PROPOSED SAN SOLAR ENERGY FACILITY & ASSOCIATED INFRASTRUCTURE ON A SITE NEAR KATHU, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT

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MetroGIS (Pty) Ltd, specialists in visual impact assessments and Geographic Information Systems, undertook this visual assessment.

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

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

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

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the proposed San Solar Energy Facility. Neither the author nor MetroGIS will benefit from the outcome of the project decision-making.

1. INTRODUCTION

San Solar Energy Facility (Pty) Ltd is proposing the establishment of the **San Solar Energy Facility** on a portion of Portion 4 of the farm Wincanton 472, which lies approximately 16 km north west of Kathu in the Northern Cape Province.

The proposed site for the San Solar Energy facility is located east of a railway line that dissects the farm Wincanton 472. The portions 6 and 4 of this farm, located west of the railway line, have been earmarked for the development of the **Sishen Solar Energy Facility** and the **Kathu Solar Energy Facility** respectively.

These two solar facilities have, to the author's knowledge, been authorised following the Environmental Impact Assessment process undertaken during November/December 2010. Please refer to the maps displayed in this report for the location of the aforementioned solar energy facilities in relation to each other and in terms of their regional locality.

The proposed development site lies within the Gamagara Local Municipality within the Kgalagadi District Municipality in the Northern Cape Province. It is located approximately 16km (at the closest) north-west of Kathu and roughly 6km north east of Dibeng.

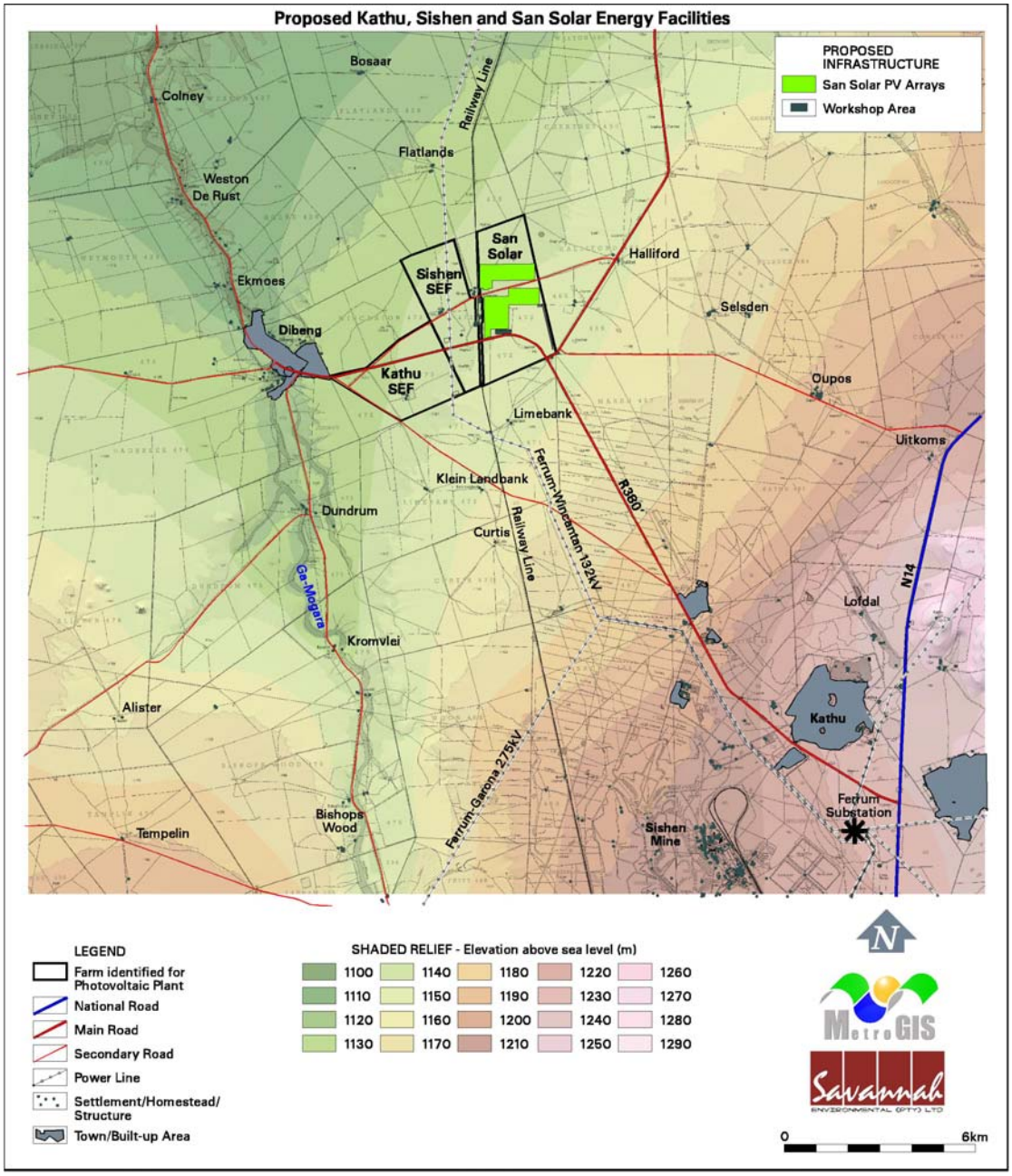
Photovoltaic technology is used to generate electricity by converting solar radiation into direct current electricity using semiconductors (i.e. silicon) through the photovoltaic effect. PV technology refers to the use of multiple PV cells which are linked together to form PV panels. The proposed PV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

The facility is proposed to have a maximum generating capacity of up to 75MW and will be comprised of photovoltaic (PV) panels strategically placed on a portion of the proposed site. An area of approximately 800ha in extent is being investigated within the EIA process within which the facility is proposed.

A provisional layout of the proposed solar energy facility (SEF) is shown on **Map 1**, indicating the PV panel arrays. Ancillary infrastructure includes the following:

- An on-site generator transformer and a single substation to facilitate the connection between the solar energy facility and the Eskom electricity grid;
- An overhead power line;
- Internal access roads (~4m x 5000m);
- Gate house and security (~6m x 6m);
- Warehouse (~30m x 15m);
- Canteen and change rooms (~20m x 10m);
- Office and control centre (~20m x 15m).

The construction phase of the solar energy facility is expected to be 26 months whilst the design lifespan of the facility is 30 years, extendible.



Map 1: Locality and shaded relief map of the broader study area (indicating the layout of the proposed San Solar SEF as well as the authorised Sishen and Kathu solar energy facilities).

2. SCOPE OF WORK

The study area for the visual assessment encompasses a geographical area of 812km^2 (extent of the maps) and includes a minimum 16km buffer zone from the proposed development area.

It includes the towns of Kathu and Dibeng, part of the Sishen iron ore mine as well as sections of the N14 national road, the R380 arterial road and a number of secondary (local) roads. See **Map 1**.

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

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

- The visibility of the solar energy facility to, and potential visual impact on, observers travelling along the N14 national road, the R380 arterial road and the secondary roads in close proximity to the proposed facility.
- The visibility of the solar energy facility to, and potential visual impact on, residents of Dibeng and individual/isolated landowners/homesteads located within areas of potential visual exposure. Some of these may include: *Limebank, Curtis, De Rust, Weston, Colney, Bosaar, Flatlands, Wincanton, Selsden, Halliford, Lyndoch, Oupos, Uitkoms, Lofdal, Bishops Wood, Tempelin,* etc.
- The visibility of the facility to, and potential visual impact on tourist routes, with specific reference to the N14.
- The potential visual impact of the construction of ancillary infrastructure (i.e. the various buildings, inverters, substation, power line, fence and internal access roads) on observers in close proximity to the facilities.
- The potential visual impact of operational, safety and security lighting of the facilities at night on observers residing in close proximity to the facility.
- Potential cumulative visual impacts (or alternately, consolidation of visual impacts).
- The visual absorption capacity of the natural vegetation (if applicable).
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts.

3. METHODOLOGY

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

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

The approach utilised to identify issues related to the visual impact included the following activities:

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

This report (visual impact assessment) sets out to identify and quantify the possible visual impacts related to the proposed San Solar Energy Facility and its related infrastructure mentioned above, as well as offer potential mitigation measures, where required.

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

- **Determine potential visual exposure**

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

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

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

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

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

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

- **Determine viewer incidence / viewer perception**

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

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

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

- **Determine the visual absorption capacity**

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

  The VAC would also be high where the environment can readily absorb the structure in terms of texture, colour, form and light / shade characteristics of the structure. On the other hand, the VAC for a structure contrasting markedly with one or more of the characteristics of the environment would be low.

  The VAC also generally increases with distance, where discernable detail in visual characteristics of both environment and structure decreases.

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

- **Determine the visual impact index**

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

4. THE AFFECTED ENVIRONMENT

The identified site for the proposed San solar energy facility is located on the remaining extent of Wincanton 472, measuring approximately 9km².

The site is located east of Dibeng and approximately 18km by road (along the R380) north-west of Kathu in the Southern Kalahari of the Northern Cape Province.

The topography of the study area is described as *plains* and elevations range from 1100m in the north west to 1290m in the south-east of the study area.

The Ga-Mogara non-perennial river (a dry river bed for most of the year) is the most prominent hydrological feature within this arid region. See **Map 1** for the shaded relief/topography map of the study area.

The area is sparsely populated (less than 5 people per km^2), with the highest concentrations occurring in the towns of Kathu and Dibeng, and at the Sishen Mine.

Cattle and game farming is undertaken within the study area, with very little agricultural activity due to the scarcity of perennial water (for irrigated agriculture) and the low annual rainfall (for dryland agriculture).

Land cover is predominantly *thicket and bushland* with large areas of *woodland* in the north east of the study area, and also scattered throughout the south west. The vegetation type is *Kalahari thornveld and shrub bushveld.*

Figure 1: Typical vegetation occurring in the vicinity of the proposed solar energy facility.

Significant tracts of land in the south of the study area have been transformed by mining and prospecting activities. See **Map 2** for the broad land cover types map of the study area.

In addition to the towns and the mine settlements, a number of isolated homesteads occur throughout the study area, usually located along or in close proximity to the national road (N1), arterial road (R380) or secondary roads.

It is uncertain whether all of the potentially affected homesteads are inhabited or not. It stands to reason that farmsteads that are not currently inhabited will not be visually impacted upon at present. These farmsteads do, however retain the potential to be affected visually should they ever become inhabited again in the future. For this reason, the author of this document operates under the assumption that they are all inhabited.

Infrastructure in the area is focussed around the Kumba (Exxaro) Sishen iron ore mine located south-west of Kathu. The expansion of the town of Kathu and most of the larger settlements within the study area are mainly attributed to the mine.

Figure 2: Visual quality on the outskirts of the town of Dibeng, west of the proposed solar energy facility.

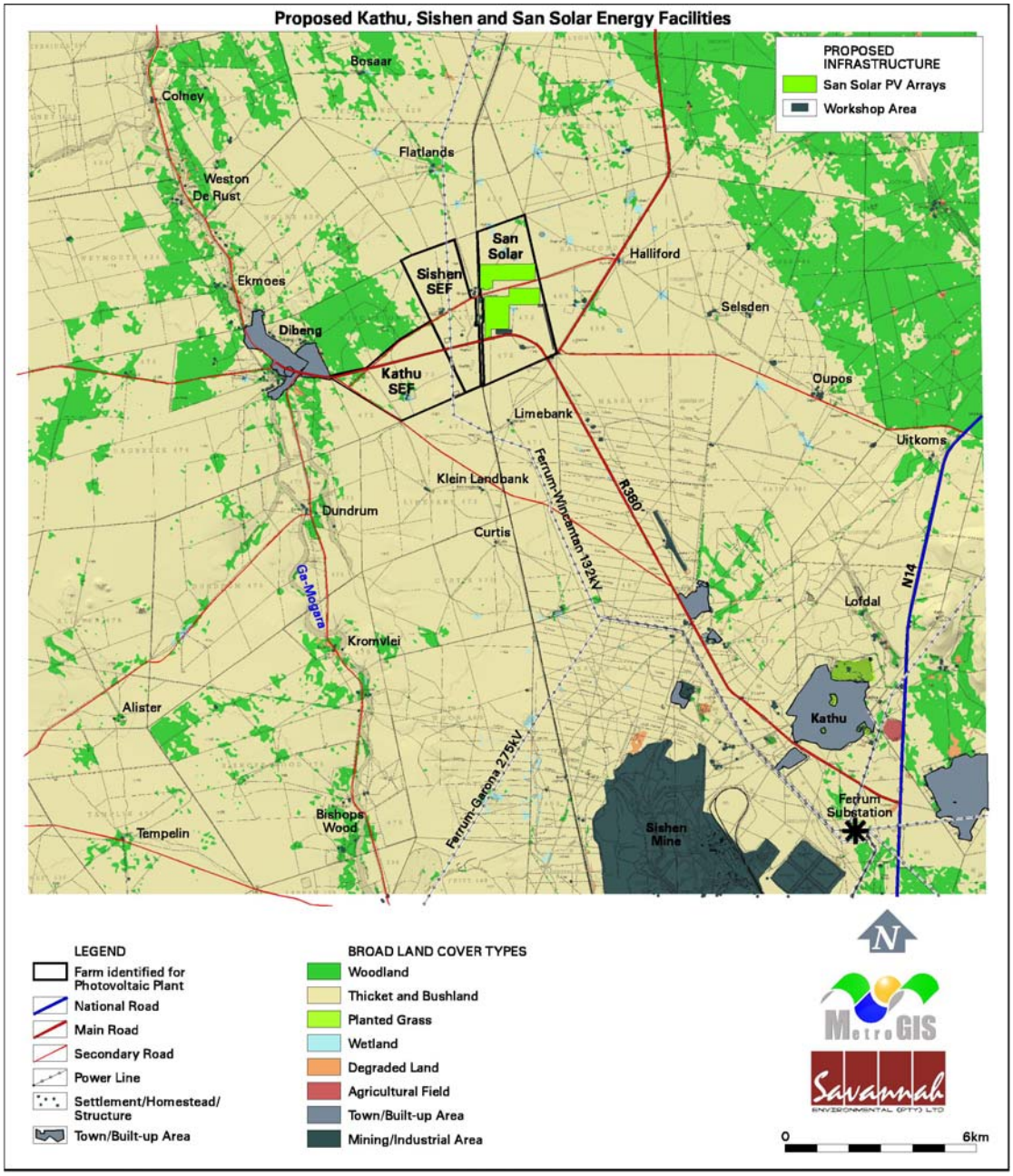
The Eskom Ferrum substation is located south of Kathu and a number of power lines, namely the Ferrum-Garona 275kV transmission line and the Ferrum-Wincantan 132kV distribution line, traverse the study area. The latter traverses west of the farm earmarked for the proposed solar energy facility.

The Sishen-Saldanha railway line bypasses the proposed solar energy facility site on its western boundary.

Figure 3: Visual quality of the receiving environment with railway line infrastructure evident in the foreground.

No formally protected areas or major tourist attractions were identified within the study area.

Sources: DEAT (ENPAT Northern Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland) and NLC2000 (ARC/CSIR).



Map 2: Land cover types and vegetation cover of the broader study area

5. RESULTS

5.1 Potential Visual Exposure

The visibility analysis was undertaken from actual ground level at an offset of 6m (the approximate maximum height of the photovoltaic panels). The development footprint areas were used (i.e. based on the preliminary layout of the proposed solar energy facility) in order to simulate a worst-case scenario.

The potential visual exposure of the facility is indicated on **Map 3.** The shading indicates areas from which the facility would potentially be visible.

It is evident from the viewshed analyses that the proposed solar energy facility would have a relatively large area of potential visual exposure due to the flat topography of the site and its surrounds.

The following is relevant in terms of potential visual exposure:

- The solar energy facility will potentially be visible from almost the entire area surrounding the development site, including a number of homesteads. Small areas protected from potential visual impact lie to the west and south west of this zone.

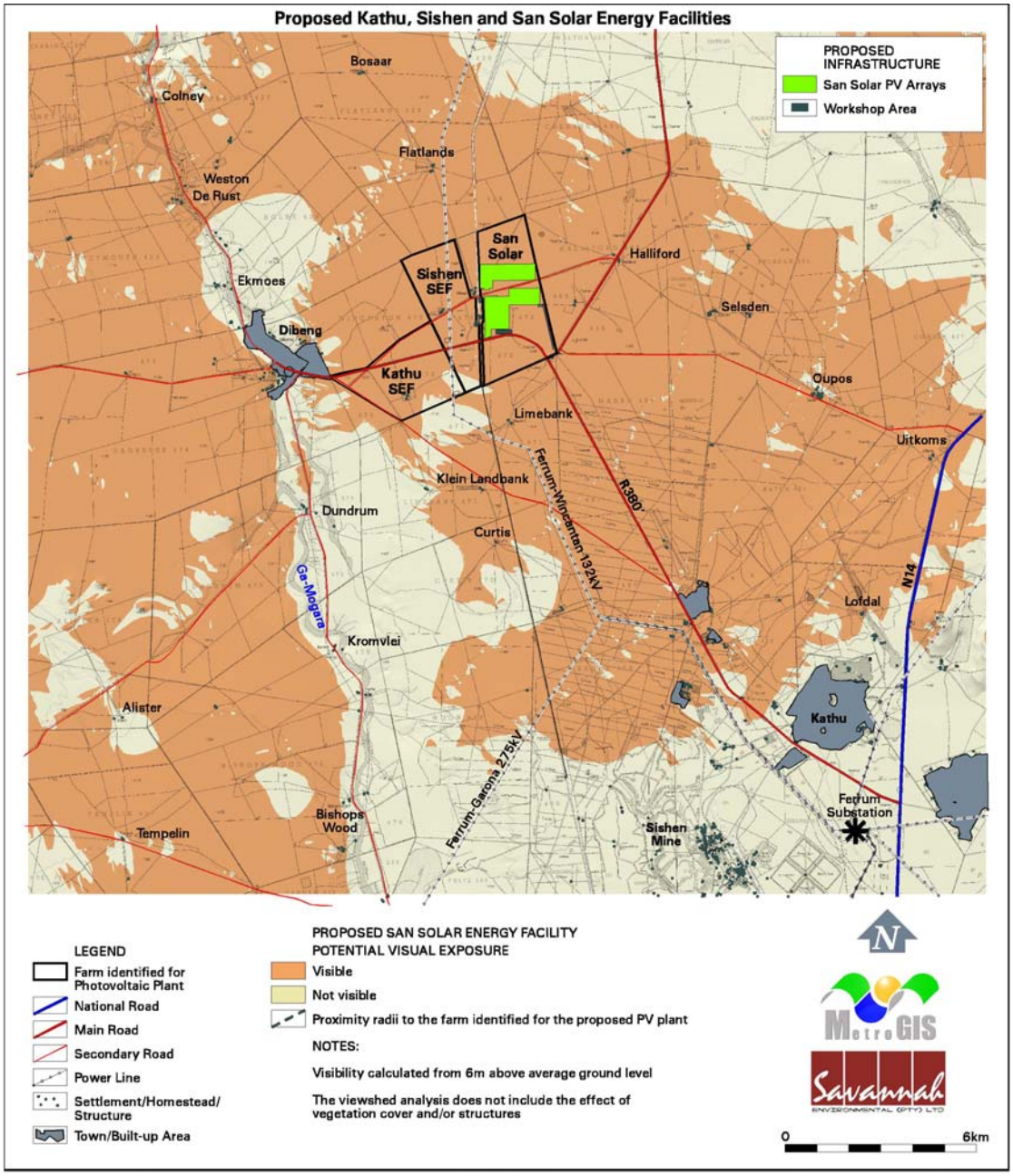
- The viewshed for the proposed solar energy facility diminishes somewhat between 3km and 6km from the facility. Within this zone, areas potentially exposed to visual impact lie primarily in the north west, the west, the east and the south east. A number of homesteads will potentially be exposed to visual impact.

- Beyond the 6km radius, potential visual exposure is further reduced. Again, only a handful of homesteads and the north western outlying parts of Kathu will be exposed to potential visual impact. Kathu itself and the Sishen Mine will not be exposed, nor is it expected that observers at Dibeng would have unobstructed views of the proposed development site.

- The proposed solar energy facility is expected to be visible from the R380 for its entire length north east of Kathu (i.e. 15km from the site). Almost all of the secondary roads within 6km of the proposed facility may be expected to have views of the facility for relatively long continuous stretches. Potential visual exposure from the N14 is limited to short stretches at a distance exceeding 15km.

The above does not, however, necessarily imply that all of these potentially exposed areas would experience a high visual impact. The PV panels are relatively small in size (i.e. 6m tall) when compared to other forms of solar energy technologies (e.g. CSP power towers).

It thus is envisaged that the facility will be easily and comfortably visible to observers travelling along the arterial and secondary roads, and from homesteads, especially within a 3km radius of the proposed site, potentially resulting in visual impact. This is due to the relatively expansive surface area (approximately 170ha in extent) utilised by the PV technology, not withstanding the constrained vertical dimensions of the PV panels.



Map 3: Potential visual exposure of the San Solar Energy Facility.

The potential visual exposure as illustrated is a theoretical representation of where visual receptors would be able to see the facility from. This does not take into consideration local factors such as vegetation, orientation of structures and localised topographical features.

5.2 Visual distance / observer proximity to the facility

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

The proximity radii (calculated from the boundary lines of the effective PV development area) are shown on **Map 4** and are as follows:

- 0 - 3 km - Short distance view where the solar facility would dominate the frame of vision and constitute a very high visual prominence.
- 3 - 6 km - Medium distance view where the solar facility would be easily and comfortably visible and constitute a high visual prominence.
- 6 - 12 km - Medium to longer distance view where the facility would become part of the visual environment, but would still be visible and recognisable. This zone constitutes a medium visual prominence.
- Greater than 12 km - Long distance view of the facility where the solar energy facility would still be visible though not as easily recognisable. This zone constitutes a low visual prominence for the facility.

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

5.3. Viewer incidence / viewer perception

Refer to **Map 4**. Viewer incidence is calculated to be the highest along corridors/roads within the study area, especially the N14 national road and the R380 arterial road.

Although the secondary roads do not carry many observers per se, they, in addition to the N14 and the R380, represent a higher *potential concentration* of observers within the study area. Of significance is that the N14 is utilised as a tourist access route within the region, giving access to visitors of the Green Kalahari, Namaqualand, and Namibia. Its visual impact thus has an influence on the visual perception of the area.

The context of the proposed facility in terms of proximity to the Sishen Mine, and more specifically the authorised Sishen and Kathu solar energy facilities, is also of relevance. This infrastructure (or future infrastructure) already represents a visual impact of an industrial nature, and as such the proposed solar energy facility and ancillary infrastructure may contribute to cumulative visual impacts within the region.

Viewer incidence within a 12 km radius of the proposed solar energy facility are also concentrated in the town of Dibeng and homesteads in close proximity include *Bosaar, Weston, De Rust, Ekmoes, Dundrum, Curtis, Klein Landbank, Limebank, Selsden, Halliford, Wincanton, Flatlands,* and *Kromvlei.*

Observers residing in or visiting these areas are accustomed to the undeveloped, relatively natural wide open vistas afforded by this rural region. The proposed

San Solar energy facility may constitute a negative visual impact, as receptors are unaccustomed to this type of visual prominence[1].

5.4. Visual absorption capacity of the natural vegetation

The visual absorption capacity (VAC) of the natural vegetation cover (*Kalahari thornveld and shrub bushveld*) is considered to be high in the area west of Dibeng, where there are larger numbers of trees. **Figure 4** illustrates this high VAC.

In this area, certain receptor sites within the viewshed may be screened from the visual impact if the vegetation *in close proximity to the receptor* is tall enough, and dense. Such occurrences are not mapped, however.

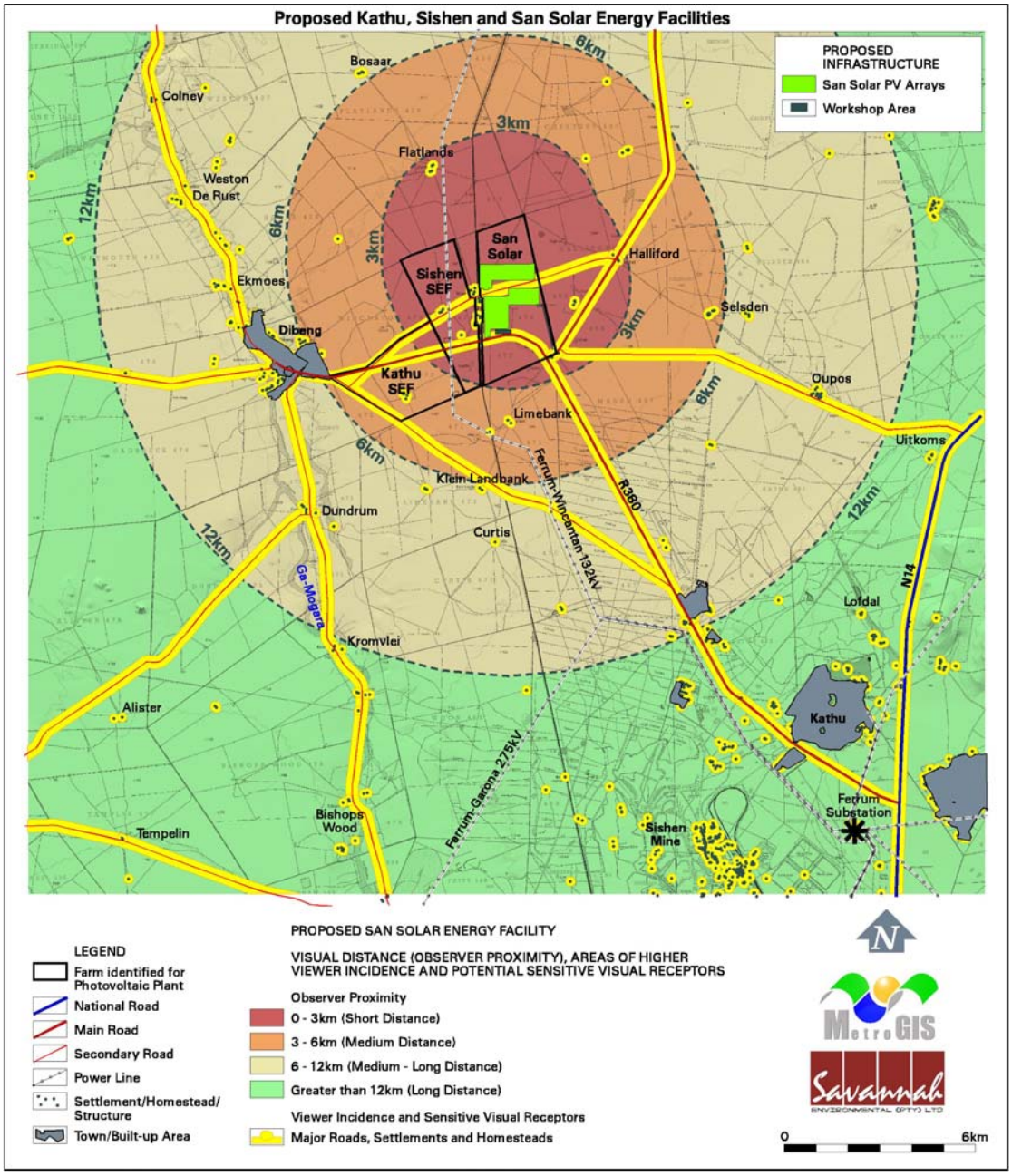
East of Dibeng, and over the majority of the study area, the vegetation is sparser and lower growing. This coupled with the height of structures (3m-6m) renders the capacity of vegetation to screen / absorb potential visual impact to be significantly lower. **Figure 5** illustrates this low VAC.

Therefore, working with the worst case scenario, the visual absorption capacity of the natural vegetation in the study area is considered to be **low** and is not factored in to the assessment of visual impacts.

Figure 4: Typical vegetation west of Dibeng illustrating high VAC.

[1] It must be noted that no complaints pertaining to potential visual impact of the construction and operation of the proposed solar facility, as far as the author is aware, were received from individual landowners in the study area during the public participation process or otherwise.

Figure 5: Typical vegetation east of Dibeng illustrating low VAC.



Map 4: Observer proximity to the proposed San Solar Energy Facility, areas of higher viewer incidence and potential sensitive visual receptors.

5.5. Visual impact index

The combined results of the visual exposure, viewer incidence, viewer perception and visual distance of the proposed solar energy facility are displayed on **Map 5.**

Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values were assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.

An area with short distance, high frequency of visual exposure to the proposed facility, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater impact) on the index. This helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

It should be noted that the visual impact index does not take into account visual clutter and structures that obstruct long distance views within built-up areas. For this reason it can be assumed that the solar energy facility would have a higher visual prominence from the outskirts of built up areas.

5.5.1 Visual impact index of the San solar energy facility

The index immediately gives a strong indication that observers in close proximity to the facility (within 3km) would have the highest visual experience of the facility and would be exposed to **high** visual impacts (where observers are present) and potentially **moderate** visual impacts where observers are absent.

Observers travelling along the R380 and the secondary roads within 3km of the site could experience **high** visual impacts. The R380 passes south of the facility and the *Halliford* to *Wincanton* secondary road pass through the site.

The homesteads of *Flatlands, Wincanton* and *Halliford* fall within 3km of the proposed solar energy facility, and will experience a **high** visual impact.

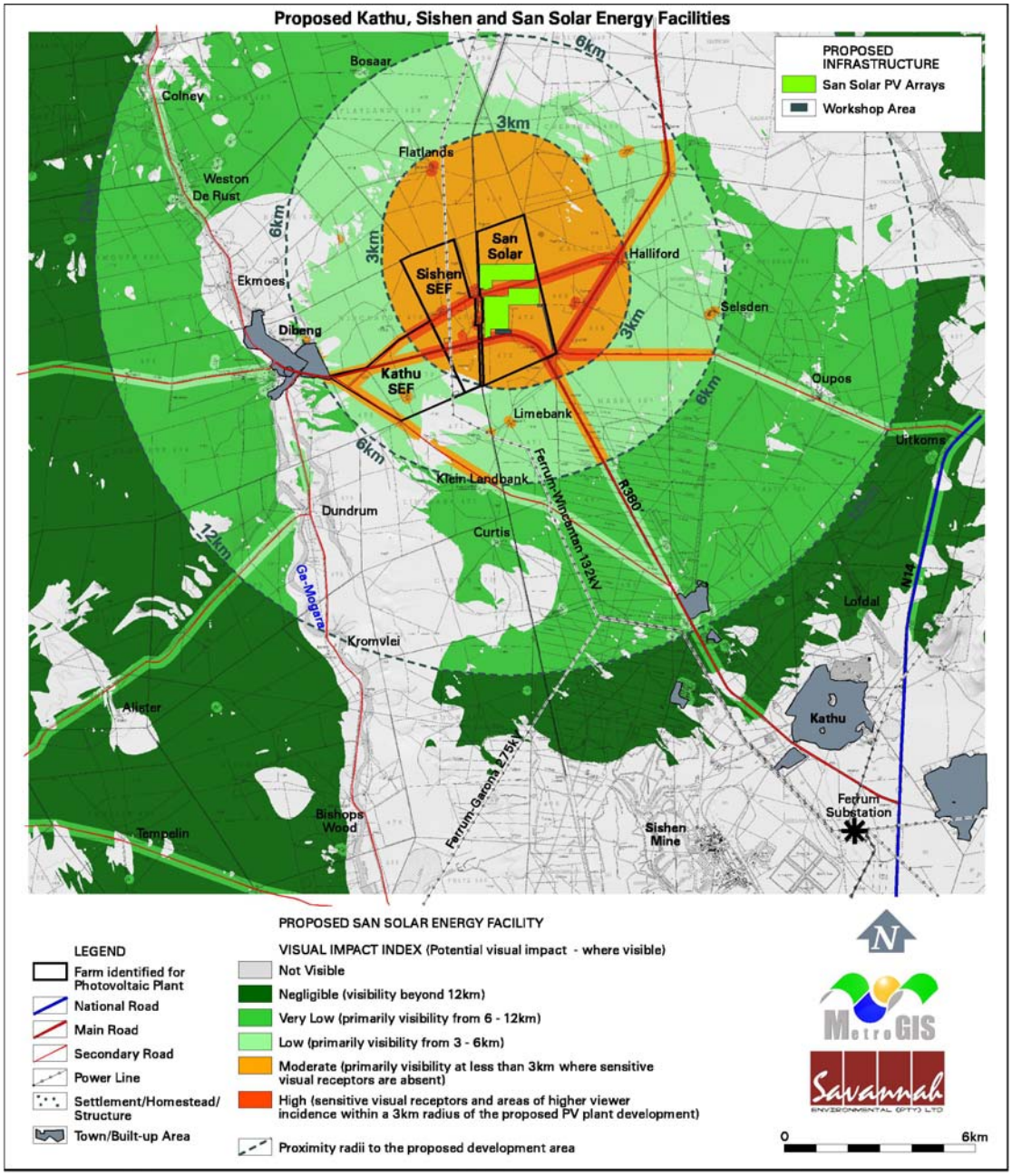
Between 3km and 6km of the facility, observers making use of the arterial road and the secondary roads could be exposed to **moderate** visual impacts, especially east and south of the facility.

Homesteads within this zone will also experience a **moderate** visual impact. These include *Limebank* and *Selsden.*

Settlements and roads beyond 6km (i.e. the R380 arterial road and the secondary roads) could experience **low** visual impacts where these lie within the viewshed. The western outskirts of Dibeng also fall within this zone of potentially **low** visual impact. It should also be noted that in the event that the Sishen and Kathu SEFs are constructed, these facilities would effectively obstruct all views from Dibeng to the San Solar facility.

The proposed facility will not be visible from the N14 except for a section in the east of the study area at distances exceeding 12km from the facility. The impact on this road is indicated as **very low** on the visual impact index.

Visual exposure beyond 12km of the proposed SEF is generally expected to be **very low** (where observers are present) and **negligible** where observers are generally absent.



Map 5: Visual impact index of the proposed San Solar Energy Facility.

5.6 Visual Impact Assessment

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

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

- **Extent** - site only (very high = 5), local (high = 4), regional (medium = 3), national (low = 2) or international (very low = 1)
- **Duration** - very short (0-1 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5)
- **Magnitude** - None (= 0), minor (= 2), low (= 4), medium/moderate (= 6), high (= 8) and very high (= 10)
- **Probability** – very improbable (= 1), improbable (= 2), probable (= 3), highly probable (= 4) and definite (= 5)
- **Status -** positive, negative and neutral
- **Reversibility** - reversible, recoverable and irreversible
- **Significance** - low, medium and high

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

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

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

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

5.6.1 The Solar Energy Facility

Potential visual impact on users of arterial and secondary roads in close proximity of the San solar energy facility.

The potential visual impact on users of the arterial road (i.e. the R380) and the secondary roads in close proximity (i.e. within 3km) of the proposed solar energy facility is expected to be **moderate** both before and after mitigation.

Please note that this result is extracted from the table below, where the value indicated as **high** (magnitude) on the **visual impact index** was inserted and further evaluated in terms of extent, duration and probability.

The table below illustrates this impact assessment.

Table 1 Impact table summarising the significance of visual impact on users of roads in close proximity of the San solar energy facility.

Nature of Impact: Potential visual impact on users of roads in close proximity of the San solar energy facility.		
	Without Mitigation	***After Mitigation***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	High **(8)**	High **(8)**
Probability	Probable **(3)**	Improbable**(2)**
Significance	Moderate **(48)**	Moderate **(32)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable	
Irreplaceable loss of resources?	No	
Can impacts be mitigated during operational phase?	Yes	

Mitigation:

Planning:

- Retain a buffer (approximately 30-50m wide) of intact natural vegetation along the perimeter of the development site.
- Retain and maintain natural vegetation in all areas outside of the development footprint.
- Plan internal roads and ancillary infrastructure in such a way and in such a location that clearing of vegetation is minimised. Consolidate infrastructure as much as possible, and make use of already disturbed areas rather than pristine sites wherever possible.

Construction:

- Rehabilitation of all construction areas.
- Ensure that vegetation is not cleared unnecessarily to make way for the access road and ancillary buildings.

Operations:

- Maintain the general appearance of the facility as a whole.
- Maintenance of roads to avoid erosion and suppress dust.

Decommissioning:

- Remove infrastructure and roads not required for the post-decommissioning use of the site.
- Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.

Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Cumulative impacts: The construction of the solar energy facility will increase the cumulative visual impact of industrial type infrastructure within the region. Existing infrastructure includes the Sishen Mine, located some 15km to the south east of the site, the railway line and the various distribution and transmission power lines. Potential/future infrastructure includes the proposed Kathu and Sishen solar energy facilities on the adjacent sites (west of the railway line) as well as the proposed Kalahari CSP facility.
Residual impacts: None. The visual impact will be removed after decommissioning.

Potential visual impact on residents of homesteads in close proximity of the San solar energy facility.

The potential visual impact on residents of homesteads in close proximity (i.e. within 3km) of the proposed solar energy facility is expected to be **moderate** both before and after mitigation.

The table below illustrates this impact assessment.

Table 2 Impact table summarising the significance of visual impact on residents of homesteads (i.e. *Halliford* and *Flatlands*) in close proximity of the San solar energy facility.

Nature of Impact: Potential visual impact on residents of homesteads in close proximity of the San solar energy facility.		
	Without Mitigation	***After Mitigation***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	High **(8)**	High **(8)**
Probability	Probable **(3)**	Improbable**(2)**
Significance	Moderate **(48)**	Moderate **(32)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable	
Irreplaceable loss of resources?	No	
Can impacts be mitigated during operational phase?	Yes	

Mitigation:

Planning:

- Retain a buffer (approximately 30-50m wide) of intact natural vegetation along the perimeter of the development site.
- Retain and maintain natural vegetation in all areas outside of the development footprint.
- Plan internal roads and ancillary infrastructure in such a way and in such a location that clearing of vegetation is minimised. Consolidate infrastructure as much as possible, and make use of already disturbed areas rather than pristine sites wherever possible.

Construction:

- Rehabilitation of all construction areas.
- Ensure that vegetation is not cleared unnecessarily to make way for the access road and ancillary buildings.

Operations:

- Maintain the general appearance of the facility as a whole.
- Maintenance of roads to avoid erosion and suppress dust.

Decommissioning:

- Remove infrastructure and roads not required for the post-decommissioning use of the site.
- Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.

Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Cumulative impacts:

The construction of the solar energy facility will increase the cumulative visual impact of industrial type infrastructure within the region.

Existing infrastructure includes the Sishen Mine, located some 15km to the south east of the site, the railway line and the various distribution and transmission power lines.

Potential/future infrastructure includes the proposed Kathu and Sishen solar energy facilities on the adjacent sites (west of the railway line) as well as the proposed Kalahari CSP facility.

Residual impacts:

None. The visual impact will be removed after decommissioning.

Potential visual impact on sensitive visual receptors in the region of the San solar energy facility.

The visual impact of the proposed solar facility on users of the arterial and secondary roads, as well as residents of homesteads within the region (i.e. which lie beyond 3km of the site) is expected to be **moderate** but may be considered **low** after mitigation.

The table below illustrates this impact assessment.

Table 3 Impact table summarising the significance of visual impact on sensitive visual receptors in the region of the San solar energy facility.

Nature of Impact: Potential visual impact on sensitive visual receptors within the region (>3km) of the San solar energy facility		
	Without Mitigation	***After Mitigation***
Extent	Regional **(3)**	Local **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(6)**	Moderate **(6)**
Probability	Probable **(3)**	Improbable **(2)**
Significance	Moderate **(39)**	Low **(26)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable	
Irreplaceable loss of resources?	No	
Can impacts be mitigated during operational phase?	Yes	

Mitigation:

Planning:

- Retain a buffer (approximately 30-50m wide) of intact natural vegetation along the perimeter of the development site.
- Retain and maintain natural vegetation in all areas outside of the development footprint.
- Plan internal roads and ancillary infrastructure in such a way and in such a location that clearing of vegetation is minimised. Consolidate infrastructure as much as possible, and make use of already disturbed areas rather than pristine sites wherever possible.

Construction:

- Rehabilitation of all construction areas.
- Ensure that vegetation is not cleared unnecessarily to make way for the access road and ancillary buildings.

Operations:

- Maintain the general appearance of the facility as a whole.
- Maintenance of roads to avoid erosion and suppress dust.

Decommissioning:

- Remove infrastructure and roads not required for the post-decommissioning use of the site.
- Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.

Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Cumulative impacts: The construction of the solar energy facility will increase the cumulative visual impact of industrial type infrastructure within the region. Existing infrastructure includes the Sishen Mine, located some 15km to the south east of the site, the railway line and the various distribution and transmission power lines. Potential/future infrastructure includes the proposed Kathu and Sishen solar energy facilities on the adjacent sites (west of the railway line) as well as the proposed Kalahari CSP facility.
Residual impacts: None. The visual impact will be removed after decommissioning.

Potential visual impact on tourist access routes in the region of the San solar energy facility.

The visual impact of the proposed solar facility on tourist access routes (i.e. the N14 national road) within the region is expected to be **negligible** due to this road's location beyond 12km from the proposed development site.

No impact table is presented in this instance.

5.6.2 Ancillary infrastructure

Potential visual impact of on-site ancillary infrastructure on visual receptors in close proximity of the San solar energy facility.

The on-site ancillary infrastructure proposed for the solar energy facility includes various buildings, a generator, a substation, a power line, a fence and internal access roads.

No dedicated viewshed has been generated for the above infrastructure, as it is expected to be located within the proposed development site. Furthermore, the ancillary infrastructure is not expected to exceed the PV panels in scale and would therefore be less noticeable and ultimately absorbed within the potential visual exposure of the primary infrastructure (i.e. the PV panels).

The potential visual impact of the on-site ancillary infrastructure is expected to be **low** in close proximity (i.e. within 3km) of the proposed facility.

The table overleaf illustrates this impact assessment.

Table 4 Impact table summarising the significance of visual impacts of the power line and the on-site ancillary infrastructure on visual receptors in close proximity of the San solar energy facility.

Nature of Impact: Potential visual impact of the pwer line and the on-site ancillary infrastructure on visual receptors in close proximity (<3km) of the San solar energy facility.		
	Without Mitigation	***After Mitigation***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**
Probability	Improbable **(2)**	Very improbable **(1)**
Significance	Low **(24)**	Low **(12)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable	
Irreplaceable loss of resources?	No	
Can impacts be mitigated during operational phase?	Yes	

Mitigation:

Planning:

- Retain a buffer (approximately 30-50m wide) of intact natural vegetation along the perimeter of the development site.
- Retain and maintain natural vegetation in all areas outside of the development footprint.
- Plan internal roads and ancillary infrastructure in such a way and in such a location that clearing of vegetation is minimised. Consolidate infrastructure as much as possible, and make use of already disturbed areas rather than pristine sites wherever possible.

Construction:

- Rehabilitation of all construction areas.
- Ensure that vegetation is not cleared unnecessarily to make way for the access road and ancillary buildings.

Operations:

- Maintain the general appearance of the facility as a whole.
- Maintenance of roads to avoid erosion and suppress dust.

Decommissioning:

- Remove infrastructure and roads not required for the post-decommissioning use of the site.
- Rehabilitate all areas. Consult an ecologist regarding rehabilitation specifications.

Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Cumulative impacts:

The construction of the solar energy facility will increase the cumulative visual impact of industrial type infrastructure within the region.

Existing infrastructure includes the Sishen Mine, located some 15km to the south east of the site, the railway line and the various distribution and transmission power lines.

Potential/future infrastructure includes the proposed Kathu and Sishen solar energy facilities on the adjacent sites (west of the railway line) as well as the proposed Kalahari CSP facility.

Residual impacts:

None. The visual impact will be removed after decommissioning.

5.7. Secondary visual impacts

5.7.1. Lighting impacts

Potential visual impact of lighting on visual receptors in close proximity of the San solar energy facility.

The area earmarked for the placement of the solar energy facility is located within 16km of the towns of Dibeng and Kathu, the Sishen Mine and a number of isolated homesteads. Although these are not densely populated areas, the light trespass and glare from the security and after-hours operational lighting will have some significance.

A second visual impact is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust, or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contributes to the increase in sky glow. The solar energy facility may contribute to the effect of sky glow in an otherwise dark environment.

To be noted in this regard is the existing light trespass from the Sishen Mine in the south, as well as the contribution of this mine to sky glow.

The anticipated impact of lighting is expected to be **moderate**, and may be mitigated to **low.**

The table overleaf illustrates this impact assessment.

Table 5 Impact table summarising the significance of visual impacts of lighting on visual receptors in the region of the San solar energy facility.

Nature of Impact: Potential visual impact of lighting on visual receptors in the region of the San solar energy facility		
	Without Mitigation	***After Mitigation***
Extent	Regional **(3)**	Regional **(3)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**
Probability	Probable **(3)**	Improbable **(2)**
Significance	Medium **(32)**	Low **(22)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable	
Irreplaceable loss of resources?	No	
Can impacts be mitigated during operational phase?	Yes	
Mitigation: Decommissioning: removal of the solar energy structures and ancillary infrastructure after 30 years (not considered in above "after mitigation" assessments).		
Cumulative impacts: The construction of the solar energy facility will increase the cumulative visual impact of industrial type infrastructure within the region. Existing infrastructure includes the Sishen Mine, located some 15km to the south east of the site, the railway line and the various distribution and transmission power lines. Potential/future infrastructure includes the proposed Kathu and Sishen solar energy facilities on the adjacent sites (west of the railway line) as well as the proposed Kalahari CSP facility.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

5.7.2. Potential visual impacts associated with the construction phase

The construction phase of a project potentially causes the most disturbances within the receiving environment. During this time there will be a noticeable increase in heavy vehicles utilising the roads to the development site that may cause, at the very least, a visual nuisance to other road users and land owners in the area. Issues such as dust will also contribute to visual impact during construction.

5.8. The potential to mitigate visual impacts

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

- The developer must, as far as possible, undertake to utilise existing or approved infrastructure related to the PV plants being planned within the immediate surroundings of the site. This relates to the various buildings, substation, power line, access roads, lay-down areas, etc. related to the authorised Sishen and Kathu solar energy facilities.

- All access roads must be properly planned, constructed and maintained, and the workshop areas must be kept neat and tidy.

  Also, the construction areas, including road servitudes, must be appropriately rehabilitated after construction. This rehabilitation must also be monitored and maintained.

- The mitigation of secondary visual impacts caused by security and functional lighting, and construction activities may be mitigated through careful planning and management.

  Mitigation of lighting impacts includes the pro-active design, planning, and specification of the lighting for the facility. The correct specification and placement of lighting and light fixtures for the infrastructure will go far to contain rather than spread the light. Additional measures include the following:

  - Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself)
  - Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights
  - Making use of minimum lumen or wattage in fixtures
  - Making use of down-lighters, or shielded fixtures
  - Making use of Low Pressure Sodium lighting or other types of low impact lighting
  - 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.

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

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

6. CONCLUSIONS AND RECOMMENDATIONS

The construction and operation of the San solar energy facility will have a visual impact on the natural scenic resources of this region.

The author is of the opinion that the solar facility have an advantage over other more conventional power generating facilities (e.g. coal-fired power stations). The facilities utilise a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a positive light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

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

However, this opinion should not distract from the fact that the PV plant would be visible within an area that incorporates a number of sensitive visual receptors.

Furthermore, the cumulative visual impact of multiple industrial initiatives in the area, both existing and proposed, is of some concern, as it threatens to alter the visual character of the region as a whole. Of specific relevance is the existing Kumba (Exxaro) Sishen iron ore mine, the existing railway line and power line infrastructure, the proposed Kalahari CSP and the Sishen and Kathu solar energy facilities, either currently in the EIA process or already authorised.

The placement of the San Solar SEF, immediately adjacent to the approved Sishen and Kathu SEFs, is ironically also preferred as this will serve to concentrate the electricity generation infrastructure within the region. This apparent contradiction (i.e. trade-off between the potential cumulative visual impacts of the facilities and the concentration of infrastructure) is ultimately favoured above spreading this type of structures throughout the region and over larger tracts of land.

There are a number of recommendations as to the mitigation of the visual impact of the solar energy facility. The following is recommended:

- The standard height of the units should be set at 3-4m and that a 6m height should only be used on exception where absolutely necessary.
- Common infrastructure, shared by the abovementioned solar energy facilities, should be used wherever possible.
- All access roads must be properly planned, constructed and maintained, and the workshop areas must be kept neat and tidy.

- All disturbed areas should be properly rehabilitated, and all infrastructure and the general surrounds should be maintained in a neat and appealing way. This rehabilitation must also be monitored and maintained.
- A lighting engineer should be consulted to assist in the planning and placement of light fixtures in order to reduce visual impacts associated with glare and light trespass.
- Secondary visual impacts associated with the construction phase, such as the sight of construction vehicles, dust and construction litter must be managed to reduce visual impacts. The use of dust-suppression techniques on the access roads (where required), timely removal of rubble and litter, and the erection of temporary screening will assist in doing this.
- The construction phase of the facility should be sensitive to potential observers in the vicinity of the construction site. The placement of lay-down areas and temporary construction camps should be carefully considered in order to not negatively influence the future perception of the facility.
- The facility should be dismantled upon decommissioning and the site and surrounding area should be rehabilitated to its original (current) visual status.

7. IMPACT STATEMENT

In light of the results and findings of the Visual Impact Assessment undertaken for the proposed San solar energy facility, it is acknowledged that the natural and undeveloped views surrounding the site will be impacted upon, for the entire operational lifespan (approximately 30 years) of the facility:

- The potential visual impact on users of the arterial road (i.e. the R380) and the secondary roads in close proximity (i.e. within 3km) of the proposed solar energy facility is expected to be **moderate** both before and after mitigation.

- The potential visual impact on residents of homesteads in close proximity (i.e. within 3km) of the proposed solar energy facility is expected to be **moderate** both before and after mitigation.

- The visual impact of the proposed solar facility on users of the arterial and secondary roads, as well as residents of homesteads within the region (i.e. which lie beyond 3km of the site) is expected to be **moderate** but may be considered **low** after mitigation.

- The visual impact of the proposed solar facility on tourist access routes (i.e. the N14 national road) within the region is expected to be **negligible** due to this road's location beyond 12km from the proposed development site.

- The potential visual impact of the on-site ancillary infrastructure is expected to be **low** in close proximity (i.e. within 3km) of the proposed facility.

- The anticipated impact of lighting is expected to be **moderate**, and may be mitigated to **low.**

These anticipated visual impacts are not considered to be a fatal flaw from a visual perspective, considering the low incidence of visual receptors in the region, the relatively contained area of potential visual exposure of the SEF and the

future solar energy facilities already authorised adjacent to the proposed development site.

Furthermore, it is the opinion of the author that this impact is not likely to detract from the numbers of tourists or tourism potential of the existing Northern Cape tourist centers and destinations. The facility may, in fact add to the plethora of attractions.

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

8. MANAGEMENT PLAN

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

Table 6: Management plan – ancillary infrastructure

OBJECTIVE: The mitigation and possible negation of the additional visual impacts associated with the construction and operation of the solar energy facility.		
Project component/s	Construction site, various buildings, a generator, a substation, a power line, a fence and internal access roads.	
Potential Impact	Potential scarring and erosion due to the unnecessary removal of vegetation.	
Activity/risk source	The viewing of the abovementioned by observers on or near the site.	
Mitigation: Target/Objective	Minimal disturbance to vegetation cover in close vicinity to the proposed solar energy facilities.	
Mitigation: Action/control	Responsibility	Timeframe
Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas thereby limiting the removal of natural vegetation to the minimum.	San SEF (Pty) Ltd / contractors	Construction
Limit access to the construction sites to existing access roads.	San SEF (Pty) Ltd / contractors	Construction / operation
Rehabilitate all disturbed areas to acceptable visual standards.	San SEF (Pty) Ltd / contractors	Construction / operation
Maintain the general appearance of the facility in an aesthetically pleasing way.	San SEF (Pty) Ltd / operator	Operation
Performance Indicator	Vegetation cover that remains intact with no erosion	
Monitoring	Monitoring of vegetation clearing during the construction phase	

Table 7: Management plan – lighting impacts

OBJECTIVE: The mitigation and possible negation of the potential visual impact of lighting at the solar energy facility		
Project component/s	Solar energy facility lighting fixtures.	
Potential Impact	The potential night time visual impact of lighting fixtures on observers in proximity to the site.	
Activity/risk source	The effects of glare and light trespass on motorists and observers.	
Mitigation: Target/Objective	The containment of light emitted in order to eliminate the risk of additional night time visual impacts. Minimal usage of security and other lighting.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Ensure that proper planning is undertaken regarding the placement of lighting structures and that light fixtures only illuminate areas inside the substation sites. Undertake regular maintenance of light fixtures.	San SEF (Pty) Ltd / lighting engineer San SEF (Pty) Ltd / operator	Planning / construction Operation
Performance Indicator	The effective containment of the light on the site and no complaints from observers.	
Monitoring	The monitoring of the condition and functioning of the light fixtures during the operational phase of the project	

9. REFERENCES / DATA SOURCES

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