PROPOSED ABERDEEN 200MW WIND ENERGY FACILITY

IN THE EASTERN 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 Aberdeen 200MW Wind Energy Facility in the Eastern 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 Limited is proposing the establishment of a commercial Wind Energy Facility (WEF) and associated infrasructure on a site located approximately 24km west of Aberdeen, within the Camdeboo Local Municipality of the Eastern 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 Limited intends to construct between 100 and 150 wind turbines over an area of approximately 8198 ha in extent. The facility will ultimately have a generating capacity of up to 200MW.

The WEF will connect to the national grid at the existing Droërivier Substation, located approximately 140 km from 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 between 1.3MW 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**.

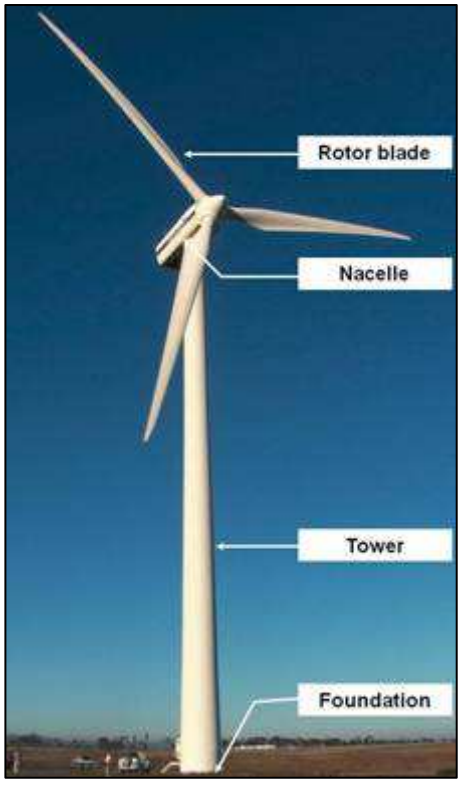


Figure 1: Illustration of the main components of a wind turbine[1]

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

- A cluster of between 100 and 150 wind turbines to be constructed over an area of ~ 8 198 ha in extent
- Concrete foundations to support the turbine towers
- Cabling between the turbines to be lain underground
- An on-site substation to facilitate the connection between the facility and the electricity grid
- An overhead power line (400kV) feeding into Eskom's electricity grid at the Droërivier Substation, approximately 140 km from the site2
- Main access road to site
- Internal access roads between wind turbines
- External roads to access the site may be required
- Borrow pits within the site for the construction of access roads
- Office/Workshop area for operations, maintenance and storage

[1] Illustration courtesy of Savannah Environmental.
[2] Note that the power line is the subject of a separate EIA process.

- Temporary water storage for construction and small storage for Operation
- Storage of fuel during construction
- Small Information centre and Operational & Maintenance building

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 150 turbines will therefore take approximately 3 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:

- Portion 3 of Sambokdoorns 92;
- RE of Portion 4 of Sambokdoorns 92;
- RE of Sambokdoorns 92;
- Portion 1 of Klipdrift 73;
- Portion 2 of Farm 94, and
- RE of Portion 2 of Farm 94.

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 2900km² (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 scoping report sets out to identify the possible visual impacts related to the proposed facility.

4. ANTICIPATED ISSUES RELATED TO VISUAL IMPACT

Anticipated issues related to the potential visual impact of the proposed Aberdeen WEF include the following:

- The visibility of the facility to, and potential visual impact on, observers travelling along national (i.e. N9), arterial (i.e. R61) 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 farms and homesteads in close proximity to the proposed WEF and 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 visibility of the facility to, and the potential visual impact on scenic and sensitive topographic features within the region, specifically the Kamdeboo mountains.
- The potential visual impact of the facility on tourist routes, tourist destinations and tourist potential of the region.
- The potential visual impact of shadow flicker on observers residing on or in close proximity to the proposed WEF.
- The potential visual impact of ancillary infrastructure (i.e. the substation, the overhead power line, the internal access roads, the borrow pits, the office / workshop and the visitor centre) on observers in close proximity to the proposed WEF.
- The potential visual impact of operational, safety and security lighting of the facility at night on observers in close proximity to the proposed WEF.
- Potential visual impacts associated with the construction phase on observers in close proximity to the proposed WEF.
- Potential cumulative visual impacts of the proposed WEF.
- Potential residual visual impacts after the decommissioning of the proposed WEF.
- 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.

5. THE AFFECTED ENVIRONMENT

Regionally, the proposed WEF site is located approximately 24km west of Aberdeen, 75 km south west of Graaff-Reinet and 120km east of Beaufort West.

The study area occurs on land that ranges in elevation from about 800m a.s.l. (in the south west and east of the study area) to about 1900m a.s.l. (at the top of the Kamdeboo mountains in the north east).

A number of non perennial rivers are present in the area. The *Sarels,* the *Ouplaas,* the *Gannaleegte* and the *Beenkuileegte* Rivers flow to the south west,

joining with the *Kariega River.* The *Kraai River* flows to the east. The Gannaleegte River originates on the site and flows across it to the south.

The terrain surrounding the proposed site is mostly flat, sloping gently to the south west and to the east. The exception is the mountainous terrain in the north of the study area, which marks the southern tip of the Kamdeboo mountains.

The terrain type of the region is described as *plains* with *low mountains* in the north east and *slightly irregular undulating plains and hills* in the north west. Refer to **Map 1**.

In terms of climate, the study area is located on the semi-arid plateau, with an annual rainfall range between approximately 135mm and 379mm.

The vegetation types on site include *Southern Karoo Riviere* and *Eastern Lower Karoo*[3].

Stock and game farming dominate the general land-use character of this region. The flat areas in the southern half of the study area are characterised by *shrubland*, while the higher lying and more mountainous areas contain zones of *thicket and bushland* as well as *Grassland.* Some *thicket and bushland* is also to be found along the drainage lines in the western part of the study area, and small scale *agricultural fields* are dotted throughout.

Significant *bare rock and soil (sheet erosion)* is evident in the north west, and to a lesser extent in the south west of the study area.

There are no towns or urban centres within the study area, but a number of farms and homesteads occur throughout the study area. These tend to lie in the vicinity of the rivers. The population density within the region is low, at an average of 5,8 people per km^2.

Major roads include the N9 National Route (which links the N1 with the East Coast) and the R61 arterial route (which runs between Beaufort West and Aberdeen). There are also a few lower order secondary roads off these main roads.

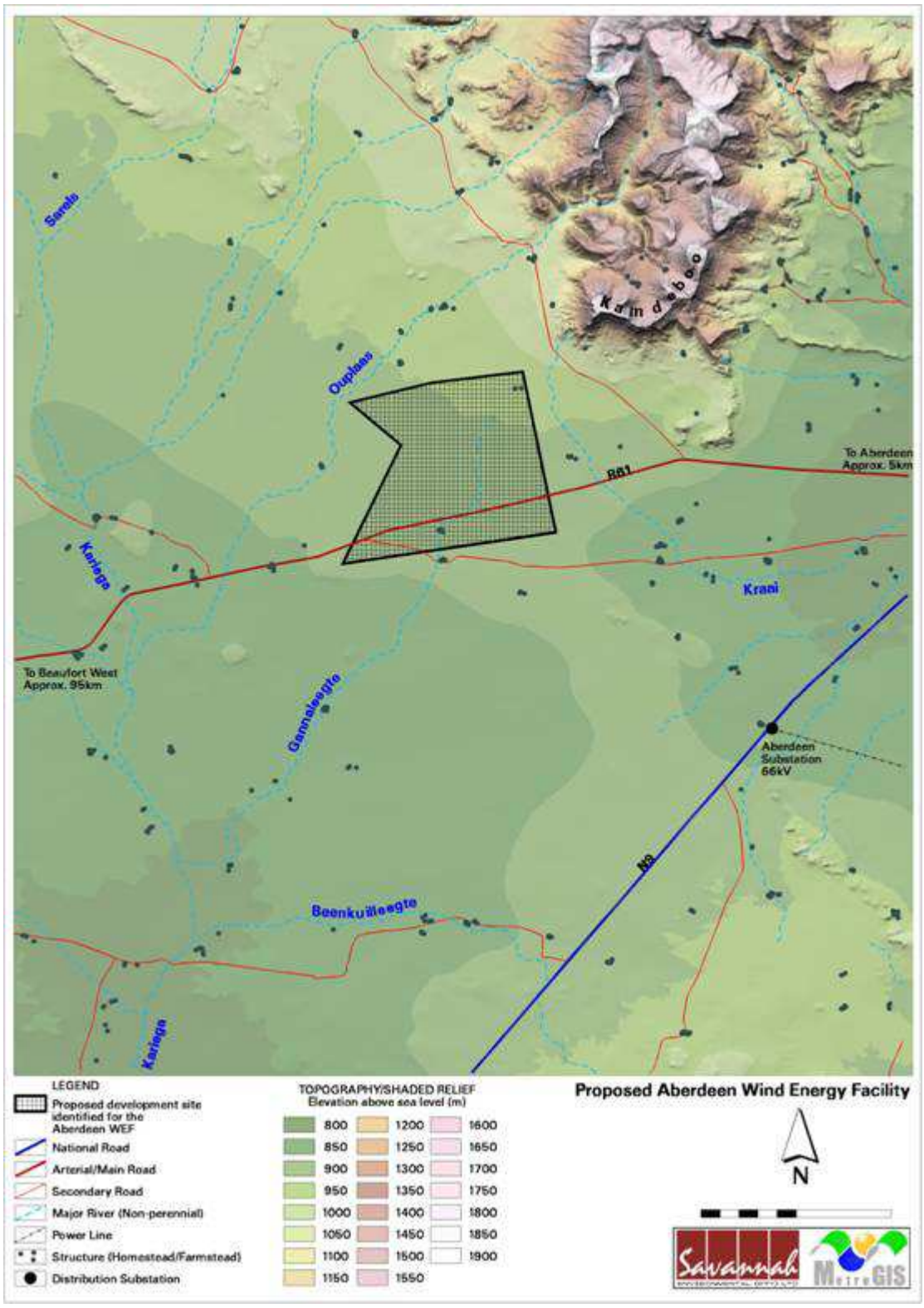
The greater region is generally seen as having a high scenic value and lies en-route to a number of known tourist destinations, including the so-called Sunshine Coast.

The study area has a rural character with very few structures. Electrical infrastructure is limited to a single power line linking with the Aberdeen Substation to the south east of the site. Refer to **Map 2**.

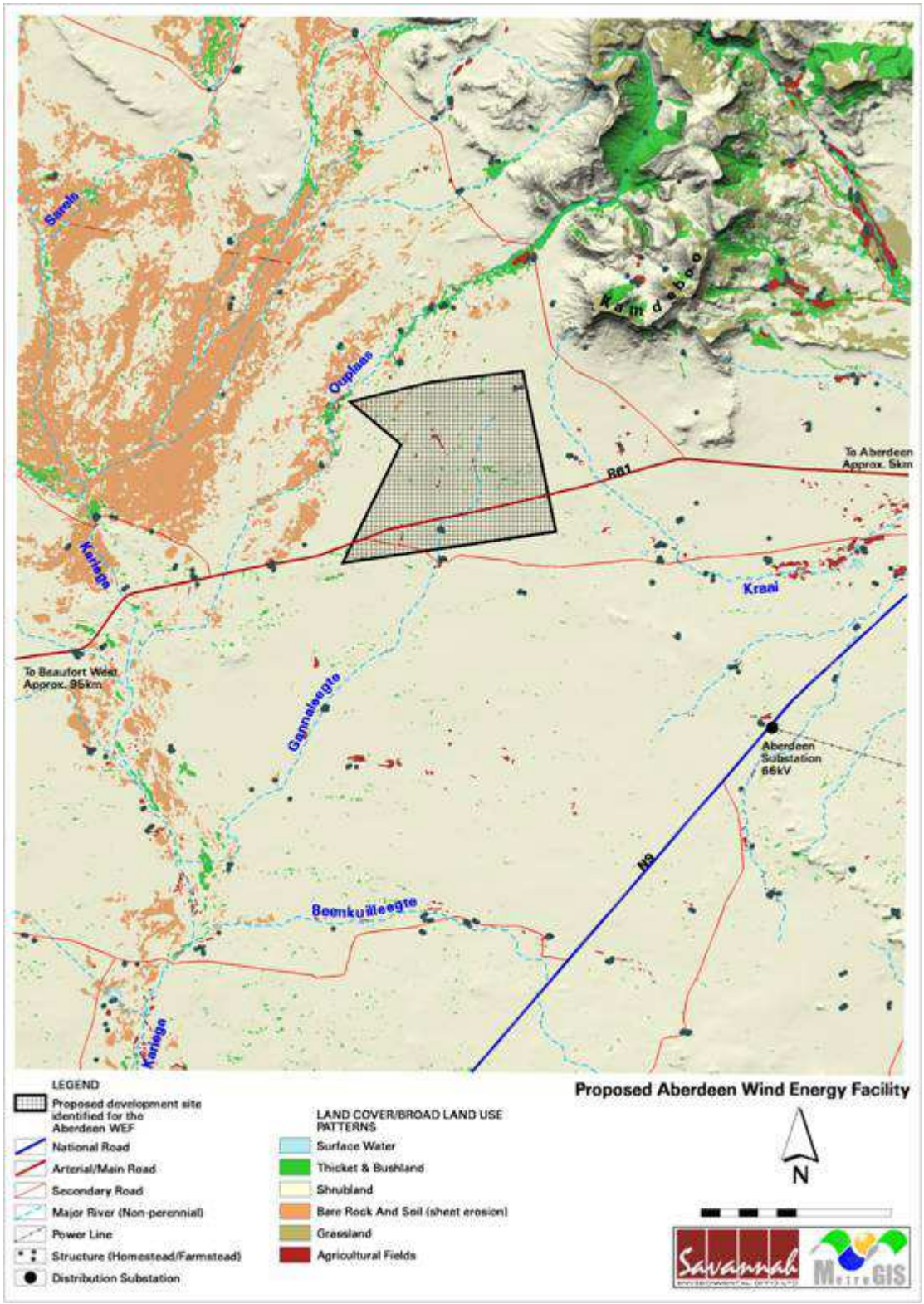
There are no formally protected conservation areas within the study area.

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

[3] Mucina and Rutherford. 2006.



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.

6. 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 R61, two secondary roads and a number of farms and homesteads. The south western tip of the Kamdeboo Mountains also lies within this zone, and the south western slopes will be visually exposed.

- Potential visual exposure remains high in the medium distance (i.e. between 5 and 10km) with visually screened areas occuring only in the north east within the mountains. In general, the southern and western slopes of the mountains are exposed to potential visual impact.

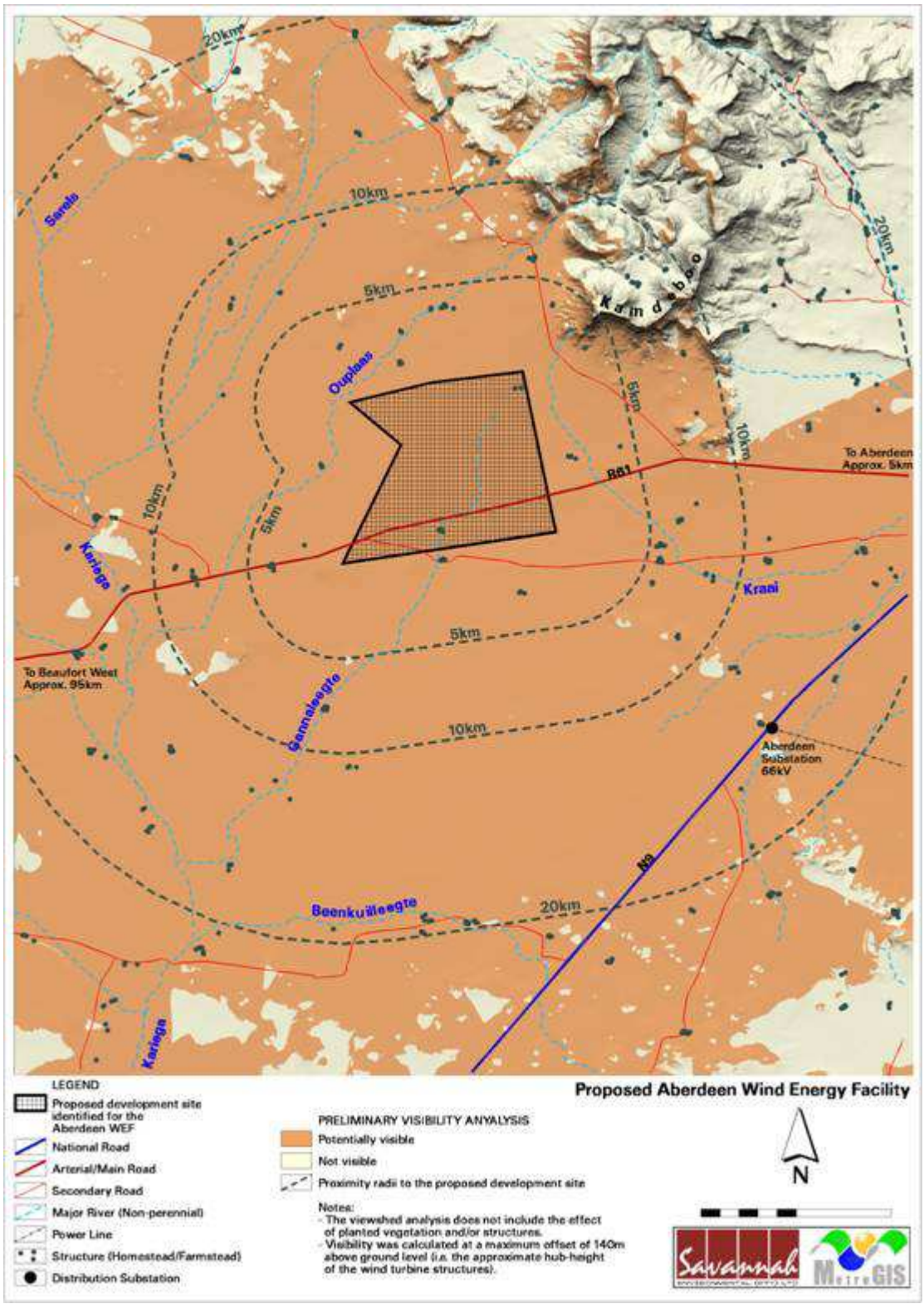
  Receptors likely to be visually exposed include the R61, three secondary roads and residents of farms and homesteads.

- In the longer distance (i.e. between 10km and 20km), potential visual exposure decreases somewhat, especially in the north eastern mountains. Some south and west facing slopes will still be visually exposed, however.

  Visual receptors that may experience visual impact include users of the N9, the R61, secondary roads as well as a number of farms and homesteads.

It is envisaged that the turbine structures would be highly visible to observers travelling along the National and arterial roads and residing on the farms and in homesteads throughout the study area.

The facility would constitute a high visual prominence within this environment, especially within a 10km radius, potentially resulting in a 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.

7. CONCLUSIONS AND RECOMMENDATIONS

The construction and operation of the proposed Aberdeen 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 high scenic value with a natural and rural character. Development and large scale infrastructure is almost entirely absent within the region.

It is therefore recommended that the severity of the potential visual impact on sensitive receptors be assessed in further detail in the EIA phase. 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 Assessment 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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