PROPOSED PHOTOVOLTAIC SOLAR ENERGY FACILITY

ON A SITE WEST OF KAKAMAS, NORTHERN CAPE PROVINCE

VISUAL IMPACT ASSESSMENT

AS PART OF A BASIC ASSESSMENT PROCESS

Produced for:

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

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

The team undertaking the visual assessment has extensive practical knowledge in spatial analysis, environmental modelling 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 Photovoltaic Solar Energy Facility on a site west of Kakamas. Neither the author, MetroGIS or V&L Landscape Architects will benefit from the outcome of the project decision-making.

1. INTRODUCTION

INCA Kakamas Solar (Pty) Ltd (INCA), a subsidiary of INCA Energy, is proposing the establishment of a Photovoltaic Solar Energy Facility approximately 3km west of Kakamas, within the Kai Garieb Local Municipality in the Northern Cape Province.

Solar energy generation is generally considered to be an environmentally friendly electricity generation option.

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.

INCA intends to utilise photovoltaic (PV) technology to construct an alternative energy generation facility with a total generating capacity of up to 10MW.

The proposed PV Solar Energy Facility will consist of a photovoltaic (PV) solar energy component and associated infrastructure. A formal layout of the facility has not yet been finalised, but infrastructure is likely to include:

- An array of Photovoltaic solar panels with a generating capacity of up to 10MW;
- A substation;
- A 22kV power line linking to the Taaipit Substation;
- Cabling between the project components (laid underground);
- Internal access roads and

- A workshop and storage area.

2. SCOPE OF WORK

The project is proposed on the Remainder of Farm 1178 (Kakamas and Suid Nedersetting).

The study area for the visual assessment encompasses a geographical area of 865km² (the extent of the maps displayed below) and includes a minimum 15km buffer zone from the proposed development area.

The N14 national road traverses the study area from east to west, while the R359 arterial road extends to the north west and south east. A number of secondary roads are also present in the area.

Urban and built up areas include *Marchland*, *Augrabies, Kakamas*, *Langverwag Lutzburg*, *Cillie* and *Taaipit*.

The Orange River represents the most significant hydrological feature within the study area, along which a significant number of farms and homesteads are clustered. The fertile Orange River valley area is known for its export quality table grapes, as well as for its peaches, dried fruit, raisins, oranges, cotton and lucern.

Industrial infrastructure includes the Taaipit Substation and associated transmission power lines extending to the west and east.

The scope of work for this assessment includes the determination of the potential visual impacts in terms of nature, extent, duration, magnitude, probability and significance of the construction and operation of the proposed infrastructure.

In this regard, specific issues related to the visual impact have been identified and include the following:

- The visibility of the facility to, and potential visual impact on observers travelling along major roads (i.e. the N14 and R359) and secondary roads in close proximity to the proposed facility as well as within the region.
- The visibility of the facility to, and visual impact on urban areas in close proximity to the proposed facility as well as within the region.
- The visibility of the facility to, and visual impact on farms and homesteads in close proximity to the proposed facility as well as within the region.
- The potential visual impact of the facility on the visual character of the landscape and sense of place of the region.
- The potential impact on tourist routes (N14), tourist destinations and tourism potential within the region.
- The potential visual impact of ancillary infrastructure (i.e. the substation, power line, internal access roads and workshop) on observers in close proximity to the proposed facility.
- The potential visual impact of operational, safety and security lighting at night on observers in close proximity to the proposed facility.
- Potential visual impacts associated with the construction phase.
- Potential cumulative visual impacts.
- Potential residual visual impacts after the decommissioning of the facility.
- The potential to mitigate visual impacts and inform the design process.

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 Surveyor General.

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 facility, including related infrastructure, as well as offer potential mitigation measures, where required.

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

- **Determine Potential visual exposure**

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

  Viewshed analyses of the proposed solar 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 each type of structure.

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

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

- **Determine Viewer Incidence / Viewer Perception**

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

  Topography and built form also have the capacity to 'absorb' visual impact.

  The digital terrain model utilised in the calculation of the visual exposure of the facility does not incorporate potential visual absorption capacity (VAC). It is therefore necessary to determine the VAC by means of the interpretation of the vegetation cover, topography and built form.

- **Determine the Visual impact index**

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

4. RESULTS

4.1 Potential visual exposure

The result of the viewshed analysis for the proposed facility is shown on the **Map 1**. The viewshed analysis was undertaken at offsets of 4m above average ground level (i.e. maximum height of the PV structures, although they are more likely to be approximately 3m in height).

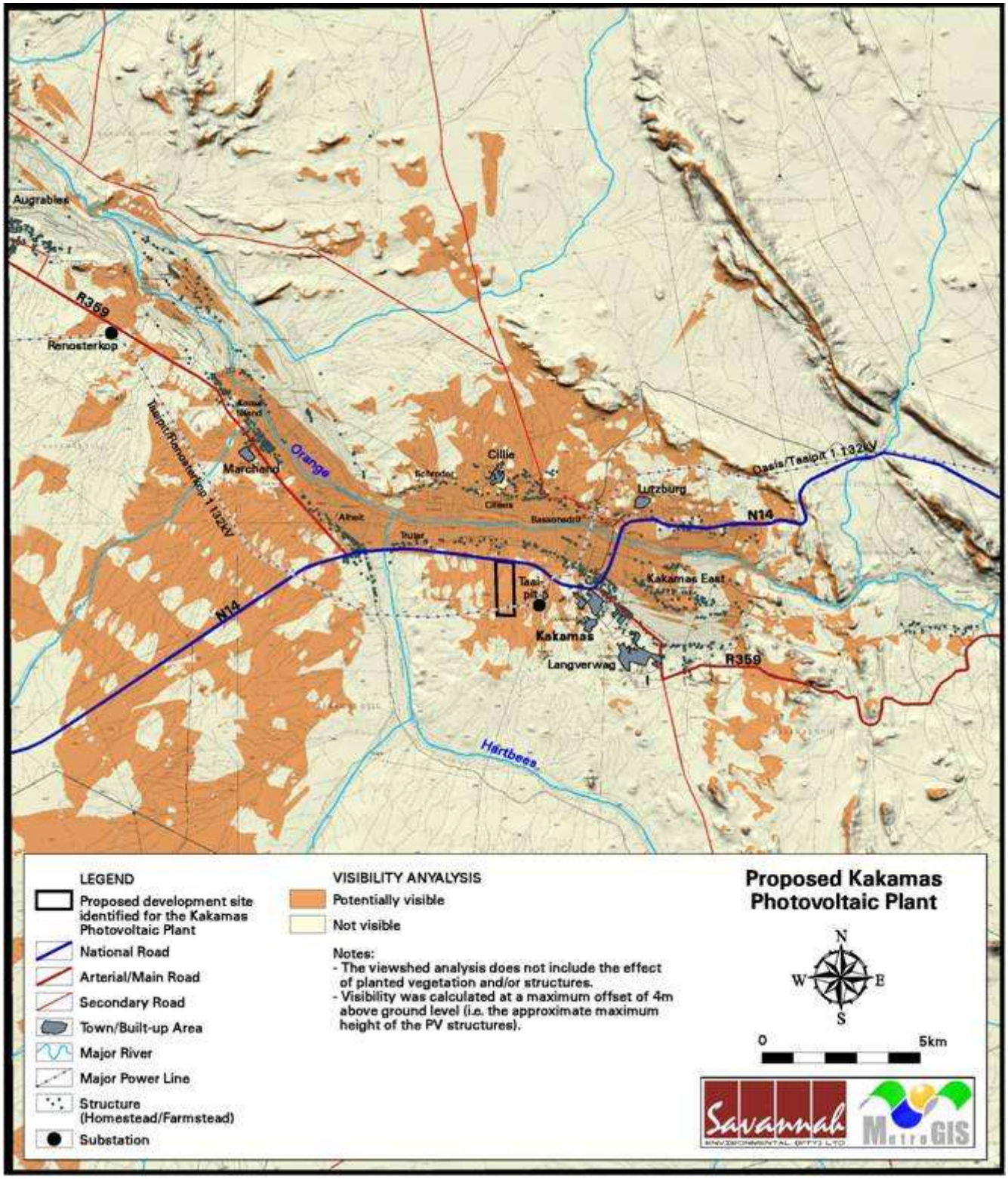
This was done in order to determine the absolute worst case general visual exposure of the area under investigation, simulating the proposed structures associated with the facility. This viewshed analysis indicates areas from which the proposed plant would be visible.

It is clear from the analysis that the PV plant is likely to be visually exposed to a primary area within approximately 7km of the proposed facility. This includes the

site itself, and the areas predominantly to the north, north west and east. Areas to the direct south of the facility appear to fall outside of the viewshed.

The visually exposed areas tend to be concentrated along the lower lying Orange River valley, and become patchy and sparse further away from the drainage line. The south west facing slopes of the ridges in the north east of the study area may also be visually exposed.

Further afield to the south west, larger areas are evident within the viewshed, but it is unlikely that the facility will be visible from such a distance.



Map 1: Potential visual exposure of the proposed facility.

4.2 Visual distance / observer proximity to the facility

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

These proximity radii (calculated from the boundary lines of the farms) are shown on **Map 2** and are as follows:

- 0 – 2,5km - Short distance view where the facility would dominate the frame of vision and constitute a very high visual prominence.
- 2,5 - 5km - Medium distance views where the facility would be easily and comfortably visible and constitute a high visual prominence.
- 5 - 10km - 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 10 km - Long distance view where the facility would still be visible though not as easily recognisable. This zone constitutes a low visual prominence for the facility.

4.3. Viewer incidence / viewer perception

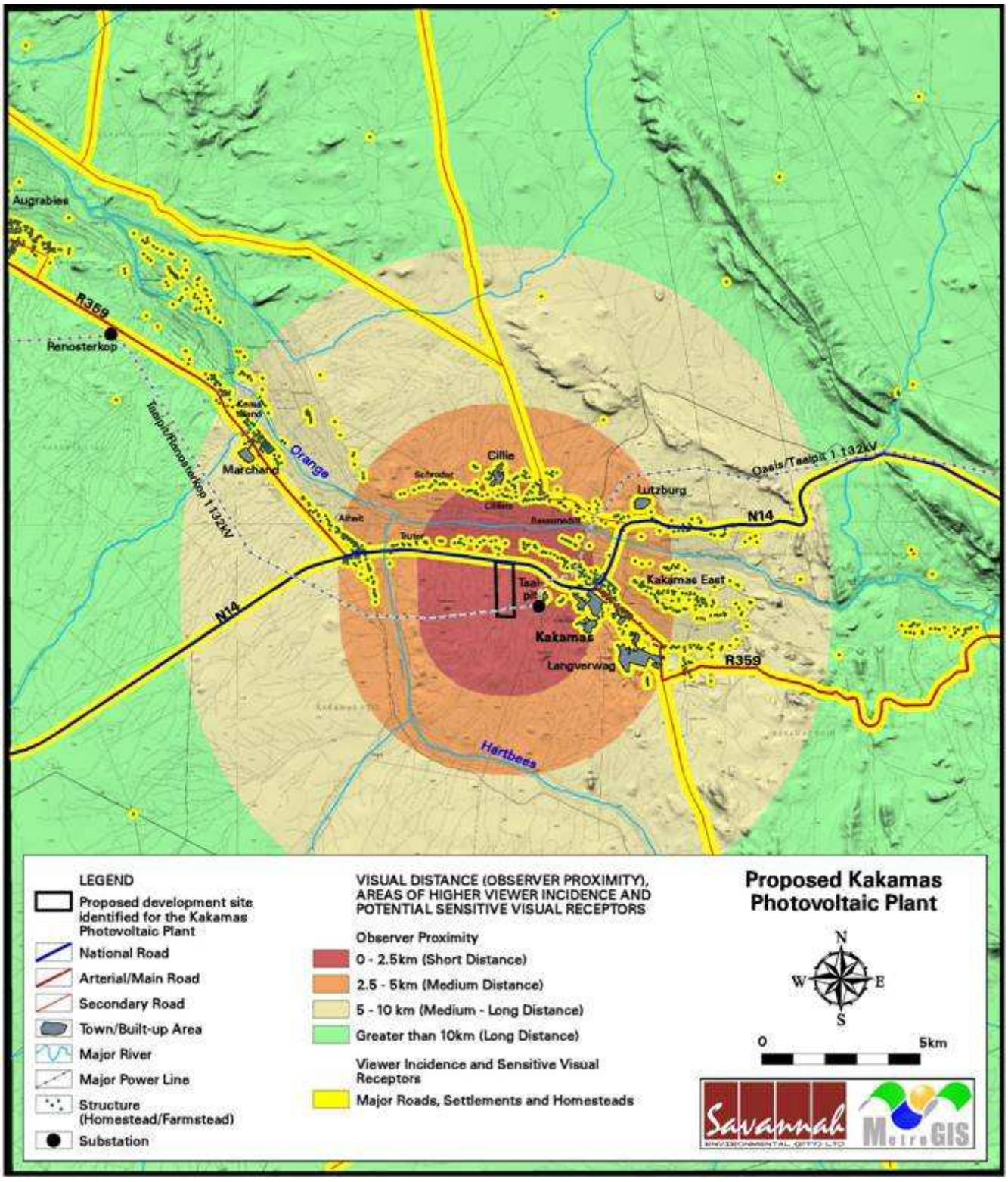
Refer to **Map 2**. Viewer incidence is calculated to be the highest along the national and arterial roads (i.e. the N14 and R359) as well as the secondary roads within the study area. Commuters using these roads could be negatively impacted upon by visual exposure to the facility.

Other than along the above roads, viewer incidence within a 10 km radius of the proposed facility is concentrated in the towns and urban areas and the significant number of farms and homesteads clustered along the Orange River.

The remaining areas consist predominantly of vacant natural land (grazing) and rural settlements and homesteads with a low occurrence of observers.

Tourists visiting and travelling through the area are seen as possible sensitive visual receptors upon which the presence of the proposed facility could have a negative visual impact. Of particular relevance is the N14 which is the primary tourist access route to the west coast, as well as the Orange River belt, which includes tourist destinations and holds potential for further tourist development.

The severity of the visual impact on these receptors decreases with increased distance from the proposed facility.



Map 2: Observer proximity to the proposed facility and areas of high viewer incidence.

4.4. Visual absorption capacity

The vegetation present in the study area is predominantly *shrubland,* with *thicket and bushland* along the drainage lines. Vegetation types include *Namaqualand broken veld* and *Orange River broken veld.*

Overall, the Visual Absorption Capacity (VAC) of the receiving environment is deemed to be negligible by virtue of the vegetation, the relatively homogenous landform and the low occurrence of industrial type infrastructure.

VAC will therefore not be taken into account.

4.5. Visual impact index

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed WEF are displayed on **Map 3**. Here the weighted impact and the likely areas of impact have been indicated as a visual impact index. Values have been 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.

The following is of relevance:

The visual impact index map clearly indicates potential areas of **high** visual impact within a 2,5km radius of the proposed facility, including the western outskirts of the town of Kakamas, the southern outskirts of Cillie as well as a number of farms and homesteads on either side of the Orange River. These include the following:

- *Bassondrift;*
- *Cilliers* and
- *Truter.*

A limited stretch of the N14 road up to the 2,5km radius is also likely to experience a **high** visual impact due to the higher frequency of observers travelling along this road. It is important to note that this is an important national and provincial tourist access routes.

Farmland along the river and to the south of the proposed site may be exposed to **moderate** visual impact.

- Between 2,5km and 5km from the facility, relatively continuous stretches of the N14 as well as the secondary road to the north are likely to be exposed to **moderate** visual impact.

  The towns of Lutzburg and Cillie may also be exposed to **moderate** visual impact, as may the eastern outskirts of Kakamas. The following farms and homesteads may be similarly affected:

  - *Schroder* and
  - *Alheit.*

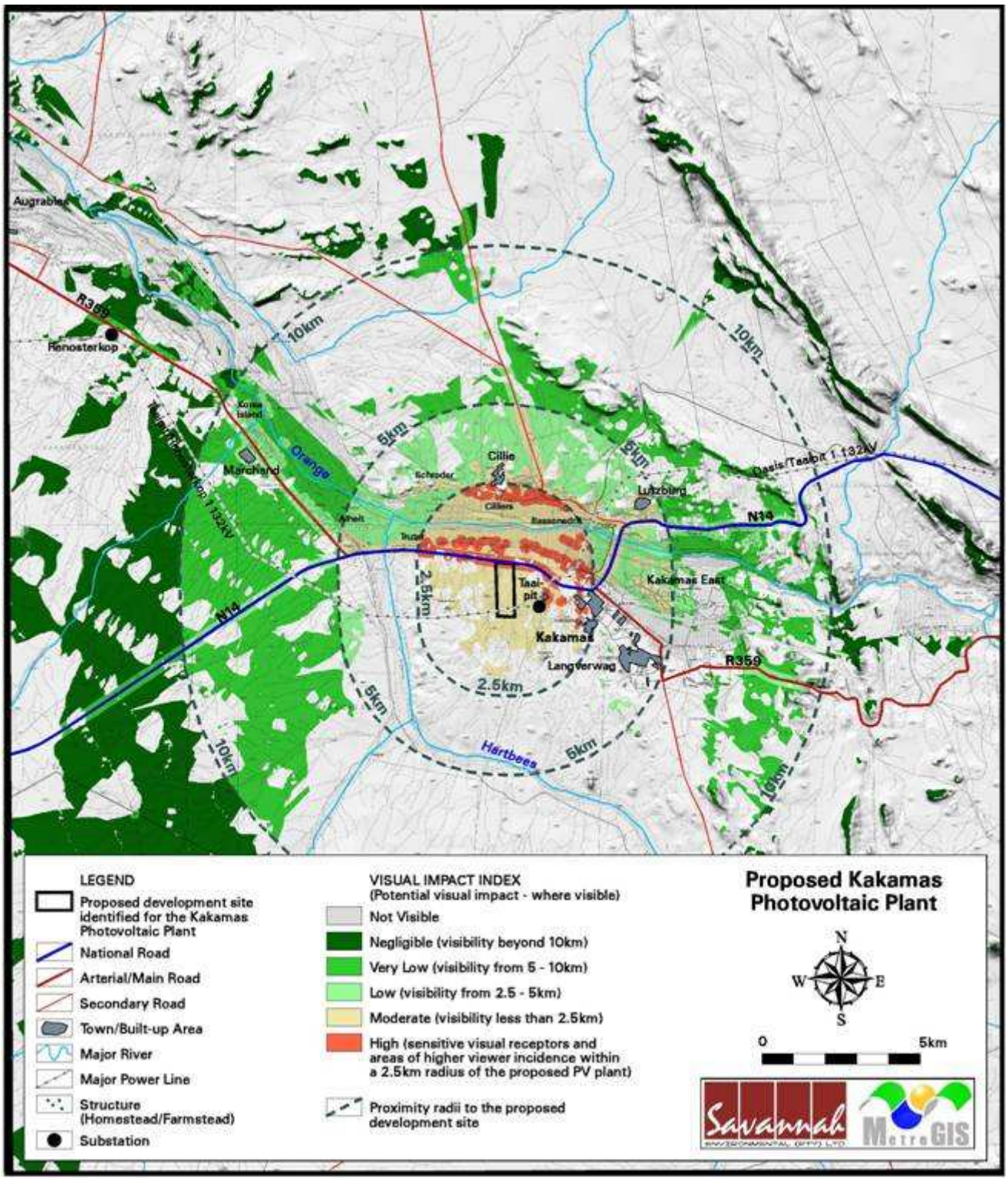
Farmland along the river and to the north may be exposed to **low** visual impact.

- Between 5km and 10km, visual impact is significantly reduced. Relatively continuous stretches of the N14, the R359 and secondary roads may be exposed to **low** visual impact. The town of Marchland and Korea Island farm may be similarly impacted upon.

- Remaining impacts, where they occur at all, are expected to be **very low** to **negligible**.

It is, however, important to note the pastoral visual quality of the farmland, and the rugged beauty of the undeveloped, wide open spaces beyond. This lends the area a specific sense of place and a tourism potential that has not yet been optimised.

It is envisaged that the proposed facility would be visible to limited numbers of observers travelling along roads, residing on farms or visiting the region, especially within a 5km radius of the proposed facility.



Map 3: Visual impact index of the proposed facility.

4.6 Visual impact assessment: methodology

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 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 (= 1), low (= 2), medium/moderate (= 3), high (= 4) and very high (= 5)
- **Probability** - none (= 0), improbable (= 1), low probability (= 2), medium probability (= 3), high probability (= 4) and definite (= 5)
- **Status** (positive, negative or neutral)
- **Reversibility** - reversible (= 1), recoverable (= 3) and irreversible (= 5)
- **Significance** - low, medium or high

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

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

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

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

4.7 Visual impact assessment: primary impacts

4.7.1 The PV Plant

Potential visual impact on users of national, arterial and secondary roads in close proximity to the proposed facility.

Potential visual impact on users of the N1 national road bypassing the site on its northern boundary (within 2,5km) is expected to be **high**.

The table below illustrates this impact assessment.

Table 1: Impact table summarising the significance of visual impacts on users of national, arterial and secondary roads in close proximity to the proposed facility.

Nature of Impact: Potential visual impact on users of national, arterial and secondary roads in close proximity to the proposed facility		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	High **(8)**	N/a
Probability	High **(4)**	N/a
Significance	High **(64)**	N/a
Status (positive, neutral or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated	No	N/a
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of the PV plant, the substation and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing substation and power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

Potential visual impact on residents of urban areas in close proximity to the proposed facility.

The visual impact of the proposed facility on the western outskirts of Kakamas and the southern outskirts of Cillie (within 2,5km) is expected to be of **high** significance.

The table below illustrates this impact assessment.

Table 2: Impact table summarising the significance of visual impacts on residents of urban areas in close proximity to the proposed facility.

Nature of Impact: Potential visual impact on residents of urban areas in close proximity to the proposed facility		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	High **(8)**	N/a
Probability	High **(4)**	N/a
Significance	High **(64)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of the PV plant, the substation and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing substation and power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

Potential visual impact on residents of farms and homesteads in close proximity to the proposed facility.

The visual impact of the proposed facility on the farms on homesteads along the Orange River, and within 2,5km of the site is expected to be of **high** significance.

The table below illustrates this impact assessment.

Table 3: Impact table summarising the significance of visual impacts on residents of farms and homesteads in close proximity to the proposed facility.

Nature of Impact: Potential visual impact on residents of farms and homesteads in close proximity to the proposed facility		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	High **(8)**	N/a
Probability	High **(4)**	N/a
Significance	High **(64)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of the PV plant, the substation and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing substation and power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

Potential visual impact on sensitive visual receptors (users of roads and residents of urban areas, farms and homesteads) within the region

The visual impact on users of roads and on residents of urban areas, farms and homesteads within the region (i.e. beyond the 2,5km radius) is expected to be of **moderate** significance.

The table below illustrates this impact assessment.

Table 4: Impact table summarising the significance of visual impacts on sensitive visual receptors within the region.

Nature of Impact: Potential visual impact on sensitive visual receptors within the region		
	No mitigation	***Mitigation considered***
Extent	Regional **(3)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Moderate **(6)**	N/a
Probability	Probable **(3)**	N/a
Significance	Moderate **(39)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of the PV plant, the substation and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing substation and power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

4.7.2 Ancillary infrastructure

Potential visual impact of the substation and workshop on observers in close proximity to the proposed facility.

The proposed substation could represent a potential visual impact. Although no dedicated viewshed has been generated for the substation, this structure will be located within the proposed PV plant footprint, and is not likely to exceed the PV panels in height. It is thus expected that the area of potential visual exposure will lie within that of the PV Plant.

The table below illustrates the assessment of this anticipated impact, which is likely to be of **low** significance.

Table 5: Impact table summarising the significance of visual impact of the substation and workshop on observers in close proximity to the proposed facility.

Nature of Impact: Potential visual impact of the substation and workshop on observers in close proximity to the proposed facility		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Low **(4)**	N/a
Probability	Improbable **(2)**	N/a
Significance	Low **(24)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of the PV plant, the substation and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing substation and power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

Potential visual impact of the power line on observers in close proximity to the proposed facility.

The proposed new 22kV power line will link with the existing Taaipit Substation about 1km to the east of the proposed site. An existing transmission line already traverses the site to link with Taaipit, and the new 22kV power line should follow this alignment.

The new power line will not exceed the existing power line structures in height. It may thus be expected that the visual impact of the new power line will be largely absorbed by the existing visual impact of the existing transmission line.

The table below illustrates the assessment of this anticipated impact, which is likely to be of **low** significance after mitigation.

Table 6: Impact table summarising the significance of visual impact of the power line on observers in close proximity to the proposed facility.

Nature of Impact: Potential visual impact of the power line on observers in close proximity to the proposed facility		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**
Probability	Improbable **(2)**	Improbable **(2)**
Significance	Low **(24)**	Low **(24)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: Planning: Follow the alignment of the existing transmission power line to Taaipit Substation. Decommissioning: removal of the PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of the PV plant, the substation and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing substation and power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

Potential visual impact of internal access roads on observers in close proximity to the proposed facility.

Within the facility's footprint, access roads will be required for both construction and operation of the proposed PV plant.

Internal access roads have the potential of manifesting as a network of landscape scarring, and may thus represent a potential visual impact within the viewshed area.

The layout and construction of the internal access roads in sympathy with the topography, as well as adequate rehabilitation post construction will go far to ameliorate potential visual impact in this regard.

The table below illustrates the assessment of this anticipated impact, which is likely to be of **low** significance before and after mitigation.

Table 7: Impact table summarising the significance of visual impact of the internal access roads on observers in close proximity to the proposed facility.

Nature of Impact: Potential visual impact of the internal access roads on observers in close proximity to the proposed facility		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Minor **(2)**	Minor **(2)**
Probability	Improbable **(2)**	Improbable **(2)**
Significance	Low **(20)**	Low **(20)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: Planning: layout and construction of roads and infrastructure with due cognisance of the topography. Construction: rehabilitation. Decommissioning: ripping and rehabilitation of the road and servitude.		
Cumulative impacts: The construction of access roads will increase the cumulative visual impact of disturbance due to vegetation clearing and disturbance within the region.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

4.7.3. Lighting

Potential visual impact of lighting at night on observers in close proximity to the proposed facility.

The area surrounding the proposed facility has a relatively low incidence of receptors, being mainly agricultural and rural in nature. In this respect, light trespass and glare from the security and after-hours operational lighting (flood lights) for the facility infrastructure will have some significance for residents in the area.

Another potential lighting impact is 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, contribute to the increase in sky glow. The facility may contribute to the effect of sky glow in an otherwise dark environment.

Mitigation of these impacts entails 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 facility and ancillary infrastructure will go far to contain rather than spread the light.

The table below illustrates the assessment of this anticipated impact, which is likely to be of **moderate** significance, and may be mitigated to **low.**

Table 8: Impact table summarising the significance of visual impact of lighting at night on observers in close proximity to the proposed facility.

Nature of Impact: Potential visual impact of lighting at night on observers in close proximity to the proposed facility.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**
Magnitude	Low **(3)**	Moderate **(6)**
Probability	High **(4)**	Improbable **(2)**
Significance	Moderate **(44)**	Low **(28)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: Planning: pro-active lighting design and planning Decommissioning: removal of the PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of the PV plant, the substation and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing substation and power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

4.7.4. Construction

Potential visual impact of construction on visual receptors in close proximity to the proposed facility.

During the construction period, 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.

In this environment, dust from construction work is also likely to represent a significant visual impact.

Mitigation entails proper planning, management and rehabilitation of the construction site to forego visual impacts.

The table below illustrates the assessment of this anticipated impact, which is likely to be of **moderate** significance, and may be mitigated to **low.**

Table 9: Impact table summarising the significance of visual impact of construction on visual receptors in close proximity to the proposed facility.

Nature of Impact: Potential visual impact of construction on visual receptors in close proximity to the proposed facility.		
	No mitigation	***Mitigation considered***
Extent	Local **(4)**	Local **(4)**
Duration	Very short term **(1)**	Very short term **(1)**
Magnitude	Moderate **(6)**	Low **(4)**
Probability	High **(4)**	Improbable **(2)**
Significance	Moderate **(44)**	Low **(18)**
Status (positive or negative)	Negative	Negative
Reversibility	Recoverable **(3)**	Recoverable **(3)**
Irreplaceable loss of resources?	No	No
Can impacts be mitigated during operational phase?	No	No
Mitigation: Construction: Proper planning, management and rehabilitation of the construction site		
Cumulative impacts: None.		
Residual impacts: None.		

4.8 Visual impact assessment: secondary impacts

4.8.1 The PV Plant

Potential visual impact of the proposed facility on the visual character and sense of place of the region.

Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria, and specifically the visual character of an area (informed by a combination of aspects such as topography, level of development, vegetation, noteworthy features, cultural / historical features, etc) play a significant role.

A visual impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light.

Specific aspects contributing to the sense of place of this region include the pastoral visual quality of the farmland and the rugged beauty of the undeveloped, wide open spaces beyond.

The anticipated visual impact of the facility on the regional visual character, and by implication, on the sense of place, is expected to be **moderate**.

The table below illustrates this impact assessment.

Table 10: Impact table summarising the significance of visual impacts on the visual character and sense of place of the region.

Nature of Impact: Potential visual impact of the proposed facility on visual character and sense of place of the region		
	No mitigation	***Mitigation considered***
Extent	Regional **(3)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Low **(4)**	N/a
Probability	Probable **(3)**	N/a
Significance	Moderate **(33)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of the PV plant, the substation and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing substation and power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

Potential visual impact of the proposed facility on tourist routes, tourist destinations and tourism potential within the region.

The fertile Orange River farmlands and the harsh rugged beauty of the Northern Cape landscape beyond afford the area a unique aesthetic appeal, and a resultant tourism potential. This tourism potential may not yet be optimised, but tourist facilities do exist along the Orange River belt. There is certainly potential for more to develop.

In addition, the N14 is the primary tourist access route to Namaqualand and the West Coast, which are established tourist destinations.

Visual intrusion through the development of industrial type infrastructure within this environment could jeopardise the area's tourism value and potential.

The anticipated visual impact of the facility on existing tourist routes, as well as on the tourism potential of the region, is expected to be **low**.

The table below illustrates this impact assessment.

Table 11: Impact table summarising the significance of visual impacts on tourist routes, tourist destinations and tourist potential within the region.

Nature of Impact: Potential visual impact of the proposed facility on tourist routes, tourist destinations and tourist potential within the region.		
	No mitigation	***Mitigation considered***
Extent	Regional **(3)**	N/a
Duration	Long term **(4)**	N/a
Magnitude	Low **(4)**	N/a
Probability	Improbable **(2)**	N/a
Significance	Low **(22)**	N/a
Status (positive or negative)	Negative	N/a
Reversibility	Recoverable **(3)**	N/a
Irreplaceable loss of resources?	No	N/a
Can impacts be mitigated during operational phase?	No	N/a
Mitigation: Decommissioning: removal of the PV plant and ancillary infrastructure after 20 to 30 years.		
Cumulative impacts: The construction of the PV plant, the substation and other associated infrastructure will increase the cumulative visual impact of electricity related infrastructure within the region. This is relevant in light of the existing substation and power line infrastructure already present in the area, albeit limited in extent and scale.		
Residual impacts: None. The visual impact will be removed after decommissioning.		

4.9 The potential to mitigate visual impacts

- The anticipated visual impact of the PV panels, the substation and the workshop is not possible to mitigate. The functional designs of these structures cannot be changed and they cannot be moved to reduce visual impacts. Screening possibilities are minimal at best.

- The proposed 22kV power line must follow the alignment of the existing transmission power line linking with Taaipit Substation.

- Mitigation of visual impacts associated with the construction of internal access roads include careful planning, taking due cognisance of the topography. Construction of roads should be undertaken with adequate drainage structures in place to forego potential erosion problems.

  Access roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning.

- 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 turbines, the PV plant and the ancillary 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.

- Mitigation of visual impacts associated with the construction phase, albeit temporary, entails proper planning, management and rehabilitation of the construction site. Construction should be managed according to the following principles:
  - Reduce the construction period through careful planning and productive implementation of resources.
  - Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing.
  - Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
  - Ensure that rubble, litter and disused construction materials are managed and removed regularly.
  - Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way
  - Reduce and control construction dust through the use of approved dust suppression techniques.
  - Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
  - Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards.

- Secondary impacts anticipated as a result of the proposed facility (i.e. visual character, sense of place and tourism potential) are not possible to mitigate.

- Once the PV plant has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated.

5. CONCLUSIONS AND RECOMMENDATIONS

The construction and operation of the Proposed Kakamas PV Solar Energy Facility and its associated infrastructure will have a visual impact on the natural scenic resources and rural character of the study area, particularly within 2,5km of the proposed facility.

The author is, however, of the opinion that the 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 facility further has a generally unfamiliar novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants. The advantage being that the facility can become an attraction or a landmark within the region, that people would actually want to come and see. As it is impossible to hide the facility, the only option would be to promote it.

Notwithstanding, these positive aspects should not distract from the fact that the facility would be visible within and area that incorporates various sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive.

In this respect, the landscape character, sense of place and tourism value of the region is of relevance. This includes not only the Orange River belt and the N14 access route, but also the tourism potential of the region.

There are not many options as to the mitigation of the visual impact of the facility, but the following measures (as detailed in section 4.9) are recommended:

- The proposed 22kV power line must follow the alignment of the existing transmission power line linking with Taaipit Substation.

- Internal access roads should be planned with due cognisance of the topography and the construction of roads should be undertaken with adequate drainage structures in place to forego potential erosion problems.

- Access roads not required for the post-decommissioning use of the site should be ripped and rehabilitated during decommissioning.

- A lighting engineer should be consulted to assist in the planning and placement of light fixtures for the facility and all ancillary infrastructure in order to reduce visual impacts associated with glare and light trespass. Mitigation 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.

- The construction phase, albeit temporary, and the construction site must be planned, managed and rehabilitated so as to reduce / minimise visual impact during the phase. Mitigation measures include the following:
  - Reduce the construction period through careful planning and productive implementation of resources.
  - Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing.
  - Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
  - Ensure that rubble, litter and disused construction materials are managed and removed regularly.
  - Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way
  - Reduce and control construction dust through the use of approved dust suppression techniques.
  - Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
  - Rehabilitate all disturbed areas, construction areas and road servitudes to acceptable visual standards.

- Once the PV plant has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated.

6. IMPACT STATEMENT

In light of the results and findings of the Visual Impact Assessment undertaken for the Proposed Kakamas PV Solar Energy Facility, it is acknowledged that the rural visual quality and wide open views surrounding the site will be transformed for the entire operational lifespan (approximately 25 years) of the facility.

The following is a summary of impacts remaining, assuming mitigation as recommended is exercised:

- The potential visual impact of the facility on users of national, arterial and secondary roads in close proximity to the proposed facility will be of **high** significance.
- The anticipated visual impact on residents of urban areas, farms and homesteads in close proximity to the proposed facility will be of **high** significance.
- Within the greater region, the potential visual impact on sensitive visual receptors (i.e. users of roads and residents of towns, farms and homesteads) will be of **moderate** significance.

- In terms of ancillary infrastructure, the anticipated visual impact of the substation, the new power line and the internal access roads will be of **low** significance in close proximity to the proposed facility.
- Similarly, visual impacts related to lighting will be of **low** significance.
- The anticipated visual impact of construction is also expected to be of **low** significance.
- In terms of secondary visual impacts, the significance of the anticipated impact on the visual character and sense of place of the region will be of **moderate** significance, while the anticipated impact on tourist routes, tourist destinations and tourism potential will be of **low** significance.

The anticipated visual impacts listed above (i.e. post mitigation impacts) are not considered to be fatal flaws from a visual perspective, considering the relatively contained area of potential visual exposure and the low occurrence of visual receptors.

Furthermore, it is the opinion of the author that the anticipated visual impact is not likely to detract from the regional tourism appeal, numbers of tourists travelling along the N14 or the tourism potential of the area. These receptors will be exposed to the proposed facility for a very short period of their journey, and it is unlikely that the facility will be visible from many tourist destinations.

It is therefore recommended that the development of the facility as proposed be supported, subject to the implementation of the recommended mitigation measures (section 4.9) and management actions (Chapter 7).

7. 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.

Table 12: Management plan – Planning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the planning of the Proposed Kakamas PV Plant.		
Project component/s	PV plant and ancillary infrastructure (i.e. substation, power line and access roads).	
Potential Impact	Primary visual impact of the core facility due to the presence of the power lines and access roads in the landscape as well as the visual impact of lighting at night.	
Activity/risk source	The viewing of the above mentioned 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**
Plan internal access roads with due cognisance of the topography. Consult a lighting engineer in the planning and placement of light fixtures for the turbines, the PV plant and the ancillary infrastructure.	INCA / design consultant INCA / design consultant	Planning. Planning.
Performance Indicator	No internal access roads are visible from surrounding areas and lighting impact is minimal.	
Monitoring	Not applicable.	

Table 13: Management plan – Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the Proposed Kakamas PV Plant.

Project component/s	Construction site.	
Potential Impact	Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing.	
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
Reduce the construction period through careful planning and productive implementation of resources.	INCA / contractor	Construction
Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing.	INCA / contractor	Construction
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	INCA / contractor	Construction
Ensure that rubble, litter and disused construction materials are managed and removed regularly.	INCA / contractor	Construction
Ensure that all infrastructure and the site and general surrounds are maintained in a neat and appealing way	INCA / contractor	Construction
Reduce and control construction dust through the use of approved dust suppression techniques.	INCA / contractor	Construction
Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.	INCA / contractor	Construction
Rehabilitate all disturbed areas, construction areas, road servitudes and cut and fill slopes to acceptable visual standards.	INCA / contractor	Construction
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact with no evidence of degradation or erosion.	
Monitoring	Monitoring of vegetation clearing during construction. Monitoring of rehabilitated areas post construction.	

Table 14: Management plan – Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the Proposed Kakamas PV Plant.		
Project component/s	PV plant and ancillary infrastructure (i.e. substation, power line and access roads).	
Potential Impact	Visual impact of facility degradation and vegetation rehabilitation failure.	
Activity/risk source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Well maintained and neat facility.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Maintain the general appearance of the facility in an aesthetically pleasing way.	INCA / operator	Operation.
Monitor rehabilitated areas, and implement remedial action as and when required.	INCA / 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.	

Table 15: Management plan – Decommissioning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the decommissioning of the Proposed Kakamas PV Plant.		
Project component/s	PV plant and ancillary infrastructure (i.e. substation, power line and access roads).	
Potential Impact	Visual impact of residual visual scarring and vegetation rehabilitation failure.	
Activity/risk source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Infrastructure required for post decommissioning use of the site and rehabilitated vegetation in all disturbed areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Remove infrastructure not required for the post-decommissioning use of the site,	INCA / operator	Operation.
Rip and rehabilitate access roads not required for the post-decommissioning use of the site.	INCA / operator	Operation.
Monitor rehabilitated areas, and implement remedial action as and when required.	INCA / operator	Operation.
Performance Indicator	Site with intact vegetation on and in the vicinity of the facility.	
Monitoring	Monitoring of rehabilitated areas.	

8. REFERENCES/DATA SOURCES

Chief Director of Surveys and Mapping, varying dates. *1:50 000 Topo-cadastral Maps and Data.*

CSIR/ARC, 2000. *National Land-cover Database 2000 (NLC 2000)*

Department of Environmental Affairs and Tourism, 2001. *Environmental Potential Atlas for the Northern Cape Province (ENPAT NC)*

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