PROPOSED NKU SOLAR PHOTOVOLTAIC ENERGY FACILITY, NORTHERN CAPE PROVINCE

VISUAL ASSESSMENT – INPUT FOR SCOPING REPORT

Produced for:

Great Karoo Renewable Energy (Pty) Ltd

On behalf of:

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Lourens du Plessis (t/a LOGIS) is a *Professional Geographical Information Sciences (GISc) Practitioner* registered with The South African Geomatics Council (SAGC), and specialises in Environmental GIS and Visual Impact Assessments (VIA).

Lourens has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990. He has extensive practical knowledge in spatial analysis, environmental modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. His GIS expertise are often utilised in Environmental Impact Assessments, Environmental Management Frameworks, State of the Environment Reports, Environmental Management Plans, tourism development and environmental awareness projects.

He holds a BA degree in Geography and Anthropology from the University of Pretoria and worked at the GisLAB (Department of Landscape Architecture) from 1990 to 1997. He later became a member of the GisLAB and in 1997, when Q-Data Consulting acquired the GisLAB, worked for GIS Business Solutions for two years as project manager and senior consultant. In 1999 he joined MetroGIS (Pty) Ltd as director and equal partner until December 2015. From January 2016 he worked for SMEC South Africa (Pty) Ltd as a technical specialist until he went independent and began trading as LOGIS in April 2017.

Lourens has received various awards for his work over the past two decades, including EPPIC Awards for ENPAT, a Q-Data Consulting Performance Award and two ESRI (Environmental Systems Research Institute) awards for *Most Analytical* and *Best Cartographic Maps*, at Annual International ESRI User Conferences. He is a co-author of the ENPAT atlas and has had several of his maps published in various tourism, educational and environmental publications.

He 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.

1. INTRODUCTION

Great Karoo Renewable Energy (Pty) Ltd is proposing the construction and operation of a photovoltaic (PV) solar energy facility and associated infrastructure on Portion 1 of Farm Rondavel 85, located approximately 35km south-west of Richmond and 80km south-east of Victoria West, within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province.

A preferred project site with an extent of ~29,909ha and a development area of ~571ha within the project site has been identified by Great Karoo Renewable Energy (Pty) Ltd as a technically suitable area for the development of the Nku Solar PV Facility with a contracted capacity of up to 100MW.

The Nku Solar PV Facility project site is proposed to accommodate the following infrastructure, which will enable the facility to supply a contracted capacity of up to 100MW:

- Solar PV array comprising PV modules and mounting structures.
- Inverters and transformers.
- Cabling between the panels.
- 33/132kV onsite facility substation.
- Cabling from the onsite substation to the collector substation (either underground or overhead).
- Electrical and auxiliary equipment required at the collector substation that serves that solar energy facility, including switchyard/bay, control building, fences, etc.
- Battery Energy Storage System (BESS).
- Site offices and maintenance buildings, including workshop areas for maintenance and storage.
- Laydown areas.
- Access roads and internal distribution roads.

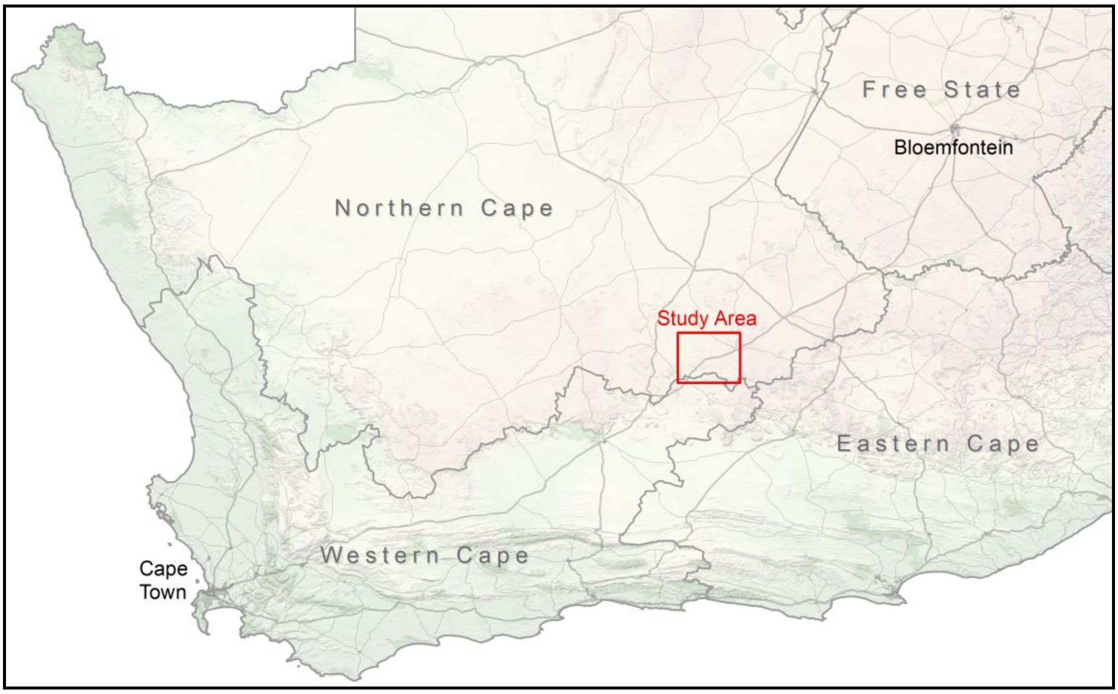

Figure 1: Regional locality of the study area.

The solar PV facility is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the Nku Solar PV Facility under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme, with the aim of evacuating the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP) with the Nku Solar PV Facility set to inject up to 100MW into the national grid.

An additional two 100MW Photovoltaic (PV) solar energy facilities (Moriri and Kwana PV projects) and two 140MW wind energy facilities (Angora and Merino Wind Farms) are concurrently being considered on farms adjacent to the project site and are assessed through separate Environmental Impact Assessment (EIA) processes.

The PV facility will take approximately four months to construct and the operational lifespan of the facility is estimated at up to 30 years.

The proposed properties identified for the PV facility and associated infrastructure are indicated on the maps within this report. Sample images of similar PV technology and Battery Energy Storage System (BESS) facilities are provided below.

Figure 2: Photovoltaic (PV) solar panels. (*Photo: SunPower Solar Power Plant – Prieska)*.

Figure 3: Aerial view of PV arrays. (*Photo: Scatec Solar South Africa*).

Figure 4: Aerial view of a BESS facility (*Photo: Power Engineering International)*.

Figure 5: Close up view of a BESS facility *(Photo: Greenbiz.com).*

2. SCOPE OF WORK

The scope of the work includes a scoping level visual assessment of the issues related to the visual impact. The scoping phase is the process of determining the spatial and temporal boundaries (i.e. extent) and key issues to be addressed in an impact assessment. The main purpose is to focus the impact assessment on a manageable number of important questions on which decision-making is expected to focus and to ensure that only key issues and reasonable alternatives are examined.

The study area for the visual assessment encompasses a geographical area of approximately 3,514km² (the extent of the full page maps displayed in this report) and includes a minimum 6km buffer zone (area of potential visual influence) from the proposed project site.

The study area includes the small town of Richmond, a long section of the N1 national road, sections of the R63 and R398 arterial roads, and a number of farm dwellings or homesteads.

3. METHODOLOGY

The study was undertaken using Geographical 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 topographical data provided by the Japan Aerospace Exploration Agency (JAXA), Earth Observation Research Centre, in the form of the ALOS Global Digital Surface Model "ALOS World 3D - 30m" (AW3D30) elevation model.

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

- The creation of a detailed digital terrain model 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 or receptors upon which the proposed facility could have a potential impact.

- The creation of viewshed analyses from the proposed project site 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 and activities.

This report (scoping report) sets out to identify the possible visual impacts related to the proposed Nku Solar PV Energy Facility from a desktop level.

4. THE AFFECTED ENVIRONMENT

The proposed project site is located approximately 32km (at the closest) from the small town of Richmond and 26km north-east of the Eskom Gamma Main Transmission Substation (MTS). The site is 2km north-west of the N1 national road and encompasses a surface area of approximately 571ha. The final surface area to be utilised for the PV facility may be smaller, depending on the final site layout and the placement of the PV arrays and ancillary infrastructure. The site is currently zoned as agricultural and has a rural and natural character.

Access to the proposed development area is provided by a secondary (gravel) road that joins the N1 national road near the Rondawel homestead.

Refer to **Figure 6** below for the farm identified for the PV facility.

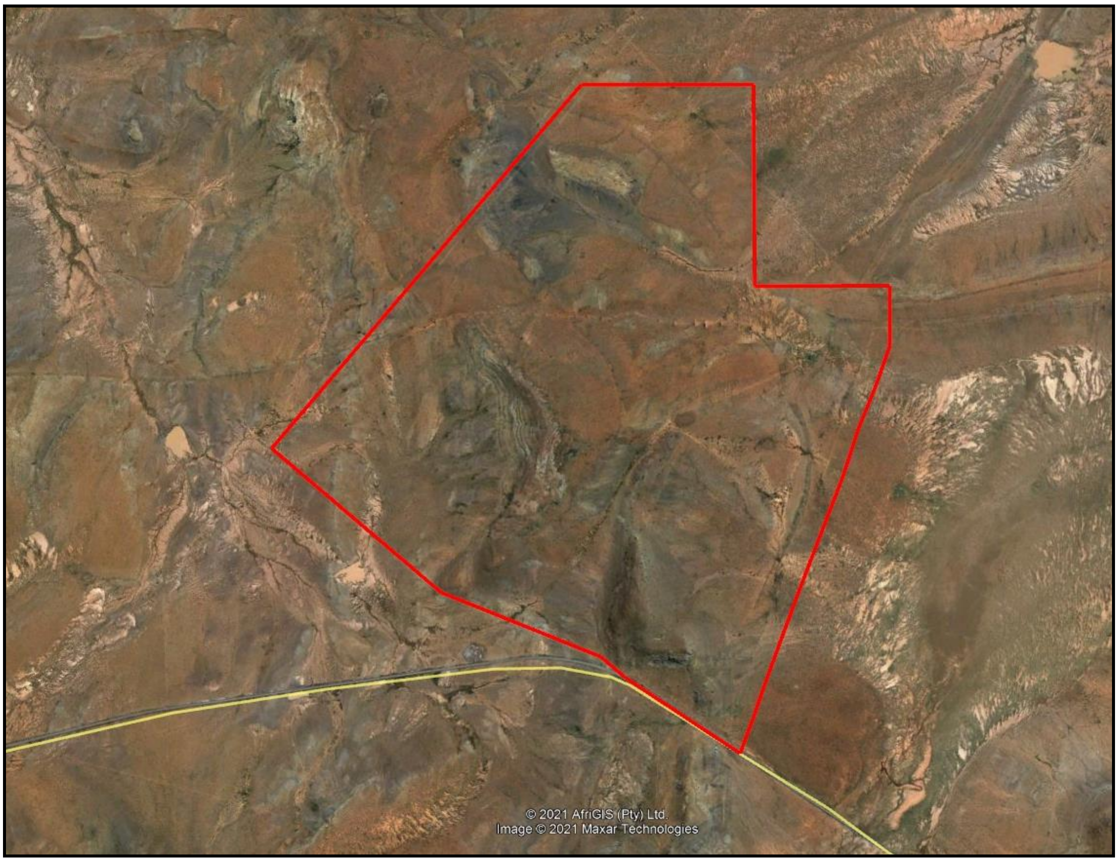

Figure 6: Aerial view of the proposed project site.

Topography, hydrology and vegetation

The study area occurs on land that ranges in elevation from approximately 1,170m (in the south-western corner of the study area) to 1,830m (at the top of the mountains to the east). The terrain of the site is predominantly flat to the north with small hills to the south.

Other mountains and hills in closer proximity to the site include:

- Bobbejaankrans
- Kamberg
- Bulberg
- Klipspringerkop
- Kromhoek se Berg
- Blouberg
- Platberg

The proposed development site itself is located at an average elevation of 1,373m above sea level. The overall terrain morphological description of the study area is described as *undulating plains* (lowlands), with *ridges*, *hills* and *mountains*. These hills and mountains are often referred to as *inselbergs* (island mountains) due to their isolated nature, or *mesas* (table mountains) due to their flat-topped summits. Refer to **Map 1** for a shaded relief map of the study area.

The larger region is known as the Great Karoo, and more locally as the Nama Karoo, consisting predominantly of large open plains and mountains. Due to the arid climate, the area is characterised by the occurrence of many non-perennial drainage lines traversing the study area. Some of the larger drainage lines, or dry river beds, include the *Bulbergspruit*, the *Ongers* and the *Brakpoort* rivers.

Other than a number of man-made farm dams, there is no permanent surface water in the study area.

Vegetation cover in this semi-desert region (200–300mm mean annual rainfall) is predominantly *low shrubland* with *grassland* mainly along the dry water courses, and *bare rock and sand* in places (depending on the season). The vegetation types are described as *Eastern Upper Karoo* (along the plains) and *Upper Karoo Hardeveld* along the mountainous terrain. The entire study area falls within the *Upper Karoo Bioregion* of the *Nama-Karoo Biome.* Refer to **Map 2** for the land cover map of the study area.

Land use and settlement patterns

The majority of the study area is sparsely populated (less than 1 person per km^2), with the highest concentration of people living in the town of Richmond (population 5,122).

The study area consists of a landscape that can be described as remote due to its considerable distance from any major metropolitan centres or populated areas. The scarcity of water and other natural resources has influenced settlement within this region, keeping numbers low, and distribution limited to the availability of water. Settlements, where they occur, are usually rural homesteads or farm dwellings.

There are quite a number of homesteads present within the study area. Some of these in closer proximity to the development site include:

- Ratelfontein
- Taaibosfontein
- De Brak
- De Hoop
- Rietfontein Wes
- Bultfontein
- Bloemhof
- Poortjie
- Esterhuispoort
- Eselsfontein
- Rondawel
- Roggefontein
- Vogelstruisfontein
- South Merino
- Schalkhanna
- Nieuwefontein
- De Novo
- Bethel
- Baardmansfontein
- Gedundefontein
- Westdene
- Excelsior
- Klipkraal
- Hebron

It is uncertain whether all of these farmsteads 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.

The predominant land use in the area is stock farming (predominantly sheep, game or goat farming). Since rainfall is low and water is scarce, crop farming accounts for only a small portion of the land use and is largely confined to the more fertile floodplain valleys. Due to the low carrying capacity, farms are large and usually at least about 5km apart.

The N1 national road provides motorised access to the region and the proposed development site. This road is the connecting spine in between the Gauteng Province and Cape Town and is frequented by both tourists visiting the Western Cape Province and freight carriers transporting goods in between these two destinations. Other arterial or main roads within the study area include the R63 (near the Gamma MTS) and the R398 near Richmond.

There are no designated protected areas within the region and no major tourist attractions or destinations were identified within the study area. There are however two overnight facilities, namely the Bloemhof Karoo Farmstay and the Rondawel Guest Farm.[1]

In spite of the rural and natural character of the study area, there are a large number of overhead power lines in the study area, all congregating at either the Gamma or Victoria Cap Substations. These include:

- Droërivier/Hydra 1, 2 & 3 400kV
- Gamma/Hydra 1 765kV
- Gamma/Perseus 1 765kV

These power lines traverse the north-western boundary of the proposed development site.

Additional power lines to the north-west of the study area (at the Brakpoort Substation) include the Brakpoort/Hutchinson 1 132kV and Brakpoort/Laken 1 132kV lines.

These power lines (and the entire study area) all fall within the Central Strategic Transmission Corridor, one of five Gazetted corridors earmarked for electricity infrastructure development within South Africa.

In spite of the fact that the study area does not fall within a Renewable Energy Development Zone (REDZ), there have been a number of applications for renewable energy facilities within the region. Some of these within the study area, that have been authorised, include:

- Mainstream Wind and Solar Energy Facility at Victoria West
- Aurora Power Solutions Betelgeuse PV solar project near Murraysburg
- Ishwati Emoyeni Wind Energy Facility and Supporting Eskom Transmission and Distribution Grid Connection Infrastructure near Murraysburg
- Proposed Trouberg 400MW wind energy facility near Beaufort West
- Proposed Wildebeest Karoo PV Solar Power Plant near Richmond
- Proposed Umsinde Emoyeni wind energy facility
- Blue Sky Solar (Pty) Ltd Brakpoort Karoo Photovoltaic Solar Facility near Victoria West

Notes:

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[1] Sources: DEAT (ENPAT Northern Cape), NBI (Vegetation Map of South Africa, Lesotho and Swaziland), NLC2018 (ARC/CSIR), REEA_OR_2021_Q1 and SAPAD2021 (DFFE), Wikipedia.

- *Some of these applications include more than one phase.*
- *The data above is provided by the Department: Forestry, Fisheries and the Environment (DFFE). The author accepts no responsibility for the accuracy thereof.*

The photographs below aid in describing the general environment within the study area and surrounding the proposed project infrastructure.

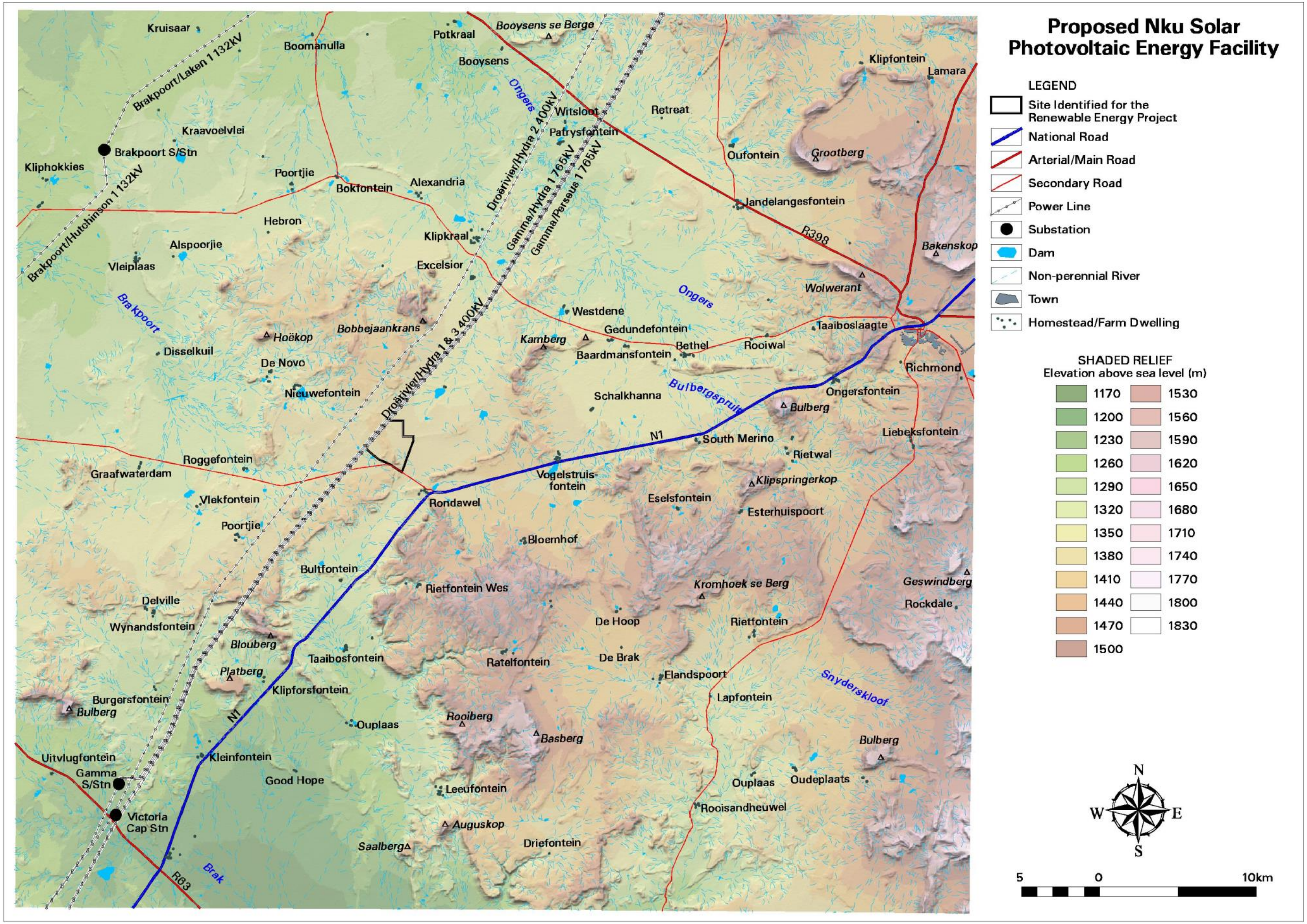
Figure 7: The N1 national road traversing the study area.

Figure 8: Ridges near the proposed development area.

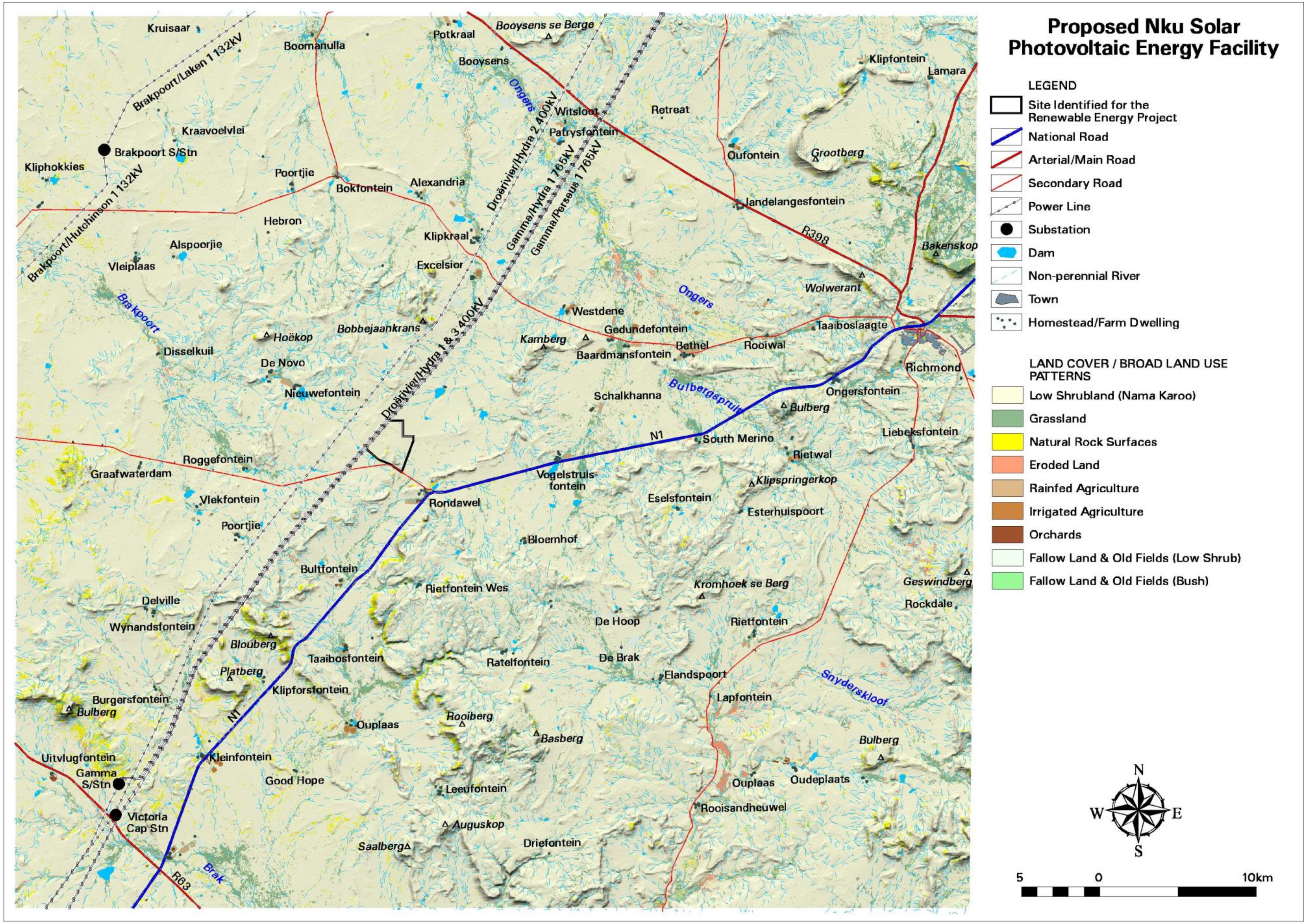
Figure 9: Typical Karoo homestead.

Figure 10: Typical Karoo scene.

Figure 11: Planted vegetation at a homestead.



Map 1: Shaded relief map of the study area.



Map 2: Land cover and broad land use patterns.

5. VISUAL EXPOSURE/VISIBILITY

The result of the viewshed analysis for the proposed facility is shown on the map below (**Map 3**). The viewshed analysis was undertaken from a representative number of vantage points within the development footprint at an offset of 5m above ground level. This was done in order to determine the general visual exposure (visibility) of the area under investigation, simulating the maximum height of the proposed structures (PV panels, inverters and BESS) associated with the facility.

The viewshed analysis will be further refined once a preliminary and/or final layout is completed and will be regenerated for the actual position of the infrastructure on the site and actual proposed infrastructure during the EIA phase of the project.

Map 3 also indicates proximity radii from the development footprint in order to show the viewing distance (scale of observation) of the facility in relation to its surrounds.

Results

It is clear that the relatively constrained dimensions of the PV facility would amount to a fairly limited area of potential visual exposure. The visual exposure would largely be contained within a 6km radius of the proposed development site, with the predominant exposure to the north-east.

The following is evident from the viewshed analyses:

0 – 1km

The facility may be highly visible within a 1km radius of the development. There are no homesteads within this zone, only a section of the Rondawel secondary road traversing south-west of the site.

1 – 3km

This zone contains the Rondawel homestead[2] (guest farm), a short section of the N1 national road and the Rondawel secondary road. Other than these potential receptor sites, the rest of the visually exposed areas fall within vacant farmland.

3 - 6km

Visual exposure within this zone will predominantly be towards the north-east, along the Droërivier/Hydro 1 and 3, Gamma/Perseus and Gamma/Hydra power lines, up to the Bobbejaankrans hills. The only homestead within this zone is the Nieuwefontein dwelling to the north-west, approximately 6km from the development site.

> 6km

At distances exceeding 6km the intensity of visual exposure is expected to be very low and highly unlikely due to the distance between the object (development) and the observer.

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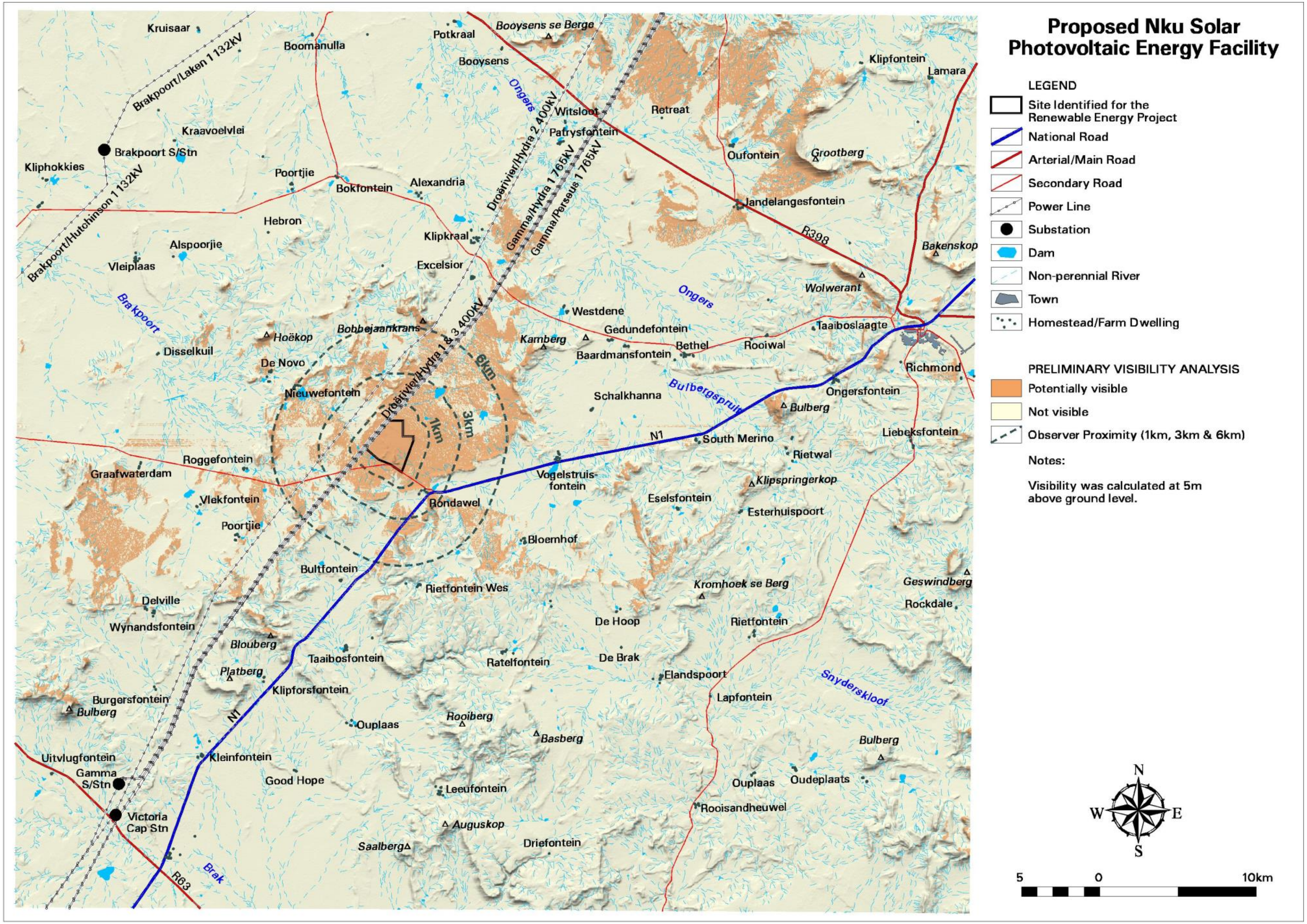
[2] The names listed below are of the homestead or farm dwelling as indicated on the SA 1: 50 000 topographical maps and do not refer to the registered farm name.

Conclusion

In general terms it is envisaged that the structures, where visible from shorter distances (e.g. less than 1km and potentially up to 3km), and where sensitive visual receptors may find themselves within this zone, may constitute a high visual prominence, potentially resulting in a visual impact. This may include residents of the farm dwellings mentioned above, as well as observers travelling along the roads in closer proximity to the facility.



Map 3: Map indicating the potential (preliminary) visual exposure of the proposed PV facility.

6. ANTICIPATED ISSUES RELATED TO THE VISUAL IMPACT

Anticipated issues related to the potential visual impact of the proposed PV facility include the following:

- The visibility of the facility to, and potential visual impact on, observers travelling along the Rondawel secondary road (and potentially the N1 national road).
- The visibility of the facility to, and potential visual impact on residents of dwellings within the study area, with specific reference to the farm residences in closer proximity to the proposed development.
- The potential visual impact of the facility on the visual character or sense of place of the region.
- The potential visual impact of the facility on tourist routes or tourist destinations/facilities (if present).
- The potential visual impact of the construction of ancillary infrastructure (i.e. internal access roads, buildings, etc.) on observers in close proximity to the facility.
- The visual absorption capacity of the natural vegetation (if applicable).
- Potential cumulative visual impacts (or consolidation of visual impacts), with specific reference to the placement of the PV facility within an area where additional solar energy facilities have been authorised.
- The potential visual impact of operational, safety and security lighting of the facility at night on observers residing in close proximity of the facility.
- Potential visual impact of solar glint and glare as a visual distraction and possible air/road travel hazard.
- Potential visual impacts associated with the construction phase.
- The potential to mitigate visual impacts and inform the design process.

It is envisaged that the issues listed above may potentially constitute a visual impact at a local and/or regional scale. These need to be assessed in greater detail during the EIA phase of the project.

Table 1: Impact table summarising the potential primary visual impacts associated with the proposed PV facility.

Impact Visual impact of the facility on observers in close proximity to the proposed PV facility infrastructure and activities. Potential sensitive visual receptors include: • Residents of homesteads and farm dwellings (in close proximity to the facility) • Observers travelling along the Rondawel secondary road (and potentially the N1 national road)			
Issue	**Nature of Impact**	**Extent of Impact**	**No-Go Areas**

<table>
<tr><td>The viewing of the PV facility infrastructure and activities</td><td>The potential negative experience of viewing the infrastructure and activities within a predominantly undeveloped setting</td><td>Primarily observers situated within a 3km radius of the facility</td><td>N.A.</td></tr>
<tr><td colspan="4">Description of expected significance of impact

Extent: Local
Duration: Long term
Magnitude: Moderate to High
Probability: Probable
Significance: Moderate to High
Status (positive, neutral or negative): Negative
Reversibility: Recoverable
Irreplaceable loss of resources: No
Can impacts be mitigated: Yes</td></tr>
<tr><td colspan="4">Gaps in knowledge & recommendations for further study

A finalised layout of the PV facility and ancillary infrastructure are required for further analysis. This includes the provision of the dimensions of the proposed structures and ancillary equipment.

Additional spatial analyses are required in order to create a visual impact index that will include the following criteria:

• Visual exposure
• Visual distance/observer proximity to the structures/activities
• Viewer incidence/viewer perception (sensitive visual receptors)
• Visual absorption capacity of the environment surrounding the infrastructure and activities

Additional activities:

• Identify potential cumulative visual impacts
• Undertake a site visit
• Recommend mitigation measures and/or infrastructure placement alternatives

Refer to the Plan of Study for the EIA phase of the project below.</td></tr>
</table>

7. CONCLUSION AND RECOMMENDATIONS

The fact that some components of the proposed Nku Solar PV Energy Facility and associated infrastructure may be visible does not necessarily imply a high visual impact. Sensitive visual receptors within (but not restricted to) a 3km buffer zone from the facility need to be identified and the severity of the visual impact assessed within the EIA phase of the project.

It is recommended that additional spatial analyses be undertaken in order to create a visual impact index that will further aid in determining potential areas of visual impact. This exercise should be undertaken for the core PV facility as well as for the ancillary infrastructure, as these structures (e.g. the BESS structures) are envisaged to have varying levels of visual impact at a more localised scale.

The site-specific issues (as mentioned earlier in the report) and potential sensitive visual receptors should be measured against this visual impact index and be addressed individually in terms of nature, extent, duration, probability, severity and significance of visual impact.

This recommended work must be undertaken during the Environmental Impact Assessment (EIA) Phase of reporting for this proposed project. In this respect, the Plan of Study for the EIA is as follows:

Visual Impact Assessment (VIA)

The VIA is determined according to the nature, extent, duration, intensity or magnitude, probability and significance of the potential visual impacts, and will propose management actions and/or monitoring programs, and may include recommendations related to the solar energy facility layout.

The visual impact is determined for the highest impact-operating scenario (worst-case scenario) and varying climatic conditions (i.e. different seasons, weather conditions, etc.) are not considered.

The VIA considers potential cumulative visual impacts, or alternatively the potential to concentrate visual exposure/impact within the region.

The following VIA-specific tasks must be undertaken:

- **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 (or where) the proposed facility and associated infrastructure were not visible, no impact would occur.

The viewshed analyses of the proposed facility and the related infrastructure are based on a detailed digital terrain model of the study area.

The first step in determining the visual impact of the proposed facility is to identify the areas from which the structures would be visible. The type of structures, the dimensions, the extent of operations and their support infrastructure are taken into account.

- **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 this type of structure.

Proximity radii for the proposed infrastructure 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 (anticipated) negative visual perception of the proposed facility.

- **Determine viewer incidence/viewer perception (sensitive visual receptors)**

The next layer of information is the identification of areas of high viewer incidence (i.e. main roads, residential areas, settlements, etc.) that may be exposed to the project infrastructure.

This is done in order to focus attention on areas where the perceived visual impact of the facility will be the highest and where the perception of affected observers will be negative.

Related to this data set, is a land use character map, that further aids in identifying sensitive areas and possible critical features (i.e. tourist facilities, protected areas, etc.), that should be addressed.

- **Determine the visual absorption capacity of the landscape**

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.

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 discernible detail in visual characteristics of both environment and structure decreases.

- **Calculate the visual impact index**

The results of the above analyses are merged in order to determine the areas of likely visual impact and where the viewer perception would be negative. An area with short distance visual exposure to the proposed infrastructure, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater impact) on the index. This focusses the attention to the critical areas of potential impact and determines the potential **magnitude** of the visual impact.

Geographical Information Systems (GIS) software is used to perform all the analyses and to overlay relevant geographical data sets in order to generate a visual impact index.

- **Determine impact significance**

The potential visual impacts are quantified in their respective geographical locations in order to determine the significance of the anticipated impact on identified receptors. Significance is determined as a function of extent, duration, magnitude (derived from the visual impact index) and probability. Potential cumulative and residual visual impacts are also addressed. The results of this section are displayed in impact tables and summarised in an impact statement.

- **Propose mitigation measures**

The preferred alternative (or a possible permutation of the alternatives) will be based on its potential to reduce the visual impact. Additional general mitigation measures will be proposed in terms of the planning, construction, operation and decommissioning phases of the project.

- **Reporting and map display**

All the data categories, used to calculate the visual impact index, and the results of the analyses will be displayed as maps in the accompanying report. The methodology of the analyses, the results of the visual impact assessment and the conclusion of the assessment will be addressed in the VIA report.

- **Site visit**

Undertake a site visit in order to collect a photographic record of the affected environment, to verify the results of the spatial analyses and to identify any additional site specific issues that may need to be addressed in the VIA report.

8. REFERENCES/DATA SOURCES

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