Visual Impact Assessment

of site for

proposed Photovoltaic (PV) Solar facility

on a portion of the farm Waterloo 992 IN

located in the Naledi Local Municipality

Vryburg

Northern Cape Province

Prepared for:
DPS79 Solar Energy (Pty) Ltd

by:

Dr L A Sandham

September 2012

Executive Summary

Project title:

The construction of a 75MW photovoltaic solar facility and associated infrastructure on a portion of the farm Waterloo 992, Registration Division IN, North West situated within the Naledi Local Municipality area of jurisdiction

DPS79 Solar Energy (PTY) Ltd appointed Dr L A Sandham to conduct a visual impact assessment (VIA) of the proposed photovoltaic energy facility at Waterloo 992, near Vryburg, Northern Cape Province.

The photovoltaic plant will be installed on a site on a farm. The land is currently vacant and surrounded by other vacant farmland used for grazing and game farming. The western boundary of the site is approximately 2.2. km east of the N18 road running from Vryburg to Warrenton.

The assessment was conducted according to standard Visual Assessment practice and aimed to identify expected visual impacts and assess their potential significance. The main conclusions are the following:

- The visual absorption capacity of the landscape is **low-medium** for this type of development.
- *Impacts*: There will be impacts on viewer sensitivity, and other impacts are the visibility of the plant, visual exposure of viewers and visual intrusion into the landscape.
- *Mitigation*. Mitigation during construction phase will entail mainly the control of dust, noise and lighting, and visual screening, while mitigation during the operational phase will consist mainly of visual screening by fences and vegetation, control of lighting, and rehabilitation of disturbed areas.
- *Value of the landscape*: The value of the landscape as a visual resource is relatively **low** and improvable, thus reducing significance of impacts.
- *Significance.* The significance of the visual impact on sensitive viewers during the construction phase of the PV plant is **low** due to the short duration of construction and the small number of sensitive viewers who will be affected, provided mitigation measures are properly implemented.
  The overall significance of the visual impact on sensitive viewers during the operational phase of the PV plant is **low**. Mitigation measures cannot reduce the duration, but the implementation of screening, and correct management of lighting will ensure that occupants of the Tiger Kloof Educational Centre and motorists travelling on the N18 situated 2 km west of the proposed plant will not be adversely affected.

Conclusion: The significance of the anticipated visual impacts after mitigation is such that it *does not constitute any reason to not allow this development to proceed*.

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1 INTRODUCTION AND BRIEF

This report presents the findings of the visual specialist study undertaken by Dr L A Sandham as part of the Basic Assessment being conducted by Environamics for the proposed DPS79 Solar Energy photovoltaic (PV) plant on the farm Waterlooin the Northern Cape Province.

1.1 GUIDING CONCEPTS FOR VISUAL IMPACT ASSESSMENTS

The Visual Impact Assessment (VIA) is based on guidelines for visual assessment specialist studies as set out by the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) (Oberholzer, 2005) as well as guidelines for Landscape and Visual Impact Assessment provided by the Landscape Institute of the UK (The Landscape Institute, 2002). The DEA&DP guidelines recommend that a visual impact assessment consider the following specific concepts:

- An awareness that 'visual' implies the full range of visual, aesthetic, cultural and spiritual aspects of the environment that contribute to the area's sense of place.
- The considerations of both the natural and cultural landscape, and their interrelatedness.
- The identification of all scenic resources, protected areas and sites of special interest, together with their relative importance in the region.
- An understanding of the landscape processes, including geological, vegetation and settlement patterns, which give the landscape its particular character or scenic attributes.
- The need to include both quantitative criteria, such as 'visibility', and qualitative criteria, such as aesthetic value or sense of place.
- The need to include visual input as an integral part of the project planning and design process, so that the findings and recommended mitigation measures can inform the final design, and hopefully the quality of the project.
- The need to determine the value of visual/aesthetic resources through public involvement.

1.2 SCOPE OF STUDY

1.2.1 Terms of Reference

The Terms of Reference from DPS79 Solar Energy (PTY) Ltd require that a Visual Impact Assessment be conducted for the proposed WaterlooPV plant, and to include the following:

- A desktop review of available information that can support and inform the specialist study.
- Identify issues and potential visual impacts for the proposed project, to be considered in combination with any additional relevant issues that may be raised through the public consultation process.
- Identify possible cumulative impacts related to the visual aspects for the proposed project.
- Assess the potential impacts, both positive and negative, associated with the proposed project for the construction, operation and decommissioning phases.
- Identify management actions to avoid or reduce negative visual impacts; and to enhance positive benefits of the project.

1.2.2 Visual triggers

Oberholzer (2005) identifies visual triggers which are used to determine the approach and scope of an impact study. The following triggers, related to the nature of the project, are applicable to this study:

1. A significant change to the fabric and character of the area;
2. Possible visual intrusion in the landscape.

In this case, the following potential visual triggers were identified:

1. Location relatively close to the N18 national road, hence the study is required by the Competent Authority.
2. The Tiger Kloof Educational Institution stated in a letter dated 23 April 2012 that visual pollution should be minimized and sites should be rehabilitated.
3. The SIA identified no sensitive receptors amongst the residents of the area but pointed out potential impacts related to potential glint/ reflection and navigational impacts on air traffic associated with the Vryburg Aerodrome may need to be confirmed with the relevant aviation authorities.
   In a letter dated 18 May 2012 the Civil Aviation Authority (CAA) confirmed that they have no objection to the proposed development with a maximum height restriction of 12m above ground level. Moreover, Sintec (2011) have shown that despite many such PV plants operating at or near major airports in the USA for several, there have been no reports of glare or reflection causing any problems for pilots.
   In view of the statement of No Objection from CAA, and the findings by Sintec (2011), pilots were not regarded as sensitive viewers in the rest of the report, although the mitigation and management suggestions deal with impacts on pilots.

1.2.3 Information base

- Documentation supplied by the client and Environamics;
- ToR for the visual specialist;
- Digital topo-cadastral data at 1:50 000 scale from the Surveyor General: Surveys and Mapping;
- Aerial imagery (0.5m resolution) from Department of Rural Development and Land Reform;
- ArcGIS 10 software.
- Google Earth software and data.

1.2.4 Assumptions and limitations

1.2.4.1 Spatial data accuracy

Spatial data used for visibility analysis originate from various sources and scales. Inaccuracy and errors are therefore inevitable. Where relevant these will be highlighted in the report. Every effort was made to minimize their effect.

1.2.4.2 View shed calculations

Initial determination of the view sheds does not take into account the potential screening effect of vegetation and buildings. Since the height of the PV plant structures is less than 3m it is likely that vegetation will play an important role in screening the PV plant from farmsteads and road users. Based on field observations, the screening effect of vegetation was incorporated in the determination of the final view sheds.

1.3 SPECIALISTS

The Visual Impact Assessment for the Waterloo Photovoltaic plant was conducted by Dr Luke Sandham (see Annexure A for CV summary).

He has undertaken this work for DPS79 Solar Energy (Pty) Ltd as independent visual assessment specialist, working in accordance with international and national guidelines for visual impact assessment, and has no vested interest in the proposed project.

1.4 METHODOLOGY

The key steps followed in the visual study are presented below.

1.4.1 Site visit and photographic survey

The field survey (conducted on 11 June 2012) provided an opportunity to:

- Determine the actual or practical extent of potential visibility of the proposed development by assessing the screening effect of landscape features;
- Conduct a photographic survey of the landscape surrounding the development;
- Identify sensitive landscape and visual receptors.

Viewpoints were chosen using the following criteria:

- High visibility – sites from where most of the PV plant will be visible.
- High visual exposure – sites at various distances from the proposed site.
- Sensitive areas and viewpoints such as nature reserves and game farms from which the plant will potentially be seen.

1.4.2 Landscape description

A desktop study was conducted to establish and describe the landscape character of the receiving environment. A combination of Geographic Information System (GIS), literature review and photographic survey was used to analyse land cover, landforms and land use in order to gain an understanding of the current landscape within which the development will take place (The Landscape Institute, 2002). Landscape features of special interest were identified and mapped, as were landscape elements that may potentially be affected by the development.

1.4.3 Visual Impact Assessment

Viewsheds were determined for various components of the proposed development using GIS. The viewsheds and information gathered during the field survey were used to determine the intensity of potential visual impacts on sensitive viewers. All information and knowledge acquired as part of the assessment process were then used to determine the potential significance of the impacts.

1.4.4 Assessment of Significance

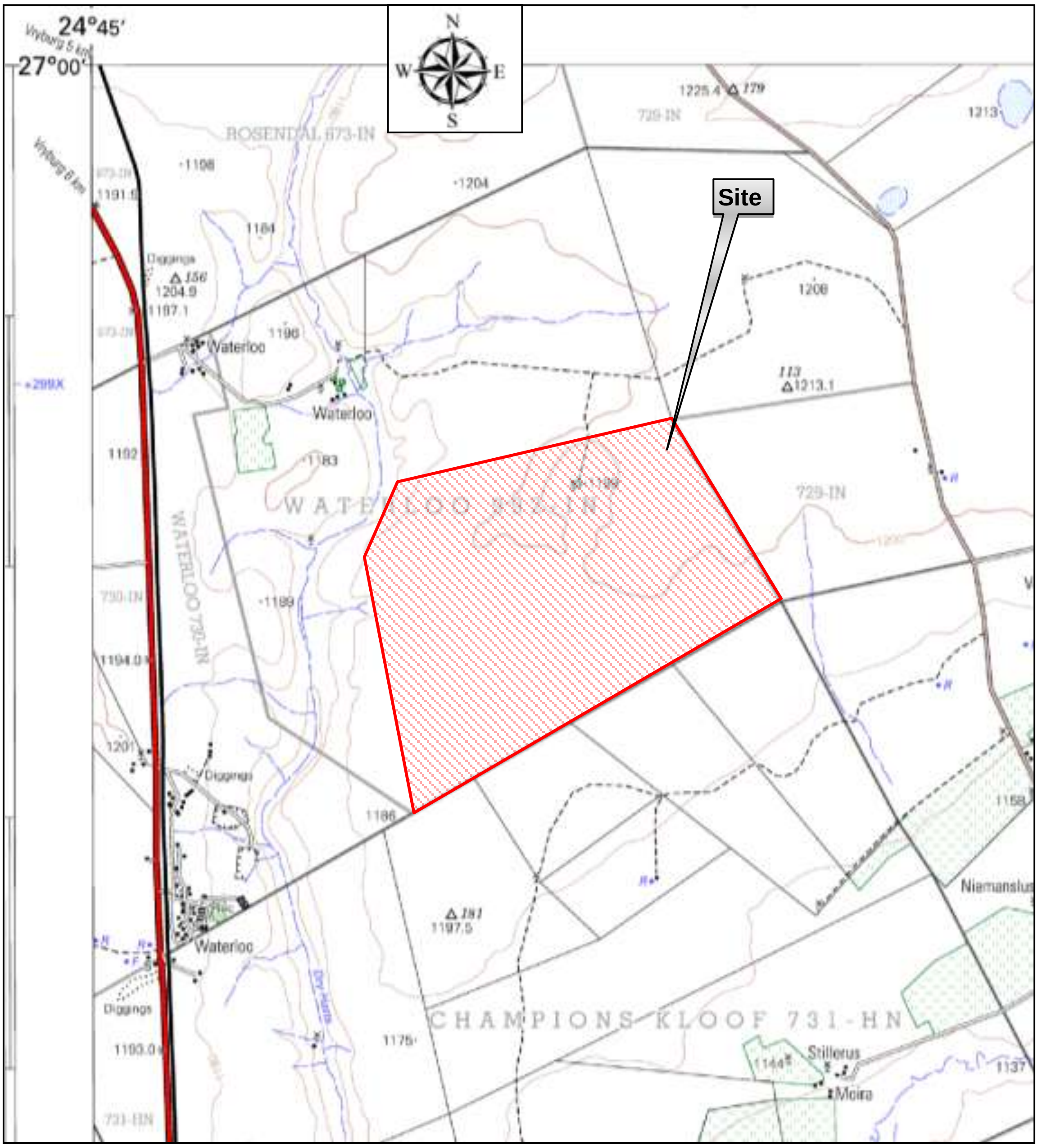
The methodology selected as the ideal approach for the assessment of potential visual impacts was matrix analysis. The matrices highlight areas of particular concern in terms of probability, scale, duration and magnitude of the visual impact. Each impact was evaluated individually n terms of certain criteria and ranking scales, which were then combined to provide a significance value of the potential visual impact. Details are provided in Section 6.

2 PROJECT DESCRIPTION

2.1 OVERVIEW OF PROJECT

(This information is taken from the Draft Scoping Report)
The activity entails the development of a 75MW photovoltaic solar facility and associated infrastructure on a portion of the farm Waterloo 992, Registration Division IN, North West situated within the Naledi Local Municipality area of jurisdiction. The proposed development is located approximately 10 kilometers south of Vryburg. The location of the site is illustrated in Figure 1 below.

Figure 1: Location of site (1:50 000 Topographical Map – 2724BB Lefton)



The project entails the generation of approximately 75MW of electrical power through photovoltaic (PV) panels. The total footprint of the project will be approximately 150 hectares, including supporting infrastructure on site. (See Table 1 for general site information.) The property on which the facility is to be constructed will be leased by DPS79 Solar Energy (Pty) Ltd. from the property owner, the Chris Van Zyl Trust, for the life span of the project (minimum of 20 years).

The site consists of and is surrounded by agricultural land uses, mostly grazing. The topography of the site is gentle with a slope of less than two percent and is described as a flat plateau with a well-developed shrub layer. There is a limited amount of moderately tall vegetation present (up to approximately 4m) in the form of scattered bushes and trees.

Table 1: General site information

Description of affected farm portion	The farm Waterloo 992, Registration Division IN, North West
21 Digit Surveyor General code	T0IN00000000099200000
Title Deed	T2995/1998 – refer to Appendix G7
Photographs of the site	Refer to Appendix B
Type of technology	Photovoltaic solar facility with crystalline silicon panels
Structure Height	Approximately 2.75 meters
Surface area to be covered	150 hectares
Structure orientation	The PV panels will be tilted at a fixed northern angle in order to capture the most sun
Laydown area dimensions	Less than 150 hectares
Generation capacity	75MW
Expected production	150 GWh per annum

2.2 PROJECT COMPONENTS AND ACTIVITIES

2.2.1 Construction of PV plant

The following main components related to construction activity will potentially cause visual impacts:

- Clearing of land for a construction compound and laydown area.
- A site compound for contractors.
- Heavy equipment such as bulldozers, graders, trenching machines and concrete trucks may be required.
- Existing roads will be used to access the sites.

2.2.2 Operational PV plant

The photovoltaic plant consists of a large number of PV modules mounted on approximately 5000 supporting structures. The modules are connected to a number of inverter and transformer cabinets which in turn are connected to a new substation, from where the power will be transmitted via 132kV overhead lines to an existing 132kV power line. The total area covered by the PV plant will be approximately 150ha and none of the components will be higher than 3 m, i.e. a normal house. The site will be fenced and will have security lighting. The proposed layout is included as an appendix to the EIA report.

3 DESCRIPTION OF RECEIVING ENVIRONMENT

3.1 LANDSCAPE BASELINE

Landscape baseline	A description of the existing elements, features, characteristics, character, quality and extent of the landscape (The Landscape Institute, 2002).

The proposed PV plant falls in an area used for grazing and game farming, and the site is therefore considered to have limited environmental sensitivity as a result. The site is currently zoned for agricultural land uses. The National Department of Agriculture (2006) classified land capability into two broad categories, namely land suited to cultivation (Classes I – IV) and land with limited use, generally not suited to cultivation (Classes V – VIII). The site falls within Class V. No sites, features or objects of cultural significance were found in the study area in the heritage impact assessment.

In terms of vegetation type the site falls within the Ghaap Plateau Vaalbosveld vegetation type (Mucina and Rutherford, 2006). Ghaap Plateau Vaalbosveld vegetation is widespread, covering areas of the North West and Northern Cape Provinces. The conservation status of this vegetation type is described by Mucina and Rutherford (2006) as 'least threatened'. The vegetation and landscape features are described as "flat plateau with well-developed shrub layer with *Tarchonanthus camphorates* and *Acacia karroo*". Therefore the loss of vegetation is unlikely to be a significant impact.

3.2 VISUAL ABSORPTION CAPACITY

Visual absorption capacity (VAC)	The capacity of the landscape to conceal the proposed development. The VAC of a landscape depends on its topography and on the type of vegetation that naturally occurs in the landscape. The size and type of the development also plays a role.

Structures associated with the PV plant are not higher than 3m. Therefore, even though the topography is flat, the occurrence of bushes and trees up to approximately 4m will allow for a moderate degree of screening of the PV Plant. The VAC is therefore seen as **low** to **medium**.

4 IDENTIFICATION OF ISSUES AND IMPACTS.

The following potential issues and impacts were identified and will be discussed (among others) in this report:

- Potential impact on views of local residents in close proximity to the development, mainly residents of Tiger Kloof Educational Centre 2 km to the west.
- A section (approximately 3 km) of the N18 passing near to Waterloo between Vryburg and Warrenton will potentially be an issue. Motorists approaching Waterloo will, for that section, be within approximately 2 km of the western boundary of the development site and the western edge of the PV plant may be in partial, distant view.
- There are no protected areas nearby and therefore no such viewpoints that will be influenced by the development.

5 PERMIT REQUIREMENTS

There are no permit requirements related to the potential visual impact.

6 ASSESSMENT AND MITIGATION OF IMPACTS

The assessment and mitigation of impacts is conducted in the following steps:

- Identification of visual impact criteria (key theoretical concepts).

- Assessment of impacts of the project on the landscape and on receptors (viewers) taking into consideration factors such as sensitive viewers and viewpoints, visual exposure, visual intrusion and the value of the visual resource.
- Determination of impact significance.
- Proposal of mitigation measures.

6.1 VISUAL IMPACT CONCEPTS AND ASSESSMENT CRITERIA

Visual impacts	Changes to the visual character of available views resulting from the development that include: obstruction of existing views; removal of screening elements thereby exposing viewers to unsightly views; the introduction of new elements into the viewshed experienced by visual receptors and intrusion of foreign elements into the viewshed of landscape features thereby detracting from the visual amenity of the area

6.1.1 Visual assessment criteria used in assessing magnitude and significance

The potential visual impact of the proposed PV plant was assessed using a number of criteria which provide the means to measure the magnitude and determine the significance of the potential impact (Oberholzer 2005).

- The **visibility** (Section 6.1.2) of the project is an indication of where in the region the development will potentially be visible from. The rating is based on viewshed size only and is an indication of how much of a region will potentially be affected visually by the development. A high visibility rating does not necessarily signify a high visual impact, although it can if the region is densely populated with sensitive visual receptors.
- **Viewer (or visual receptor) sensitivity** (Section 6.1.3) is a measure of how sensitive potential viewers of the development are to changes in their views. Visual receptors are identified by looking at the development viewshed, and include scenic viewpoints, residents, motorists and recreational users of facilities within the viewshed.
- A large number of highly sensitive visual receptors can be a predictor of a high **intensity/magnitude** visual impact although their distance from the development (measured as **visual exposure** – Section 6.1.4) and
- The current composition of their views (measured as **visual intrusion** – Section 6.1.5) will have an influence on the significance of the impact.
- The **value of the visual resource** (Section 6.1.6) indicates the visual quality of the landscape and hence its value as a visual resource to affected viewers..

The impacts in terms of these criteria were combined to deliver a measure of significance.

6.1.2 Visibility

Visibility of Project	The geographic area from which the project will be visible, or view catchment area. (The actual zone of visual influence of the project may be smaller because of screening by existing trees and buildings). This also relates to the number of receptors affected (Oberholzer 2005). • *High visibility* - visible from a large area (e.g. several square kilometres). • *Moderate visibility* – visible from an intermediate area (e.g. several hectares). • *Low visibility* – visible from a small area around the project site.

In this report there is also another sense in which 'visibility' is used. Cumulative viewsheds indicate not only where a feature is visible from (the meaning of visibility as used in the definition above), but also how much of the feature will be visible from that point or area.

Figures 2 and 3 show the spatial extent of areas with potential views of the PV plant. The view catchment covers a large area, which according to the definition above, indicates a **high** visibility. However, within a 2 km radius little of the site is visible, and there are no areas in the catchment where all or most of the site be seen. The bright red areas in Figure 2 indicate where only parts of the site are visible and the largest such area is 2.5 km and further to the west, but due to the low population density of the area, there are very few visual receptors that may be affected by the development. Moreover, due to the location of the site on a slightly elevated plateau, and the fact that the PV structures of the development are less than 3m high, existing and additional vegetation will be effective at screening the development from most of the surrounding area.

Figure 2: Viewshed

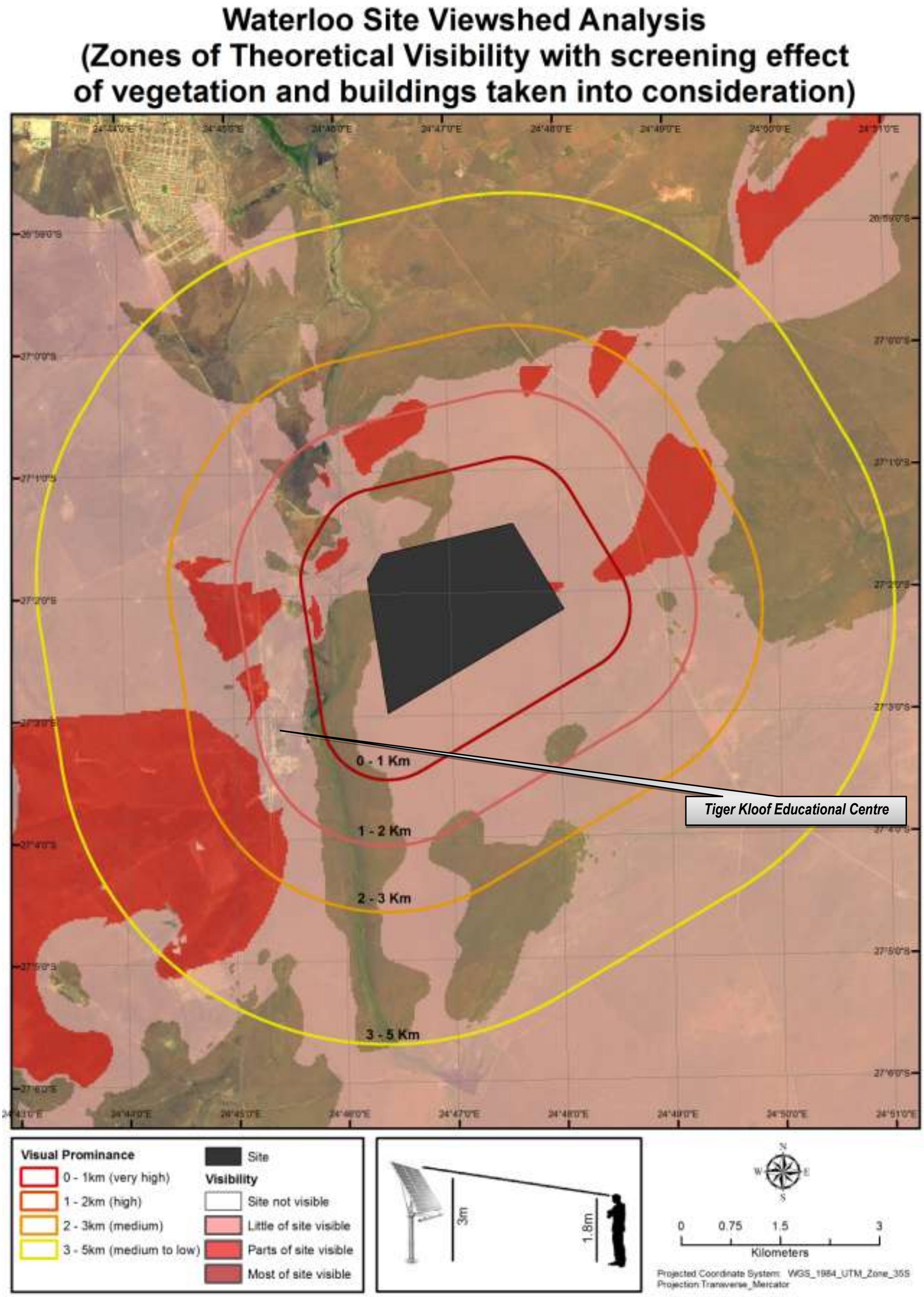
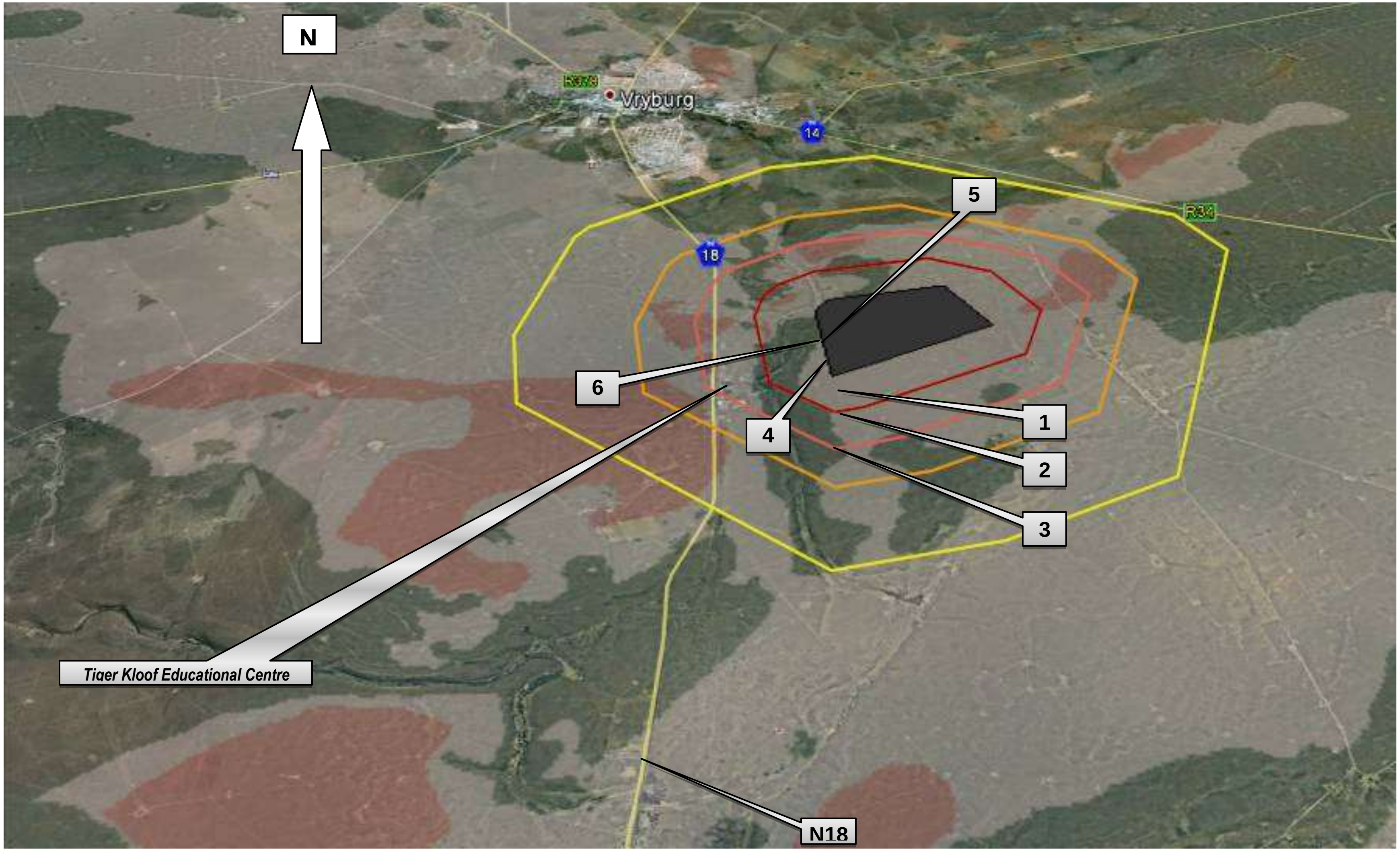


Figure 3: Oblique viewshed



Viewpoints 1 – 9: Arrows indicate direction of site photographs that appear below

Figures 2 and 3 show that the 1 km zone in which the site is most visible occupies the land all around the site. Since this is mostly sparsely populated agricultural land, there are very few receptors. Beyond the 1 km zone the receptors are the residents of Tiger Kloof Educational Centre, and motorists on the N18, for who the view is transient, partial and distant. In addition, since Tiger Kloof and the N18 are located at the same or slightly lower height than the site (1180 m above sea level, only the edge of the facility is likely to be visible, and there will be a significant degree of screening by the 2 km width of land cover on the intervening land.

The erection of a visual screen (fence and vegetation) will substantially reduce the visibility within the 1 km zone. Beyond the 1 km zone, the effect of viewing distance comes into play, as follows:

Viewing distance is a critical factor in the experiencing of visual impacts, as beyond a certain distance, even large developments such as a solar power plant tend to be much less visible, and are hard to differentiate from the surrounding landscape. The visibility of an object is likely to decrease exponentially with increasing distance away from the object. Distance of receptors from the proposed development is also an important factor in the analysis of visual sensitivity, with maximum impact being exerted on receptors at a distance of 500m or less. The impact decreases exponentially as one moves away from the source of impact, with the impact at 1000m being a quarter of the impact at 500m away. At 5000m away or more, the impact would be negligible.

This principle is illustrated below in Figures 4, 5 and 6 with the *simulated* appearance of a solar plant of 3 m height as seen from 500m (Viewpoint 1), 1 km (Viewpoint 2), and 2 km away (Viewpoint 3). The decrease in visibility and visual impact with increasing distance from the object is very noticeable.

Figure 4: Viewpoint 1 (500m) with simulated screening

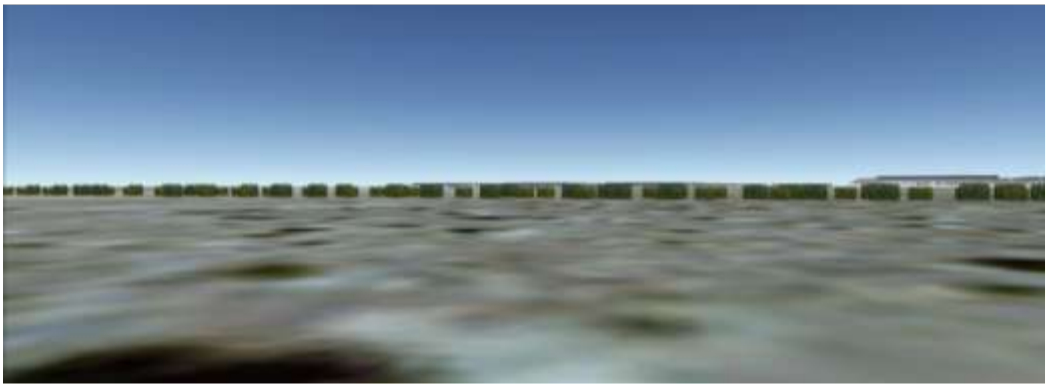


Figure 5: Viewpoint 2 (1km)

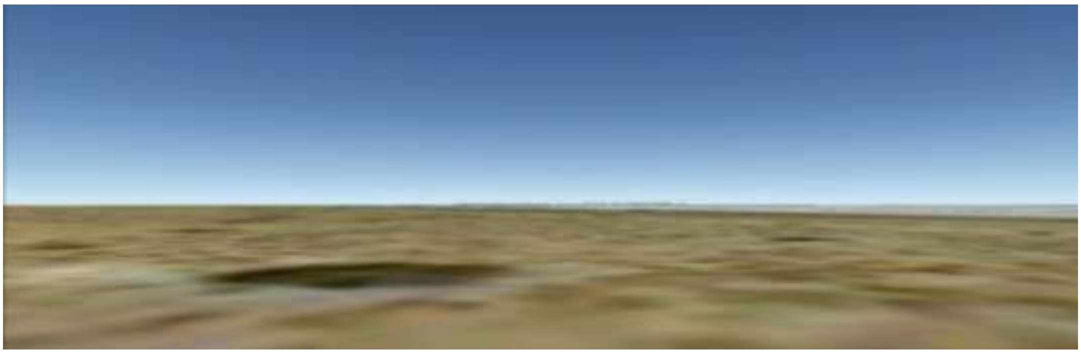


Figure 6: Viewpoint 3 (2 km)

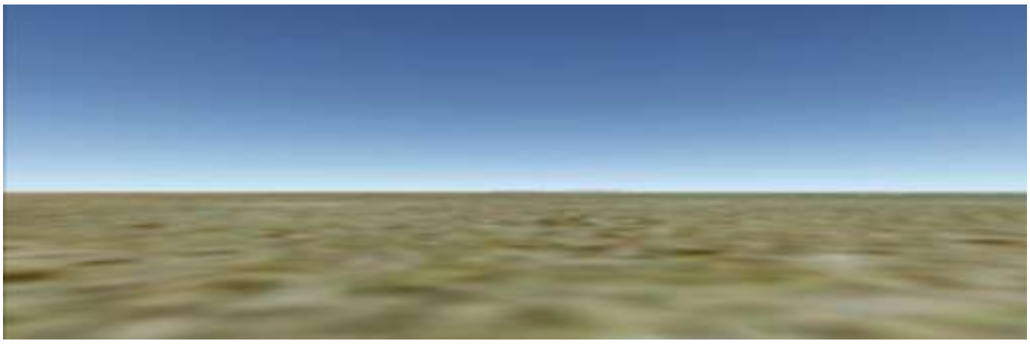
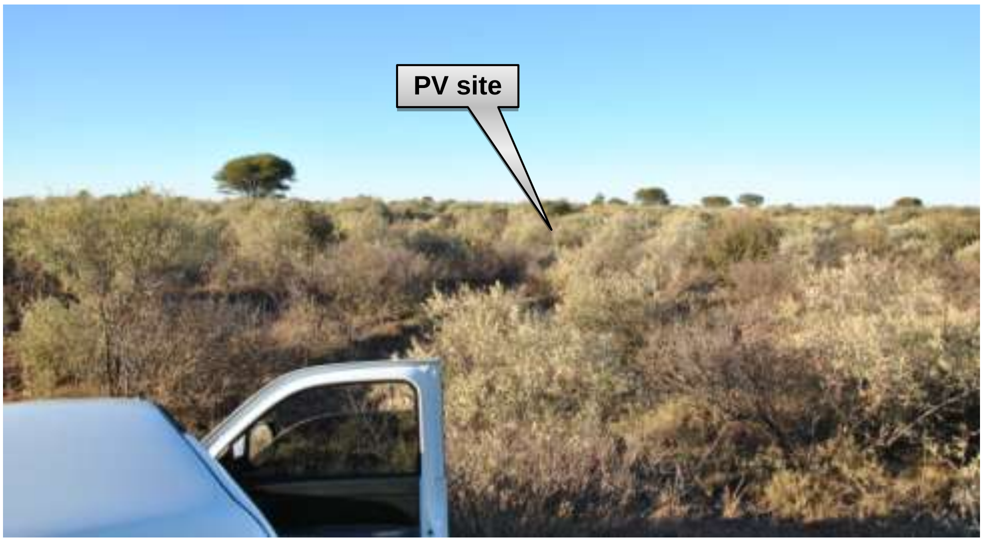


Figure 7: Example of screening effect of trees. View of PV plant site from the south (Viewpoint 4).



The trees and taller bushes provide some screening, and suggest mitigation potential by planting additional indigenous trees and bushes to achieve effective screening.

6.1.3 Sensitive Viewers and Viewpoints

Viewer sensitivity	The assessment of the receptivity of viewer groups to the visible landscape elements and visual character and their perception of visual quality and value. The sensitivity of viewer groups depends on their activity and awareness within the affected landscape, their preferences, preconceptions and their opinions.

A rating system provided by the Landscape Institute of the United Kingdom was used to determine viewer sensitivity:

	Definition (The Landscape Institute, 2002)
Exceptional	Views from major tourist or recreational attractions or viewpoints promoted for or related to appreciation of the landscape, or from important landscape features.
High	Users of all outdoor recreational facilities including public and local roads or tourist routes whose attention may be focussed on the landscape; Communities where the development results in changes in the landscape setting or valued views enjoyed by the community; Residents with views affected by the development
Moderate	People engaged in outdoor sport or recreation (other than appreciation of the landscape).
Low	People at their place of work or focussed on other work or activity; People travelling through or passing the affected landscape on transport routes Views from urbanised areas, commercial buildings or industrial zones;
Negligible (uncommon)	Views from heavily industrialised or blighted areas.

The following sensitive viewers or viewpoints were identified:

- Residents of the Tiger Kloof Educational Centre.
- Motorists using the N18.

- Small number of residents and workers of surrounding farmsteads.

The sensitivity of these groups can be rated as **low,** as explained below..

6.1.3.1 Residents of the Tiger Kloof Educational Centre

The development will potentially be visible from the residents of the Tiger Kloof Educational Centre (2 km to west). Due to distance from the site (see effect of distance on visibility in Section 6.12 above), and also due to the topography which places the PV site at the same height as Tiger Kloof and thereby presents only the edge of the site to view, the sensitivity is rated as low. This effect is illustrated in Figure 8 wher it can be seen that the view is downwards to Tiger Kloof. It must be noted that this is a telephoto view. The “normal” view of Tiger Kloof is presented in Figure 9.

Figure 8: Telephoto view of Tiger Kloof from western edge of site (Viewpoint 5)

Figure 9: Normal view of Tiger Kloof Education Centre 2 km west of the PV site

6.1.3.2 Residents of surrounding areas and farmsteads

The development will potentially be visible from a small number of residents on neighbouring farms, whose viewpoints may be affected by the development. However, due to distance and the small numbers of such people, this area falls in the category of low viewer sensitivity.

Figure 10: View of the site from farmland to the west (Viewpoint 6)

6.1.3.3 Motorists

The N18 runs 2 km to the west of the site. Motorists are seen as low sensitivity visual receptors since they are transient and therefore likely to spend very little time studying the landscape, which will be only a partial, distant view from the N18.

6.1.4 Visual Exposure

Visual exposure	Visual exposure refers to the relative visibility of a project or feature in the landscape (Oberholzer, 2005). Exposure and visual impact tend to diminish exponentially with distance. The exposure is classified as follows: • *High exposure* – dominant or clearly noticeable; • *Moderate exposure* – recognisable to the viewer; • *Low exposure* – not particularly noticeable to the viewer

6.1.4.1 Residents of the Tiger Kloof Educational Centre

The residents of Tiger Kloof will have potentially **moderate** exposure to the project.

6.1.4.2 Residents on surrounding farmsteads

There are very few farmhouses surrounding the site that will have potentially **low** exposure to the project.

6.1.4.3 Motorists

A short section of the N18 will be partially and distantly exposed to the PV plant where it passes 2 km west of the western boundary of the site with potentially **low** exposure to the project.

6.1.5 Visual Intrusion

Visual intrusion	Visual intrusion indicates the level of compatibility or congruence of the project with the particular qualities of the area – its *sense of place*. This is related to the idea of context and maintaining the integrity of the landscape (Oberholzer 2005). It can be ranked as follows: • *High* – results in a noticeable change or is discordant with the surroundings; • *Moderate* – partially fits into the surroundings, but is clearly noticeable; *Low* – minimal change or blends in well with the surroundings.

6.1.5.1 Residents of the Tiger Kloof Educational Centre

Residents of Tiger Kloof Education Centre currently have some elements common to this development in some of their views, including main roads (N18) and power lines. They will experience **low** visual intrusion due mainly to distance from the site (see effect of distance on visual intrusion in Section 6.12 above), and also due to the topography which places the PV site at the same height as Tiger Kloof and thereby presents only the edge of the site to view.

6.1.5.2 People on surrounding farmsteads

Residents and workers on surrounding farmsteads currently have some elements common to developments in some of their views, including main roads (N18) and power lines. They will experience **low** visual intrusion due mainly to distance from the site (see effect of distance on visual intrusion in Section 6.12 above), and also due to the topography which places the PV site at the same height or higher than and thereby presents only the edge of the site to view.

6.1.5.3 Motorists

Motorists driving on the N18 between Vryburg and Warrenton will experience **low** visual exposure and intrusion for a short section (3-4 km) as the road approaches from the north and the south. Photovoltaic panels may be partially and distantly visible (Figure 10) for a very brief period.

6.1.6 Visual resource value

Value of the visual resource	This provides an indication of the value attached to the landscape as a visual resource. A quality ranking scale is often used. This ranks landscapes terms of visual quality from very high or irreplaceable, down to really poor and in need of improvement, such as in badly degraded urban areas,

Table 2: Landscape as a visual resource. (After Hankinson, 1999: 357)

Criteria	Descriptions
Irreplaceable	Pristine landscapes, with the only change by humans resulting from very low intensity 'hunter-gatherer' uses
Above average	Wild and remote landscapes, with a high proportion of original land cover and with human influence small-scale, e.g. subsistence agriculture in limited locations renewable logging systems
Renewable, average	Managed landscapes, strongly related to underlying geology, with the use of predominantly local materials in structures. Long-term, consistent management giving a traditional character to the landscape
Improvable	Ordinary, pleasant countryside, taking its inherent character from underlying geology, soil and climate, but with a predominantly human-influenced land cover. Most agricultural land and managed forests
Seriously degraded and able to be substantially improved	Degraded landscapes, with abandoned land uses, piecemeal development, visually intrusive features, such as pylons. Urban fringe. Landscapes substantially degraded by human uses, with permanent change to soil (e.g. built over, erosion or peat accumulation) such that potential productivity is substantially reduced Seriously damaged, derelict or polluted landscapes, not capable of a return to a productive land use (in either ecological or human terms) without high inputs

6.1.6.1 Residents of Tiger Kloof, surrounding farmsteads and motorists

The site falls very clearly in the second lowest category i.e. it is improvable. It is therefore of low visual quality and hence of low value as a visual resource, to all of the affected visual receptors i.e. the occupants of Tiger Kloof, surrounding farms, and motorists making use of the roads.

Table 3: Summary of potential visual impacts

Criteria	***Impact***
Viewer Sensitivity	Residents of Tiger Kloof Education Centre – **Low** sensitivity due to distance from the site and topography. Occupants of surrounding farms – **Low** sensitivity due to distance from the site. Motorists – **Low** sensitivity due to distance from the site and short exposure time and the fact that their focus on landscape is reduced.
Visibility of Development	**High** due to the large spatial extent of the plant (approx. 150 ha).
Visual Exposure	**Moderate** for Tiger Kloof and closest farmsteads due to distance effect beyond 1 km. Motorists – **low** for approximately 4 km of the N18.
Visual Intrusion	**Low** for those with high visual exposure but living further away, due to distance effect. Motorists – **Low** for a 4 km section of the N18.
Value of visual resource	**Low** value since the area is ordinary farming countryside and improvable. The anticipated change of this view will not constitute a serious loss of the visual resource.

6.2 SIGNIFICANCE OF VISUAL IMPACTS ON VIEWERS

The relative significance of the visual impacts have to be determined. For this VIA the following criteria and ranking scales were selected:

Probability of the impact – an assessment of the degree of certainty underlying the potential impact. A value is used to denote the degree of confidence:
- 5 – Definite occurrence
- 4 – Highly probable occurrence
- 3 – Medium probability
- 2 – Low probability
- 1 – Improbable
- 0 – None

Scale / extent of the impact - A value is used to indicate extent:
- 5 – International
- 4 – National
- 3 – Regional
- 2 – Local
- 1 – Site specific
- 0 – None

Duration of the impact – an indication of when the effect will be felt. A value is used to denote the duration:
- 5 – Permanent
- 4 – Long term (impact ceases after the operational live of the activity)
- 3 – Medium term (5 – 15 years)
- 2 – Short term (0 – 5 years)
- 1 – Immediate
- 0 – None

Magnitude of the impact – A value is used to denote the intensity of the impact
- 10 – Very high
- 8 – High
- 6 – Moderate
- 4 – Low
- 2 – Minor

Once the above factors have been ranked for each impact, the significance of each was assessed using the following formula:

Significance = (probability + duration + scale) x magnitude

The maximum value is 150 Significance Points (SP). Visual impacts were rated as high, moderate or low on the following basis: More than 75 SP indicates ‘high visual impact significance'; Between 50 and 75 SP indicates 'moderate visual impact significance'; less than 50 SP indicated 'low visual impact significance'. The outcome of the scoring is presented in Table 9.

6.2.1 Construction phase: Potential visual impacts of constructing a PV plant

Significance was calculated using the methodology outlined above.

Table 4: Significance of visual impacts in construction phase

Nature of Impact: ***Potential visual impact on residents of farmsteads and motorists in close proximity to proposed facility***		
	No mitigation	***Mitigation considered***
Probability	Highly probable (4)	Highly probable (4)
Duration	Short term (2)	Short term (2)
Scale / Extent	Local (2)	Local (2)
Magnitude	High (8)	Low (4)
Significance	Moderate (64)	Low (32)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Recoverable	Recoverable
Irreplaceable loss of resources?	No	No
Mitigation: Dust suppression; prevention of fires and erosion scarring, control of lighting; screening		
Cumulative impacts; The construction of the PV plant and ancillary infrastructure may eventually increase the cumulative visual impact of industrial type infrastructure within the region. This is not yet relevant in light of relatively low level occurrence of such infrastructure. However, cumulative impacts are best addressed at the level of Strategic Environmental Assessment.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

6.2.1.1 Significance Statement

The probability of the impact occurring is *probable* since the scale of construction is similar to that of other structures already in the view shed, such as power line pylons and substations. The duration for the impact is *short term* - it is expected that construction should be complete within 2 years. The extent of the impact is *local* since it is unlikely that construction activity will be noticed from further than 5km away. The magnitude of the impact is expected to be *high* due to the nature of the development. The overall significance of the visual impact without mitigation is **moderate**.

However, if mitigation is properly implemented, the significance is reduced to **low**, since the number of sensitive visual receptors is reduced, and because this is not a visual resource of high value.

Figure 11. PV plant construction.

6.2.1.2 Mitigation Measures

There is good screening opportunity since the land is slightly elevated, relatively flat and with scattered trees and bushes. Generation of dust will increase the visibility of the project, and it is therefore important to employ techniques to suppress dust generation during construction. Measures include:

- Dust suppression is important as dust will raise the visibility of the development.
- New road construction should be minimised and existing roads should be used where possible.
- The contractor should maintain good housekeeping on site to avoid litter and minimise waste.
- Although there are no readily erodible slopes on the site, erosion risks should be assessed and minimised as erosion scarring can create areas of strong visual contrast with the surrounding vegetation, which can often be seen from long distances since they will be exposed against the hill slopes.
- Mitigation of lighting impacts includes the pro-active design, planning and specification lighting for the facility by a lighting engineer. The correct specification and placement of lighting and light fixtures for the PV plant and the ancillary infrastructure will go far to contain rather than spread the light.
- Fires and fire hazards need to be managed appropriately.
- Screening should be implemented by erection of the security fence, and by retaining existing and establishing additional vegetation. The growth of vegetation will improve screening into the operational phase.

6.2.2 Operational phase: Potential visual impact of operation a PV plant

Table 5: Significance of visual impacts in operational phase

Nature of Impact: ***Potential visual impact on residents of farmsteads and motorists in close proximity to proposed facility***		
	No mitigation	***Mitigation considered***
Probability	Highly probable (4)	Highly probable (4)
Duration	Long term (4)	Long term (4)
Scale / Extent	Local (2)	Local (2)
Magnitude	High (8)	Low (4)
Significance	Moderate (80)	Low (40)
Status (positive, neutral or negative)	Negative	Negative
Reversibility	Recoverable	Recoverable
Irreplaceable loss of resources?	No	No
Mitigation: Control of lighting; screening		
Cumulative impacts; The operation of the PV plant and ancillary infrastructure may eventually increase the cumulative visual impact of industrial type infrastructure within the region. This is not yet relevant in light of the relatively infrequent level occurrence of such infrastructure in this region. However, cumulative impacts are best addressed at the level of Strategic Environmental Assessment.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

6.2.2.1 Significance Statement

The probability of the impact occurring is **high**. Duration is **long term** (a lifetime of at least 20 years is envisaged after which most of the installation can be dismantled and removed, or refurbished for another term).The extent of the impact is **local** due to the nature of the development – it is unlikely to be noticed in the landscape from more than 5km away (it will have low visual intrusion). The magnitude of the impact is expected to be *high* due to the nature of the development. The overall significance of the visual impact without mitigation is **moderate**.
In view of the low visual value of the site, and if mitigation is properly implemented the number of sensitive visual receptors is reduced, and therefore the significance is reduced to **low**.

6.2.2.2 Mitigation Measures

- Solar panels have the potential for “glint” or “glare” effects on viewers. However, PV solar panels are designed to be highly absorbent and therefore have minimal glint and glare (Sintec, 2011), in contrast to Concentrated Solar Power (CSP) plants that rely on mirrors. It is particularly important that glare does not affect motorists on the N18 approaching Waterloo from Warrenton or Vryburg, nor pilots landing aircraft at Vryburg aerodrome to the east. However, since the N18 is 2 km west of the site and the panels will be tilted north to optimise solar influx, there is reduced likelihood of glare or glint affecting motorists on the N18. Moreover, Sintec (2011) have shown that despite many such PV plants operating at or near major airports in the USA for several, there have been no reports of glare or reflection causing any problems for pilots, and therefore an even lower likelihood of adverse effects on motorists.
- Structures must be limited to a height of no more than 3m.
- Mitigation of lighting impacts includes the pro-active design, planning and specification lighting for the facility by a lighting engineer. Security lighting should make use of

down-lights to minimise light spill, and motion detectors where possible so that lighting at night is minimised. Care should be taken with the layout of the security lights to prevent motorists on the N18 from being blinded by lights at the approach to Waterloo.

- Screening should be implemented by means of vegetation in conjunction with security fencing.

6.2.3 Decommission phase: Potential visual impact of decommissioning a PV plant

Table 6: Significance of visual impacts in decommissioning phase

Nature of Impact: ***Potential visual impact on visual receptors in close proximity to proposed facility***		
	No mitigation	***Mitigation considered***
Probability	Highly probable (4)	Highly probable (4)
Duration	Short term (2)	Short term (2)
Scale / Extent	Local (2)	Local (2)
Magnitude	High (6)	Low (4)
Significance	Moderate (48)	Low (32)
Status (positive, neutral or negative)	Positive	Positive
Reversibility	Recoverable	Recoverable
Irreplaceable loss of resources?	No	No
Mitigation:		
Cumulative impacts; Reduction in potential cumulative impact		
Residual impacts: None. The visual impact will be removed after decommissioning.		

6.2.3.1 Significance Statement

Decommissioning will constitute an overall *positive* visual impact of **low** significance due to removal of the original visual intrusion and rehabilitation to its state prior to development of the PV plant.

7 CONCLUSIONS AND RECOMMENDATIONS

The construction and operation of the Proposed PV Solar Energy Facility and its associated infrastructure will have a limited visual impact on the visual environment within 2 km of the proposed facility.

However, it is important to note that this facility has an advantage over other more conventional power generating plants (e.g. coal-fired power stations). The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The plant is an unfamiliar but novel facility that invokes a curiosity factor not generally present with other conventional power generating plants. The advantage is that the facility can become an attraction or a landmark within the region that people would actually want to come and see, particularly students at the Tiger Kloof Educational Centre. As it is impossible to completely hide the facility, the only option would be to promote it as an alternative and sustainable energy facility.

But these positive aspects should not distract from the fact that the facility would be visible within an area that incorporates certain sensitive visual receptors, including residents of Tiger Kloof Educational Centre and farmsteads, and motorists and tourists using the N18 national road.

In view of the moderately low visual value of this landscape, the small numbers of sensitive receptors, and the strategic importance of developing sustainable energy alternatives, the significance of the overall visual impact of this development can be regarded as low.

It is therefore recommended that the development of the facility as proposed be supported, subject to the implementation of the recommended mitigation measures (Section 6) and management actions (Section 8).

8 DRAFT IMPACT MANAGEMENT PLANS

The draft management plans aim to summarise the key findings of the visual impact report and to suggest management actions in order to mitigate the potential visual impacts.

Table 7: Management plan - Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the proposed Waterloo PV plant.		
Project components	Construction site	
Potential Impact	Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing and resulting erosion.	
Activity risk source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Minimal visual intrusion by construction activities and intact vegetation cover outside of immediate works areas.	
Mitigation: Action control	Responsibility	Timeframe
Consult a lighting engineer in the planning and placement of light fixtures for the facility.	Applicant, design consultant	Construction
Reduce the construction period through careful planning and productive contractor implementation of resources	Applicant /contractor	Construction
Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing.	Applicant /contractor	Construction
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	Applicant /contractor	Construction
Ensure that rubble, litter and disused construction materials are managed and removed regularly.	Applicant /contractor	Construction
Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way	Applicant /contractor	Construction
Reduce and control construction dust through the use of approved dust suppression techniques	Applicant /contractor	Construction
Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.	Applicant /contractor	Construction
Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards	Applicant /contractor	Construction
Screening should be implemented by means of vegetation in conjunction with security fencing.	Applicant /contractor	Construction
Performance indicator	Vegetation cover in the vicinity of the site is intact with no evidence of degradation or erosion; visibility of plant is effectively screened.	
Monitoring	Monitoring of rehabilitated areas post construction.	

Table 8: Management plan - Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the proposed Waterloo PV plant.		
Project components	PV plant and ancillary infrastructure (i.e. substation, internal access roads and office).	
Potential Impact	Primary visual impact of the facility including lighting at night, facility degradation and vegetation rehabilitation failure, and failure of screening elements (plants and fence).	
Activity risk source	The viewing of the potential impact by observers on or near the site as well as within the region.	
Mitigation: Target/Objective	Optimal planning of infrastructure so as to minimise visual impact.	
Mitigation: Action control	Responsibility	Timeframe
Maintain the general appearance of the facility in an aesthetically pleasing way, including screening elements	Applicant, design consultant	Operation
Monitor rehabilitated areas, and implement remedial action as and when required	Applicant, operator	Operation
Performance indicator	Well maintained and neat facility with intact vegetation on and in the vicinity of the facility	
Monitoring	Monitoring of rehabilitated areas and of efficacy of screening elements	

Table 9: Management plan - Decommissioning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the Proposed Waterloo PV plant.		
Project components	PV plant and ancillary infrastructure (i.e. substation, internal access roads and office).	
Potential Impact	Visual impact of residual visual scarring and vegetation rehabilitation failure	
Activity risk source	The viewing of the potential impact by observers on or near the site as well as within the region.	
Mitigation: Target/Objective	Infrastructure required for post decommissioning use of the site retained and rehabilitated vegetation in all disturbed areas	
Mitigation: Action control	Responsibility	Timeframe
Remove infrastructure not required for the post-decommissioning use of the site,	Applicant, operator	Operation
Rip and rehabilitate access roads not required for the post-decommissioning use of the site.	Applicant, operator	Operation
Monitor rehabilitated areas, and implement remedial action as and when required	Applicant, operator	Operation
Performance indicator	Site with intact vegetation on and in the vicinity of the facility.	
Monitoring	Monitoring of rehabilitated areas	

9 REFERENCES

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Annexure A: *Curriculum vitae of specialist*

Dr Luke Sandham

Environmental Specialist

PERSONAL DETAILS:

Name:	***Luke Sandham***
Date of Birth:	***15 Sept 1956***
Nationality:	***South African***
Profession:	***Academic and Environmental Assessment Practitioner (EAP)***

POSITION WITH NWU:

Associate Professor

ACADEMIC QUALIFICATIONS:

M Sc, Ph.D

REGISTRATIONS:

IAIA, SSAG

KEY QUALIFICATIONS:

Doctor of Philosophy (Ph.D), Geography
Master of Science (M.Sc)
Both from former Rand Afrikaans University (RAU),currently the University of Johannesburg, South Africa

Registered at:
International Association for Impact Assessment (IAIA)
Society of South African Geographers (SSAG)

MAJOR PROJECT EXPERIENCE:

Dr Sandham has focused his research on the quality of EIA Reports in South Africa.

His experience with EIA processes and the intricacies around effectiveness flows from his involvement in research, teaching and consultation in Environmental Impact Assessment.

He has acted as EAP for over 60 EIA and Section 24G Rectification applications for a range of different activities in three provinces.

He has conducted extensive reading in the UK and Netherlands on Visual impact assessment, conducted a number of Visual Impact Assessments, and reviewed and authored various Visual Impact Assessment Reports.

He has taught EIA at honours and masters level for 10 years.

In addition, he has supervised several post graduate studies in various aspects of EIA effectiveness, with a particular focus on EIA report quality, as well as current studies on effectiveness of Social Impact Assessment in South Africa.

He is a co-founder of the Environmental Assessment Research Group at the NWU which specializes in research on the following four assessment themes: quality, efficiency, effectiveness and cost of EIA. Emanating from the research conducted in this group, he has made numerous conference presentations on these topics and published several internationally peer-reviewed papers on EIA effectiveness, with further articles in preparation.

This experience has ensured valuable insight in terms of EIA practice and extensive exposure to the practical complexities of EIA.