PROPOSED KLEINZEE 300MW WIND ENERGY FACILITY
IN THE NORTHERN CAPE PROVICE

VISUAL ASSESSMENT - INPUT FOR SCOPING REPORT

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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 modeling and digital mapping, and applies this knowledge in various scientific fields and disciplines. The expertise of these practitioners is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

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

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the Proposed Klienzee 300MW Wind Energy Facility in the Northern Cape Province. Neither the author, MetroGIS or V&L Landscape Architects will benefit from the outcome of the project decision-making.

1. INTRODUCTION

Eskom Holdings SOC Limited is proposing the establishment of a commercial Wind Energy Facility (WEF) and associated infrastructure on a site located 6km south of Kleinzee, within the Nama Khoi Local Municipality of the Northern Cape Province.

A WEF generates electricity by means of wind turbines that harness the wind of the area as a renewable source of energy. Wind energy generation, or wind farming as it is commonly referred to, is generally considered to be an environmentally friendly electricity generation option.

The effectiveness of the WEF, or amount of power generated by the facility, is dependent on the number of wind turbines erected in the area as well as the careful placement of the turbines in relation to the topography and each other in order to optimise the use of the wind resource.

Eskom Holdings SOC Limited intends to construct between 150 and 200 wind turbines over an area of approximately 9300 ha in extent. The facility will ultimately have a generating capacity of approximately 300MW.

The WEF will connect to the national grid at the existing Gromis Substation, approximately 60 km north east of the site.

A locality map indicating the proposed WEF site is shown on **Map 1**.

The overall aim of the design and layout of the facility is to maximise electricity production through exposure to the wind resource, while minimising infrastructure, operation and maintenance costs, and social and environmental impacts.

Therefore, detailed and reliable information about the strength, direction, and frequency of the wind resource is vital when considering the installation of a wind energy facility, as the wind resource is a critical factor to the success of the installation.

Each turbine will have a capacity of of between 1.5MW and 2MW and will consist of a concrete foundation, a steel tower and nacelle (hub height at a height of 140m), and a rotor (140m diameter, consisting of 3 blades of 70m in length). The rotational power generated by the turbine blades is transmitted to the generator housed within the nacelle via a gearbox and drive train. Refer to **Figure 1**.

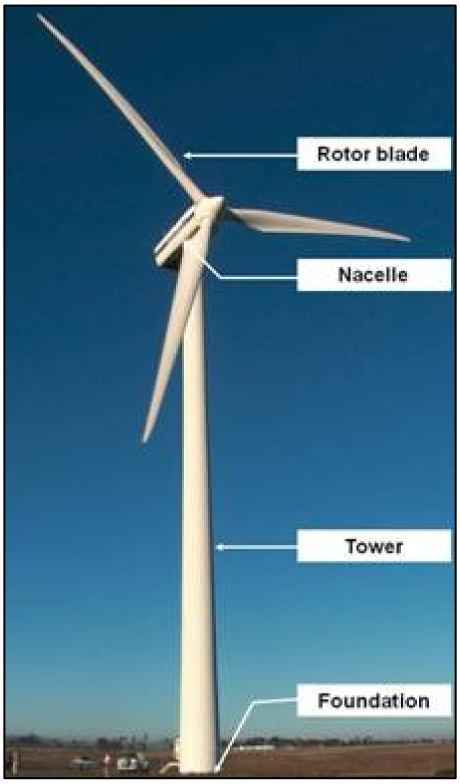

Figure 1: Illustration of the main components of a wind turbine[1]

The layout of ancillary infrastructure has not been finalised, but will include the following:

- Concrete foundations to support the turbines;
- Cabling between the turbines to be lain underground where practical;
- An on-site substation to facilitate the connection between the facility and the electricity grid;
- Internal access roads;
- Borrow pits within the site for construction of access roads;
- An office / workshop area for maintenance and storage, and
- A visitors centre.

An overhead power line (400kV) will be required to feed into Eskom's electricity grid. Gfour alternative alingments are being considered:

[1] Illustration courtesy of Savannah Environmental.

- Altenrative 1 exits the north eastern corner of the site, and heads straight for the Gromis Substation, located some 12km to the north east, on the northern side of the R355;
- Alternative 2 exits the eastern boundary of the site and heads in a north easterly direction to link with the Juno-Oranjemond Power Line, which bypasses the site some 7,5km to the east;
- Alternative 3 also exits the site on its eastern boundary and heads straight for the Juno-Oranjemond Power Line in the east. This alignment alternative lies less than 2km south of Alternative 2.
- Alternative 4 exits the site in the east, follows the alignment of the existing Kommagas-Sandveld Switching Station 66kV line and then links with the Juno-Oranjemond Power Line.

It is expected, from a visual impact perspective, that the wind turbines would constitute the highest potential visual impact of the WEF.

Complete turbine erection and commissioning is typically one tower per week. A facility consisting of up to 200 turbines will therefore take approximately 3 and a half years to construct and commission. The lifespan of the facility is approximated at 20 years.

2. SCOPE OF WORK

The project is proposed on the following farm portions:

- RE of Brazil 329,
- RE of Goraap 323,
- RE of Honde Vlei 325,
- Portion 1 of Kannabieduin 324 and
- Portion 2 of Rooivlei 327.

The scope of work for the proposed facility 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 1716km² (the extent of the maps displayed below) and includes a minimum 20km buffer zone from the proposed development area.

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 procedure utilised to identify issues related to the visual impact includes the following activities:

- The creation of a detailed digital terrain model (DTM) of the potentially affected environment.

- The sourcing of relevant spatial data. This includes 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 (scoping report) sets out to identify the possible visual impacts related to the proposed facility.

4. THE AFFECTED ENVIRONMENT

Regionally, the proposed WEF site is located approximately 80km west of Springbok. The properties lie along the coastline with the proposed WEF located less than 5km from the shore.

The study area for visual assessment occurs on land that ranges in elevation from 0m above sea level (asl) along the coast to about 380m asl at the top of the local hills. The non-perennial, westward flowing Buffels River and its tributary, the Komaggas River are the main hydrological features within the study area. The Buffels River bypasses the site some 7km to the north.

The terrain surrounding the proposed site is generally flat, sloping gently westwards towards the shore. The terrain type of the region is described as *slightly undulating plains*. Low hills are present in the far east of the study area, and to a lesser extent in the north. Refer to **Map 1**.

The small town of Kleinzee lies about 6km north of the proposed site. Other than Melkbospunt, this town represents the only populated place within the study area. Large parts of the region are mine-owned, and as a result, significant diamond mining activities are evident, especially within a 7km band along the coast.

The region has a very low population density of 3 people per km^2[2].

Roads include the R355 arterial route (to Springbok) and a number of lower order secondary roads extending to the north and south from Kleinzee.

Other than the mining activity, industrial infrastructure within the region includes a network of distribution power lines, a distribution substation in Kleinzee and the Gromis Transmission Substation.

The desert climate of the study area is dry, receiving between 28mm and 123mm of rainfall per annum. Land cover is primarily *shrubland* with localised areas of *exposed rock and sand.* The vegetation type is *Strandveld of the West Coast.*

The Namaqua National Park lies approximately 45km to the south east and is therefore outside of the study area (and not shown on the maps). Of relevance, however, is the location of the proposed WEF within an area demarcated as a *Priority Natural Area* by the SANParks Planning Department. See **Map 2**.

'...Priority natural areas include areas identified for future park expansion as well as reasonably natural areas of high biodiversity value which are critical for the

[2] www.wikipedia.org/wiki/Nama_Khoi_Local_Municipality

long-term persistence of biodiversity within the park. These include adjacent natural areas which function as an ecologically integrated unit with the park, as well as areas critical for maintaining ecological links and connectivity with the broader landscape…'[3]

Considerations are related to biodiversity and ecological connectivity rather than visual aspects. However, this zone represents a visual buffer for the National Park, and as such influences both the visual character and sense of place of the area and of the National Park.

The greater region is generally seen as having a high scenic value and high tourism value potential. It is well known for its scenic natural beauty (West Coast as a whole) and annual wild flower displays (Namaqualand)[4].This occurs once a year between July and October, depending on a number of environmental factors, but mainly the occurance and duration of rainfall. The length of the display is also highly variable, and depends on the rainfall.

Within this scenic context, it is noteworthy that the mining areas along the coastline are significantly disturbed and visually apparent due to the scale and nature of the surface based mining. In this respect the visual quality of the receiving environment is already impacted upon to some extent.

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

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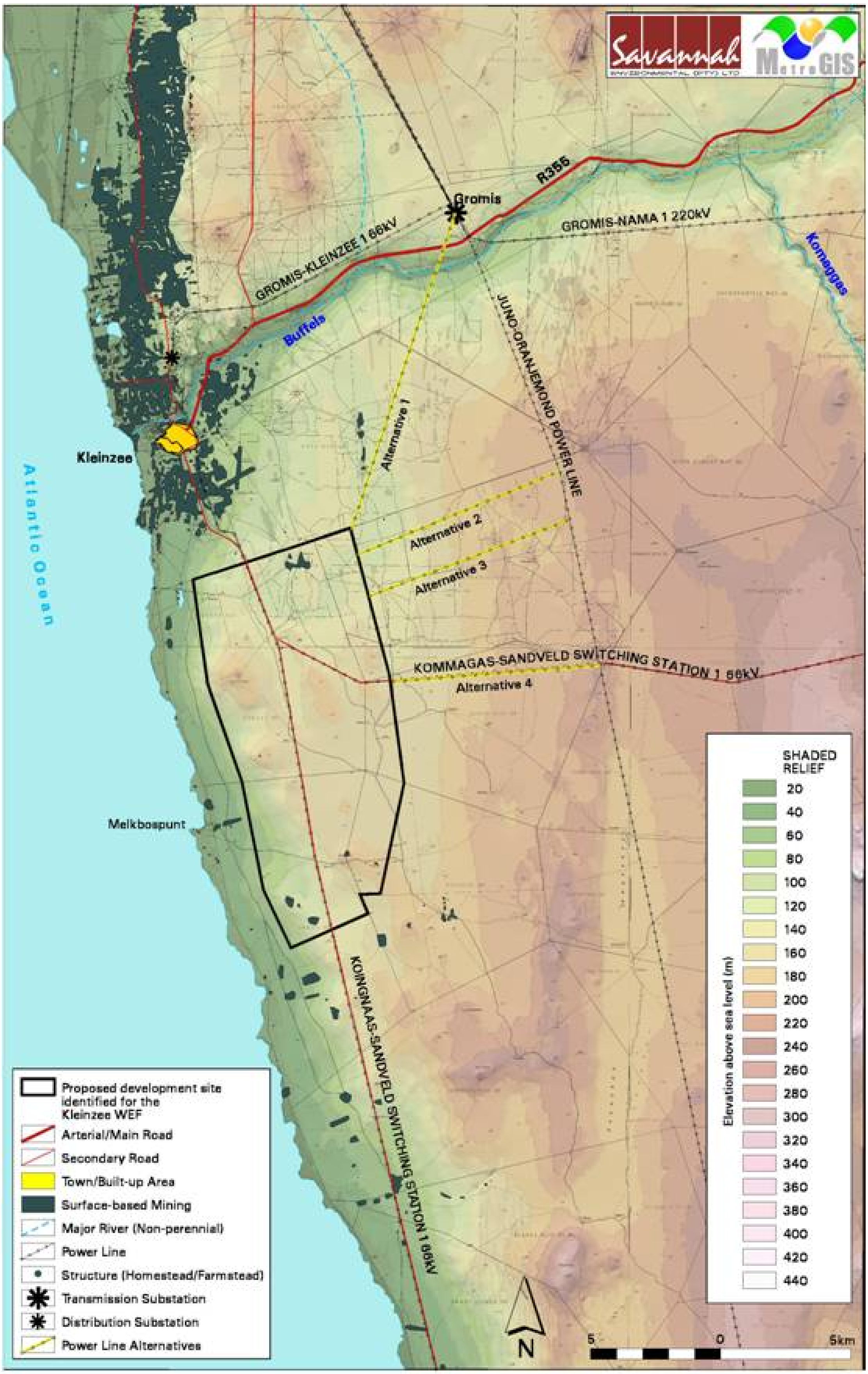
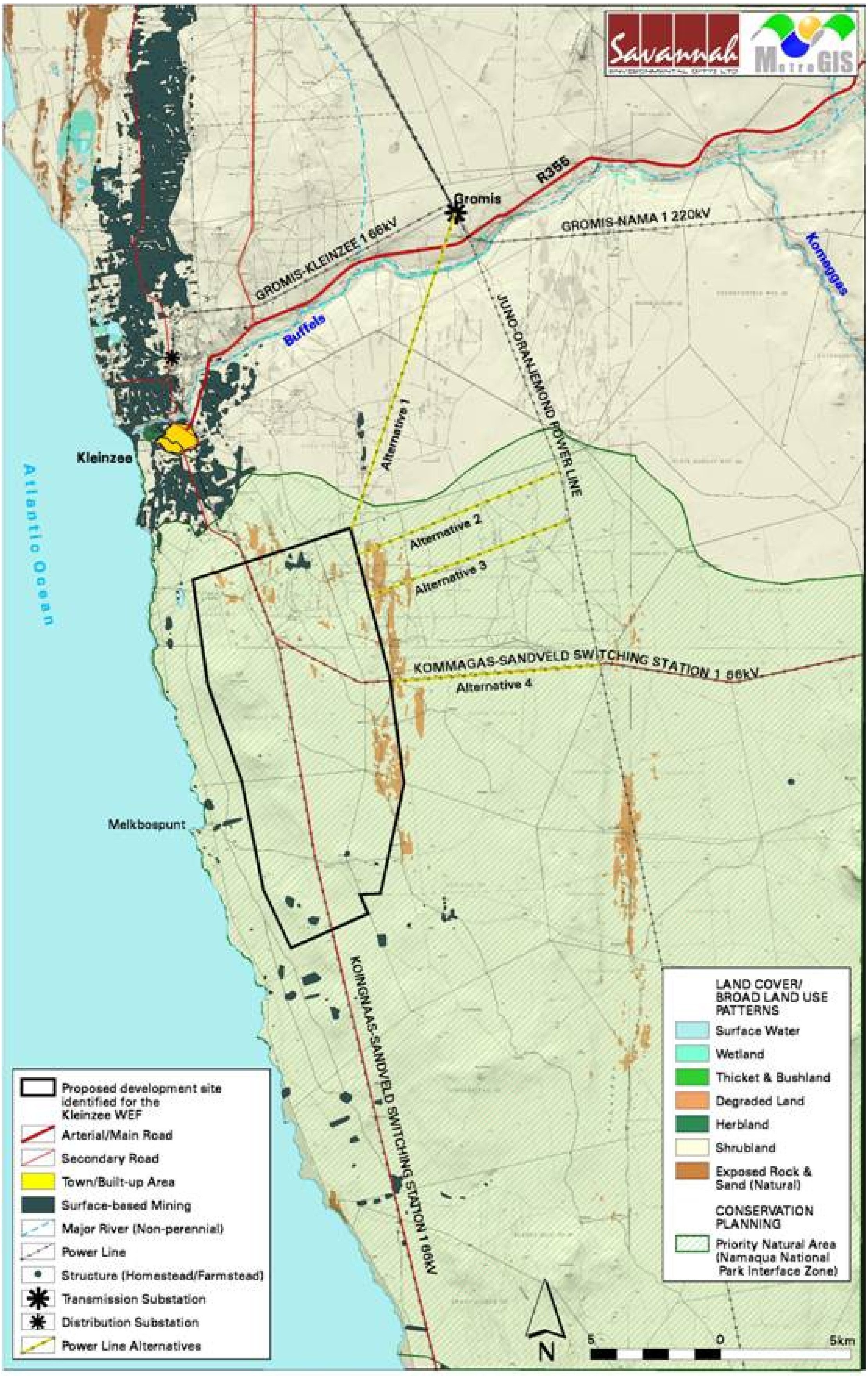
[3] Extract from the *Namaqua National Park Zoning Plan*, which explains the principle of a priority natural area.

[4] Namaqualand stretches from the small town of Garies in the south to the Orange River to the north, its western border is the wild Atlantic coast, the remote town of Pofadder marks the eastern border (http://www.discoverthecape.com/namaqualand/flower-route.html)



Map 1: Shaded relief map (indicating the location of the proposed facility and the topography and elevation above sea level) of the study area.



Map 2: Land cover / land use map of the study area.

5. POTENTIAL VISUAL EXPOSURE

The result of the preliminary viewshed analyses for the proposed facility is shown on **Map 3**. The initial viewshed analysis was undertaken from preliminary vantage points within the proposed development area at offsets of 140m above average ground level (i.e. the approximate hub height of the proposed wind turbines).

This was done to determine the general visual exposure of the area under investigation, simulating the proposed structures associated with the facility. It must be noted that the viewshed analyses do not include the effect of vegetation cover or existing structures on the exposure of the proposed wind turbines, therefore signifying a worst-case scenario.

The viewshed analyses will be refined once a layout of the wind energy facility is completed and will be regenerated per actual turbine position (and actual proposed turbine height) during the EIA phase of the project. This will be undertaken for the full number of turbines.

Map 3 indicates areas from which any number of turbines (with a minimum of one turbine) could potentially be visible as well as proximity offsets from the proposed development area. The following is evident from the viewshed analyses:

- The proposed facility will have a large core area of potential visual exposure on the WEF site itself, and within a 5km offset. Almost the entire area within 5km will be visually exposed to the WEF.

  This core area includes the southern edge of the town of Kleinzee, the settlement of Melkbospunt and the secondary roads leading south from Kleinzee. Most of this core area lies within the Namaqua National Park's *Priority Natural Area*.

- Potential visual exposure decreases somewhat in the medium distance (i.e. between 5 and 10km) with visually screened areas occuring in the north, east, south east and south. This visual screening is by virtue of local topography (i.e. the hills and incised river valleys).

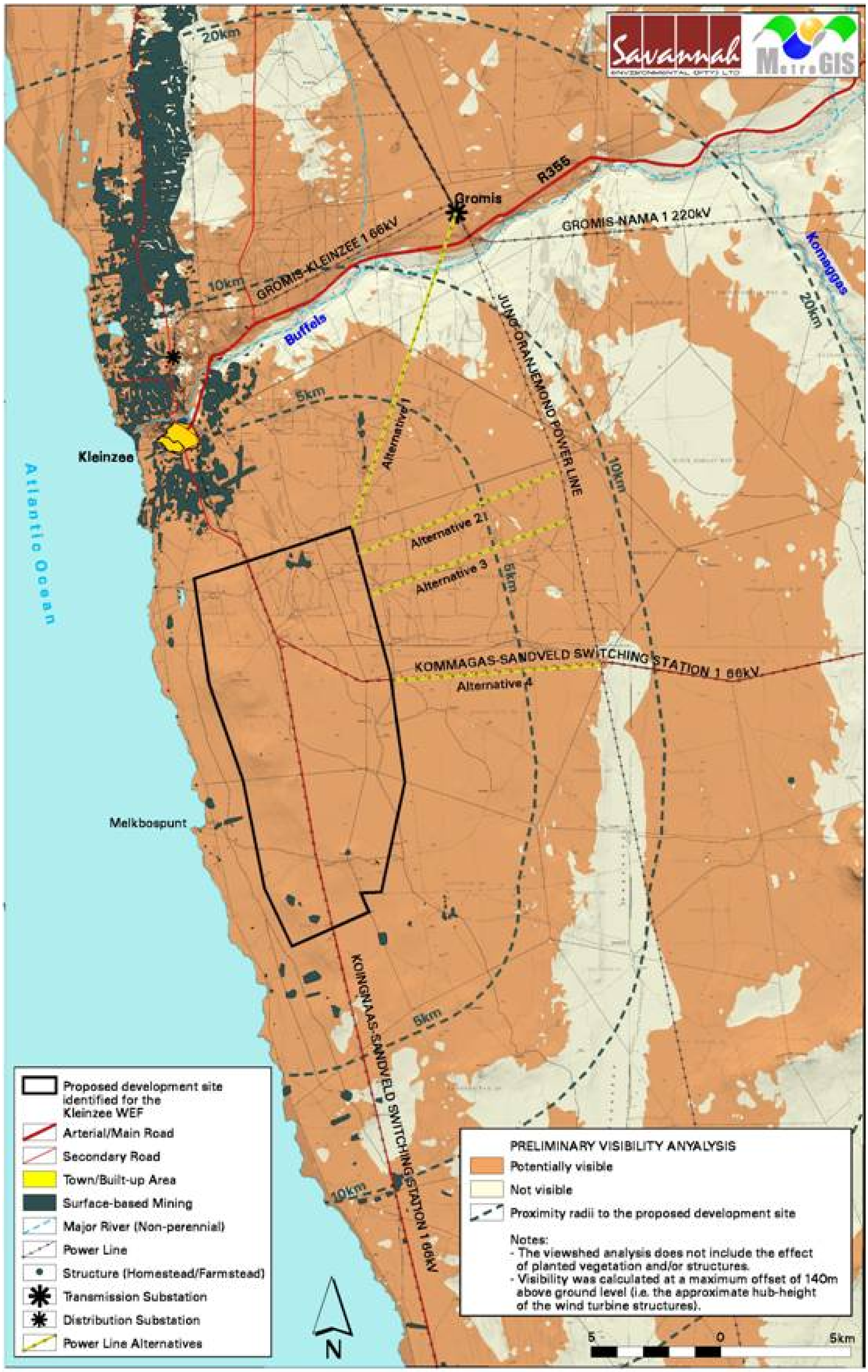
  Receptors likely to be visually exposed include the residents of Kleinzee and the users of the R355 and secondary roads. The southern two thirds of this visually exposed area still falls within the Namaqua National Park's *Priority Natural Area*.

- In the longer distance (i.e. between 10km and 20km), potential visual exposure remains moderately high with significant visually protected areas evident in the north east, east and south east.

  Visual receptors that may experience visual impact are limited to users of the R355, and the secondary roads running to the north and south, along the coast. More than half of this visually exposed zone (to the south) lies within the Namaqua National Park's *Priority Natural Area*.

- The facility will be visible for the entire length of the R355 as well as for most of the lengths of secondary road within the study area.

It is envisaged that the turbine structures would be highly visible to limited numbers of observers (i.e. people travelling along roads and residing in Kleinzee and Melkbospunt) and would constitute a high visual prominence, especially within a 10km radius, potentially resulting in visual impact.



Map 3: Potential visual exposure of the proposed facility.
(Note: the visible area indicates areas from which any number of wind turbines (with a minimum of one turbine) may be visible.

6. ANTICIPATED ISSUES RELATED TO VISUAL IMPACT

Anticipated issues related to the potential visual impact of the proposed Kleinzee 300 Wind Farm include the following:

- The visibility of the facility to, and potential visual impact on, observers travelling along arterial (i.e. R355) and secondary roads in close proximity to the proposed WEF and within the region.
- The visibility of the facility to, and potential visual impact on, the small town of Kleinzee and the settlement of Melkbospunt located in close proximity to the proposed WEF.
- The visibility of the facility to, and the potential visual impact on conservation planning features, specifically the Namaqua National Park's *Priority Natural Area.*
- The potential visual impact of the facility on the visual character of the landscape and sense of place of the region.
- The potential visual impact of the facility on tourist routes, tourist destinations and tourist potential of the region, especially in terms of events such as the Namaqualand flower displays.
- The potential visual impact of on site ancillary infrastructure (i.e. the substation, the internal access roads, the borrow pits, the office / workshop and the visitor centre) on observers in close proximity to the facility and/or the associated infrastrcuture.
- The potential visual impact of the prower line on observers in close proximity thereto.
- The potential visual impact of operational, safety and security lighting of the facility at night on observers in close proximity to the facility.
- Potential visual impacts associated with the construction phase on observers in close proximity to the facility and power line.
- Potential cumulative visual impacts of the WEF and associated infrastructure.
- Potential residual visual impacts after the decommissioning of the facility.
- The potential to mitigate visual impacts and inform the design process.

It is envisaged that the issues listed above may constitute a visual impact at a local and/or regional scale.

These anticipated visual impacts should be assessed in greater detail during the EIA phase of the project as this report is only focussed on defining the potential visual exposure of the proposed development and identifying the potential issues associated with the visibility of the development.

7. CONCLUSIONS AND RECOMMENDATIONS

The construction and operation of the proposed Kleinzee WEF will in all likelihood have a visual impact on a limited number of potentially sensitive visual receptors especially within (but not restricted to) a 10km radius of the facility.

The area potentially affected by the proposed development is generally seen as having a tourism value and tourism potential based on the proximity of the Namaqua National Park (not shown on the maps as it is outside of the study area) and its associated *Priority Natural Area.*

Another important consideration is the annual Namaqualand Flower event. This occurs once a year between July and October, depending on a number of environmental factors, but mainly the occurance and duration of rainfall. The length of the display is also highly variable, and depends on the rainfall.

It is therefore recommended that the severity of the potential visual impact on sensitive receptors be assessed in further detail in the EIA. Additional spatial analyses must be undertaken in order to create a visual impact index that will further aid in determining potential visual impact.

Specific spatial criteria need to be applied to the visual exposure of the proposed facility in order to successfully determine visual impact and ultimately the significance of the visual impact. In addition, photo simulations of critical viewpoints should be undertaken where required, in order to aid in the visualisation of the envisaged visual impact.

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

- **Determine Visual Distance / Observer Proximity to the facility**

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

  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.

  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 wind energy facilities.

  The proximity radii (calculated from the boundary lines of the farm selected for the facility) are as follows:

  - 0 - 5km. Short distance view where the facility would dominate the frame of vision and constitute a very high visual prominence.
  - 5 - 10km. Medium distance view where the structures would be easily and comfortably visible and constitute a high visual prominence.
  - 10 - 20km. 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 20km. Long distance view of the facility where the facility could potentially still be visible, though not as easily recognisable. This zone constitutes a medium to low visual prominence for the 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 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 of the landscape**

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

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

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

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

- **Determine the Visual Impact Index**

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

The above exercise should be undertaken for the core wind energy facility as well as the ancillary infrastructure, as these structures (i.e. the substation, the overhead power line, the internal access roads, the borrow pits, the office / workshop and the visitor centre) 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.

In addition, cumulative visual impact should be addressed, as well as suggested mitigation measures for all identified impacts (if any).

8. REFERENCES / DATA SOURCES

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