PROPOSED DICOMA PV FACILITY AND ASSOCIATED INFRASTRUCTURE, NORTH WEST PROVINCE

Visual Assessment – Input for Scoping Report

Produced for:

Dicoma PV (Pty) Ltd

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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. Although the guidelines have been developed with specific reference to the Western Cape Province of South Africa, the core elements are more widely applicable (i.e. within the North West Province).

1. INTRODUCTION

The Applicant, Dicoma PV (Pty) Ltd, is proposing the construction of a photovoltaic (PV) solar energy facility (known as the Dicoma PV facility) located on a site approximately 5km north-west of the town of Lichtenburg in the North West Province. The solar PV facility will comprise several arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 75MW. The development area is situated within the Ditsobotla Local Municipality within the Ngaka Modiri Molema District Municipality. The site is accessible via an existing gravel road which provides access to the development area off the R505, located east of the development area.

The development area for the PV facility and associated infrastructure will be located on the following properties: [1]

- Portion 1 of the Farm Houthaalboomen 31
- Portion 9 of the Farm Houthaalboomen 31
- Portion 10 of the Farm Houthaalboomen 31
- Portion 0 of Farm Talene 25
- Portion 7 of Farm Elandsfontein 34

Figure 1: Regional locality of the study area.

Two additional 75MW PV facilities (Barleria PV and Setaria PV) are concurrently being considered on the project site (within Portion 1, Portion 9, and Portion 10 of the Farm Houthaalboomen 31) and are assessed through separate Environmental Impact Assessment (EIA) processes.

A facility development area (approximately 180ha) as well as two alternative grid connection solutions (within a 100m wide corridor) has been considered in the Scoping Phase. The infrastructure associated with this 75MW PV facility includes:

[1] Two alternative locations for the grid connection infrastructure have been provided for assessment.

- PV modules and mounting structures
- Inverters and transformers
- Battery Energy Storage System (BESS)
- Site and internal access roads (up to 8m wide)
- Site offices and maintenance buildings, including workshop areas for maintenance and storage.
- Temporary and permanent laydown area
- Grid connection solution (two alternative locations assessed) within a 100m wide corridor, including:

    - 33kV cabling between the project components and the facility substation
    - A 132kV facility substation
    - A 132kV Eskom switching station
    - A Loop-in-Loop out (LILO) overhead 132kV power line between the Eskom switching station and the existing Delareyville Munic–Watershed 1 88kV power line.[2]

The alternative grid connection configurations assessed include:

Grid Connection Alternative 1: 33kV MV cabling will connect the Dicoma PV solar array to the 132kV facility substation. The 132kV Eskom switching station is located directly adjacent to the development footprint of the facility substation. The facility substation and Eskom switching station are located approximately 1.3km east of the Dicoma PV facility on Portion 1 of the Farm Houthaalboomen 31. A 132kV Loop-in-Loop Out power line from the Eskom switching station will connect into the Delareyville Munic–Watershed 1 88kV.2 The grid connection infrastructure is located within an assessment corridor of 100m wide.

Grid Connection Alternative 2: 33kV MV cabling will connect the Dicoma PV solar array to the 132kV facility substation. The 132kV Eskom switching station is located directly adjacent to the development footprint of the facility substation. The facility substation and Eskom switching station are located within the development footprint of the Dicoma PV facility on Portion 1 of the Farm Houthaalboomen 31. A 132kV Loop-in-Loop Out power line from the Eskom switching station will connect into the Delareyville Munic–Watershed 1 88kV.2 The grid connection infrastructure is located within an assessment corridor of 100m wide.

To avoid areas of potential sensitivity and to ensure that potential detrimental environmental impacts are minimised as far as possible, the developer will identify a suitable development footprint within which the infrastructure of Dicoma PV facility and its associated infrastructure is proposed to be located and fully assessed during the EIA Phase.

The PV Plant 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 Plant 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.

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[2] The LILO corridor intersects with several existing parallel Eskom power lines (Watershed-Sephaku 1 132kV, Dudfield–Watershed 2 88kV, Dudfield-Watershed 1 88kV, and Watershed-Klerksdorp North 1 132kV). Therefore, should the connection to the Delareyville Munic–Watershed 1 88kV not be technically feasible, connection to the above mentioned power lines would still be within the assessed LILO corridor and considered feasible through the construction of a shorter LILO connection.

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 potential visual impact of the Docima PV Facility and Associated Infrastructure as described above.

The study area for the visual assessment encompasses a geographical area of approximately 298km² (the extent of the full page maps displayed in this report) and includes a 6km buffer zone (area of potential visual influence) from the proposed development footprint. It includes the town of Lichtenburg, sections of the R503 and R505 arterial roads as well as a number of major secondary (local) roads.

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 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 Dicoma PV Facility and Associated Infrastructure from a desktop level.

4. THE AFFECTED ENVIRONMENT

The identified site for the proposed PV facility is situated approximately 8km by road north-west of Lichtenburg on the farm *Houthaalbomen 31*. This farm is located in an area that has a distinct rural and agricultural character, with some mining/quarrying activity (cement works) located south-east of the proposed development site at a distance of 5km at the closest. The Watershed substation is located at a distance of 3.4km east of the proposed site. A great number of power lines, associated with this substation, are located south and north of the site. The power lines traversing the site to the south include:

- Watershed-Klerksdorp North 1 132kV
- Delareyville Municipal-Watershed 1 88kV
- Dudfield-Watershed 1 and 2 88kV

The power line traversing the site to the north is the Watershed-Sephaku 88kV line.

Additional power lines associated with the Watershed Substation include:

- Watershed-Zeerust 1 132k
- Slurry PPC-Watershed 1 88kV

- Watershed-Mmabatho 1 and 2 88kV
- Pluto-Watershed 1 275kV
- Hera-Watershed 1 275kV
- Halfpad Traction-Watershed 1 132kV
- Whites North-Watershed 1 and 2 88kV
- Lichtenburg Munic/Watershed 1 88kV

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

Access to the proposed development area is provided by a secondary (gravel) road that joins the R505 arterial road near the Watershed substation, east of the proposed site.

The natural vegetation or land cover types of the region are described as *Grassland*, with very limited *Thicket and Bushland* and *Wetlands* (in the south-east) and large tracts of agricultural fields (altered vegetation) to the west (see **Map 1**). The majority of the remaining natural vegetation within the study area is indicated as *Carltonville Dolomite Grassland* (to the north) with limited sections of Western *Highveld Sandy Grassland* to the south. Pans are generally absent within the study area.

Land use activities within the broader region are predominantly described as maize farming (both dryland and irrigated agriculture), with some mining/quarrying activity (cement works located west of Lichtenburg) evident towards the south-east of the proposed site.

Farm settlements or residences occur at irregular intervals throughout the study area. Some of these, in close proximity to the proposed development site, include: *Houthaalbomen, Boskoppie, Elandsfontein, Brakpan, Scherppunt, Greeflaagte*, etc. The Elandsfontein small holdings are located east of the farm identified for the PV facility. The population density of the region is indicated as approximately 19 people per km^2, predominantly concentrated within the town of Lichtenburg.

The topography or terrain morphology of the region is broadly described as *Plains and Pans* or *Slightly Undulating Plains* of the *Central Interior Plain*. The slope of the entire study area is extremely even (flat) with a very gradual drop (approximately 70m) from the northern section of the study area (1520m above sea level) to the *Die Vlei* River (1450m) which flows through Lichtenburg. This perennial river, wetlands and farm dams near this town, account for the dominant hydrological features within this region that receives between 500mm to 650mm rainfall per annum. See **Map 2** for the shaded relief/topography map of the study area.

No formally protected or conservation areas or major tourist attractions/resorts were identified within the study area. [3]

[3] Sources: DEAT (ENPAT North West), NBI (Vegetation Map of South Africa, Lesotho and Swaziland), NLC2018 (ARC/CSIR), REEA_OR_2021_Q1 and SAPAD2021_Q1 (DEA).

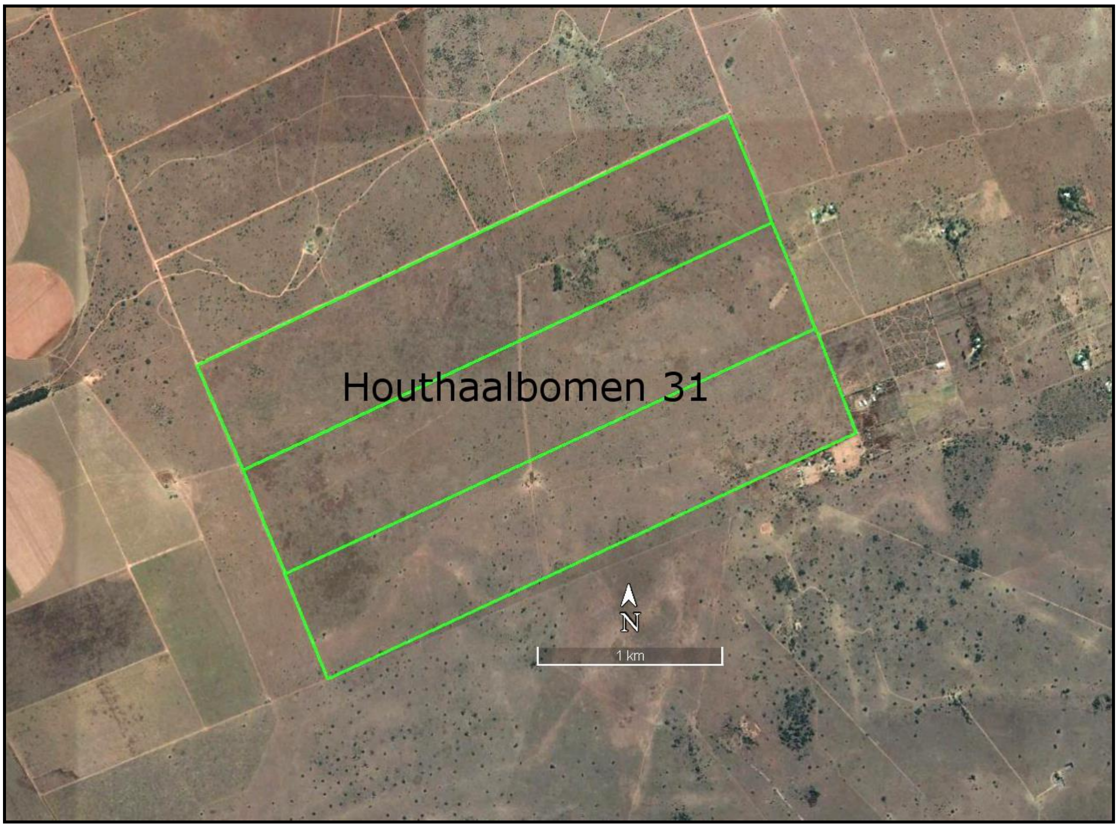
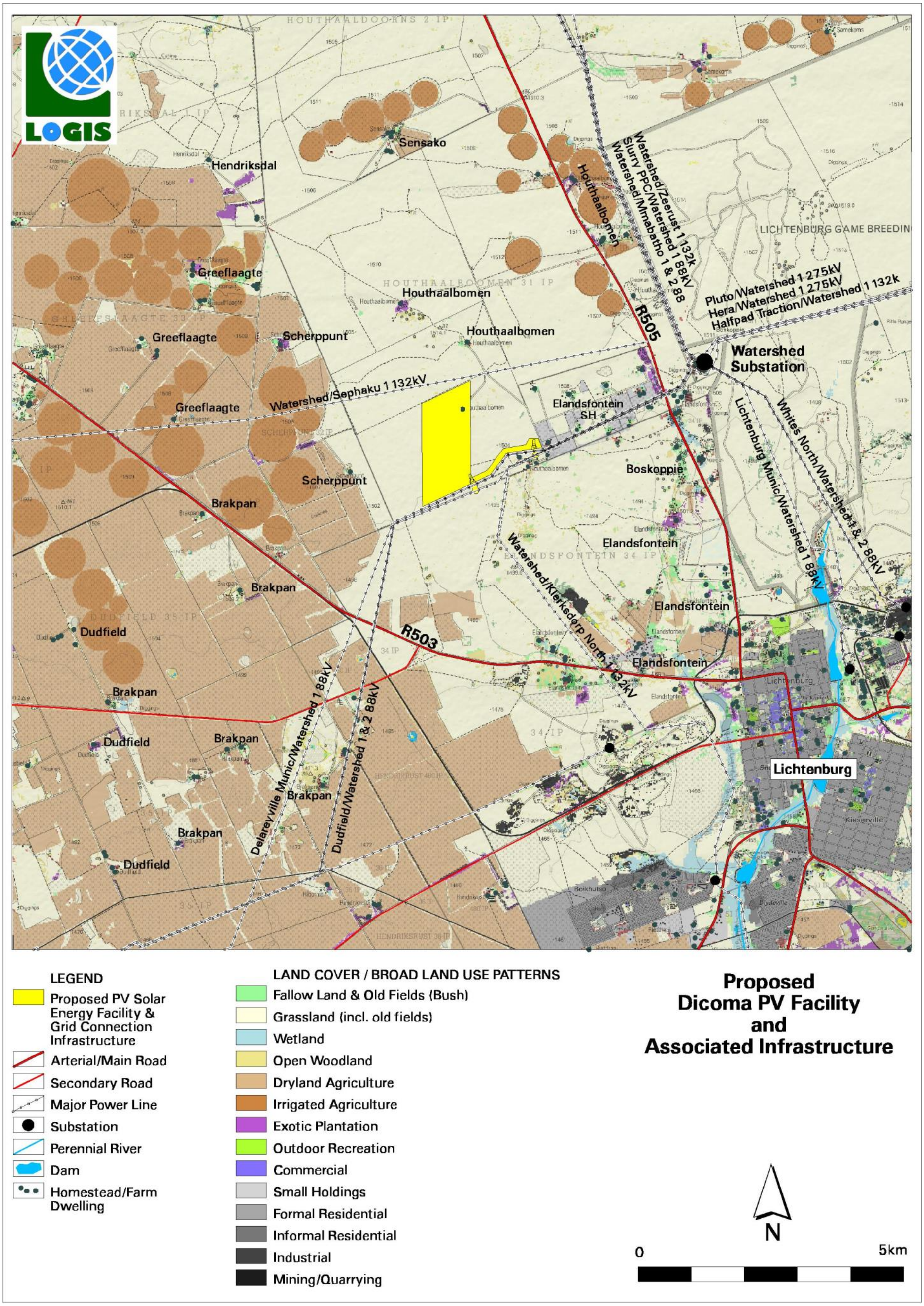


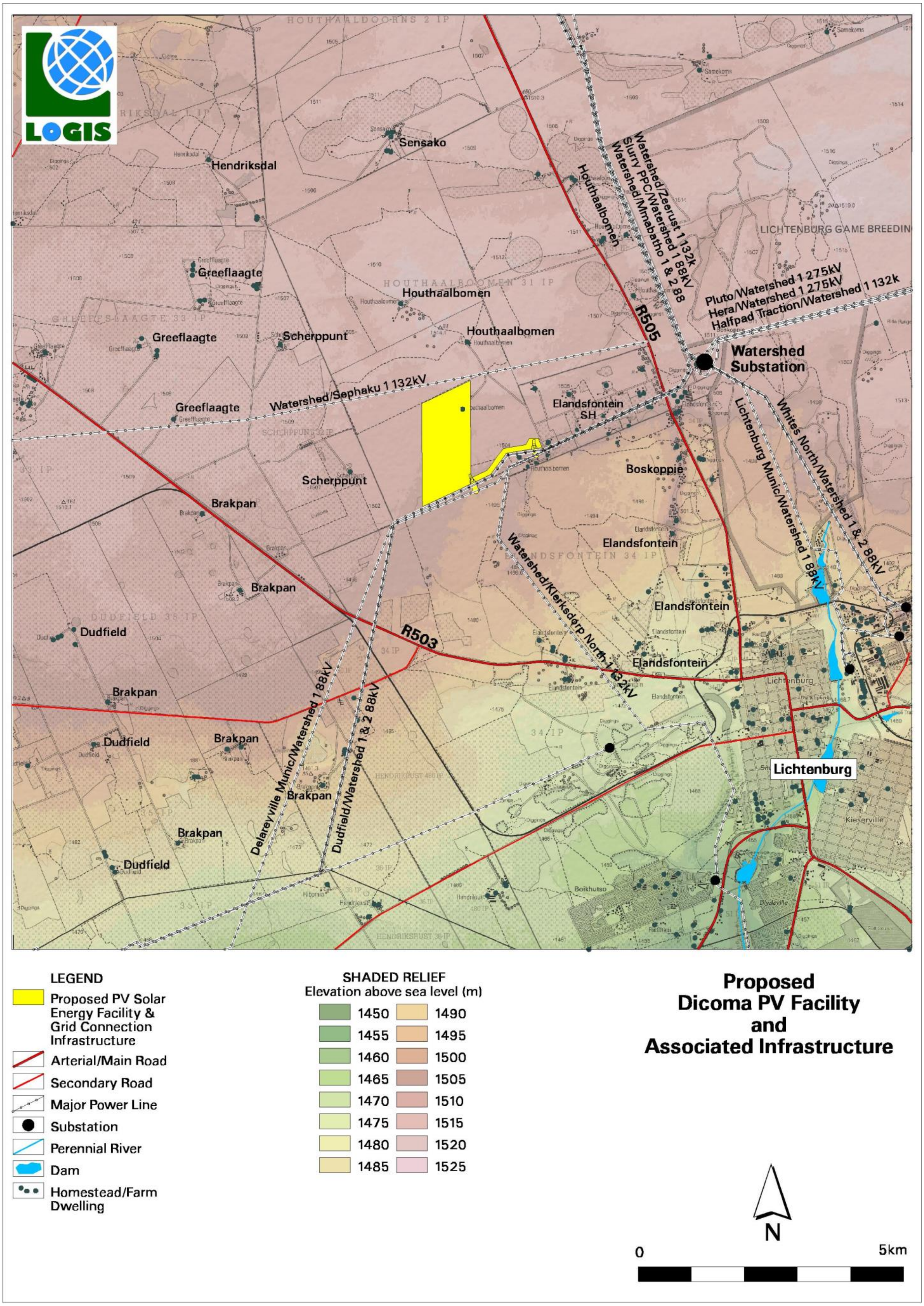
Figure 6: Aerial view of the farm identified for the PV Plant.

Figure 7: Gravel access road from the R505 arterial road (Note: planted vegetation cover (*eucalyptus* trees) along this road).

Figure 8: General environment within the study area (Note: grassland land cover with limited *thicket and woodland*).



Map 1: Land cover and broad land use patterns.



Map 2: Shaded relief map of the study area.

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 4m 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 and inverters) 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.

The viewshed analysis includes the effect of vegetation cover and existing structures on the exposure of the proposed infrastructure.

Results

The development would be quite easily visible within a 1km radius of the site. This area of visual exposure (0 – 1km) is generally restricted to vacant farmland and agricultural fields, but may contain some potential sensitive visual receptors. This pattern of exposure is generally attributed to the flat topography of the study area, with no hills or ridges influencing or interrupting the viewshed analysis. There is a single residence (Houthaalboomen 1) within this zone (to the north of the proposed PV facility).

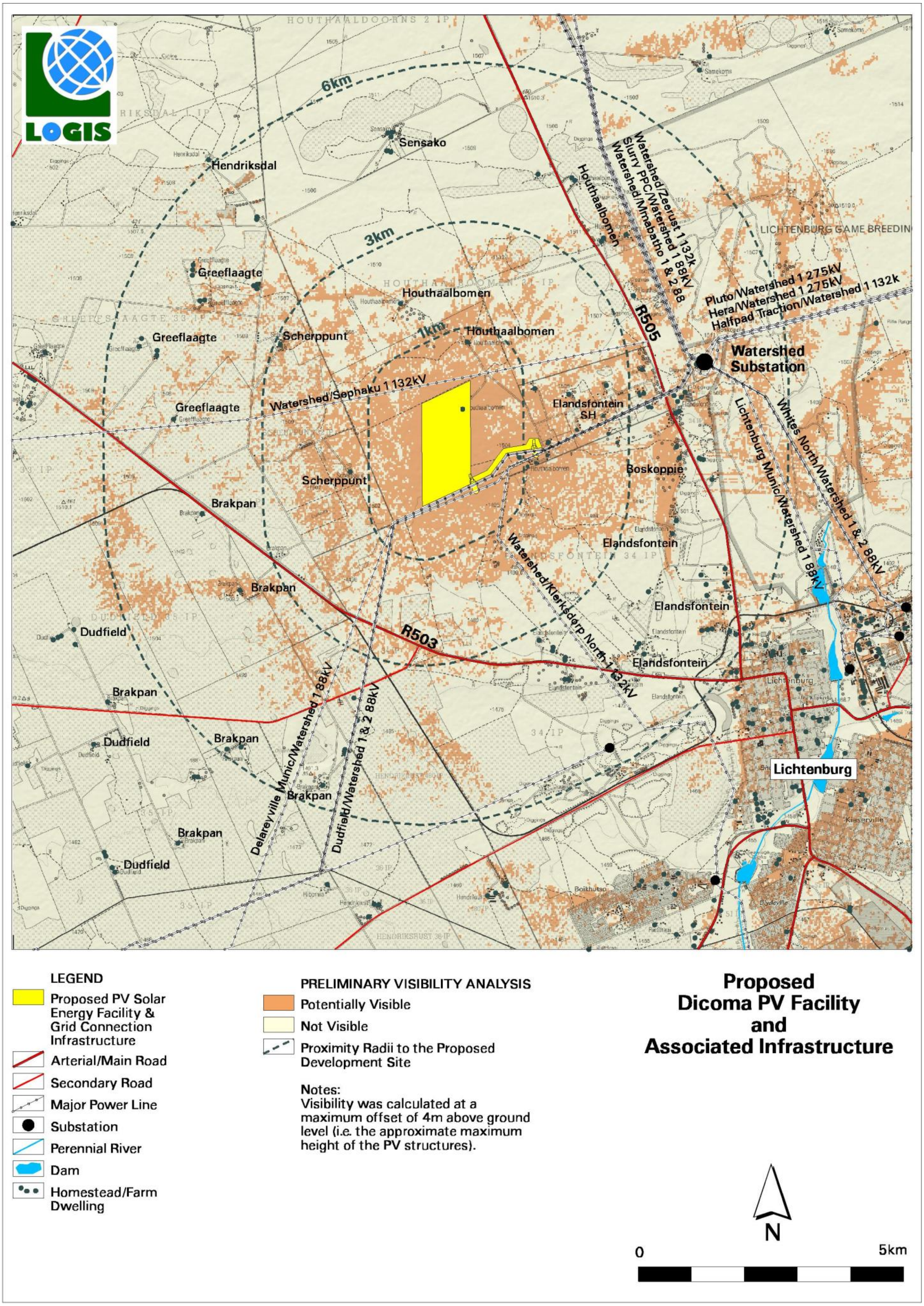
Within a 1 – 3km radius, the visual exposure is more scattered and interrupted due to the undulating nature of the topography. Most of this zone falls within vacant open space and agricultural land, but does include some farm dwellings and residences. Some of these include Scherppunt 1 and 2, and Houthaalboomen 2, as well as residences within the Elandsfontein small holdings. The R503 arterial road traverses a section of this zone to the south, where the facility may be visible.

Visibility between the 3 - 6km radii is greatly reduced, but does include sections of the R505 and R503 arterial roads and a number of farm residences, namely Boskoppie, Elandsfontein and Brakpan.

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. The town of Lichtenburg is located beyond 6km from the facility, and although visibility my theoretically be possible, it is highly unlikely due to the built-up nature of the town.

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 and small holdings 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 plant.

6. ANTICIPATED ISSUES RELATED TO THE VISUAL IMPACT

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

- The visibility of the facility to, and potential visual impact on, observers travelling along the secondary or arterial roads within the study area.
- 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 or small holdings 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 plant 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 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 plant.

<table>
<tr><td colspan="4">Impact

Visual impact of the facility on observers in close proximity to the proposed PV plant infrastructure and activities. Potential sensitive visual receptors include:

• Residents of the Elandsfontein small holdings
• Residents of homesteads and farm dwellings (in close proximity to the facility)
• Observers travelling along the arterial and secondary roads</td></tr>
<tr><td>Issue</td><td>Nature of Impact</td><td>Extent of Impact</td><td>No-Go Areas</td></tr>
<tr><td>The viewing of the PV plant 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 plant 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 Dicoma PV 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 plant 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**

A site visit must be undertaken in order 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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