. ○ AGES responded to SiVEST request for the FBAR and specialist reports noting that the proposed development has not been awarded preferred Bidder Status in terms on the DoE's IPP programme. ○ AGES further stated that they are not in a position to send any of the reports through to SiVEST. However, they were able to provide SiVEST with the locality map for the proposed Lichtenburg Solar Park as well as layout plans. ▪ Additionally, SiVEST attempted to contact the developers of the proposed development, however contact details were not publically available.	
Watershed Solar Energy Facility Phase 1	Savannah Environmental (Pty) Ltd	▪ Google Search for PV facilities near Lichtenberg North West Province; ▪ The proposed Development was found on Leads 2 Business website (www.l2b.co.za/project-region/North-West). ▪ Google search of the proposed development project name was undertaken. FEIR (excluding appendices) was able to be downloaded as a PDF. ▪ Consulted the SAHRA Website for Heritage Report (http://sahra.org.za/sahris/heritage-reports/heritage-report-watershed-solar-facility).	▪ Watershed PV (phase I and II) FEIR ▪ Visual Scoping Report ▪ Social Scoping report ▪ Draft EMPr (Phase 1) ▪ Draft EMPr (Phase 2) ▪ Archaeological Impact Assessment Report ▪ Background Information Documents ▪ EAs
Watershed Solar Energy Facility Phase 2	Savannah Environmental (Pty) Ltd		

		▪ From the SAHRA website other documents were available to be downloaded. (http://sahra.org.za/sahris/cases/watershed-solar-energy-facilities-556-557). ▪ Attempted to download reports from the Savannah Environmental Website o Reports were not publically available to download. ▪ Contacted Savannah Environmental in an effort to obtain outstanding specialist reports that we not available for public download. o Savannah Environmental noted that the project has already been archived and handed over to the developers. o Savannah Environmental noted that it is against their company policy to give out developers contact details. However, they were able to provide SiVEST with the EA's for the proposed development.	
Hibernia PV Solar Energy Facility	Savannah Environmental (Pty) Ltd	▪ Google Search for PV facilities near Lichtenberg North West Province; ▪ The proposed Development was found on Leads 2 Business website (www.l2b.co.za/project-region/North-West). ▪ Google search of the proposed development project name was undertaken. BID was able to be downloaded as a PDF. ▪ Consulted the SAHRA Website for Heritage Report (http://sahra.org.za/sahris/heritage-reports/aia-paleo-reports-hibernia).	▪ Heritage Assessment Report ▪ Final BAR ▪ BID

		▪ From the SAHRA website other documents were available to be downloaded. FEIR (excluding appendices)was able to be downloaded as a PDF. http://sahra.org.za/sahris/cases/hibernia-solar-facility-1062).
		▪ Attempted to download reports from the Savannah Environmental Website
		  ○ Reports were not publically available to download
		▪ Contacted Savannah Environmental in an effort to obtain outstanding specialist reports that we not available for public download.
		  ○ Savannah Environmental noted that the project has already been archived and handed over to the developers.
		  ○ Savannah Environmental noted that it is against their company policy to give out developers contact details. However, they were able to provide SiVEST with the EA's for the proposed development.
		▪ Additionally, SiVEST attempted to contact the developers of the proposed development, however contact details were not publically available.	

Some of the project sites are at a very advanced stage, and the initial studies were undertaken in 2012. As a result, many of the documents are not currently publically available to download. Nonetheless, SiVEST was able to source some of information that was available. The information (including specialist studies, EIA / Scoping and EMPr Reports) that could be obtained for the surrounding renewable energy sites planned that were taken into account by the various specialists is elaborated on below.

11.1 Biodiversity Impacts

Cumulative impacts on indigenous natural vegetation

The regional terrestrial vegetation type in the broad study area is Carletonville Dolomite Grassland, listed as Vulnerable. This is the same vegetation type that will be affected by many of the other proposed projects. Loss of habitat will definitely occur, but this will be a small area in comparison to the total area of the vegetation type concerned. The vegetation type occupies an area in excess of 8 800 km^2, of which just less than 25% has been altered. The total loss of habitat due to all the projects together will be greater than for any single project, so a cumulative effect will occur. However, the area lost in total will be small compared to the total area of the vegetation type and will not result in a change in the conservation status of the vegetation type. The cumulative effect will therefore be low.

Cumulative impacts on listed plant species

There are four species that may occur in the study area, the bulb, *Boophone disticha,* listed as Declining, the bulb, *Crinum macowanii*, listed as Declining, the succulent herb, *Brachystelma incanum*, listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened. Three of the species are relatively widespread, whereas the species listed as Vulnerable is known from a general area that includes the study area. An increased number of projects increases the likelihood of one of the populations being affected, but unless a population is directly affected, there is no cumulative effect.

Cumulative impacts on protected plant species

There is one species protected according to the National Environmental Management: Biodiversity Act, *Harpagophytum procumbens*, which may potentially occur on site. There are also a number of plant species protected according to Provincial legislation. An increased number of projects will increase the likelihood of protected species being affected as well as the number of individuals likely to be affected. There is therefore a cumulative effect, but this is considered to be low.

Cumulative impacts on protected trees

There are three protected tree species that could occur on site, *Acacia erioloba, Combretum imberbe* and *Boscia albitrunca*. With each additional project that is constructed there will be an increasing likelihood of individuals being affected and the number of individuals affected will increase. There is therefore a cumulative effect. The significance of this effect is, however, likely to be low due to the high number of individuals of each of these species that occurs over their entire geographical range.

Cumulative impacts on populations of sedentary fauna

There are three species of sedentary fauna likely to be impacted by the current project, the Southern African Hedgehog, the White-tailed Rat and the Giant Bullfrog. All three have a relatively wide geographical distribution and loss of some habitat in part of their range will have a minimal effect on the species. The combination of a number of projects will have a cumulative effect, but this is likely to be of low significance.

Cumulative impacts on mobile fauna

Construction activities, loss of habitat, noise, dust and general activity associated with the construction phase of the project are likely to cause all mobile species to move away from the site. This effect will be increased if there are a number of projects being constructed at the same time or in quick succession, so the effect is likely to be cumulative. However, the geographical ranges of the species of concern is wide and it is considered that the significance of the effect will be low**.**

Cumulative impacts due to spread of declared weeds and alien invader plants

There is a moderate possibility that alien plants could be introduced to areas within the footprint of the proposed infrastructure from surrounding areas in the absence of control measures. The greater the number of projects, the more likely this effect will happen, therefore the effect is cumulative. For the current site, the impact is predicted to be low due to existing impacts on site and the high ability to control any additional impact. The significance will therefore be low, especially if control measures are implemented.

11.2 Avifauna Impacts

The total surface area in a 20km radius around the Watershed Substation amounts to approximately 126 120ha. The combined area taken up by the proposed renewable energy developments in this 20km radius, including the Tlisitseng PV 2 project, amounts to approximately 5 071ha. This is approximately 4% of the total amount of habitat available. The potential cumulative impact of the Tlisitseng PV 2 project on priority species is therefore rated as **Low on a regional scale, and the project could therefore proceed from an avifaunal impact perspective.**

11.3 Surface Water Impacts

In terms of the review undertaken on the above reports, no surface water resources (including watercourses and wetlands) were identified on the proposed renewable energy sites including the Hibernia PV Solar Energy Facility, Watershed Solar Energy Facilities Phase 1 and 2 as well as the Lichtenburg Solar Park. With this in mind, there are no cumulative impacts from a catchment perspective for surface water resources in the regional area.

11.4 Soils and Agricultural Potential 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 Lichtenburg (seven 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.

11.5 Visual 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. FFor the purpose of this study, renewable energy developments which are proposed within a 25km radius from the Tlisitseng 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.

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 86 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 86: Cumulative visual impact on sensitive visual receptors

Sensitive Visual Receptors	Tlisitseng Solar 1 PV Energy Facility	Lichtenburg Solar Park	Watershed Solar Energy Facility Phase 1	Watershed Solar Energy Facility Phase 2	Hibernia PV Solar Energy Facility
VR 14 – Rafters Pub	√	√	√	√	
VR 69 – Lichtenburg Vakansie Oord	√	√			
VR 52 – Lichtenburg Game Breeding Centre	√	√	√	√	
R505 main road	√	√	√	√	

As indicated in the table above, the cumulative impact on Rafters Pub, the Lichtenburg Game Breeding Centre and Lichtenburg Vakansie Oord were assessed as these were identified as sensitive receptor locations. Rafters Pub and the Lichtenburg Game Breeding Centre could therefore be visually exposed to four (4) additional proposed PV energy facilities should they all be constructed. The Lichtenburg Vakansie Oord will however only be impacted on by one (1) of the additional proposed PV energy facilities, namely the Lichtenburg Solar Park. In addition, the R505 highway is considered to be a visually sensitive road as it is the main access road between Lichtenburg and the N18 national route to the north and can be used to access tourism attractions to the north of the study area such as the diamond diggings at Bakerville and the Wondergat sinkhole (http://www.tourismnorthwest.co.za). The relatively high volumes of motorists travelling along this road could therefore be visually exposed to four (4) 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 three (3) 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.

In response to the DEA's request, a literature review of other visual impact assessments / studies on the neighbouring adjacent properties was subsequently undertaken. It should be noted that some of the project sites are at a very advanced stage, and the initial studies were undertaken in 2012. As a result, many of the documents are not currently publically available to download. Nonetheless, SiVEST was able to source some of information that was available. The relevant information (including visual impact specialist studies, EIA / Scoping and EMPr Reports) that could be obtained for the surrounding proposed renewable energy sites that were taken into account are shown in **Table 87** below.

Table 87: Literature Review of Visual Impacts for Surrounding Renewable Energy Developments

Project	Relevant Impacts to be Taken into Consideration from a Visual Perspective	Proposed Mitigation Measures	Impacts Significance Rating after Mitigation
Tlisitseng Solar 1 PV Energy Facility	▪ The following visual impacts are expected during the construction of the proposed PV energy facility and associated infrastructure: 1) 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	▪ The following mitigation measures are recommended: - If possible, 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 gravel access roads, where possible. - 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.	▪ The visual impacts expected during the construction of the proposed PV energy facility and associated infrastructure will be negative low after the implementation of mitigation measures; ▪ The cumulative visual impacts expected as a result of the other proposed renewable energy developments and their associated infrastructure during construction will be negative low after the implementation of mitigation measures; ▪ The visual impacts expected during the operation of the proposed PV energy facility will be medium negative after the implementation of mitigation measures; ▪ The visual impacts expected during the operation of the infrastructure associated with the proposed PV energy facility will be low negative after the implementation of mitigation measures; and

	activities could adversely affect farmsteads / homesteads within the visual assessment zone, motorists travelling along the R505 and visitors at Rafters Pub and the Lichtenburg Game Breeding Centre. 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. ▪ The following cumulative visual impacts are expected as a result of the other proposed renewable energy facilities and their	- 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). - Establish erosion control measures on areas which will be exposed for long periods of time. This is to reduce the potential impact heavy rains may have on the bare soil. - Light fittings for security at the PV energy facility and proposed substation 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 gravel access roads, where possible. - Only clear vegetation on site and adjacent to the site which is required to be cleared for the correct operation of the facility. - Ensure that the PV arrays are not located within 500m from any of the	▪ The cumulative visual impacts expected as a result of the other proposed renewable energy developments and their associated infrastructure during operation will be medium negative after the implementation of mitigation measures.

	associated infrastructure during construction: 1) The cumulative impacts during the construction phase will only be realised if the construction timelines of one or more of the nearby renewable energy facilities are aligned. Large construction vehicles and equipment during the construction phase of the other proposed renewable energy developments may further 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 other proposed renewable energy facilities on gravel access roads could increase dust emissions. The increased traffic on the gravel roads and the dust plumes as a result of the other proposed renewable energy developments could create	surrounding farmhouses, in order to limit the visual impact of the solar facility on these dwellings. - The O&M buildings should not be illuminated at night. - If overhead power lines are required, align power lines to run parallel to other linear elements and the farm boundaries, where possible. - 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 - Ensure that dust suppression techniques are implemented on gravel access roads, where possible. - Non-reflective surfaces should be utilised where possible. - Ensure that the associated infrastructure are not located within 500m from any of the surrounding farmhouses, in order to limit the visual impact on these dwellings.	

	a larger visual impact and may evoke further negative sentiments from surrounding viewers. The visual intrusion of the construction activities associated with the other proposed renewable energy developments could adversely affect farmsteads / homesteads within certain visual assessment zones, motorists travelling along the R505 and visitors at identified sensitive visual receptors. Surface disturbance during construction of the other proposed renewable energy developments could also increase the exposure of bare soil which could increase the visual contrast with the surrounding environment. Additionally, temporarily stockpiling soil during construction may alter the generally flat landscape further. Wind blowing over these disturbed areas could therefore result in a greater amount of dust which would have a larger visual impact. The clearing of vegetation will also be required during the construction of the other renewable energy facilities. This is expected to result in an increase in		

	the generation of dust, alter the natural character of the surrounding area further and therefore create a greater visual impact. ▪ The following visual impacts are expected during the operation of the proposed PV energy facility: 1) The proposed Tlisitseng Solar 1 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 R505 and visitors at Rafters Pub and the Lichtenburg Game Breeding Centre. ▪ The following visual impacts are expected during the operation of the infrastructure associated with the proposed PV energy facility: 1) The infrastructure associated with the proposed Tlisitseng Solar 1 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 R505 and visitors at Rafters Pub and the Lichtenburg Game Breeding Centre. ▪ The following cumulative visual impacts are expected as a result of the other proposed renewable energy developments and their		

	infrastructure associated during operation: 1) The other proposed renewable energy developments and their associated infrastructure could result in a greater visual impact by altering the visual character of the surrounding area and further exposing more sensitive visual receptor locations to visual impacts. The developments and their associated infrastructure may be perceived as unwelcome visual intrusions, particularly in more natural undisturbed settings. Maintenance vehicles may need to access the other proposed renewable energy developments and their associated infrastructure 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 greater visual impact and may evoke more negative sentiments from surrounding viewers. Security and operational lighting at the other proposed renewable energy		

	developments and their associated infrastructure could result in an increase in light pollution and glare, which could be a significant annoyance to surrounding viewers. The visual intrusion of the other proposed renewable energy developments and their associated infrastructure could adversely affect farmsteads / homesteads within certain visual assessment zones, motorists travelling along the R505 and visitors at identified visual receptors.		
Watershed Solar Energy Facility Phase 1 and Phase 2	It should be noted that the visual impact assessments for the Watershed (Phase I & II) Solar Energy Facility were combined because the main visual receptors within a 2 km radius are located around phase II of the project. Anticipated issues related to the potential visual impact of the proposed Solar PV project include the following: 1) The visibility of the facility to, and potential visual impact on, observers travelling along the R503 and R505 arterial roads and the	▪ The following mitigation measures are recommended for the visual impact of construction on sensitive visual receptors: - Ensure that vegetation is not unnecessarily cleared or removed during the construction period; - Reduce the construction period through careful logistical planning and productive implementation of resources; - Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. already in disturbed areas) wherever possible;	▪ The visual impact of construction on sensitive visual receptors will be moderate after the implementation of mitigation measures; ▪ The visual impact on users of arterial roads in close proximity to the proposed solar energy facility will be low after the implementation of mitigation measures; ▪ The visual impact on residents of homesteads and settlements in close proximity to the proposed solar energy facility will be moderate after the implementation of mitigation measures;

	major local roads traversing near the proposed facility; 2) The visibility of the facility to, and potential visual impact on observers residing at homesteads (farm residences) located within close proximity of the site; 3) Potential cumulative visual impacts (or alternately, consolidation of visual impacts) with specific reference to the existing power line infrastructure traversing the development site; 4) The potential visual impact of the construction of ancillary infrastructure (i.e. the substation at the facility, associated power line and access roads) on observers in close proximity of the facility; 5) The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in close proximity of the facility; 6) The visual absorption capacity of natural or planted vegetation (if applicable); 7) Potential visual impacts associated with the construction phase; and	- Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads; - Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities; - Reduce and control construction dust through the use of approved dust suppression techniques as and when required, especially on the dirt road giving access to the site (i.e. whenever dust becomes apparent); - Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting; and - Rehabilitate all disturbed areas, construction areas, roads, slopes etc. immediately after the completion of construction works. ▪ The following mitigation measures are recommended for the visual impact on users of arterial roads in close proximity to the proposed solar energy facility: **<u>Planning:</u>**	▪ The visual impact on sensitive visual receptors within the region will be low after the implementation of mitigation measures; and ▪ The visual impact of lighting on sensitive visual receptors will be moderate after the implementation of mitigation measures.

	8) The potential to mitigate visual impacts. It is envisaged that the issues listed above may constitute a significant visual impact at a local and/or regional scale.	- Retain and maintain natural vegetation in all areas outside of the development footprint. **<u>Operations:</u>** - Maintain the general appearance of the facility as a whole. **<u>Decommissioning:</u>** - Remove infrastructure not required for the post-decommissioning use of the facility; - Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications; and - Monitor rehabilitated areas post-decommissioning and implement remedial actions. **<u>Site specific mitigation measures:</u>** - Plant vegetation barriers along the south western (Phase I) borders of the solar energy facility in order to shield the structures from observers travelling along these roads; and - Plant vegetation barriers along the south-eastern (Phase II) borders of the solar energy facility in order to shield the structures from observers travelling along these roads.	

		▪ The following mitigation measures are recommended for the visual impact on residents of homesteads and settlements in close proximity to the proposed solar energy facility: **<u>Planning:</u>** - Retain and maintain natural vegetation in all areas outside of the development footprint. **Operations:** - Maintain the general appearance of the facility as a whole. **<u>Decommissioning:</u>** - Remove infrastructure not required for the post-decommissioning use of the facility; - Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications; and - Monitor rehabilitated areas post-decommissioning and implement remedial actions. **<u>Site specific mitigation measures:</u>** - Plant vegetation barriers along the western borders of the Phase I PV plant	

		in order to shield the structures from observers residing at the abovementioned homesteads; - Plant vegetation barriers along the eastern borders of the Phase II PV plant in order to shield the structures from observers residing at the abovementioned homesteads; and - Engage with landowners in order to inform, plan and execute mitigation measures. ▪ The following mitigation measures are recommended for the visual impact on sensitive visual receptors within the region: **<u>Planning:</u>** - Retain and maintain natural vegetation in all areas outside of the development footprint. **<u>Operations:</u>** - Maintain the general appearance of the facility as a whole. **<u>Decommissioning:</u>** - Remove infrastructure not required for the post-decommissioning use of the facility;	

		- Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications; and - Monitor rehabilitated areas post-decommissioning and implement remedial actions. **Site specific mitigation measures:** - Plant vegetation barriers (where required) along the borders of the solar energy facility in order to shield the structures from observers residing at the abovementioned homesteads. ▪ The following mitigation measures are recommended for the visual impact of lighting on sensitive visual receptors: **Planning:** - Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself); - Limiting mounting heights of lighting fixtures, or alternatively using foot-light or bollard level lights; - Making use of minimum lumen or wattage in fixtures; - Making use of Low Pressure Sodium lighting or other types of low impact lighting; and	

		Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.	
Hibernia PV Solar Energy Facility	▪ The following impacts are expected during the construction of the PV array, access roads and associated infrastructure: **<u>Direct impacts:</u>** 1) Impact of initial site works, construction camp, site set up, setting out, laying services, ground works; 2) Construction of access roads, from junction at local road to site and through site; and 3) Impact of the building construction works to completion. **<u>Indirect impacts:</u>** 1) Hauling and delivery of construction materials regularly on local roads during contract period. **<u>Cumulative impacts:</u>** - None	▪ The following mitigation measures have been provided for the impacts expected during the construction of the PV array, access roads and associated infrastructure: **<u>Direct impacts:</u>** 1) Establish screening structures to shield construction works from sensitive receptors, good traffic and site management and keeping local people informed regarding construction activities; and 2) No working after 6pm. **<u>Indirect impacts:</u>** 1) Protection of existing local trees where needed; and 2) Operate site within construction industry management guidelines. **<u>Cumulative impacts:</u>** - None	▪ The direct and indirect impacts expected during the construction of the PV array, access roads and associated infrastructure will be medium after the implementation of mitigation measures; ▪ The direct and indirect impacts expected during the operation of the PV array, access roads and associated infrastructure will be medium after the implementation of mitigation measures; and ▪ The cumulative impacts expected during the operation of the PV array, access roads and associated infrastructure will be medium after the implementation of mitigation measures.

	▪ The following impacts are expected during the operation of the PV array, access roads and associated infrastructure: **Direct impacts:** 1) Effect on people living and working locally, change of local site character from agriculture to industrial; 2) Impact from regular maintenance visits to clean the panels, etc. The operatives would be on site for a period of time to allow the cleaning of the panels with a water based solution and to undertake infrastructure repairs if required. The visual impact would likely be minimal; and 3) Impact of the colours, finishes and heights of the buildings. **Indirect impacts:** - None **Cumulative impacts:** 1) Based on the present information the cumulative impacts are associated with the substation and power lines in the area.	▪ The following mitigation measures have been provided for the impacts expected during the operation of the PV array, access roads and associated infrastructure: **Direct impacts:** 1) Protection afforded to shielding objects such as the trees. **Indirect impacts:** - None **Cumulative impacts:** - None	

A literature review of other visual specialist studies which were conducted for the other renewable energy developments being proposed and/or constructed in the area was undertaken as part of this VIA. This was done in order to clearly define the identified cumulative impacts, and to indicate how the recommendations, mitigation measures and conclusions of the other visual impact assessment reports have been taken into consideration when drafting this visual impact assessment report. In terms of the review undertaken on the above reports, it can be noted that the findings of the other specialist studies identified similar impacts for each of the renewable energy developments mentioned above. These include the visual impacts on users of arterial and secondary roads, the visual impacts on residents of homesteads and settlements, the visual impacts on sensitive visual receptors, the visual impacts of lighting at night on sensitive visual receptors, the visual impacts of construction on sensitive visual receptors and the visual impacts on the visual quality of the landscape and sense of place. As such, this VIA is deemed to have adequately defined, identified and assessed the cumulative visual impacts which could arise as a result of the development of the renewable energy facilities.

The visual impact assessment undertaken for the proposed Tlisitseng Solar 1 PV energy facility and associated infrastructure has provided mitigation measures which are in-line with those recommended in the other specialist studies consulted above. As such, the mitigation measures provided in this visual impact assessment are considered to be sufficient to reduce the visual impacts experienced within the study area. Additional mitigation measures have also been added where required. Should all of the recommended mitigation measures be implemented, it is anticipated that the visual impacts associated with the renewable energy developments could be mitigated to acceptable levels. This will also reduce the significance of the identified visual impacts and will aid in reducing the cumulative impacts experienced as a result of the other renewable energy facilities being proposed and/or constructed within the surrounding area. This was evident during the review of the other specialist studies as the significance rating for most of the identified impacts were deemed to be of medium to low significance after the implementation of mitigation measures. Additionally, with the correct mitigation and integrating planning, the significance rating of majority of the cumulative impacts will be relatively low.

The visual specialist for the Phase 1 and Phase 2 Watershed Solar Energy Facility projects has provided certain site-specific recommendations / mitigation measures which are aimed at reducing the visual impact associated with the proposed development. These site-specific recommendations / mitigation measures include the planting of vegetation barriers (where required) along various borders of the Phase I and Phase II solar energy facilities in order to shield the structures from observers travelling along the affected arterial roads as well as observers residing at the affected homesteads; engagement with landowners in order to inform, plan and execute mitigation measures and shielding the sources of light by making use of physical barriers such as walls, vegetation, or the structure itself. In addition, it should be noted that the visual specialist for the Hibernia PV Solar Energy Facility has recommended that screening structures (such as trees) be established in order to shield construction works from sensitive receptors. In light of the above, it is SiVEST's opinion that the above-mentioned site-specific mitigation measures are worth investigating and should be implemented during the construction and operation of the proposed Tlisitseng Solar Solar 1 PV energy facility. Should the above-mentioned site-specific mitigation measures be implemented accordingly, it is anticipated that the visual impacts associated with the Tlisitseng Solar Solar 1 PV energy facility and its associated infrastructure could be further mitigated to acceptable levels. This will also reduce the significance of the identified visual impacts further and will aid in reducing the cumulative impacts experienced as a result of the other renewable energy facilities and their associated infrastructure being proposed and/or constructed within the surrounding area.

This VIA is deemed to have clearly defined the identified cumulative impacts, and has indicated how the recommendations, mitigation measures and conclusions of the other visual impact specialist reports have been taken into consideration when drafting this report. It should however be noted that it is not possible to quantify or provide the spatial extent of the anticipated visual impacts as these impacts would not be site-specific and would be significantly influenced by a number of factors such as the presence of sensitive visual receptor, the amount of screening present, the orientation of the sensitive visual receptors and the visual character of the study area.

Table 88: Rating of cumulative visual impacts as a result of the other proposed renewable energy developments (including associated infrastructure) during construction

IMPACT TABLE	
Environmental Parameter	Cumulative Visual Impact
Issue/Impact/Environmental Effect/Nature	The cumulative impacts during the construction phase will only be realised if the construction timelines of one or more of the nearby renewable energy facilities are aligned. Large construction vehicles and equipment during the construction phase of the other proposed renewable energy developments may further 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 other proposed renewable energy facilities on gravel access roads could increase dust emissions. The increased traffic on the gravel roads and the dust plumes as a result of the other proposed renewable energy developments could create a larger visual impact and may evoke further negative sentiments from surrounding viewers. The visual intrusion of the construction activities associated with the other proposed renewable energy developments could adversely affect farmsteads / homesteads within certain visual assessment zones,

	motorists travelling along the R505 and visitors at identified sensitive visual receptors. Surface disturbance during construction of the other proposed renewable energy developments could also increase the exposure of bare soil which could increase the visual contrast with the surrounding environment. Additionally, temporarily stockpiling soil during construction may alter the generally flat landscape further. Wind blowing over these disturbed areas could therefore result in a greater amount of dust which would have a larger visual impact. The clearing of vegetation will also be required during the construction of the other renewable energy facilities. This is expected to result in an increase in the generation of dust, alter the natural character of the surrounding area further and therefore create a greater visual impact.	
Extent	Local / District (2)	
Probability	Possible (2)	
Reversibility	Partly reversible (2)	
Irreplaceable loss of resources	Marginal loss (2)	
Duration	Medium term (2)	
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	2	2
Reversibility	2	1
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-26 (low negative)	-24 (negative low)
Mitigation measures	▪ Where possible, plan carefully to reduce the construction period.	

	▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible, in accordance with the recommendations of the biodiversity specialist. ▪ Vegetation clearing should take place in a phased manner. ▪ Make use of nurseries to speed up recovery of vegetation. ▪ 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 gravel access roads, where possible. ▪ 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. ▪ Establish erosion control measures on areas which will be exposed for long periods of time. This is to reduce the potential impact heavy rains may have on the bare soil. ▪ Where possible, laydown areas and temporary construction equipment and camps should be placed in already in disturbed areas in order to minimise vegetation clearing. ▪ Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting. ▪ Where possible, protect existing local trees and maintain natural vegetation outside the development footprint.

Table 89: Rating of cumulative visual impacts as a result of the other proposed renewable energy developments (including associated infrastructure) during operation

IMPACT TABLE	
Environmental Parameter	Cumulative Visual Impact
Issue/Impact/Environmental Effect/Nature	The other proposed renewable energy developments and their associated infrastructure could result in a greater visual impact by altering the visual character of the surrounding area and further exposing more sensitive visual receptor locations to visual impacts. The developments and their associated infrastructure may be perceived as unwelcome visual intrusions, particularly in more natural undisturbed settings. Maintenance vehicles may need to access the other proposed renewable energy developments and their associated infrastructure 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 greater visual impact and may evoke more negative sentiments from surrounding viewers. Security and operational lighting at the other proposed renewable energy developments and their associated infrastructure could result in an increase in light pollution and glare, which could be a significant annoyance to surrounding viewers. The visual intrusion of the other proposed renewable energy developments and their associated infrastructure could adversely affect farmsteads / homesteads within certain visual assessment zones, motorists travelling along the R505 and visitors at identified visual receptors.
Extent	Local / District (2)
Probability	Probable (3)
Reversibility	Irreversible (4)
Irreplaceable loss of resources	Significant loss of resources (3)
Duration	Long term (3)
Cumulative effect	Medium cumulative impact (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	3	3
Reversibility	4	4
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-36 (medium negative)	-34 (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 the sites. ▪ If possible, light sources should be shielded by physical barriers (walls, vegetation, or the structure itself); ▪ Make use of minimum lumen or wattage in fixtures; ▪ Limiting mounting heights of lighting fixtures, or alternatively using foot-light or bollard level lights; ▪ If possible, make use of motion detectors on security lighting. ▪ As far as possible, limit the number of maintenance vehicles which are allowed to access the sites. ▪ Ensure that dust suppression techniques are implemented on gravel access roads, where possible. ▪ Only clear vegetation on the sites and adjacent to the sites which is required to be cleared for the correct operation of the facilities. ▪ Ensure that the PV arrays are not located within 500m from any of the surrounding farmhouses, in order to limit the visual impact of the solar facilities on these dwellings. ▪ Light fittings for security at the proposed substations at night should reflect the light toward the ground and prevent light spill. ▪ The O&M buildings should not be illuminated at night.	

	▪ If overhead power lines are required, align power lines to run parallel to other linear elements and the farm boundaries, where possible. ▪ 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 (i.e. Substation and O&M Building Alternative 1 as well as Laydown Area Alternative 2). ▪ Limit the number of maintenance vehicles which are allowed to access the sites. ▪ Ensure that dust suppression techniques are implemented on gravel access roads, where possible. ▪ Non-reflective surfaces should be utilised where possible. ▪ Ensure that the associated infrastructure are not located within 500m from any of the surrounding farmhouses, in order to limit the visual impact on these dwellings.

11.6 Heritage Impacts

This section evaluates the possible cumulative impacts (CI) on heritage resources with the addition of the Tlisitseng 2 Project. The CI on heritage resources evaluated a 20-kilometer radius. It must further be noted that the evaluation is based on available heritage studies and cannot take the findings of outstanding studies on current ongoing EIA's in consideration.

The following must be considered in the analysis of the cumulative effect of development on heritage resources:

- **Fixed datum or dataset:** There is no comprehensive heritage data set for the Copperton region and thus we cannot quantify how much of a specific cultural heritage element is present in the region. The region has never been covered by a heritage resources study that can account for all heritage resources. Further to this none of the heritage studies conducted can with certainty state that all heritage resources within the study area has been identified and evaluated;
- **Defined thresholds**: The value judgement on the significance of a heritage site will vary from individual too individual and between interest groups. Thus implicating that heritage resources'

significance can and does change over time. An so will the the tipping threshold for impacts on a certain type of heritage resource;

- **Threshold crossing**: In the absence of a comprehensive dataset or heritage inventory of the entire region we will never be able to quantify or set a threshold to determine at what stage the impact from developments on heritage resources has reached or is reaching the danger level or excludes the new development on this basis. (Godwin, 2011)

Keeping the above short comings in mind, the methodology in evaluating cumulative impacts on heritage resources has been as follows.

The analysis of the competed studies as listed in above, took in to account the findings and recommendation of each of the four evaluated HIA's. The cumulative impact on the cultural landscape was discounted as the HIA's, in most cases, did not address this and the Visual Impact Assessment covers such analysis in detail.

The overall findings of the four studies all concur that the area is characterised by a low density of Stone Age findspots and a low palaeontological significance baring the Tlisitseng 2 project site.

This cumulative assessment has also not addressed the possible cumulative impacts on the heritage landscape. The evaluated studies have in most cases not addressed or quantified the possible impact on the cultural landscape.

Table 90 provides an analysis of the projected cumulative impact this project will add to impact on heritage resources.

Table 90: Regional HIA's conducted		
Study	**Findings**	**Recommendation**
Tlisitseng 1 *Fourie, W. 2016. Heritage Impact Assessment for the Tlisitseng 1 PV Project.* *Groenewald. G. 2016 palaeontological Impact Assessment for the Tlisitseng PV 1 Project.*	During the fieldwork 1 low significance heritage resources were identified in or close to the footprint area of the PV site. No outcrop of bedrock with fossils was recorded and sites with cave breccia were recorded inside the PV 1 footprint, in areas where chert breccia was obviously present in the loose material. Final identification of possible sites where significant cave breccia will occur will only be identified after completion of the geotechnical surveys.	▪ No further mitigation required ▪ **Post mitigation impact Low negative** ▪ Due to the large number of boulders with stromatolites present on site it is recommended that an 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; ▪ **Post mitigation impact Low negative**
Lichtenburg Solar Park *Hutten, M. 2012. Heritage Impact Assessment for the Lichtenburg Solar Park.* *Rubidge, B. 2012. Palaeontological Impact Assessment for the Lichtenburg Solar Park.*	No heritage resources were identified during the HIA. The PIA found that it is very unlikely that fossils will be uncovered by the proposed construction activities	▪ No further action required

Table 90: Regional HIA's conducted		
Study	**Findings**	**Recommendation**
Watershed Solar Energy Facility Phase 1 *Van der Walt, J. 2013. Archaeological Impact Assessment and Palaeontological Exemption for the Watershed Solar Energy Facility Phase 1.* *No palaeontological study*	Two low density MSA scatters were identified during the fieldwork. These sites were grades as having a medium heritage significance by generally protected.	▪ A surface collection at the two identified site swere recommended along with ECO monitoring during earth moving.
Watershed Solar Energy Facility Phase 2 *Van der Walt, J. 2013. Archaeological Impact Assessment for Watershed Solar Energy Facility Phase 2.* *No palaeontological study*	The original surveyed area showed only a background scatter of LSA material. The layout has however changed and new fieldwork was recommended.	▪ Additional fieldwork was recommended as the layout changed. No further work was recorded after this recommendation.

Table 90: Regional HIA's conducted		
Study	**Findings**	**Recommendation**
Hibernia PV Solar Energy Facility *Van der Walt, J. 2013. Archaeological Impact Assessment for the Hibernia PV Solar Energy Facility.* *Almond, J. 2012. Palaeontological Exemption for the Hibernia PV Solar Energy Facility.*	A single MSA occurrence was noted in the study area. No palaeontological significant resources were identified and exemption from further work was recommended	No further action required

Table 91: Cumulative Heritage Impact Assessment

IMPACT TABLE	
Environmental Parameter	Heritage Resources
Issue/Impact/Environmental Effect/Nature	The extent that the addition of this project will have on the overall impact of developments in the region on heritage resources
Extent	Regional
Probability	Possible
Reversibility	Non- renewable.
Irreplaceable loss of resources	The nature of heritage resources is that they are non-renewable. The proper mitigation and documentation of these resources can however preserve the data for research
Duration	Permanent
Cumulative effect	It is my considered opinion that this additional load on the overall impact on heritage resources will be low. With a detailed and comprehensive regional dataset this rating could possibly be adjusted and more accurate.
Intensity/magnitude	Low
Significance Rating	Negative medium impact before mitigation and low negative after mitigation.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	2	1
Reversibility	4	4
Irreplaceable loss	4	4
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	**-19 (Negative Low impact)**	**-18 (Low negative)**
Mitigation measures	Implementation of the recommended mitigation measures as per the Tlisitseng 1 project management measures will ensure the management of the envisaged cumulative impact.	

11.7 Socio-Economic Impacts

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 Moreover, the fact that there are numerous developments planned for the rest of the North West Province (the project proponent is proposing three more in Vryburg in addition to the two in Lichtenburg) by the project proponent and other developers, the case can be made that any cumulative impact will spread further than the Tlisitseng 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 Lichtenburg 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. 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 Lichtenburg 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, the 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 both solar PV projects are to be built on Portion 25 of Farm Houthaalboomen 31. The land owner has indicated that the maize production will not be affected by any of these developments; however, commercial livestock farming activities will need to be relocated to an alternative land. Consultation revealed though that the owner plan to use the rental earned from the proposed Tlisitseng development to acquire alternative land, ensuring that the current production (generating an estimated profit of R5 000/ha) can continue as is. Therefore, the negative impact on the livestock production will be limited.

11.1 Traffic Impacts

A total of 5 project were identified – 4 of similar size (±75MW) and nature (Solar PV Facilities) as the proposed project and the 5th being much smaller in size. Information regarding the various developments in the project area have been found to be very limited or not available at this time. With consideration of the proposed project's expected traffic as well as all available data from the other project in the areas can the following be concluded:

- As stated earlier in the report is it assumed that traffic on the R505 to be reasonably low thus should additional capacity be available without a significant impact on existing traffic patterns, safety and level of service.

- The proposed development will only require a short section of gravel access road which can potentially be shared with the adjacent proposed project (Tlisitseng 2). This may result in a longer use of the road during the applicable construction period and/or a slight increase in number of users.
- The cumulative impact of other REIPPPP in the area will therefore only have a noticeable traffic impact if the construction timelines as well as components, manufacturing centre, importation ports, etc. are exactly aligned, which is extremely unlikely to occur.
- Even for the scenario with more than one of the projects are constructed at the same time, the traffic impact will still be considered as negligible for the area. The cumulative impact can be mitigated further during construction following a few basic and standard practices such as:
    - Manage traffic volumes by means of the management of delivery volumes and times by distributing it throughout the day.
    - Implement dust control measures during construction with speed limits and regular watering for gravel roads.
    - Ensure delivery drivers are licensed and competent, and vehicles are in good road worthy condition.

12 DESCRIPTION AND COMPARATIVE ASSESSMENT OF ALTERNATIVES

As described above, layout alternatives have been considered during the EIA phase. Due to contraints in terms of the available area only one alternative was considered for the PV array area, however two alternative locations for the substation, O&M building and laydown area were considered. Each of these alternatives are comparatively assessed below in terms of the findings from the specialist studies conducted during the EIA.

Table 92 below highlights the issues and preferences associated with each alternative thereby identifying the preferred alternative.

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 92: Alternatives Assessment summarising the impacts, highlighting issues/concerns and indicating the preference associated with each alternative

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
SUBSTATION SITE				
Tlisitseng PV 2 Substation Site Alternative 1	Biodiversity	FAVOURABLE	Affects similar habitat to Alternative 2.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts.	No Fatal Flaws
	Surface Water	NO PREFERENCE	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws
	Agricultural Potential and Soils	PREFERRED	Shallow soils, low agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	FAVOURABLE	No sensitive or potentially sensitive visual receptors can be found within 500m of the substation site alternative, within the high impact zone. Eleven (11) potentially sensitive visual receptors can be found within 2km of this proposed substation site alternative, within the moderate impact zone. In addition, one (1) sensitive visual receptor, namely VR 14 – Rafters Pub, can also be found within 2km of this	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
			proposed substation site alternative, within the moderate impact zone and one (1) sensitive visual receptor, namely VR 71 – Lichtenburg Game Breeding Centre, is situated further than 2km from the proposed alternative, within the low impact zone. It must also be noted that one (1) sensitive visual receptor, namely VR 69 – Lichtenburg Vakansie Oord, is situated further than 5km from this alternative, and will therefore be negligible from a visual perspective. Although Substation and O&M Building Alternative 1 is located slightly closer to one (1) of the sensitive receptor locations, it is still favourable as the substation and O&M building would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible. In addition, one (1) of the sensitive visual receptors will be located further than 5km from this alternative and is therefore not expected to be impacted on from a visual perspective.	
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws
Tlisitseng PV 2 Substation Site Alternative 2	Biodiversity	PREFERRED	Closer to existing disturbance and will be situated between the solar arrays and the existing disturbance.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts.	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Surface Water	NO PREFERENCE	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws
	Agricultural Potential and Soils	FAVOURABLE	Possibility of deeper soils, moderate to high agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	PREFERRED	No sensitive or potentially sensitive visual receptors can be found within 500m of the substation and O&M building site alternative, within the high impact zone. Twelve (12) potentially sensitive visual receptors can be found within 2km of this proposed substation & O&M building site alternative, within the moderate impact zone. The rest of the potentially sensitive visual receptors can be found further than 2km from the proposed alternative. It must be noted that three (3) sensitive visual receptors, namely VR 14 – Rafters Pub, VR 69 – Lichtenburg Vakansie Oord and VR 71 – Lichtenburg Game Breeding Centre, can be found further than 2km from this proposed substation & O&M building site alternative, within the low impact zone. Despite the fact that Substation and O&M Building Alternative 2 is located slightly closer to most of the potentially sensitive visual receptors, it will be marginally preferred as it is located slightly further from one (1) of the sensitive receptor locations. In addition, the substation and O&M building would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws
O&M BUILDING				
Tlisitseng PV 2 Internal Road Alternative 1	Biodiversity	FAVOURABLE	Affects similar habitat to Alternative 2.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts	No Fatal Flaws
	Surface Water	NO PREFERENCE	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws
	Agricultural Potential and Soils	PREFERRED	Closer to existing disturbance and will be situated between the solar arrays and the existing disturbance.Shallow soils, low agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	FAVOURABLE	No sensitive or potentially sensitive visual receptors can be found within 500m of the substation site alternative, within the high impact zone. Eleven (11) potentially sensitive visual receptors can be found within 2km of this proposed substation site alternative, within the moderate impact zone. In addition, one (1) sensitive visual receptor, namely VR 14 – Rafters Pub, can also be found within 2km of this proposed substation site alternative, within the moderate impact zone and one (1) sensitive visual receptor, namely VR 71 – Lichtenburg Game Breeding Centre, is situated	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
			further than 2km from the proposed alternative, within the low impact zone. It must also be noted that one (1) sensitive visual receptor, namely VR 69 – Lichtenburg Vakansie Oord, is situated further than 5km from this alternative, and will therefore be negligible from a visual perspective. Although Substation and O&M Building Alternative 1 is located slightly closer to one (1) of the sensitive receptor locations, it is still favourable as the substation and O&M building would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible. In addition, one (1) of the sensitive visual receptors will be located further than 5km from this alternative and is therefore not expected to be impacted on from a visual perspective.	
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws
Tlisitseng PV 2 Internal Road Alternative 2	Biodiversity	PREFERRED	Closer to existing disturbance and will be situated between the solar arrays and the existing disturbance.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts	No Fatal Flaws
	Surface Water	NO PREFERENCE	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws
	Agricultural Potential and Soils	FAVOURABLE	Possibility of deeper soils, moderate to high agricultural potential.	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	PREFERRED	No sensitive or potentially sensitive visual receptors can be found within 500m of the substation and O&M building site alternative, within the high impact zone. Twelve (12) potentially sensitive visual receptors can be found within 2km of this proposed substation & O&M building site alternative, within the moderate impact zone. The rest of the potentially sensitive visual receptors can be found further than 2km from the proposed alternative. It must be noted that three (3) sensitive visual receptors, namely VR 14 – Rafters Pub, VR 69 – Lichtenburg Vakansie Oord and VR 71 – Lichtenburg Game Breeding Centre, can be found further than 2km from this proposed substation & O&M building site alternative, within the low impact zone. Despite the fact that Substation and O&M Building Alternative 2 is located slightly closer to most of the potentially sensitive visual receptors, it will be marginally preferred as it is located slightly further from one (1) of the sensitive receptor locations. In addition, the substation and O&M building would form part of the PV complex and would be dwarfed by the large number of PV panels that would be visible.	No Fatal Flaws
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
LAYDOWN AREAS				
Tlisitseng PV 2 Laydown Area Alternative 1	Biodiversity	FAVOURABLE	Affects similar habitat to Alternative 2.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts	No Fatal Flaws
	Surface Water	PREFERRED	No wetlands in the proposed location or nearby vicinity (500m).	No Fatal Flaws
	Agricultural Potential and Soils	PREFERRED	Shallow soils, low agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	FAVOURABLE	No sensitive or potentially sensitive visual receptors can be found within 500m of Laydown Area Alternative 1, within the high impact zone. Thirteen (13) potentially sensitive visual receptors can be found within 2km of this proposed laydown area alternative, within the moderate impact zone. In addition, one (1) sensitive visual receptor, namely VR 14 – Rafters Pub, can also be found within 2km of this alternative, within the moderate impact zone. It must be noted that VR 71 – Lichtenburg Game Breeding Centre is located further than 2km from the laydown area alternative, within the low impact zone, while VR 69 – Lichtenburg Vakansie Oord is located further than 5km from the alternative and will therefore be negligible from a visual perspective. Although Laydown Area Alternative 1 is located slightly closer to one (1) of the sensitive receptor	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
			locations, as well as most of the potentially sensitive visual receptors, it is still considered to be favourable	
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws
Tlisitseng PV 2 Laydown Area Alternative 2	Biodiversity	PREFERRED	Closer to existing disturbance and will be situated between the solar arrays and the existing disturbance.	No Fatal Flaws
	Avifauna	NO PREFERENCE	The alternative will result in equal impacts	No Fatal Flaws
	Surface Water	FAVOURABLE	Pan wetland located approximately 300m to the south east of the Laydown Area. No direct impact to the wetland will result. However, indirect increased run-off and sedimentation impacts may occur. This alternative is viewed as favourable in that no direct impact will occur to the wetland. Additionally, the potential impacts can be mitigated to acceptable levels during construction to minimise any impact taking place during this period.	No Fatal Flaws
	Agricultural Potential and Soils	FAVOURABLE	Possibility of deeper soils, moderate to high agricultural potential.	No Fatal Flaws
	Heritage	NO PREFERENCE	No significant heritage resources identified.	No Fatal Flaws
	Visual	PREFERRED	No sensitive or potentially sensitive visual receptors can be found within 500m of Laydown Area Alternative 2, within the high impact zone. Six (6) potentially sensitive visual receptors can be found within 2km of this proposed	No Fatal Flaws

ALTERNATIVE	ENVIRONMENTAL ASPECT	PREFERENCE	CONCERNS / IMPACT SUMMARY	FATAL FLAWS
			laydown area alternative, within the moderate impact zone. The rest of the potentially sensitive visual receptors can be found further than 2km from this alternative. It must be noted that two (2) sensitive visual receptors, namely VR 14 – Rafters Pub and VR 71 – Lichtenburg Game Breeding Centre, can be found further than 2km from Laydown Area Alternative 2, within the Low impact zone. In addition, one (1) sensitive visual receptor, namely VR 69 – Lichtenburg Vakansie Oord, can be found further than 5km from this alternative and is therefore considered to be negligible from a visual perspective. As such, Laydown Area Alternative 2 will be preferred as it is located slightly further from one (1) of the sensitive receptor locations, as well as most of the potentially sensitive visual receptors.	
	Socio-economic	NO PREFERENCE	No differentiation from a socio-economic perspective	No Fatal Flaws
	Geotechnical	NO PREFERENCE	Based upon the assessment of the data gathered during this literary review, it is our opinion that both alternative sites exhibit the same geotechnical suitability.	No Fatal Flaws

As depicted in **Table 92** above no fatal flaws were identified and therefore all the alternatives mentioned above are considered to be acceptable, although not necessarily preferable from an environmental perspective.

Tlisitseng PV 2 Substation Alternative 2 and **O&M building Alternative 2** is preferred from a biodiversity and visual perspective as the proposed substation alternative is located closer to existing disturbance and will be situated between the solar arrays and the existing disturbance and no sensitive or potentially sensitive visual receptors can be found within 500m of the substation and O&M building site alternative, within the high impact zone. However, from an agricultural and soils perspective Substation Alternative 1 is preferred due to the shallow soils and the low agricultural potential.

Tlisitseng PV 2 Laydown area alternative 2 is preferred from a biodiversity and visual perspective as the proposed substation alternative is located closer to existing disturbance and will be situated between the solar arrays and the existing disturbance and no sensitive or potentially sensitive visual receptors can be found within 500m of the substation and O&M building site alternative, within the high impact zone. However, from a surface water and agricultural perspective **Tlisitseng PV 2 Laydown area alternative 1 is the preferred alternatives as there are n**o wetlands in the proposed location or nearby vicinity (500m) in conjunction with the presence of shallow soils, low agricultural potential. Based on this either alternative is favourable.

As a result **Tlisitseng PV 2 Substation Alternative 2, O&M building Alternative 2 and Laydown area alternative 2** are considered the preferred alternative for the proposed development.

As such, the preferred site layout is indicated in

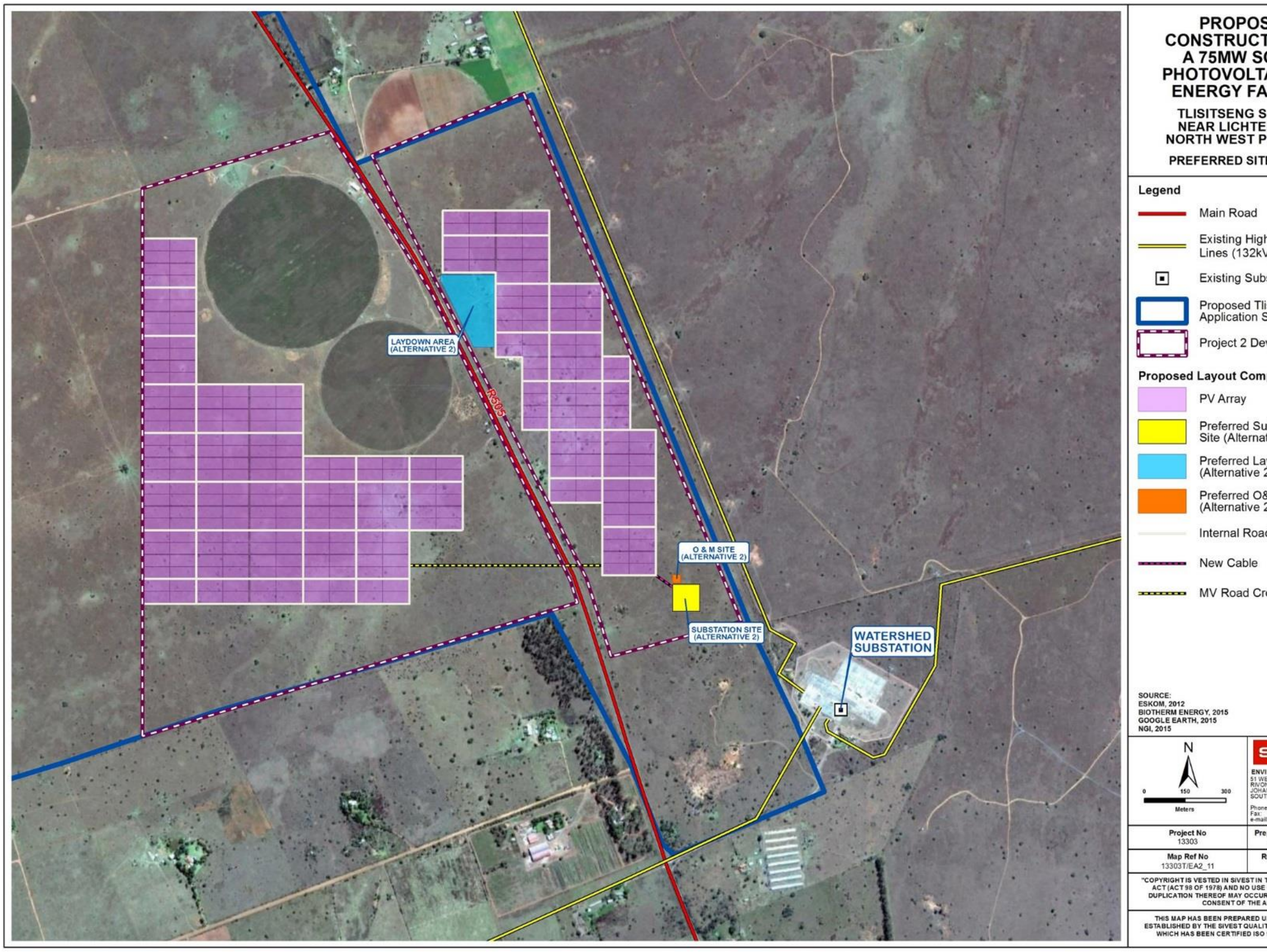

Figure **74** below. The preferred site layout in relation to the sensitive areas identified by the specialists is indicated in

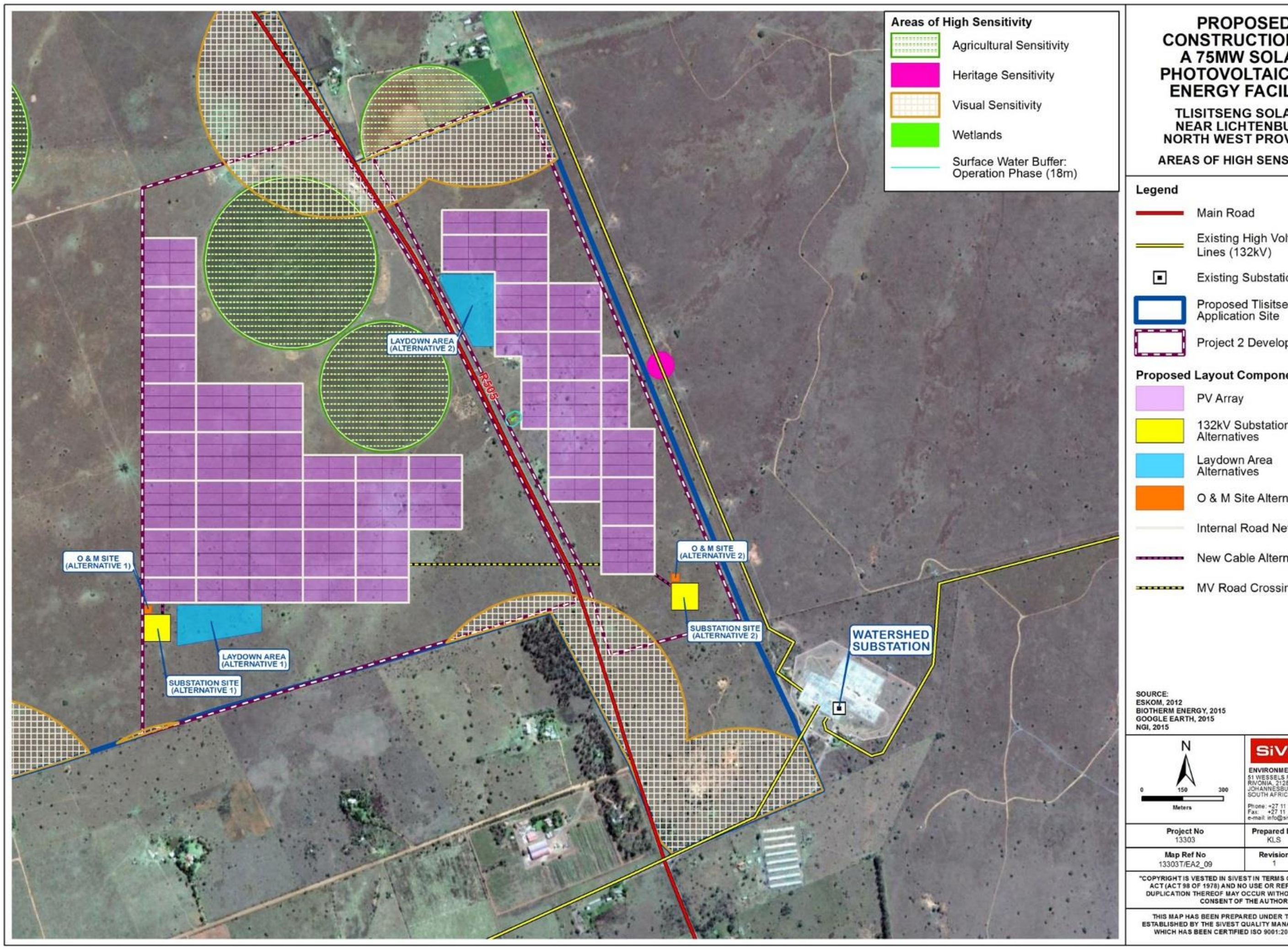

Figure 75.

It should be noted that some micro siting may be required at the construction phase within the authorised buildable area. This is to enable the avoidance of any unidentified features on site or any design constraints when the project reaches construction.

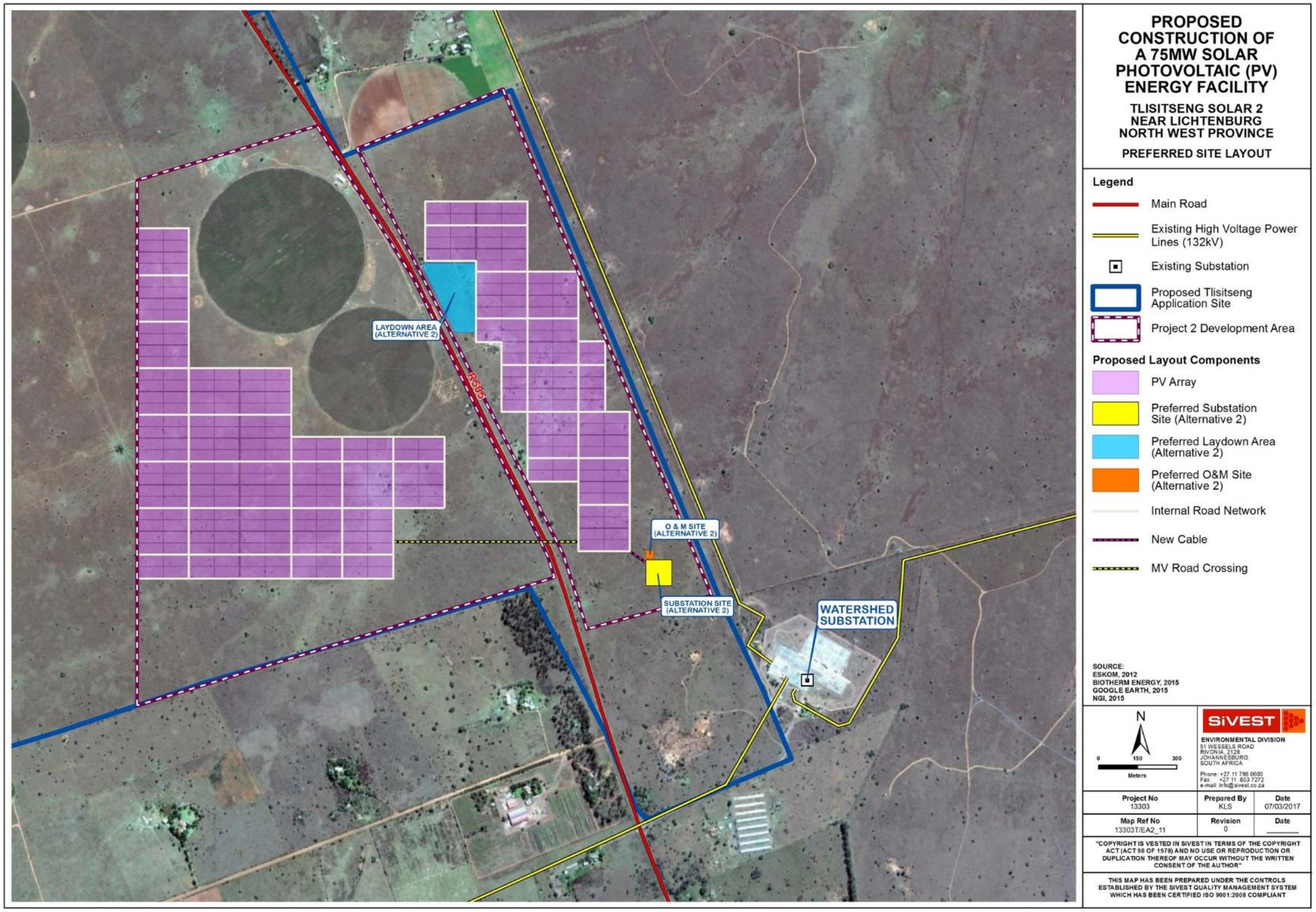

Figure 74: Preferred Site Layout

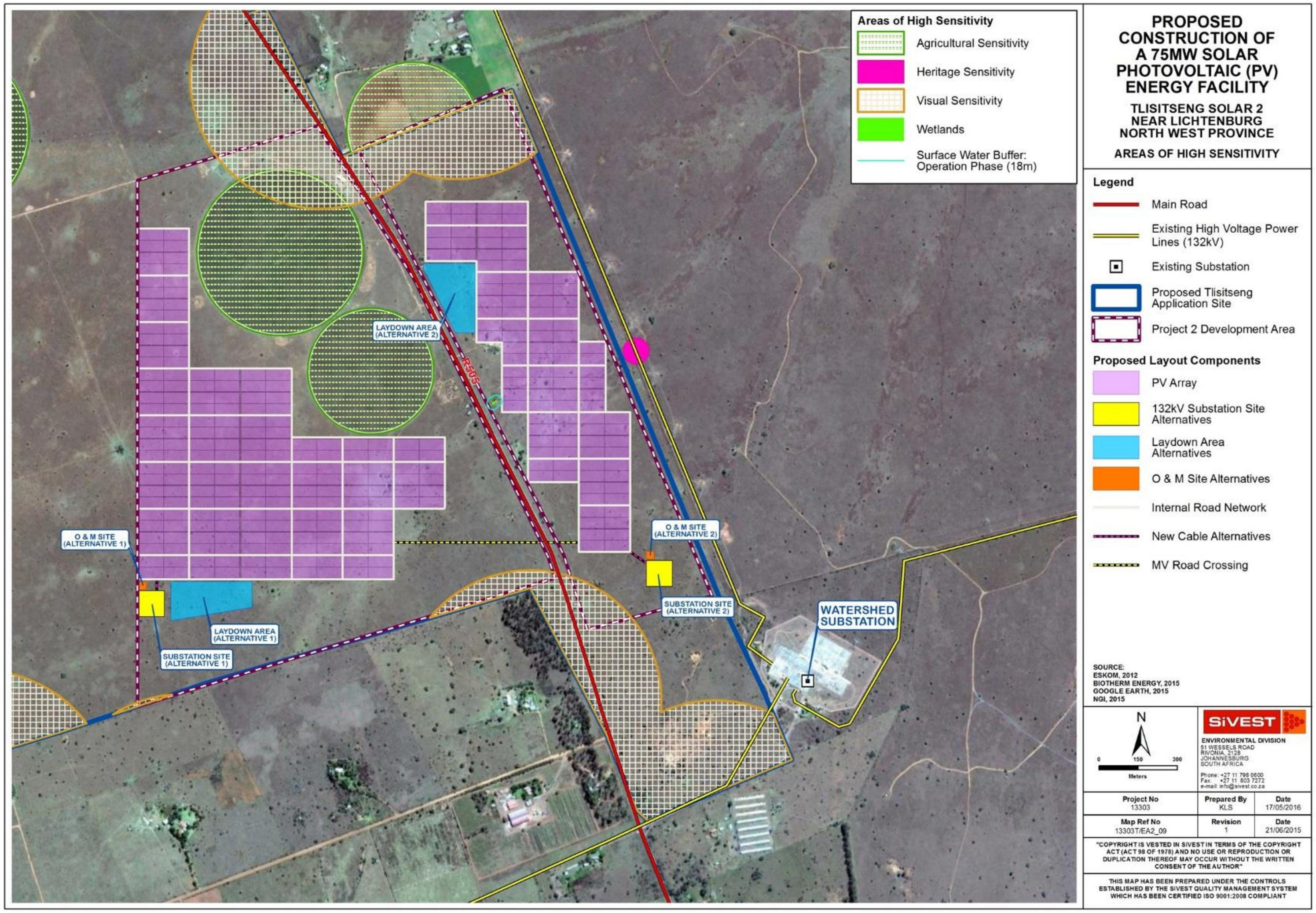

Figure 75: Preferred Site Layout in relation to Sensitive Areas

12.1 No Go Alternative

The No-Go Alternative is the option of not establishing the proposed Tlisitseng 2 solar facility near Lichtenburg, implying a continuation of the current situation or the status quo. The “no-go” or “no-action” alternative is regarded as a type of alternative that provides the means to compare the impacts of project alternatives with the scenario of a project not going ahead. In evaluating the “no-go” alternative it is important to take into account the implications of foregoing the benefits of the proposed project.

The No-Go option would therefore result in not contributing to meeting the demand for electricity and more specifically renewable energy targets in South Africa. This would also hinder the economic injection that the project promises to provide for the town of Lichtenburg in the form of short term employment, long term job creation and financial injection.

Although the negative impacts identified, such as visual impacts and impacts on biodiversity, would not occur if the project did not go ahead, the socio economic benefits of the proposed project should not be overlooked. The No-Go alternative has thus been eliminated due to the fact that the identified environmental impacts can be suitably mitigated and that by not building the project, the socio-economic benefits would be lost.

13 ENVIRONMENTAL MONITORING AND AUDITING

The Environmental Management Programme (EMPr) becomes a tool by which compliance on the proposed site can be measured against. In order to utilise this tool, environmental monitoring needs to take place with regular audits against the EMPr to ensure that all aspects are attended to.

Environmental monitoring establishes benchmarks to judge the nature and magnitude of potential environmental and social impacts.

Some of the key parameters for monitoring and auditing of the proposed project include the following inter alia:

- Soil erosion and siltation.
- Oil spillages
- Dust and gaseous emissions.
- Water quality
- Noise and vibration
- Change in biodiversity
- Socio-economic change
- Land use changes.

The overall objective of environmental and social monitoring is to ensure that mitigation measures are implemented and that they are effective. Environmental and social monitoring will also enable responses to new and developing issues of concern. The activities and indicators that have been recommended for monitoring are presented in the EMPr.

Environmental monitoring will be carried out to ensure that all construction activities comply and adhere to environmental provisions and standard specifications, so that all mitigation measures are implemented. The contractor shall employ an officer responsible for implementation of social/environmental requirements. This person will maintain regular contact with the local / district Environmental Officers. The contractor and proponent will have a responsibility to ensure that the proposed mitigation measures are properly implemented during the construction phase.

The environmental monitoring program will operate through the preconstruction, construction, and operation phases. It will consist of a number of activities, each with a specific purpose with key indicators and criteria for significance assessment. The following aspects will be subject to monitoring:

- Encroachment into sensitive areas
- Maintenance of project footprint

- Vegetation maintenance around project work sites, workshops and camps
- Health & Safety

Monitoring should be undertaken at a number of levels. Firstly, it should be undertaken by the Contractor at work sites during construction, under the direction and guidance of the Supervision Consultant who is responsible for reporting the monitoring to the implementing agencies. It is not the Contractor's responsibility to monitor land acquisition and compensation issues. It is recommended that the Contractor employ local full time qualified environmental inspectors for the duration of the Contract. The Supervision Consultant should include the services of an independent environmental and monitoring specialist on a part time basis as part of their team.

Environmental monitoring is also an essential component of project implementation. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measure, as they are required. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time.

Periodic ongoing monitoring will be required during the life of the Project and the level can be determined once the Project is operational.

The EMPr is included in Appendix 8.

14 COMPLIANCE WITH WORLD BANK STANDARDS AND EQUATOR PRINCIPLES

This report has been prepared to comply with various environmental legislation as well as World Bank Standards (IFC Guidelines) and the Equator Principles. Thus in order to ensure compliance with these, a checklist has been compiled to ensure that all aspects of these guidelines have been taken into account when compiling this document. **Table 93** below indicates that all applicable performance standards have been complied with.

The performance standards which have not been addressed at this stage as indicated in **Table 93** below will be addressed at a later stage when the proponent has reached financial closure. Therefore, the compliance level is partially compliant at this stage. It is important to note that the project proponent is committed to achieving compliance with the EPs.

The coding key is as follows:

Compliance level			
Clear			
Not assessed/determined	Not compliant	Partially compliant	Compliant

Appendix 10 includes the IFC Performance Standards on Environmental and Social Sustainability.

Table 93: Compliance with Equator Principles

PRINCIPLES	COMPLIANCE LEVEL	REFERENCE
Performance Standard 1 Environmental & Social Reporting		
1. Baseline Information		Refer to Chapter 6 – Description of Receiving environment
2. Impacts and Risks		Refer to Chapter 9
3. Global impacts		N/A
4. Transboundary		N/A
5. Disadvantaged / vulnerable groups		Refer to Chapter 8.7
6. Third party		Refer to Chapter 8.7
7. Mitigation measures		Refer to Chapter 10.1 and the EMPr - Appendix 8
8. Documentation of Assessment process		Refer to Chapter 9
9. Action Plans		No major Action Plans required as mostly generic

		mitigation measures have been required.
10 Organizational capacity		Refer to Appendix 10
11. Training		Refer to Appendix 10
12. Grievance mechanism	The proponent will commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project.	Refer to Appendix 10
Performance Standard 2, Labour & Working Conditions		
1. Human Resource Policy	The proponent commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project.	Refer to Appendix 10
2. Working relationship		Refer to Appendix 10
3. Working conditions with and terms of employment		Refer to Appendix 10
4. Workers organization		Refer to Appendix 10
5. Non-discrimination and equal opportunities		Refer to Appendix 10
7. Occupational Health and Safety		Refer to Appendix 10
8. Non-employee workers		Refer to Appendix 10
9. Supply Chain		Refer to Appendix 10
10. Labour Assessment Component of a Social and Environmental Assessment		Refer to Appendix 10
Performance Standard 3, Pollution		
1. Pollution Prevention, Resource Conservation & Energy Efficiency		Refer the EMPr - Appendix 8

2. Wastes		Refer the EMPr - Appendix 8
3. Hazardous material		Refer the EMPr - Appendix 8
4. Emergency preparedness & response	The proponent commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project.	Refer to Appendix 10
5. Technical guidance – ambient considerations		Refer to Appendix 10
6. Greenhouse gas emissions		No greenhouse gas emissions will result from the proposed development.
Performance Standard 4, Health & Safety		
1. Hazardous materials safety		Refer the EMPr - Appendix 8
2. Environmental and natural resource issues		Refer to chapters 6 and 8
Performance Standard 5, Land Acquisition		**Refer to chapter 5**
Performance Standard 6, Biodiversity		**Refer to Chapter 6.6 and 8.1**
Performance Standard 7, Indigenous People		**Refer to Chapter 8.7**
Performance Standard 8, Cultural Heritage		**Refer to Chapter 8.7**

15 EVALUATION AND RECOMMENDATIONS

Table 94 summarises the key recommendations for the environmental issues identified in the DEIAr. In order to achieve appropriate environmental management standards and ensure that the findings of the environmental studies are implemented through practical measures, the recommendations from this EIA (where practical and possible) must be included within an Environmental Management Programme (EMPr). This EMPr should form part of the contract with the contractors appointed to construct and maintain the proposed. The EMPr would be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases (i.e. construction, operation and de-commissioning) of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.

An Environmental Management Programme is included with this Environmental Impact Assessment Report as Appendix 8.

It is also recommended that the process of communication and consultation with the community representatives is maintained after the closure of this EIA process, and, in particular, during the construction phase associated with the proposed project.

15.1 Summary of Findings

Table 94: Summary of findings and Recommendations

Environmental Parameter	**Summary of major findings**	**Recommendations**
Biodiversity	The vegetation type that occurs on site (Carletonville Dolomite Grassland) is classified as Vulnerable, but has a wide distribution and extent. The natural vegetation on the sites is therefore considered from this perspective to have moderately high conservation value. The area is not within a Centre of Plant Endemism, nor does it occur in close proximity to an area identified as part of the National Parks Area Expansion Strategy. However, the site is within areas identified in the Provincial Conservation Assessment to be of importance for various reasons, including as buffer areas for protected areas, as part of a biodiversity feature, as part of a biodiversity node and as part of a dolomite aquifer recharge zone. Local factors that may lead to parts of the sites having elevated ecological sensitivity are the potential presence of the following: ▪ Presence of natural vegetation on site, some of which is of elevated conservation priority. ▪ Potential presence of four plant species of concern, the bulb, *Boophone disticha* (occurs on site), listed as Declining, the bulb, *Crinum macowanii* (possibly occurs on site - individuals seen were not flowering), listed as Declining, the succulent herb, *Brachystelma incanum*,	Proposed mitigation measures include compiling a surface runoff and stormwater management plan, formalising a rehabilitation programme, undertaking a botanical walk-through survey, undertaking search-and-rescue for any appropriate species, obtaining permits for any protected species that will be affected, undertaking a search and rescue of plants that can be rescued, compiling an alien plant management plan and undertaking regular monitoring.

	listed as Vulnerable, and the herb, *Cleome conrathii*, listed as Near Threatened. ▪ Potential presence of one protected plant species, *Harpagophytum procumbens.* ▪ Potential presence of three protected tree species, *Acacia erioloba*, *Combretum imberbe* and *Boscia albitrunca*. The tree *Acacia erioloba* occurs in large numbers on site. ▪ Potential presence of the following animals of potential conservation concern: o Brown Hyaena (NT) o Honey badger (NT) o Southern African Hedgehog (NT) o White-tailed Rat (EN) o Giant Bullfrog (NT/LC). ▪ Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features. Potential risks (impacts) to the ecological receiving environment are as follows: ▪ Loss of indigenous natural vegetation during construction; ▪ Impacts on listed plant species; ▪ Impacts on a protected plant species; ▪ Impacts on protected tree species; ▪ Mortality of populations of sedentary species during construction; ▪ Displacement of populations of mobile species (terrestrial); ▪ Introduction and/or spread of declared weeds and alien invasive plants in terrestrial habitats.	

	Cumulative impacts of this project in combination with similar projects is likely to be of low significance, with the exception of impacts on pan depressions, which may possibly be moderate due to impacts from other sources.	
Avifauna	The proposed Tlisitseng PV 1 facility is located in the endemic region with the fourth highest number of endemics in southern Africa. With 18% 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. Within the core study area, potential high sensitive areas are surface water (boreholes). Within the adjacent surroundings, high voltage lines, a vulture restaurant, and wetlands and dams are potential high sensitive areas, as all of these micro-habitats are potential focal points of bird activity. When full, the wetlands and dams may be an aggravating factor in that birds commuting to and from them could mistake the solar panels for surface water and attempt to land on them, thereby exposing themselves to the risk of collision. Boreholes could potentially be declassified as high sensitivity should it be confirmed that they will be relocated and therefore cease to function as potential focal points for bird activity after the construction of the solar panels. The potential impact of displacement of priority species due to disturbance associated with construction of the PV 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 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 used should be made of existing access roads and the construction of new roads should be kept to a minimum. ▪ 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. ▪ 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

	construction of the PV plant and associated infrastructure, are 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 plant and associated infrastructure is likewise rated as low and could be further reduced through mitigation.	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.
Surface Water	Ultimately, it was found that there is one ephemeral pan wetland within close proximity (approximately 18m to the west) of the PV layout area and approximately 35m to the east of the R505. A 15m construction buffer zone and 18m operation phase buffer zone is to be applied to the wetland based on the type and condition of the wetland, as well as the potential impacts expected and mitigations measures to be implemented. In terms of potentially applicable environmental and water related legislature, one listed activity and two 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), Activity 12 of Government Notice 983 was identified as being applicable where the proposed development will take place within 32m of the identified wetland, respectively. With respect to the NWA (1998), water uses (c) and (i) are assessed to potentially be applicable where the proposed development will be within 500m of the identified wetland. The above identified environmental	▪ Should no direct impacts need to take place to the identified wetland, the need for water use licensing can be avoided where it can be demonstrated to DWS that significant impacts will not take place and/or where other water uses are not required. ▪ Where impacts to surface water resources is not avoidable, the relevant water use license and environmental authorisations are to be applied for before construction is allowed to commence. ▪ All identified mitigation measures are to be implemented in order to minimise the identified potential impacts.

	activity and water uses should however be confirmed with the relevant government departments.	
Agricultural Potential and Soils	Despite the dominance of shallow soils in the area, areas of cultivation on the deeper soils can be seen in the vicinity. These include the various centre pivot fields, two of which occur in or close to the north-west corner of the part of the PV 2 site occurring to the west of the R505 road. The rainfall in the area is adequate for rain-fed cultivation, but due to the unreliability of the distribution, irrigation is a viable means of supplementing the rainfall in times of shortage, especially in the areas where deeper soils occur. The climatic parameters 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. The land use in the area is dominantly grazing, but with areas of cultivation, some under irrigation as classified by the National Land Cover.	▪ Due to the generally 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. ▪ 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 loamy nature of the soils means that if exposed, there is only a small hazard of soil removal by wind erosion, especially in the drier winter months. However, 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.
Visual	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 three (3) sensitive receptors are present in the study area, namely Rafters Pub (VR 14), the Lichtenburg Vakansie Oord (VR 69) and the Lichtenburg Game Breeding Centre (VR 71). These three (3) visually sensitive receptors are regarded as facilities with current and future tourism	▪ Where possible, 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.

	potential and are therefore expected to experience the most significant visual impacts as a result of the proposed development. It should however be noted that at this stage, the game breeding centre is not operational. Despite the tourism significance of the three (3) sensitive visual receptor locations, the proposed development is expected to have a low visual impact on the Lichtenburg Vakansie Oord while it will have a moderate visual impact on Rafters Pub as well as the Lichtenburg Game Breeding Centre. It must also be noted that the R505 main road, which traverses the application site as well as 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 the potentially visual receptors. It must however be noted that the proposed development would have high visual impact on only one (1) potentially sensitive visual receptor location, namely VR 1. 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 Tlisitseng Solar 2 PV energy facility would have a low visual impact during construction and a medium visual impact during operation, with a	▪ 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). ▪ 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. ▪ The operations and maintenance (O&M) buildings should not be illuminated at night. ▪ If overhead power lines are required, align power lines to run parallel to other linear elements and the farm boundaries, where possible. ▪ 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

	number of mitigation measures available. The associated infrastructure would have a low visual impact during construction and operation.	▪ Limit the number of maintenance vehicles which are allowed to access the site. ▪ Non-reflective surfaces should be utilised where possible.
Heritage	The Heritage Impact Assessment has shown that the proposed Tlisitseng Solar projects does have heritage resources present on the property. This has been confirmed through archival research, evaluation of aerial photography of the sites and a field survey. During the fieldwork 3 heritage resources were identified in or close to the footprint area of the PV site 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.	▪ Although no significant fossils were recorded in situ in both PV sites as well as the proposed alternative route corridors for the power lines, several well-defined micro-stromatolites and possible sites with cave breccia have been identified. Depending on the results of the geotechnical investigation and where potential excavations for foundations will exceed 1.5m, the ECO must investigate the possible presence of stromatolites and/or cave breccia and inform the HIA consultants immediately for appropriate action and appointment of a qualified palaeontologist to investigate the site before destruction of fossils occurs. ▪ Site visits as stipulated in the management tables will include an initial 2 day site visit and then fortnightly during construction. ▪ 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.
Socio-economic	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; however, care will have to be taken to ensure that the establishment and growth of activities identified as drivers of economic development	▪ Consultation with the directly affected land owner 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.

	in the study area is not unduly negatively impacted by the establishment of the project in the proposed region. Portion 25 of Farm Houthaalboomen 31 is currently being used for irrigated maize farming and some commercial livestock farming. The land owner has indicated that the proposed development will impact the grazing land only and irrigated land will remain. He plans to acquire alternative land to continue with commercial livestock farming. Overall, the impact analysis and evaluation revealed that no fatal flaws are present from a socio-economic perspective preventing the proposed development from being approved and implemented. All of the expected negative socio-economic impacts can be mitigated to low significance. 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 ▪ Severing of existing community ties ▪ 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	▪ Areas of high agriculture potential should be avoided to curb the cumulative effect on food security. ▪ 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. ▪ Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers. ▪ 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. ▪ During construction the rules and regulations must be clearly communicated to all workers, personal property must be respected and avoided.

	▪ Increased tax revenue for government Impacts that will ensure as a result of operational activities, i.e. operational phase impacts: ▪ Impact on commercial agriculture activities ▪ 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 realisation of nearby properties' tourism business potential ▪ Impact on property values ▪ Increased tax revenue for government 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 be considered for implementation. However, care should be taken that the proposed development does not affect the supply of water extracted from boreholes located on the nearby farms and access to some of the nearby farms. The issues of safety and livestock theft should also be addressed and proposed mitigation measures for these are implemented.	▪ Participate in ongoing consultation with directly and indirectly affected land owners to avoid unduly influencing any processes or day to day activities of these individuals. Ensure that all interested and affected parties understand the project and its requirements as far as is feasible, reasonable, and possible. ▪ Ensure clear communication of the project information and effective public participation processes to minimise the influx of migrant job seekers. ▪ Set up a recruitment office in the nearby town of Lichtenburg and adhere to strict labour recruitment practices that would reduce the desire of potential job seekers to loiter around the properties in hope to find temporary employment ▪ Employ locals as far as feasible through the creation of the local skills database and recruitment of suitable candidates. ▪ Set up a gate or access control to site to limit or completely eliminate the possibility of loitering on site and movement of people from site to the adjacent properties. ▪ Movement of workers and vehicles on the roads linked to the construction activities should be limited to working hours and workdays ▪ 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.

		▪ Limit construction activity to normal working hours and avoid activity over weekends ▪ 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. ▪ 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. ▪ The water supply options will need to be considered and discussed with the interested and affected parties in the area prior the operations to discard any of the above-mentioned concerns. ▪ Engage with the owners of the local tourist attractions (Portion 1 of Farm Talene 25 specifically) and discuss with them the opportunities to establish educational tours in partnership between the two (or more) local parties that could be packaged, advertised and sold by the businesses surrounding the solar farm. ▪ Other opportunities linked to realising the potential for eco-tourism linked to the proposed solar PV project/s need to be examined. This could include the use of Socio-Economic Development and Enterprise Development funding allocated by the project during operations on realising these

		opportunities and developing the local tourism industry. ▪ Ensure that the establishments surrounding the farms are kept safe by insetting a stringent access control and proper fencing between the boundaries of properties.
Geotechnical	For the substation, build on a 1 hectare property, this DSI will comprise a gravity survey and the drilling of a minimum of 3 boreholes for a feasibility level (Phase 1) investigation. It is also evident from the Topographical maps and Google Images that a water borehole is present between the two alternative sites. This borehole is probably used for irrigation purpose and as mentioned in above, dewatering has a significant effect on the underlying dolomite stability.	Due to fact that this entire site is underlain at depth by dolomite, it is a legal requirement that a Dolomite Stability Investigation (DSI) be undertaken in accordance with the South African National Standards SANS 1936-Parts 1 to 4 Development of Dolomitic Land.
Traffic	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 Tlisitseng 2 Solar PV Energy Facilities will be from the Durban Port. The distance of 765 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 1035 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	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. It is recommended that the majority of construction personnel is transported to and from site by means of buses and some by private vehicles. The access road should be upgraded to at least a 5m width (preferable 6m with sufficient shoulders) finished with a gravel wearing course layer.

	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 roads from the R505 to the site for is situated close to the site and requires minimal upgrades. 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.	

A summary of the impact rating of the proposed development according to each environmental aspect are provided in **Table 95** below.

Key

LOW NEGATIVE	**LOW POSITIVE**
MEDIUM NEGATIVE	**MEDIUM POSITIVE**
HIGH NEGATIVE	**HIGH POSITIVE**

Table 95: Impact rating summary for the proposed Tlisitseng 2 solar energy facility during the construction phase

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Biodiversity	Loss, degradation or fragmentation of indigenous natural vegetation	-38 (medium negative)	-38 (medium negative)

	Loss of individuals of listed plants, as per Red & Orange List.	-12 (low negative)	-10 (low negative)
	Loss of individuals of protected plants, as per NEM:BA and provincial legislation.	-11 (low negative)	-9 (low negative)
	Loss of individuals of protected trees, as per National Forests Act.	-17 (low negative)	-9 (low negative)
	Loss of populations of sedentary animals, species of conservation concern	-10 (low negative)	-7 (low negative)
Avifauna	Displacement of priority species due to disturbance associated with construction of the PV plant and associated infrastructure.	-54 (High negative)	-51 (High negative)
Surface Water	Impact rating for pre-construction impacts related to the construction lay-down area and the wetland	- 24 (low negative)	- 8 (low negative)
	Impact rating for construction vehicle and machinery degradation impacts to the wetland	- 24 (low negative)	- 6 (low negative)
	Impact rating for construction phase human degradation of flora and fauna associated with the wetland	- 18 (low negative)	- 6 (low negative)
	Impact rating for construction phase degradation and removal of vegetation and soils associated with the wetland and the associated buffer zone	- 42 (medium negative)	- 6 (low negative)
	Impact rating for construction phase increased storm water run-off, erosion and sedimentation impacts	- 49 (medium negative)	- 6 (low negative)
Agricultural Potential and Soils	The loss of agriculturally productive soil due to the establishment of the infrastructure of the PV project	-22 (low negative)	-10 (low negative)
	The loss of topsoil by being exposed to wind action due to construction processes	-42 (medium negative)	-9 (low negative)
Visual	Visual impacts of the proposed Tlisitseng Solar 2 PV energy facility (including associated infrastructure) during construction	-24 (low negative)	-20 (low negative)

Heritage	The possibility of encountering previously unidentified heritage resources and specifically Stone Age archaeological sites. As well as the impact on the identified archaeological sites	-26 (low negative)	-9 (low negative)
	The possibility of encountering previously unidentified heritage resources and specifically Palaeontological sites. As well as the impact on the identified palaeontological sites	-63 (high negative)	+57 (high positive)
Socio-economic	Rating of impacts of a loss of productive agriculture land	-34 (medium negative)	-17 (low negative)
	Rating of impacts of temporary employment creation	+16 (low positive)	+34 (medium positive)
	Rating of skills development	+17 (low positive)	+36 (medium positive)
	Rating of impact on living standard (due to temporary increase in income)	+13 (low positive)	+16 (low positive)
	Rating of impact of severing of existing community ties	-15 (low negative)	-14 (low negative)
	Rating of impact of temporary increase in social pathologies	-36 (medium negative)	-17 (low negative)
	Rating of impact on business safety and security	-32 (medium negative)	-15 (low negative)
	Rating of impact of change in the sense of place	-19 (low negative)	-16 (low negative)
	Rating of impact of temporary increase in production	+36 (medium positive)	+36 (medium positive)
	Rating of impact of upgrading of existing local road infrastructure	+28 (low positive)	+28 (low positive)
	Rating of impact of temporarily increased traffic and the impact on road	-30 (medium negative)	-15 (low negative)
	Rating of impact of increased demand for social facilities	-30 (medium negative)	-14 (low negative)
	Rating of impact on service delivery	-30 (medium negative)	-14 (low negative)
	Rating of impact of temporary increase in household disposable income	+24 (medium positive)	+24 (medium positive)
	Rating of impact of temporary increase in tax revenue for government	+24 (medium positive)	+24 (medium positive)

Traffic	Traffic impact of additional traffic on existing routes during the construction and de-commission of the proposed solar facility	-12 (low negative)	- 11 (low negative)

Table 96: Impact rating summary for the proposed Tlisitseng 2 solar energy facility during the operational phase

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Biodiversity	Loss of habitat due to invasion by alien plants	-28 (low negative)	-11 (low negative)
Avifauna	Displacement of priority species due to habitat transformation associated with construction of the PV plant and associated infrastructure.	-54 (high negative)	-51 (medium negative)
	Mortality of priority species due to collisions with solar panels	-28 (low negative)	-22 (low negative)
Surface Water	Impact rating for operation phase vehicle damage	- 26 (low negative)	- 8 (low negative)
Visual	Visual impacts of the proposed Tlisitseng Solar 2 PV energy facility during operation	-36 (medium negative)	-36 (medium negative)
	Visual impacts of the infrastructure associated with the Tlisitseng Solar 2 PV energy facility during operation	-17 (low negative)	-15 (low negative)
	Rating of impacts on employment creation	+14 (low positive)	+28 (low positive)
	Rating of impacts on skills development	+18 (low positive)	+38 (medium positive)
	Rating of impact on living standard	+16 (low positive)	+16 (low positive)
	Rating of impact of increased social pathologies	-48 (medium negative)	-18 (low negative)
	Rating of impact of increase in production	+26 (low positive)	+26 (low positive)
	Rating of impact of increased demand for social facilities	-34 (medium negative)	-16 (low negative)
	Rating of impact on service delivery	-32 (medium negative)	-15 (low negative)
	Rating of impact of increased household disposable income	+30 (medium positive)	+30 (medium positive)
	Rating of impact on property values	+22 (low positive)	+22 (low positive)

	Rating of impact of increased government tax revenue	+28 (medium positive)	+28 (medium positive)
Traffic	Traffic impact of additional traffic on existing routes during operation of the proposed Solar Facility	-11 (low negative)	- 11 (low negative)

Table 97: Impact rating summary for the proposed Tlisitseng 2 solar energy facility during the decommissioning phase

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Avifauna	Displacement of priority species due to disturbance associated with de-commissioning of the PV plant and associated infrastructure.	-11 (low negative)	-10 (low negative)

Table 98: Impact rating summary for the cumulative impacts associated with the proposed Tlisitseng 2 solar energy facility

Environmental Aspect	Environmental Impacts	Impact Rating without Mitigation
Biodiversity	Cumulative impacts on indigenous natural vegetation	Low negative
	Cumulative impacts on listed plant species	Low negative
	Cumulative impacts on protected plant species	Low negative
	Cumulative impacts on protected trees	Low negative
	Cumulative impacts on populations of sedentary fauna	Low negative
	Cumulative impacts on mobile fauna	Low negative
	Cumulative impacts due to spread of declared weeds and alien invader plants	Low negative
Avifauna	Cumulative impact of the Tlisitseng PV project on priority species	Low negative
Agriculture and Soils	Potential of increased dust production as a result of construction activities	Low negative
Visual	Cumulative visual impacts as a result of the other proposed renewable energy developments (including associated infrastructure) during construction	Low negative
	Cumulative visual impacts as a result of the other proposed renewable energy developments (including associated infrastructure) during operation	Medium Negative
Heritage	Extent that the addition of this project will have on the overall impact of developments in the region on heritage resources	Low Negative
Traffic	Additional traffic on existing routes during the Construction and De-commission of the proposed Solar Facility	Low Negative
	Additional traffic on existing routes during operation of the proposed Solar Facility	Low Negative

15.2 Conclusion

The findings of the specialist studies undertaken within this EIA provide an assessment of both the benefits and potential negative impacts anticipated as a result of the proposed solar PV energy facility. The findings conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding. Areas of special concern have however been identified which will require site specific mitigation measures to reduce impacts. These are included within the EMPr to ensure that these areas receive special attention.

It was determined during the EIA that the proposed project will result in limited potential negative impacts and certain positive impacts. A preferred site layout has been identified which is less environmentally sensitive and will result in the least environmental impact.

A detailed public participation process was followed during the EIA process which conforms to the public consultation requirements as stipulated in the EIA Regulations. In addition, all issues raised by I&APs will be captured in the FEIAr and where possible, mitigation measures provided in the EMPr to address these concerns.

As sustainable development requires all relevant factors to be considered, including the principles contained in section 2 of NEMA, the DEIAr has strived to demonstrate that where impacts were identified, these have been considered in the determination of the preferred site layout.

It is the opinion of the EAP that the information and data provided in this DEIAr is sufficient to enable the DEA to consider all identified potentially significant impacts and to make an informed decision on the application. Further, it is the opinion of the EAP that based on the findings of the EIA that the proposed project should be granted an EA and allowed to proceed provided the following conditions are adhered to:

- The substation and O&M building should be constructed with the preferred substation and O&M building sites 2.
- The laydown site should be located in the area designated for the laydown alternative 2.
- Where applicable monitoring should be undertaken to evaluate the success of the mitigation measures recommended by the various specialists.
- Final EMPr should be approved by DEA prior to construction.
- The final layouts should be submitted to the DEA for approval prior to commencing with the activity.

SiVEST as the EAP is therefore of the view that:

- An environmentally preferred substation site, as well as an O&M building site has been identified which is less environmentally sensitive compared to the other site considered during the EIA phase.
- Through the implementation of mitigation measures, together with adequate compliance monitoring, auditing and enforcement thereof by the appointed ECO as well as competent authority, the potential detrimental impacts associated with the proposed project can be mitigated to acceptable levels.

- A cumulative impact assessments of similar development in the area was undertaken by the specialist. Based on their findings the cumulative impacts associated with the proposed development will be low.

The date on which the activity will commence cannot be determined at this stage as they are based on the timeframes dictated by the Renewable Energy Independent Power Producer Procurement Programme (REIPPP) bid windows. The date of the next round of bid submissions has not yet been announced. The construction of the proposed Tlisitseng 2 solar energy facility is dependent on being selected as a preferred bidder. The project will therefore require an authorisation of at least 5 years.

It is trusted that the DEIAr provides the reviewing authority with adequate information to make an informed decision regarding the proposed project.

16 REFERENCES

ACOCKS, J.P.H. 1988. Veld types of South Africa (3rd edn.). *Mem. Bot. Surv. S. Afr.* No 28. Government printer, Pretoria.

ALEXANDER, G. & MARAIS, J. 2007. A guide to the reptiles of southern Africa. Struik, Cape Town.

ANIMAL DEMOGRAPHY UNIT. The southern African Bird Atlas Project 2. University of Cape Town. http://sabap2.adu.org.za. Accessed 9 May 2016.

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

BARNES, K.N. (ed.) (2000) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.

BARNES, K.N. (ed.) 1998. The Important Bird Areas of southern Africa. BirdLife South Africa: Johannesburg.

BARTHWAL, R. 2002. Environmental Impact Assessment. New Age International Publishes, New Delhi.

BERGH, J.S. 1999. Geskiedenisatlas van Suid-Afrika: die Vier Noordelike Provinsies. Van Schaik, Pretoria

BOEYENS, JCA, 2003. The Late Iron Age Sequence in the Marico and early Tswana history. The South African Archaeological Bulletin. Vol 58, No 178. December 2003.

BRANCH, W.R. (1988) South African Red Data Book—Reptiles and Amphibians. South African National Scientific Programmes Report No. 151.

BREEDLOVE, G., 2002. A systematic for the South African Cultural Landscapes with a view to implementation. Thesis – University of Pretoria.

BREUTZ, P.J. 1955. The Tribes of the Mafeking District. Department of Native Affairs, Ethnological Publications No. 32, Pretoria.

CHIEF SURVEYOR-GENERAL. (2016, February 11). Spatial Cadastral Data. Retrieved from Chief Surveyor-General.

CLOETE, P.G. 2000. The Anglo-Boer War a Chronology.

COETZEE, N. & MONADJEM, A. 2008. *Mystromys albicaudatus*. The IUCN Red List of Threatened Species 2008: Downloaded on 25 October 2015.

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.

DENT, M.C., LYNCH, S.D. & SCHULZE, R.E. 1989. Mapping mean annual and other rainfall statistics in southern Africa. Department of Agricultural Engineering, University of Natal. ACRU Report No. 27. Massachusetts: Clark University.

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 ECONOMIC DEVELOPMENT. (2010). The New Growth Path: The Framework.

DEPARTMENT OF MINERALS AND ENERGY. (2003). White Paper on Renewable Energy.

DITSOBOTLA LM. (2011). Integrated Development Plan 2011/12 - 2015/16.

DRIVER, A., MAZE, K., ROUGET, M., LOMBARD, A.T., NEL, J., TURPIE, J.K., COWLING, R.M., DESMET, P., GOODMAN, P., HARRIS, J., JONAS, Z., REYERS, B., SINK, K and STRAUSS, T. 2005. National Spatial BIODIVERSITY ASSESSMENT 2004: priorities for biodiversity conservation in South Africa. Strelitzia 17. South African National Biodiversity Institute, Pretoria.

DU PREEZ, L. & CARRUTHERS, V. 2009. A complete guide to the frogs of southern Africa. Random House Struik, Cape Town.

FAIRBANKS, D.H.K., THOMPSON, M.W., VINK, D.E., NEWBY, T.S., VAN DEN BERG, H.M & EVERARD, D.A. 2000. The South African Land-Cover Characteristics Database: a synopsis of the landscape. *S.Afr.J.Science* 96: 69-82.

Feris, P. L. (2014). A Sense of Place: New frontiers for the law. *UCT Inaugural lectures.*

FOURIE, W. 2008. Archaeological Impact Assessments within South African Legislation. South African Archaeological Bulletin 63 (187): 77–85, 2008

FOURIE, W. 2009. Heritage Impact Assessment. The Watershed to Sephaku 132kV power reticulation line, NORTH WEST PROVINCE. Version 1.0. Professional Grave Solutions (Pty) Limited. For SSI Engineering and Environmental (Pty) Ltd

FRIEDMANN, Y. & DALY, B. (eds.) 2004. The Red Data Book of the Mammals of South Africa: A CONSERVATION ASSESSMENT: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.

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

GEOTERRAIMAGE. 2015. 2013 – 2014 South African National Land-Cover Dataset: Data User Report and MetaData.

GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y and KEITH, M. (eds.) (2006). A checklist of South African plants. Southern African Botanical Diversity Network Report No. 41, SABONET, Pretoria.

GROENEWALD GH. 2015. Palaeontological Desktop Assessment for the proposed Tlisitseng Solar PV. INTERNAL REPORT, PGS Heritage (Pty) Ltd.

GROENEWALD, G. 2016. Palaeontological Impact Assessment for the Tlisitseng PV2 development.

GROENEWALD, GH., GROENEWALD SM. AND GROENEWALD DP. 2014. Palaeontological Heritage of the Free State, Gauteng, Limpopo, Mpumalanga and North West Provinces. Internal Palaeotechnical Reports, SAHRA.

GROOMBRIDGE, B. (ed.) 1994. *1994 IUCN Red List of Threatened Animals*. IUCN, Gland, Switzerland.

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

IUCN (2001). *IUCN Red Data List categories and criteria: Version 3.1*. IUCN Species Survival Commission: Gland, Switzerland.

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 Wildife 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.

KOTZE, A.V. & LONERGAN, A.T., 1984. Climate data. In Land types of the maps 2626 West Rand and 2726 Kroonstad. *Mem. Agric. nat. Res. S. Afr*. No. 4. Department of Agriculture and Water Supply, Pretoria.

LAVERY,K. Personal communication to the author on 13 February 2016 by the bird monitor who did the field work at the site.

LEWIS-WILLIAMS, J D. 1983. The Rock Art of Southern Africa (The imprint of man) Cambridge University Press.

LICHTENBURG MUSEUM, 2009. (http://home.intekom.com/lichtenburg/stig-a.htm)

MACLEAN, G.L. 1999. Southern African endemic birds: their distribution and conservation. An invited evening public lecture. http://www.int-ornithunion.org/files/proceedings/durban/South%20African%20Papers/SApaper1.htm.

MACVICAR, C. N., SCOTNEY, D. M. SKINNER, T. E. NIEHAUS, H. S. & LOUBSER, J. H., 1974. A classification of land (climate, terrain form, soil) primarily for rainfed agriculture. S. Afr. J. Agric. Extension, 3(3): 1-4.

MARAIS, J. 2004. A complete guide to the snakes of southern Africa. Struik Publishers, Cape Town.

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.

MASON, RJ. 1974. Background to the Transvaal Iron Age – New Discoveries at Olifantspoort and Broederstroom. Journal of the South African Institute of Mining and Metallurgy. January 1974

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.

MILLS, G. & HES, L. 1997. The complete book of southern African mammals. Struik Publishers, Cape Town.

MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. and KLOEPFER, D. (eds.) 2004. Atlas and Red Data Bookof the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9. Smithsonian Institution, Washington, DC.

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.The North West Parks and Tourism Board Official Site: http://www.tourismnorthwest.co.za

MODISE, M. (2013). Overview of Renewable Energy Roadmap - Public workshop on Draft Integrated Energy Planning Report. Department of Energy.

MONADJEM, A., TAYLOR, P.J., COTTERILL, E.P.D. & SCHOEMAN, M.C. 2010. Bats of southern and central Africa. Wits University Press, Johannesburg.

MUCINA, L, BREDENKAMP, G.J., HOARE, D.B & MCDONALD, D.J. 2000. A National Vegetation Database for South Africa *South African Journal of Science* 96: 1–2.

MUCINA, L. AND RUTHERFORD, M.C. (editors) 2006. Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.

MUCINA, L., RUTHERFORD, M.C. AND POWRIE, I.W. (editors) 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 SCALE SHEET MAPS South African National Biodiversity Institute, Pretoria.

MUCINA, L., RUTHERFORD, M.C., HOARE, D.B. & POWRIE, L.W. 2003. VegMap: The new vegetation map of South Africa, Lesotho and Swaziland. In: Pedrotti, F. (ed.) Abstracts: Water Resources and Vegetation, 46th Symposium of the International Association for Vegetation Science, June 8 to 14 – Napoli, Italy.

MUCINA, L., RUTHERFORD, M.C., PALMER, A.R., MILTON, S.J., SCOTT, L., VAN DER MERWE, B., HOARE, D.B., BEZUIDENHOUT, H., VLOK, J.H.J., EUSTON-BROWN, D.I.W., POWRIE, L.W. & DOLD, A.P. 2006. *Nama-Karoo Biome.* In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

MUCINA. L. & RUTHERFORD, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. STRELITZIA 19. South African National Biodiversity Institute, Pretoria.

NATIONAL PLANNING COMMISSION. (2011). National Development Plan 2010 – 2030.

NGAKA MODIRI MOLEMA DISTRICT MUNICIPALITY. (n.d.). Integrated Development Plan - Amendment 2015/2016 financial year.

NGAKA MODIRI MOLEMA DISTRICT MUNICIPALITY. (n.d.). Integrated Development Plan 2012 – 2016.

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).

NTAMU, P.M. 1996. Report on the history of the Batswana in the Lichtenburg region, with specific reference to the history and the culture of the Bakolobeng in the past thirty years. Lichtenburg Museum.

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.

PASSMORE, N.I. & CARRUTHERS, V.C. (1995) South African Frogs; a complete guide. Southern Book Publishers and Witwatersrand University Press. Johannesburg.

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.

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).

RUTHERFORD, M.C. & WESTFALL, R.H. (1994). Biomes of southern Africa: an objective categorization. *Memoirs of the Botanical Survey of South Africa* No. 63.

SA PLACES WEBSITE: http://www.places.co.za/html/lichtenburg.html

SA VENUES.COM WEBSITE: http://www.sa-venues.com/game-reserves/nwp_lichtenburg.htm

SCHULZE, B.R. 1984. Climate of South Africa, Part 8, General Survey, WB 28. *South African Weather Bureau* 60. Government Printer, Pretoria.

SHOW ME WEBSITE: http://showme.co.za/south-africa/north-west/central-district/lichtenburg/

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.

SOIL CLASSIFICATION WORKING GROUP, 1991. Soil Classification. A Taxonomic System for South Africa. ARC-Institute for Soil, Climate & Water, Pretoria.

SOUTH AFRICA.COM OFFICIAL WEBSITE: http://www.southafrica.com/museums/lichtenburg/

STATS SA. (2012). National Census 2011.

STEYNBERG, M. 2016. Environmental Impact Assessment for the Tlisitseng 1 75MW Solar Photovoltaic (PV) ENERGY FACILITY NEAR LICHTENBURG, North West: Socio-Economic Impact Study. Urban-econ Development Economists, Hatfield.

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.

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

TOLLEY, K. & BURGER, M. 2007. Chameleons of southern Africa. Struik Publishers, Cape Town.

UNESCO., 2005. Operational Guidelines for the Implementation of the World Heritage Convention. UNESCO World Heritage Centre. Paris.

URBAN-ECON . (2016). GIS Department.

VAN WYK, A.E. & SMITH, G.F. 2001. Regions of floristic endemism in southern Africa. Umdaus press, Hatfield.

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