HIDDEN VALLEY WIND ENERGY FACILITY

AND ASSOCIATED INFRASTRUCTURE ON A SITE SOUTH OF SUTHERLAND, NORTHERN CAPE PROVINCE

VISUAL IMPACT ASSESSMENT

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- March 2012 –

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1. STUDY APPROACH

1.1. Qualification and Experience of the Practitioner

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

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

The team undertaking the visual assessment has extensive practical knowledge in spatial analysis, environmental modelling and digital mapping, and applies this knowledge in various scientific fields and disciplines. The expertise of these practitioners is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

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

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant to undertake the visual impact assessment for the Proposed Hidden Valley 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.

1.2. Assumptions and Limitations

This assessment was undertaken during the planning stage of the project and is based on information available at that time.

1.3. Level of Confidence

Level of confidence[1] is determined as a function of:

- The information available, and understanding of the study area by the practitioner:
  - 3: A high level of information is available of the study area and a thorough knowledge base could be established during site visits, surveys etc. The study area was readily accessible.
  - 2: A moderate level of information is available of the study area and a moderate knowledge base could be established during site visits, surveys etc. Accessibility to the study area was acceptable for the level of assessment.
  - 1: Limited information is available of the study area and a poor knowledge base could be established during site visits and/or surveys, or no site visit and/or surveys were carried out.

- The information available, understanding of the study area and experience of this type of project by the practitioner:

[1] Adapted from Oberholzer (2005).

- 3: A high level of information and knowledge is available of the project and the visual impact assessor is well experienced in this type of project and level of assessment.
- 2: A moderate level of information and knowledge is available of the project and/or the visual impact assessor is moderately experienced in this type of project and level of assessment.
- 1: Limited information and knowledge is available of the project and/or the visual impact assessor has a low experience level in this type of project and level of assessment.

These values are applied as follows:

	Information on the project & experience of the practitioner			
Information on the study area		**3**	**2**	**1**
	3	9	6	3
	2	6	4	2
	1	3	2	1

*The level of confidence for this assessment is determined to be **9** and indicates that the author's confidence in the accuracy of the findings is high:*

- The information available, and understanding of the study area by the practitioner is rated as **3** and
- The information available, understanding of the project and experience of this type of project by the practitioner is rated as **3**.

1.4. 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.

Site visits were undertaken to source information regarding land use, vegetation cover, topography and general visual quality of the affected environment. It further served the purpose of verifying the results of the spatial analyses and to identify other possible mitigating/aggravating circumstances related to the potential visual impact.

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

- The creation of a detailed digital terrain model (DTM) of the potentially affected environment;
- The sourcing of relevant spatial data. This included cadastral features, vegetation types, land use activities, topographical features, site placement, etc;
- The identification of sensitive environments upon which the proposed facility could have a potential impact;
- The creation of viewshed analyses from the proposed development area in order to determine the visual exposure and the topography's potential to absorb the potential visual impact. The viewshed analyses take into account the dimensions of the proposed structures.

This report (visual impact assessment) sets out to identify and quantify the possible visual impacts related to the proposed WEF and related infrastructure mentioned above, as well as offer potential mitigation measures, where required.

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

- **Determine Potential visual exposure**

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

  Viewshed analyses of the proposed WEF facility and the related infrastructure, based on a 20m interval digital terrain model of the study area, indicate the potential visibility.

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

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

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

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

- **Determine Viewer Incidence / Viewer Perception**

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

  It is therefore necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the proposed WEF 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 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 natural vegetation of the region. It is therefore necessary to determine the VAC by means of the interpretation of the vegetation cover, 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.

- **Determine Impact significance**

  The potential visual impacts identified and described 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 and probability.

2. BACKGROUND

ACED Renewables Hidden Valley (Pty) Ltd is proposing to establish a commercial wind energy facility and associated infrastructure on a site located within the Karoo Highland Local Municipality. The site identified for consideration within an Environmental Impact Assessment (EIA) is within the Northern Cape Province, and lies approximately 31km south of Sutherland and 31km north of Matjiesfontein.

The proposed WEF will be comprised of the following development Phases:

- *Phase 1* - Proposed Karusa Wind Farm (to be located on Farm De Hoop 202, Farm Standvastigheid 210, and Portion 1, 2, 3 and the remainder of Farm Rheebokke Fontein 209).

- *Phase 2* – Proposed Soetwater Wind Farm (to be located on the remainder of, and Portion 1 of Farm Orange Fontein 203, Annex Orange Fontein 185, Farm Leeuwe Hoek 183 and Farm Zwanepoelshoek 184).

- *Phase 3* – Proposed Great Karoo Wind Farm (to be located on Farm Kentucky 206 and Portion 1 of Farm Wolvenkop 207).

A wind energy facility 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 efficiency of a wind energy facility, or amount of power generated, 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.

ACED intends to construct 207 wind turbines over an area of approximately 332km² in extent defined by cadastral boundaries. The final surface area to be utilised for the facility will be smaller than this, as turbines are placed on exposed highpoints and ridges.

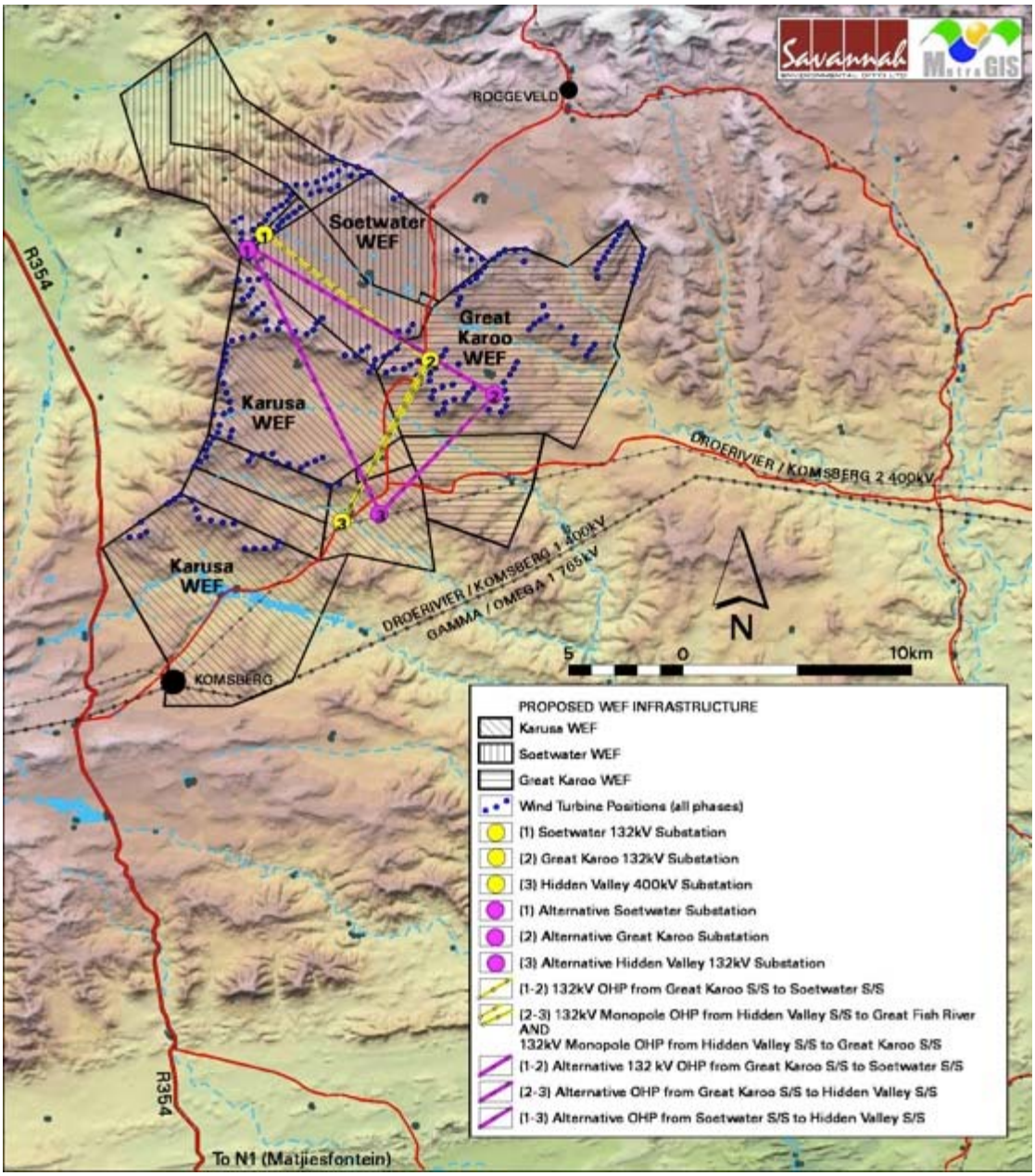
Each turbine would generate between 2 and 3,5MW, implying that the facility will have a combined energy producing capacity of between 416 and 725 MW (depending on the choice of turbine).

The WEF will connect to the national grid at Eskom's existing Komsberg Substation, which is located on the site. The proposed layout of the WEF infrastructure (including substation/power line alternatives) is shown on **Map 1**.

Additional infrastructure will include the following:

- Cabling between the turbines, to be laid underground where practical;
- Internal access roads to each turbine;
- Workshop area / office for control, maintenance and storage;
- Up to three 132kV on-site substations and one 400kV substation to facilitate the connection between the wind energy facility and the grid;
- New 132kVA overhead power line/s likely to be connected to Eskom's existing Komsberg substation which is located on the site.

The infrastructure above will be located within the confines of the farms identified for the wind energy facility.



Map 1: Proposed layout of the Hidden Valley WEF indicating the proposed wind energy facility infrastructure.

Each wind turbine is expected to consist of a concrete foundation, a steel tower, a hub (between 80m and 120m above ground level, depending on the turbine size decided upon) and three 40-55m long blades attached to the hub.

Variations of these dimensions may occur, depending on the preferred supplier or commercial availability of wind turbines at the time of construction. Refer to **Figure 1**.

Figure 1: Illustration of the main components of a wind turbine[2]

A turbine is designed to operate continuously, with low maintenance. The length of the construction period for the wind energy facility is estimated to be approximately 12 months. The lifespan of the facility is approximated at 20-30 years.

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

3. SCOPE OF WORK

The combined Hidden Valley Wind Energy Facility is proposed on farm portions totalling 337km^2, but the final surface area to be utilised for the facility will be smaller (see Map 1).

The study area for the visual assessment encompasses a geographical area of approximately 4000km^2 (the extent of the maps displayed below) and includes a minimum 20km buffer zone from the proposed site boundary.

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

Anticipated issues related to the potential visual impact of the proposed WEF as identified through the scoping study include the following:

- The visibility of the facility from, and potential visual impact on observers travelling along the arterial (R354) and secondary roads in close proximity to the proposed WEF and within the region.

[2] Illustration courtesy of Savannah Environmental (Pty) Ltd.

- The visibility of the facility from, and potential visual impact on residences and homesteads in close proximity to the proposed WEF and within the region.
- The visibility of the facility from and potential visual impact on tourist access routes (i.e. the R354) within the region.
- The potential visual impact of the facility on the visual character of the karoo landscape and sense of place of the region.
- The potential visual impact of ancillary infrastructure (i.e. the substations, power lines, internal access roads etc.) on observers in close proximity to the proposed WEF.
- The potential visual impact of shadow flicker on observers residing on or 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 and within the region, with specific reference to the South African Large Telescope (SALT) near Sutherland.
- Potential visual impacts associated with the construction phase on observers in close proximity to the proposed WEF.
- The potential cumulative visual impact of the proposed WEF and associated infrastructure.
- Potential residual visual impacts after the decommissioning of the proposed WEF.
- The potential to mitigate visual impacts and inform the design process.

4. THE AFFECTED ENVIRONMENT

Regionally, the proposed site for the Hidden Valley WEF is located 31km south of Sutherland and about 35km north of Laingsburg (at the closest points).

The study area occurs on land that ranges in elevation from about 650m a.s.l in the north west of the study area, along the drainage lines, to more than 1600m a.s.l in the high lying north east.

The study area appears to incorporate 3 catchment areas, within which non-perennial drainage lines and small water bodies occur. There is a clearly defined escarpment in the north of the study area, giving rise to the plateau above. Mountainous terrain within the southern part of the study area is concentrated in a band extending from the escarpment toward the south west, effectively forming a watershed between the north west and the south east.

The proposed WEF is located within the band of mountainous terrain, below the escarpment. The proposed site incorporates a number of east flowing drainage lines and wetlands.

The terrain adjacent to the proposed WEF is mountainous to the north east and south west, with the hilly terrain abating somewhat in the north west and south east.

The terrain type of the region is described as *low mountains* for the most part, with *escarpment* giving rise to *mountains and lowlands* in the north east. Refer to **Map 2&3**.

The semi arid karoo climate of the area yields between 185mm and 433mm of rainfall per year and gives rise to land cover that is entirely *shrubland*. Vegetation types are predominantly *mountain renoster-bush veld* with *western mountain karoo* in the north western corner.

The study area does not include any towns or urban areas, but a number of structures occur scattered throughout the study area. Some of these are occupied residences or farming homesteads, whilst others are pump houses, ruins or stone walls (kraals).

Only one arterial road (i.e. the R354) runs in a north south direction and a number of lower order secondary roads traverse the study area in different directions.

Three Eskom 400kV transmission lines (i.e. the Komsberg-Muldersvlei, the Bacchus-Komsberg and the Gamma-Omega) traverse the southern section of the proposed development site. Another power line runs in a north south direction to the east of the site

The Southern African Large Telescope (SALT) observatory is located approximately 35km to the north east of the site. The telescope, funded by a consortium of international partners (USA, Germany, the UK, Poland, India, etc.), was specifically located within this region due to the absence of light sources brought about by urban developments.

The population density of the region is less than 1 person per km^2. The environment has therefore remained in a natural state with little or no large-scale development. Sheep farming is the predominant land use activity.

The study area has harsh, rugged character with vast expanses of natural and undeveloped landscape. Views are wide open and expansive, and unimpeded by development.

No major conservation or protected areas (either statutory or private) were identified within the study area.

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

Figure 2: Visual quality of the environment east of the proposed WEF site. (Note: wind turbines from the Karusa WEF is expected to protrude above the ridgeline).

Figure 3: Long distance view (10km) of the proposed WEF (located above the ridgeline) taken from the R354 arterial road.

Figure 4: Visual quality of the environment south of the proposed WEF.

Figure 5: Visual quality of the environment along the secondary road traversing the proposed development site.

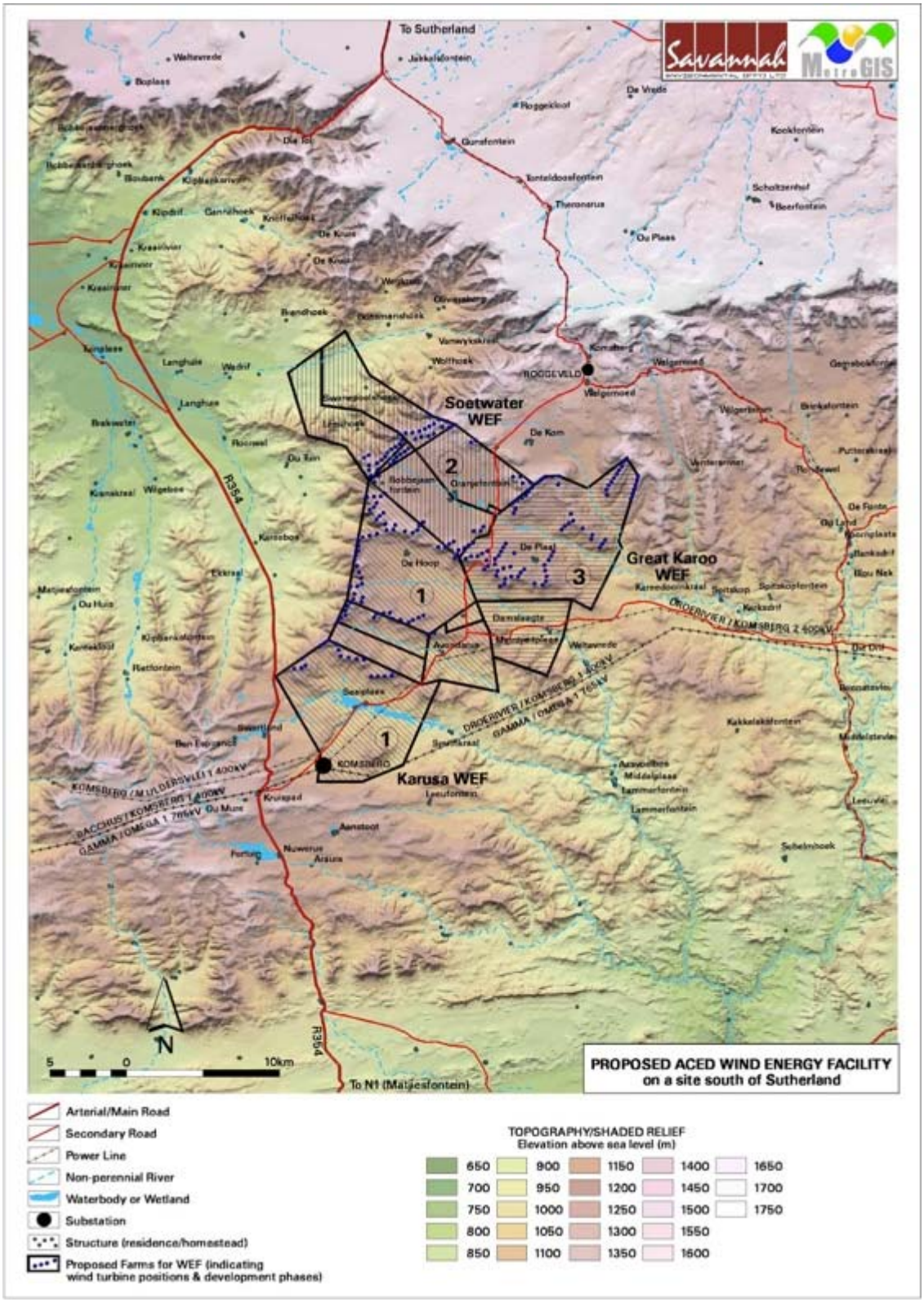
Figure 6: View from the north the proposed WEF.

Figure 7: Visual quality of the environment west of the proposed WEF. (Note: 400kV power line infrastructure).

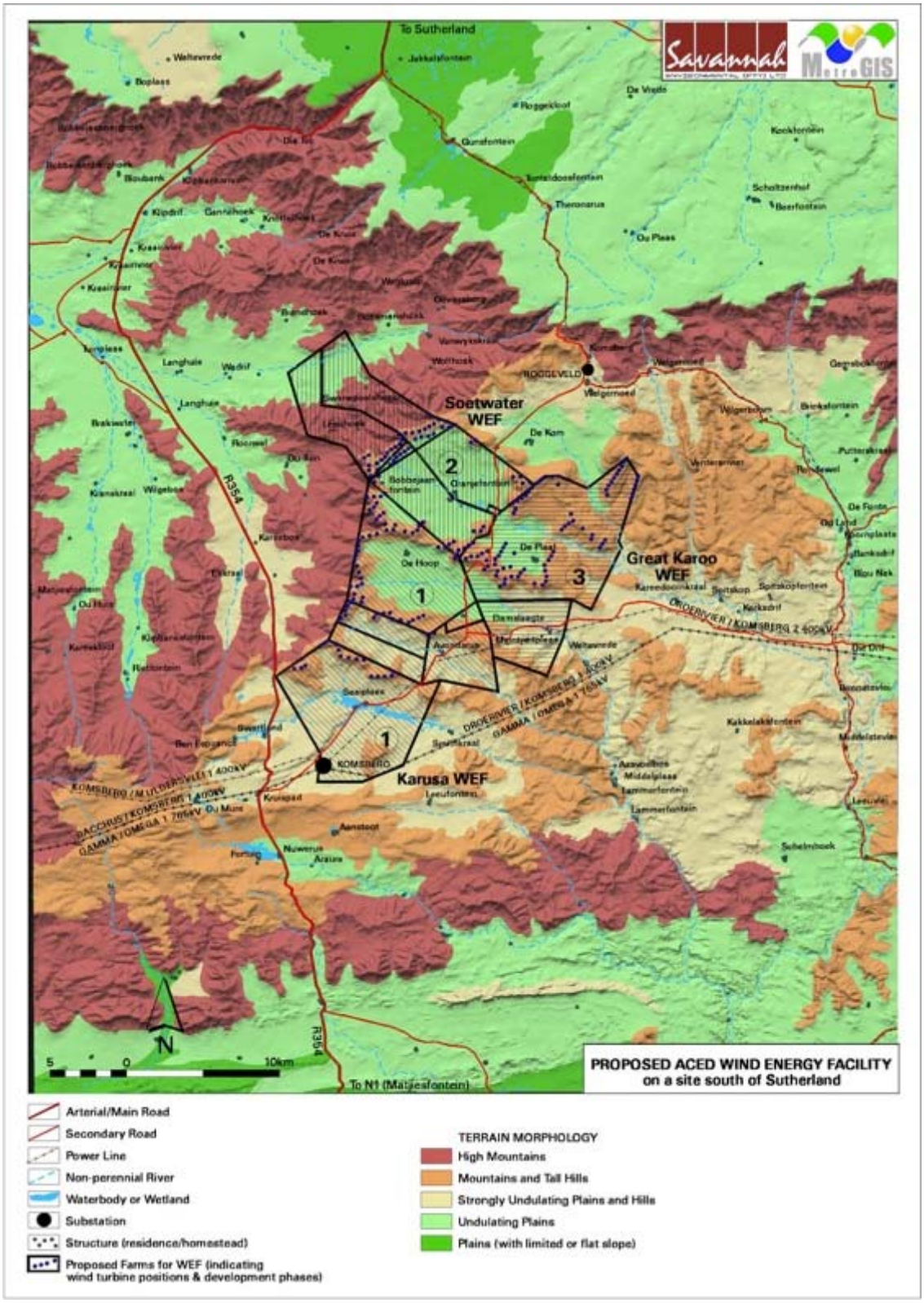
Figure 8: Long distance view from the north (near the Roggeveld substation).

Figure 9: Elevated secondary road near the centre of the proposed WEF. (Note: wind turbines to be erected on these hills).

Figure 10: *Shrubland* is the dominant land cover type for most of the site.



Map 2: Shaded relief and topography of the study area, showing the locality and layout of the proposed Hidden Valley WEF.



Map 3: Broad terrain morphology within the study area.

5. RESULTS

5.1. Potential visual exposure

The phased nature of the Hidden Valley WEF necessitates that the visual impacts of individual phases are evaluated separately to provide analysis of each phase; ***and*** in combination with one another to provide analysis of the cumulative impact of the entire facility.

The results of the viewshed analyses for the proposed facility are shown on the maps overleaf (**Map 4-7**).

The visibility analysis was undertaken from all wind turbine positions at an offset of 100m above average ground level (i.e. the maximum hub height of the proposed turbines) in order to simulate a worst case scenario.

Phase 1 – Karusa Wind Energy Facility comprises 74 turbine sites located on elevated points and ridgelines

Phase 2 – Soetwater Wind Energy Facility comprises 56 turbine sites located along the escarpment edge and selected high points.

Phase 3 – Great Karoo Wind Energy Facility comprises 77 turbine sites located on elevated points and ridgelines

The viewshed analysis not only indicates areas from which the wind turbines would be visible (any number of turbines with a minimum of one turbine), but also indicates the potential frequency of visibility (i.e. how many turbines are exposed). The dark orange areas indicate a high frequency (i.e. 90-100% of turbines or parts thereof may be visible) while the yellow areas represent a low frequency (i.e. 1-10% of turbines or parts thereof may be visible).

No dedicated viewshed analyses were undertaken for the proposed overhead power line infrastructure and substation alternatives. These structures are located within the proposed development site and is not expected to be highly visible amongst the much taller wind turbine infrastructure (i.e. the area of potential visual exposure will fall entirely within the viewshed catchment of the turbines).

Phase 1 – Karusa WEF (Map 4)

The dark orange areas indicate a high frequency (i.e. 68-74 turbines or parts thereof may be visible) while the yellow areas represent a low frequency (i.e. 1-7 turbines or parts thereof may be visible).

Potential visual exposure as a result of the proposed WEF extends primarily to the north west of the study area, following the trajectory of the R354 and the Tankwa River valley. Elevated East facing slopes are also exposed. Several residences and homesteads occur along these east facing slopes. Moderate exposure is expected in these areas.

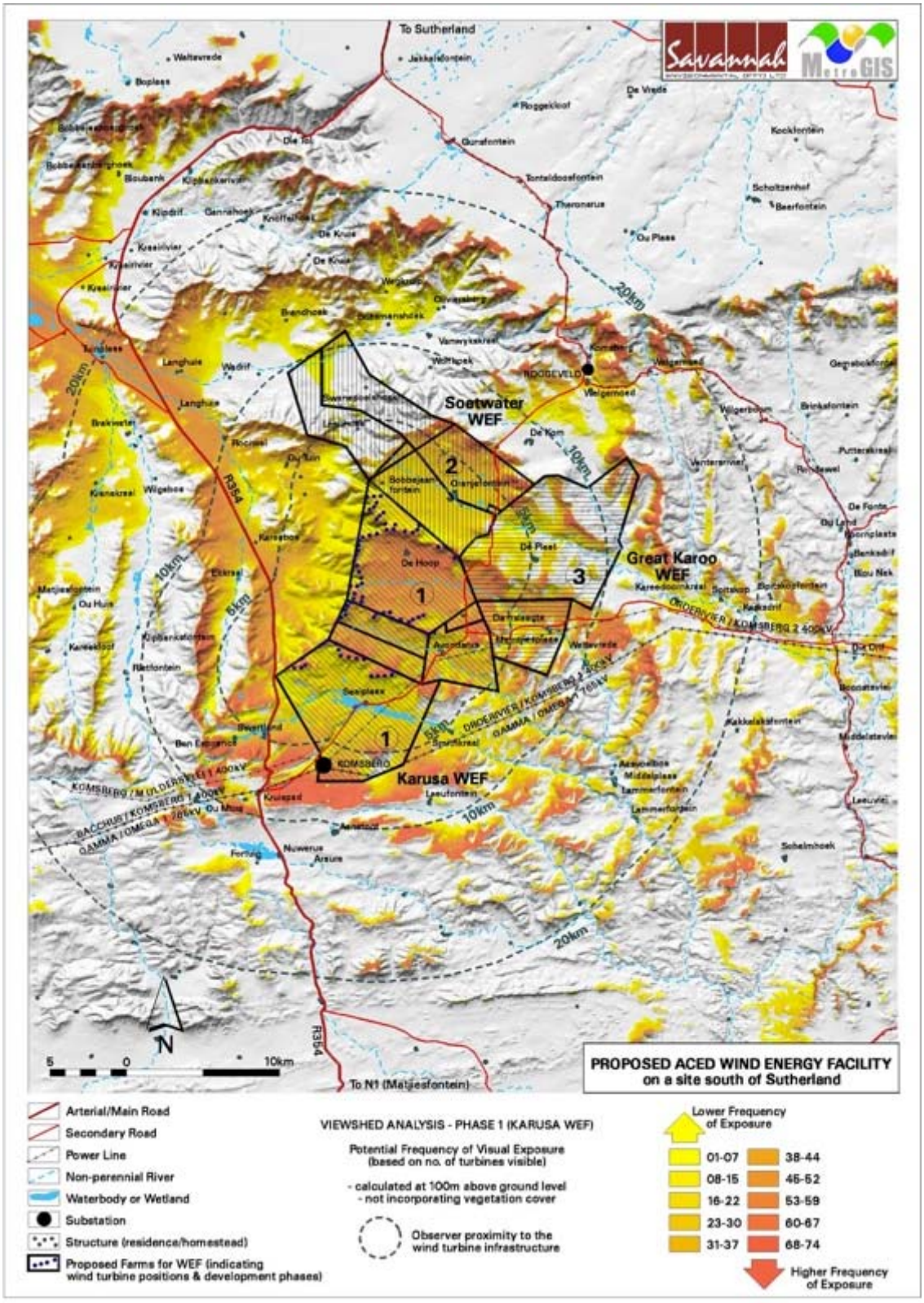
Visual exposure to the north is interrupted by high ridgelines lying approximately 5km north of the site. While exposure is medium to high, very few residences or farmsteads are present in this zone. There is some spill over of low to moderate visual exposure onto south facing slopes between 10- 15km to the north with several residences and homesteads potentially affected.

The far north of the study area is visually screened by the mountain range.

In the south, the extent of potential visual exposure is limited to less than 10km by east-west orientated ridgelines. The elevation decreases to the south of the site resulting in low to moderate potential visual exposure being limited to the very crests of north facing ridges between 10 and 20km to the south. There are very few settlements to the south of the site with the majority of these not expected to be visually impacted.

The highest frequency of potential visual exposure is centred on the site itself. The settlement of De Hoop falls within the site and up to 74 turbines may be visible from within these areas, due to the elevated location of the proposed turbines.

Visual exposure to the east within a 5km radius is moderate to high. Several settlements are present. Beyond 5km visual exposure is low to moderate and limited to elevated west facing slopes. Several settlement occur to the east, however the majority of these are along the valley floors and will be unaffected.



Map 4: Potential visual exposure of Phase 1 (Karusa Wind Farm) of the proposed Hidden Valley WEF.

Phase 2 – Soetwater WEF (Map 5)

The dark orange areas indicate a high frequency (i.e. 51-56 turbines or parts thereof may be visible) while the yellow areas represent a low frequency (i.e. 1-6 turbines or parts thereof may be visible).

Potential visual exposure as a result of the proposed Soetwater WEF extends primarily to the west of the study area, extending in excess of 20km up the Tankwa River valley. Elevated East facing slopes are also exposed. Several residences and homesteads occur along these east facing slopes and Tankwa River valley. Moderate exposure is expected in these areas.

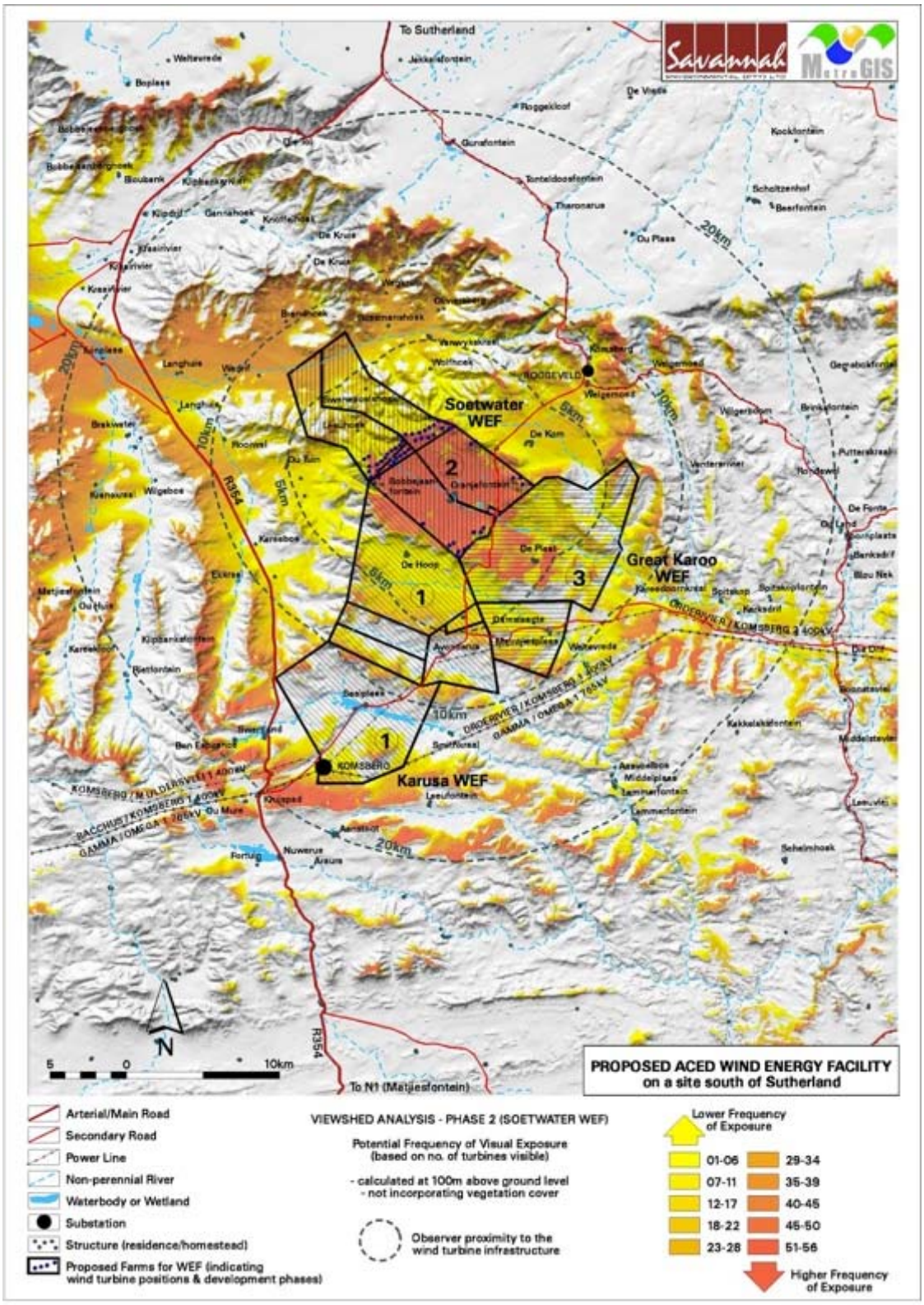
Visual exposure to the north is low to moderate within a 5km radius north of the site due to the topography falling away. Visual exposure increases to moderate between 10-15km north of the site in areas with a southerly aspect. Several settlements are present on these south facing slopes.

The far north of the study area, beyond 15km, is visually screened by the mountain range.

In the south, the extent of potential visual exposure is limited to north facing slopes by east-west orientated ridgelines. The elevation decreases to the south of the site resulting in low to moderate potential visual exposure being limited to the crests of north facing ridges between 10 and 20km to the south. There are very few settlements to the south of the site with the majority of these not expected to be visually impacted.

The highest frequency of potential visual exposure is centred on the site itself. The site lies on an elevated plateau. The settlements of Bobbejaanfontein and Oranjefontein fall on this plateau and up to 56 turbines may be visible from these areas, due to the elevated location of the proposed turbines.

Visual exposure to the east within a 5km radius is low to moderate as a result of the decrease in elevation to the east. Beyond 5km visual exposure is low to moderate and limited to elevated west facing slopes. Several settlement occur to the east, however the majority of these are along the valley floors and will be unaffected.



Map 5: Potential visual exposure of Phase 2 (Soetwater Wind Farm) of the proposed Hidden Valley WEF.

Phase 3 – Great Karoo WEF (Map 6)

The dark orange areas indicate a high frequency (i.e. 70-77 turbines or parts thereof may be visible) while the yellow areas represent a low frequency (i.e. 1-8 turbines or parts thereof may be visible).

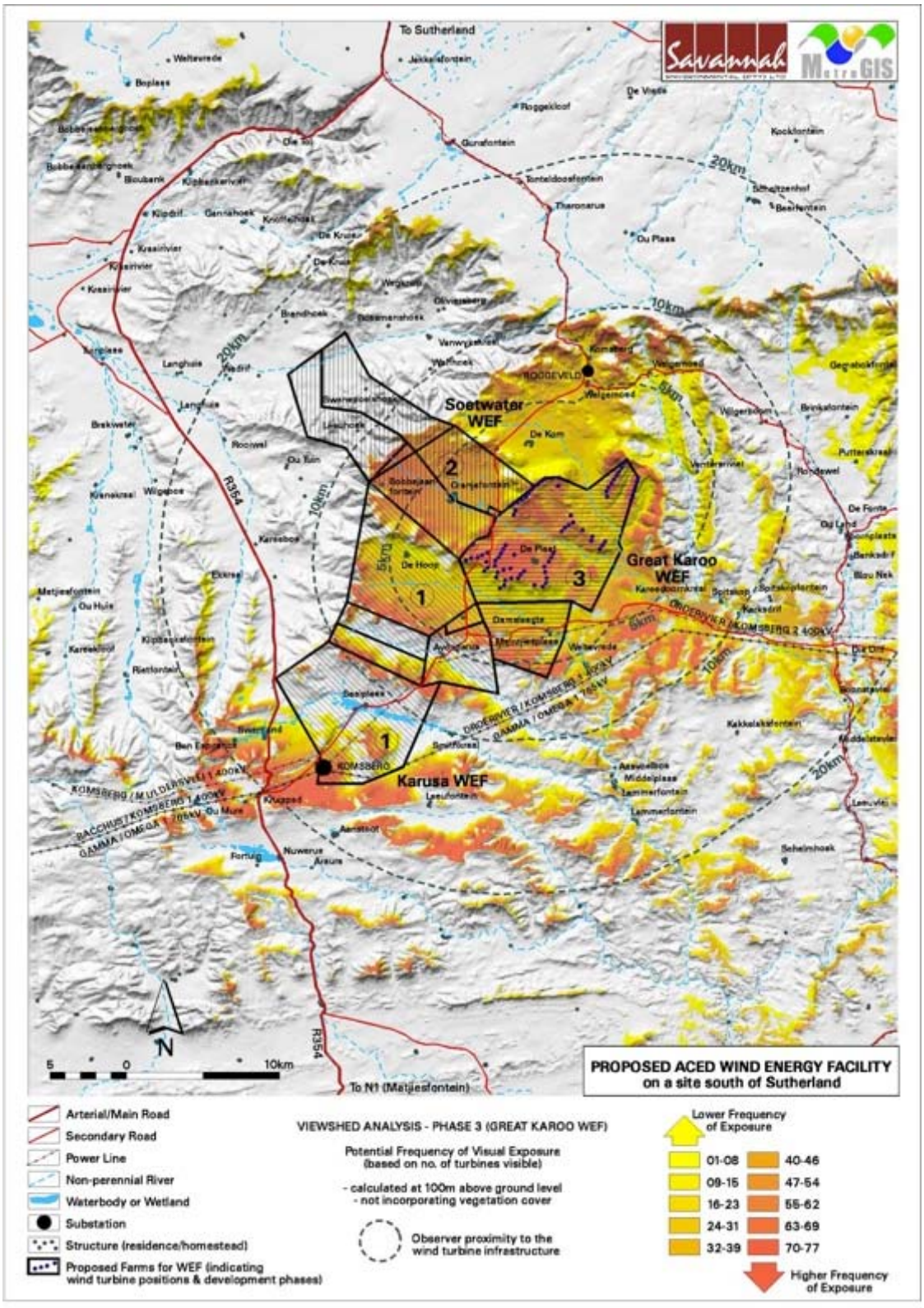
Potential visual exposure as a result of the proposed Great Karoo WEF is focussed primarily to the north and west of the study area. Visual exposure is moderate to high to the north and west, but is limited to a radius of about 8km by ridgelines and mountains.

Visual exposure to the west is limited to the farm portions (and turbine sites) reserved for Phase 1 and Phase 2 of the Hidden Valley WEF. Only three settlement nodes are identified in this area, namely De Hoop, Oranjefontein and Bobbejaansfontein.

There is very limited potential visual exposure along the crests of south and east facing ridges beyond a 10 km radius. None of these areas are settled or traversed by roads.

There is a high frequency of potential visual exposure is on the site itself with up to 77 turbines may be visible from within this are, due to the elevated location of the proposed turbines. The settlement of De Plaat is located in the center of this area.

The frequency of visual exposure is moderate to high to the immediate south and east of the site (5km radius), with visual exposure beyond this radius being limited to exposed south and west facing ridgelines. Potentially affected settlements with a high potential exposure are Damslaagte and Meintjiesplaas to the south and Kareedoornkraal to the east.



Map 6: Potential visual exposure of Phase 3 (Great Karoo Wind Farm) of the proposed Hidden Valley WEF.

Cumulative Visual Analysis – Hidden Valley WEF

The dark orange areas indicate a high frequency (i.e. turbines or parts thereof from all three phases may be visible) while the yellow areas represent a low frequency (i.e. turbines or parts thereof from only one phase may be visible).

Potential visual exposure is highest within the site of the proposed WEF. The following farm portions will experience high visual exposure to turbines from all three phases:

Standvastigheid 210 – northern and southern portions only.
Rheebokkefontein 3/209
Rheebokkefontein 1 /209
Rheebokkefontein 2 /209 – excluding central portions
De Hoop 202
Wolvenkop 1/207
Kentucky 206
Oranjefontein 1/203
Oranjefontein RE/203
Oranjefontein 185
Zwanepoelshoek 184 – very easterly portion only

Potential visual exposure as a result of the proposed Hidden Valley WEF extends primarily in an east west direction with the Tankwa River valley providing a visual conduit to the north-west. Visual exposure is to a large degree contained by the elevated mountains and plateau 10km to the north of the site and by several east-west ridges approximately 10km to the south of the site.

Numerous ridges running in a north-south direction also provide interruption to the visual exposure of the facility.

The Tankwa River Valley to the north west of the study area has several settlements located in the valley bottom. These, together with the R354 will experience visual exposure to turbines from at least 2 of the phases.

To the west of the site continuous visual exposure to at least one phase may occur to the viewshed east of the Tankwa River. This area includes the R354 and several settlements. Beyond the Tankwa River visual exposure to the west is limited to elevated east facing ridges that are uninhabited.

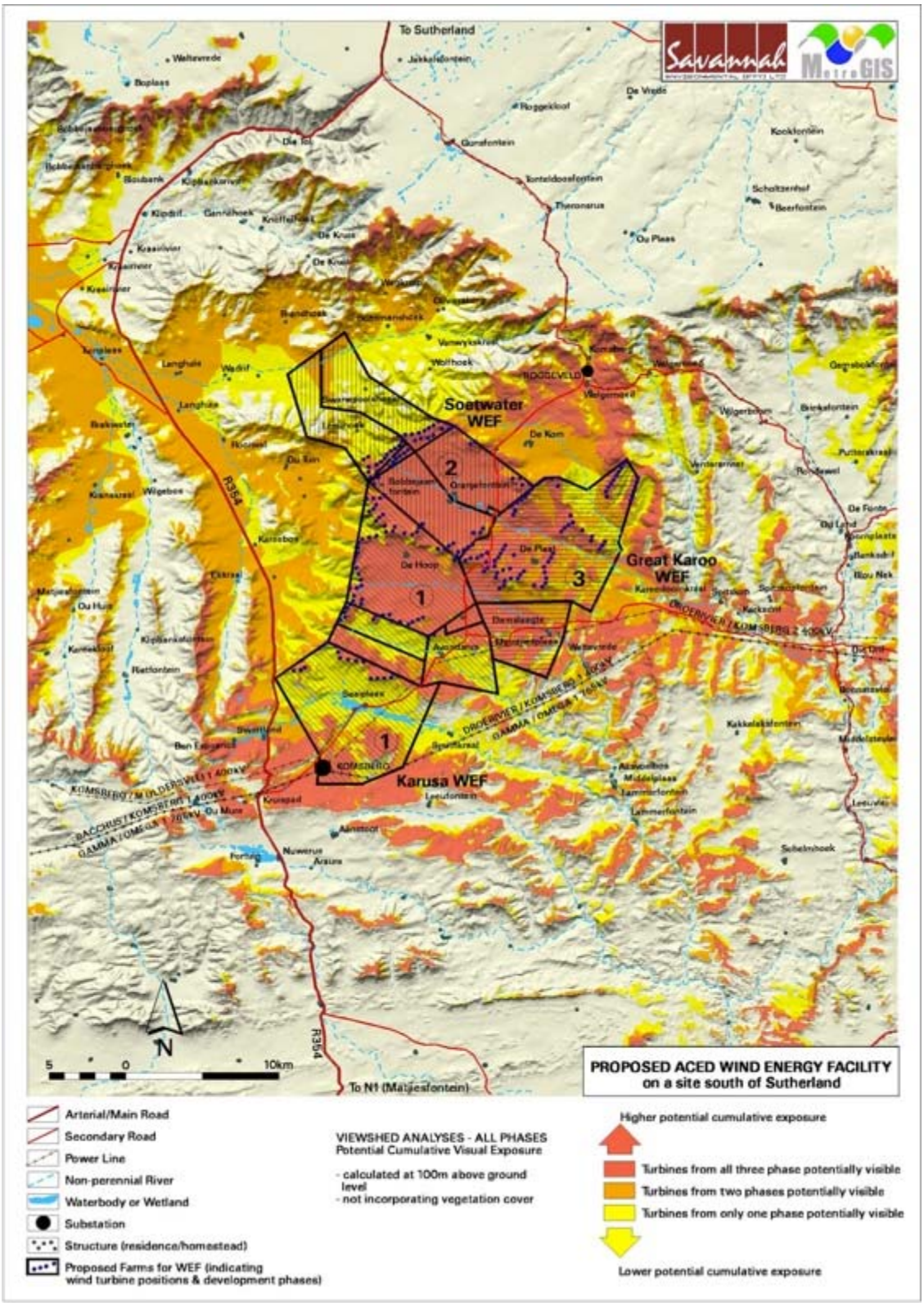
Visual exposure immediately to the south of the WEF will be low to moderate in the valley accommodating the settlements of Saaiplaas and Smithskraal, increasing to be high in the region of the Komsberg substation, with turbines from all three phase potentially visible from these north facing slopes. Potentially affected settlements are Ben Espiranca, Swartland, Ou Mure and Kruispad. High visual exposure is also expected in the vicinity of the intersection of the R354 and the 400kV powerlines near Kruispad.

Further to the south visual exposure is limited to the tops of high ridges and hills only. There are no settlements that will be affected.

Potential visual exposure to the east of the WEF is medium to high on west facing slopes to distance of approximately 8km from the WEF, whereafter the visual exposure is limited to the upper elevations of north south ridgelines. The route followed by the Droerivier/Komsberg 1&2 400kV Powerlines and the district road provide a visual conduit to the east extending beyond 15km, however no settlements are expected to be affected.

Visual exposure to the north is moderate to high within a natural amphitheatre surrounding the settlement of De Kom and extending to include the settlements of Welgemoed and Komsberg. The District road, Roggeveld substation and 66kV powerline are included in this amphitheatre.

Beyond this amphitheatre visual exposure is limited to south facing slopes, within a 10km radius. Several settlements occur on these slopes to the NNW of the WEF. The elevation of the plateau beyond this precludes any further visual exposure to the north.



Map 7: Potential cumulative visual exposure of the 3 phases of the proposed Hidden Valley WEF.

5.2. Visual distance / observer proximity to the facility

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

The proximity radii (calculated from the boundary lines of the farm selected for the WEF) are shown on **Map 8** and 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 views where the facility 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 where the facility would still be visible though not as easily recognisable. This zone constitutes a low visual prominence for the facility.

5.3. Viewer incidence / viewer perception

Refer to **Map 8**. Viewer incidence is calculated to be the highest along the arterial road (i.e. the R354) as well as the secondary roads within the study area. Commuters and tourists using these roads could be negatively impacted upon by visual exposure to the WEF.

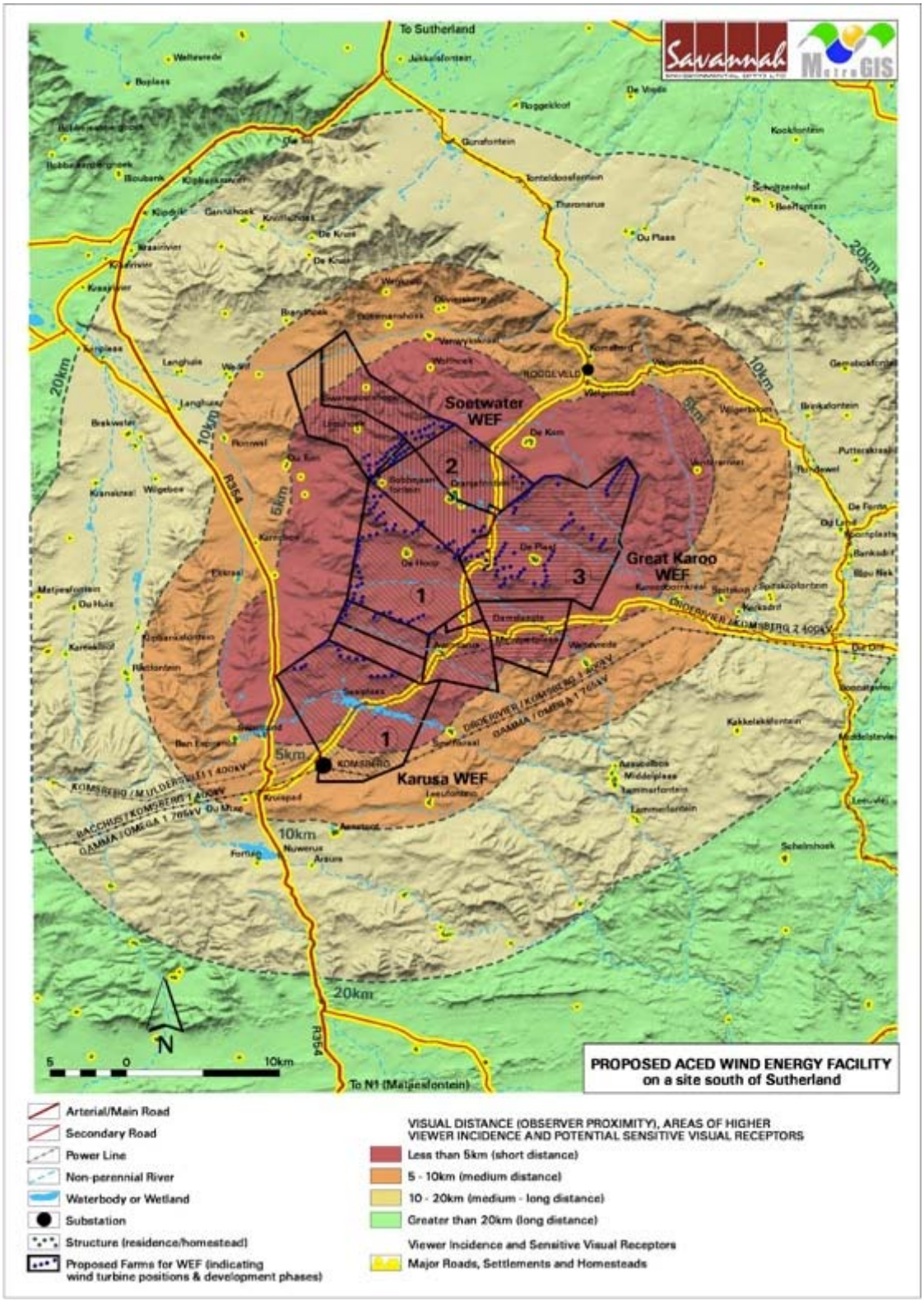
Other than along the above roads, sensitive viewer incidence within the study area is concentrated in the homesteads and settlements, which are scattered throughout the study area. The density of settlements is very low with slightly higher densities occur along the river valleys.

It is uncertain whether all of the potentially affected settlements are inhabited or not, so the author of this document operates under the assumption that they are all inhabited.

The low density of settlements and untransformed nature of the environment provides the area with a high visual quality that is likely to result in visual receptors being highly sensitive to visual disturbance.

The R354 is the primary route to Sutherland which has a unique tourism industry that is centred around astronomy, users of roads and visitors to the area are assumed to be more sensitive to visual disturbance than in areas where tourism is less prominent.

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



Map 8: Observer proximity to the proposed Hidden Valley WEF and areas of high viewer incidence.

5.4 Visual absorption capacity

The semi arid karoo climate of the area yields between 185mm and 433mm of rainfall per year and gives rise to land cover that is entirely *shrubland.* Vegetation types are predominantly *mountain renoster-bush veld* with *western mountain karoo* in the north western corner.

Overall, the Visual Absorption Capacity (VAC) of the receiving environment and especially the area in close proximity to the proposed WEF is deemed to be low by virtue of the nature of the vegetation and the low occurrence of urban development.

In addition, the design, appearance and colour of the turbine structures means that it is unlikely that the environment will visually absorb them in terms of texture, colour, form and light / shade characteristics.

Where homesteads and settlements occur, some more significant vegetation and trees may have been planted, which would contribute to visual absorption. As this is not a consistent occurrence, however, VAC will not be taken into account for any of the homesteads or settlements, thus assuming a worst case scenario in the impact assessment.

5.5. Visual impact index

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed WEF are displayed on **Maps 9-12**.

Again it is necessary to consider visual impact for the three phases individually as well as in combination with one another.

Here the weighted impact and the likely areas of impact are indicated as a visual impact index. Values are assigned for each potential visual impact per data category and merged in order to calculate the visual impact index.

An area with short distance, high frequency of visual exposure to the proposed facility, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater magnitude) on the index. This helps in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

The figure overleaf helps to place the above explanations in context, illustrating what scale a turbine structure will be perceived at different viewing distances.

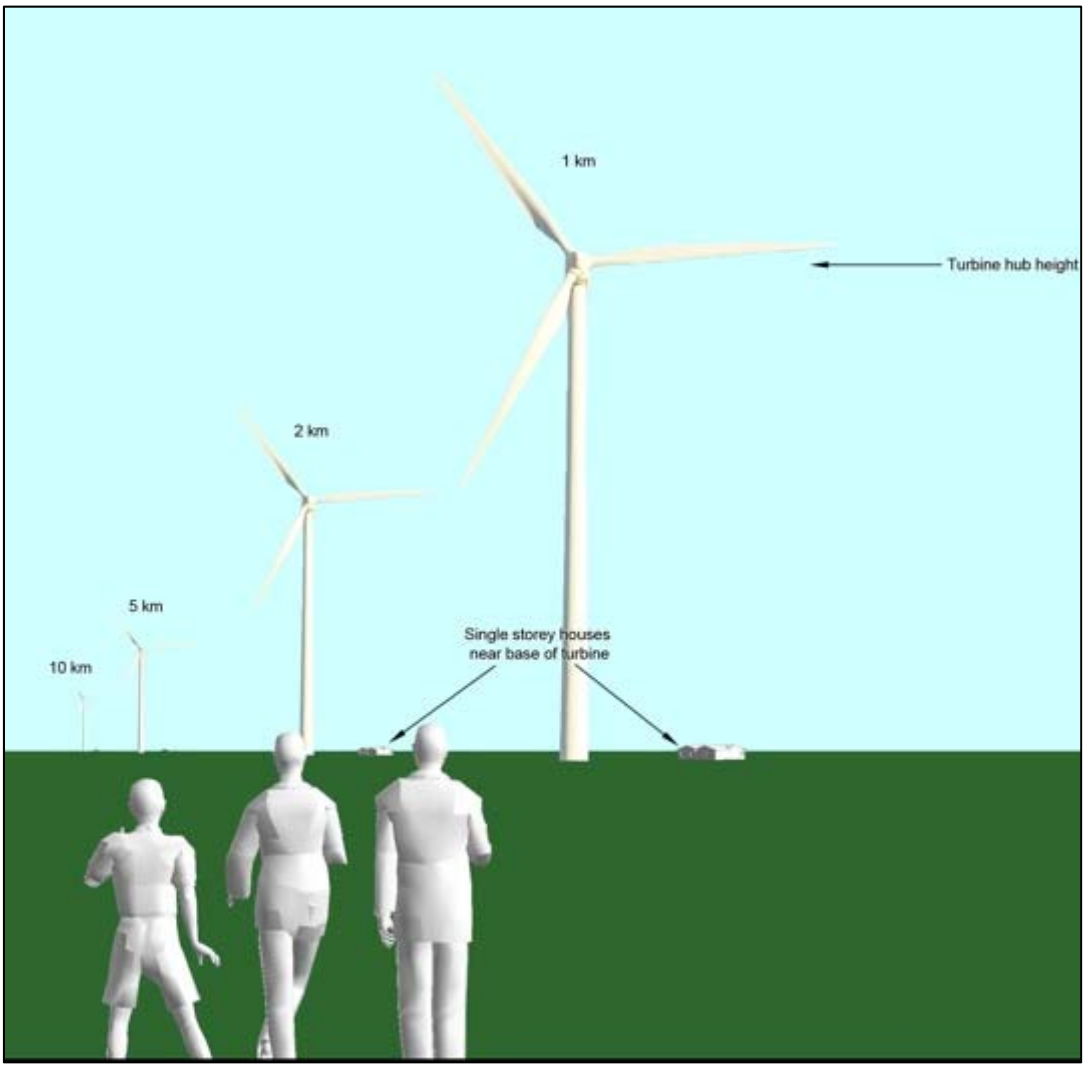


Figure 11: Visual experience of a wind turbine structure at a distance of 1km, 2km, 5km and 10km.

Phase 1 – Karusa WEF (Map 9)

The following is of relevance:

- There exists a core area of potentially **moderate** visual impact on the site itself and within a 5km radius of the proposed WEF.

  Potential areas of **high** visual impact within this 5km radius include a stretch of the R354 road to the west and a section of the secondary road between the Komsberg substation and the Roggeveld substation. Several settlements and homesteads also fall within this 5km radius. These receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 74 turbines). Specific homesteads and settlements include the following:

  - Ou Tuin;
  - Bobbejaansfontein;
  - Oranjefontein;
  - De Hoop;
  - Meitjiesplaas;
  - Avondrus;
  - Saaiplaas;

- The extent of potential visual impact is **Low** between the 5km and 10km radius, while the hilly topography results in large visually screened patches in north and west, with smaller visually screened areas to the east and south. Areas of potentially **moderate** visual impact are restricted to roads and only a few settlements.

  A stretch of the R354 in the west, as well as discontinuous stretches of all the secondary roads south, east and north of the site will be exposed to potentially **moderate** visual impact, as will a number of homesteads and settlements. Again, these receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 74 turbines). Homesteads and settlements include the following:

  - De Plaat;
  - Damslaagte;
  - Smithkraal;
  - Leeufontein;
  - Kruispad;
  - Bon Espirance;
  - Kareebos;
  - Outuin;
  - Rooiwal.

- Beyond the 10km radius (but within the 20km radius), the extent of potential visual impact decreases quite markedly, with visually exposed areas located mainly in the north west, north east and south west. The magnitude of visual impact in the visually exposed areas is reduced to **very low**.

  Large areas north of this zone are visually screened by the undulating topography.

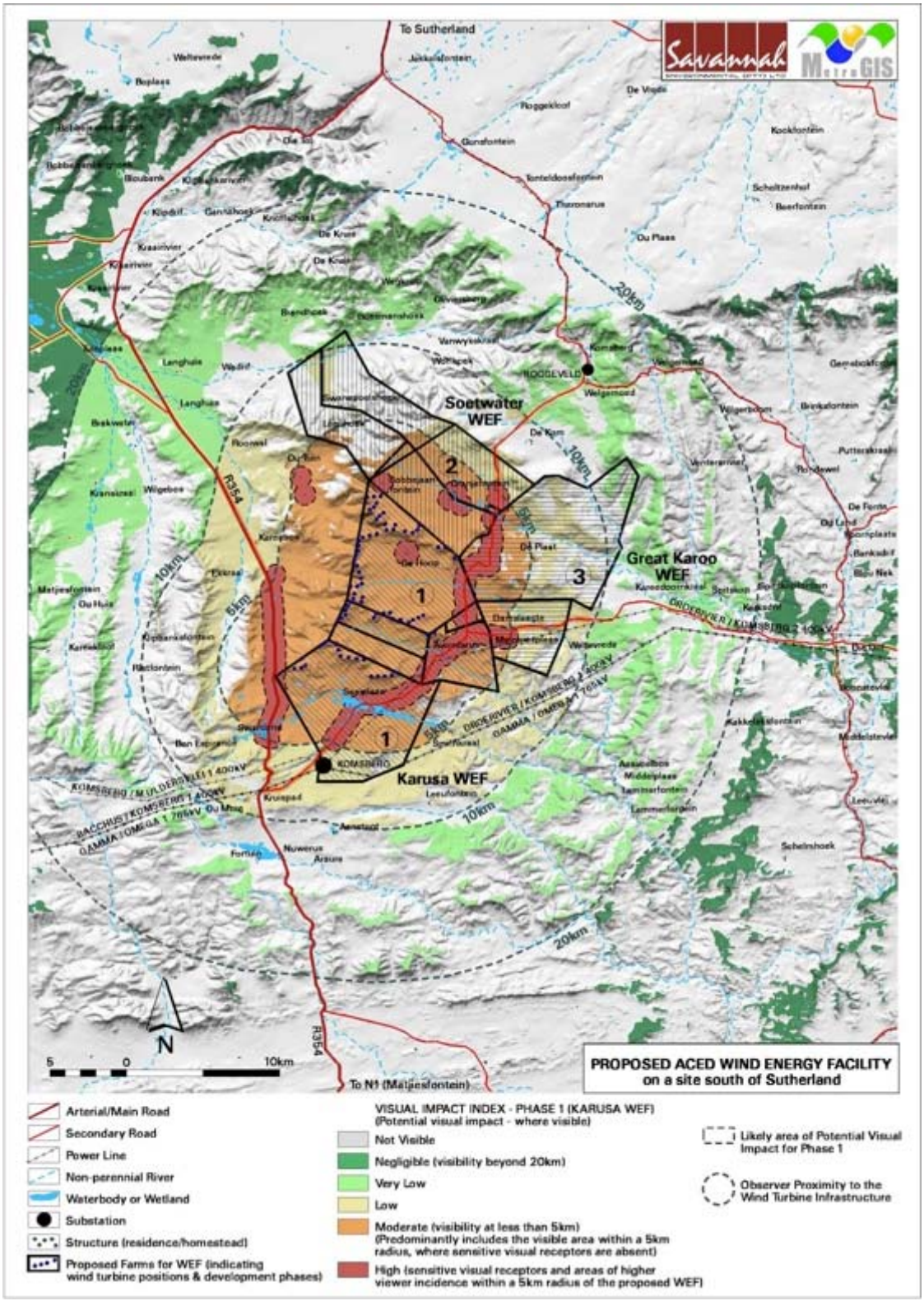
  Sensitive visual receptors likely to be exposed to high frequencies of visual exposure include a section of the R354 and secondary road to the north west of the site, and limited discontinuous stretches of secondary roads to the east and north east. These receptors are likely to experience **low** visual impact. A number of settlements and homesteads are likely to experience a similar impact. These are located primarily in the north and north west of the zone.

  Affected homesteads and settlements include the following:

  - Kranskraal;
  - Brakwater;
  - Langhuis;
  - TuinPlaas;
  - Brandhoek;
  - Wegkruip;
  - Welgemoed

- In the longer distance (i.e. beyond the 20km radius), visual exposure is further reduced in both extent and magnitude. Visual impacts are likely to be **negligible**.

  Visual receptors include the area to the north west along the Tankwa river Valley and elevated ridges to the east and south east.



Map 9: Visual impact index of phase 1 (Karusa Wind Farm) of the proposed Hidden Valley WEF.

Phase 2 – Soetwater WEF (Map 10)

The following is of relevance:

- There exists a core area of potentially **moderate** visual impact on the site itself and within a 5km radius of the proposed WEF. There are several visually screened patches towards the periphery of this zone.

  Potential areas of **high** visual impact within this 5km radius include a stretch the secondary road between the Komsberg substation and the Roggeveld substation. Several settlements and homesteads also fall within this 5km radius. These receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 56 turbines). Specific homesteads and settlements include the following:

  - Ou Tuin;
  - Leeuhoek;
  - Swanepoelshoek;
  - Wolfhoek;
  - De Kom;
  - De Plaat
  - Bobbejaansfontein;
  - Oranjefontein;
  - De Hoop.

- The extent of potential visual impact is **Low** between the 5km and 10km radius, while the hilly topography results in large visually screened patches. Areas of potentially **moderate** visual impact are restricted to roads and only a few settlements.

  A stretch of the R354 in the west, as well as discontinuous stretches of secondary roads to the south and east of the site, will be exposed to potentially **moderate** visual impact, as will a number of homesteads and settlements. Again, these receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 56 turbines). Homesteads and settlements include the following:

  - Meintjiesplaas;
  - Damslaagte;
  - Kareebos;
  - Rooiwal;
  - Boesmanshoek;
  - Wegkruip;
  - Oliviersberg;
  - Vanwykskraal;
  - Welgemoed.

- Beyond the 10km radius (but within the 20km radius), the extent of potential visual impact decreases quite markedly, with visually exposed areas located mainly in the north west, south and east. The magnitude of visual impact in the visually exposed areas is reduced to **very low**.

  Large areas in the north and east of this zone are visually screened by the elevated plateau and undulating topography.

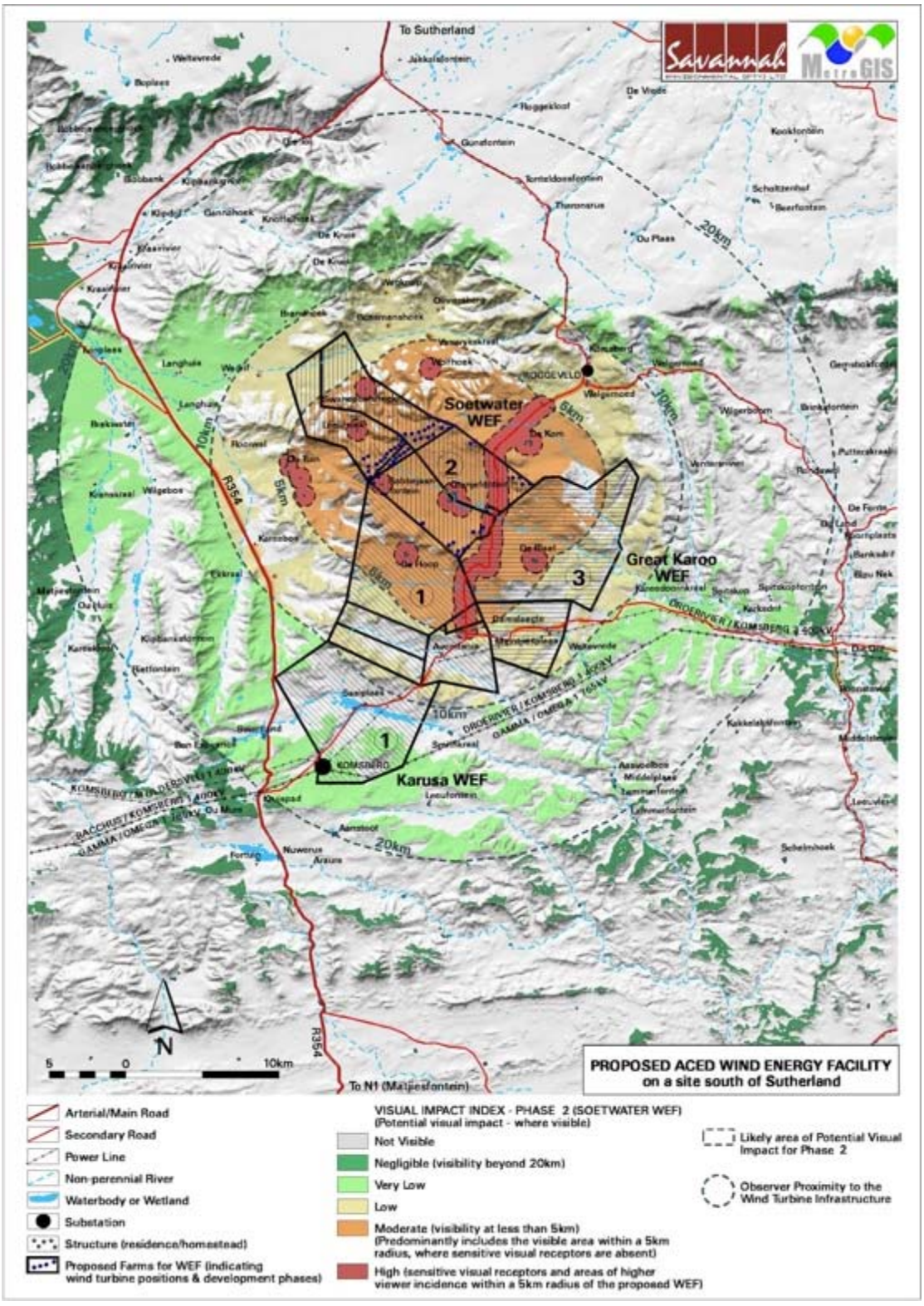
Sensitive visual receptors likely to be exposed to high frequencies of visual exposure include a section of the R354 and secondary road to the north west and south west of the site, and limited discontinuous stretches of secondary roads to the east and north east. These receptors are likely to experience **low** visual impact. A number of settlements and homesteads are likely to experience a similar impact. These are located primarily in the north west of the zone.

Affected homesteads and settlements include the following:

- Kranskraal;
- Langhuis;
- TuinPlaas;
- Wadrif;
- Brandhoek.

- In the longer distance (i.e. beyond the 20km radius), visual exposure is further reduced in both extent and magnitude. Visual impacts are likely to be **negligible**.

  Visual receptors include the area to the north west along the Tankwa river Valley and elevated ridges to the west, east and south east.



Map 10: Visual impact index of phase 2 (Soetwater Wind Farm) of the proposed Hidden Valley WEF.

Phase 3 – Great Karoo WEF (Map 10)

The following is of relevance:

- There exists a core area of potentially **moderate** visual impact on the site itself and within a 5km radius of the proposed WEF. There are several visually screened patches towards the eastern periphery of this zone.

  Potential areas of **high** visual impact within this 5km radius include a stretches of the secondary road between the Komsberg substation and the Roggeveld substation and the secondary road following the Droerivier/Komsberg Powerline. Several settlements and homesteads also fall within this 5km radius. These receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 76 turbines). Specific homesteads and settlements include the following:

  - De Kom;
  - De Plaat;
  - Oranjefontein;
  - De Hoop;
  - Damslaagte;
  - Meintjiesfontein;

- The extent of potential visual impact is **Low** between the 5km and 10km radius, while the hilly topography results in large visually screened patches. Areas of potentially **moderate** visual impact are restricted to roads and only a few settlements.

  Discontinuous stretches of secondary roads to the south-west, soth-east and north of the site, will be exposed to potentially **moderate** visual impact, as will a number of homesteads and settlements. Again, these receptors are those deemed to be sensitive, and which are likely to be exposed to high frequencies of visual exposure (i.e. up to 76 turbines). Homesteads and settlements include the following:

  - Bobbejaanfontein
  - Komsberg;
  - Welgemoed;
  - Spitskop;
  - Kareedoornkraal;
  - Weltevrede.

- Beyond the 10km radius (but within the 20km radius), the extent of potential visual impact decreases quite markedly, with visually exposed areas located mainly in the south and east. The magnitude of visual impact in the visually exposed areas is reduced to **very low**.

  Large areas in the north and west of this zone are visually screened by the elevated plateau and undulating topography.

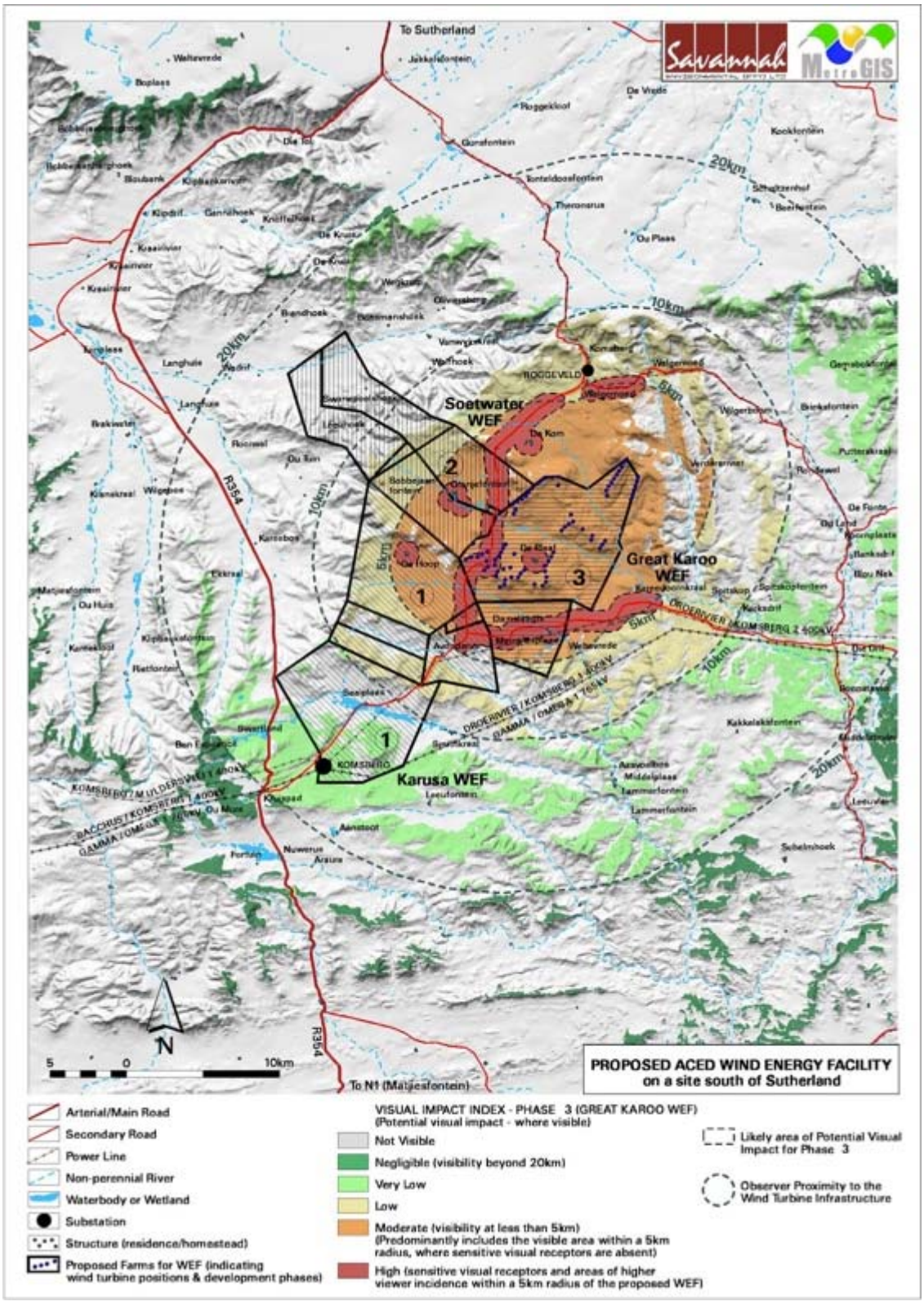
  Sensitive visual receptors likely to be exposed to high frequencies of visual exposure include a small section of the R354 and secondary road near kruispad, and limited discontinuous stretches of secondary roads to the east. These receptors are likely to experience **low** visual impact. A number of settlements and homesteads are likely to experience a similar impact. These are located primarily in the east of the zone.

Affected homesteads and settlements include the following:

- Gemsbokfontein;
- Putterskraal;

- In the longer distance (i.e. beyond the 20km radius), visual exposure is further reduced in both extent and magnitude. Visual impacts are likely to be **negligible**.

  Visual receptors include the elevated ridges to the west, east and south.



Map 11: Visual impact index of phase 3 (Great Karoo Wind Farm) of the proposed Hidden Valley WEF.

Combined Hidden Valley WEF (Map 12)

The cumulative visual impact shown in Map 12 is a summation of the individual impacts for each phase.

In addition to a Visual Impact Index ranging from 1 (low visual impact) to 7 (high visual impact), the map also indicates the Visual Impact Intensity for sensitive receptors within the 5km radius.

The following is of relevance:

- The cumulative visual impact is highest within a 5km radius of the turbine infrastructure. This impact moderates with distance. Slopes that have aspects that face the WEF experience **very high visual impact**. There are several visually screened patches towards the eastern periphery of this zone.

  15 settlements that will experience visual impact fall within this zone. 11 of these settlements potentially experience a very high visual impact. These are further categorised in terms of intensity of visual impacts below.

  Potential areas of **high intensity** visual impact (3 phases visible) within this 5km radius include a stretch the secondary road running north-south through the center of the WEF and two settlements located centrally within the WEF, namely:

  - De Hoop;
  - Oranjefontein.

  Areas of high intensity visual impact (3 phase visible) are restricted to within the footprint of the WEF.

  Potential areas of **moderate intensity** visual impact (2 phases visible) within this 5km radius include a stretch the secondary road running north from the northern periphery of the WEF towards the Roggeveld substation and a short stretch of secondary road west of Meintjiesplaas. Five settlements are identified as having a moderate intensity visual impact within this zone, namely:

  - Meintjiesplaas;
  - De Plaat;
  - Bobbejaanfontein;
  - De Kom;
  - Ou Tuin.

  Areas of **lower intensity** visual impact (1 phase visible) within this 5km radius include a section of the R354 to the east of the facility; two sections of secondary road to the south between Komsberg substation and Kareedoornkraal; a section of secondary road in the north between Roggeveld substation and Welgemoed; and four settlements to the north-west of the WEF. These receptors are those deemed to be sensitive, and which are likely to be exposed to low frequencies of visual exposure (i.e. only turbines from a single phase). Specific homesteads and settlements include the following:

  - Ou Tuin;
  - Leeuhoek;
  - Swanepoelshoek;

- Wolfhoek.

- Between the 5km and 10km radius, cumulative visual impact ranges from **moderate** to **low** while the hilly topography results in large visually screened patches. Areas of potentially **moderate** visual impact are restricted to areas of higher elevation with aspects orientated towards the WEF.

  A stretch of the R354 in the west, as well as discontinuous stretches of secondary roads to the south and east of the site, will be exposed to potentially **moderate** visual impact, as will a number of homesteads and settlements. Again, these receptors are those deemed to be sensitive, and which are likely to be exposed to higher frequencies of visual exposure. Homesteads and settlements with moderate impact include the following:

  - Kruispad;
  - Bon Espirance;
  - Kareebos;
  - Rooiwal;
  - Boesmanshoek;
  - Wegkruip;
  - Oliviersberg;
  - Vanwykskraal;
  - Komsberg;
  - Welgemoed.

- Beyond the 10km radius (but within the 20km radius), the extent of potential visual impact decreases quite markedly, with visually exposed areas located mainly in the north west, south and east. The magnitude of visual impact in the visually exposed areas is reduced to **very low**.

  Large areas in the north and south of this zone are visually screened by the elevated plateau and undulating topography.

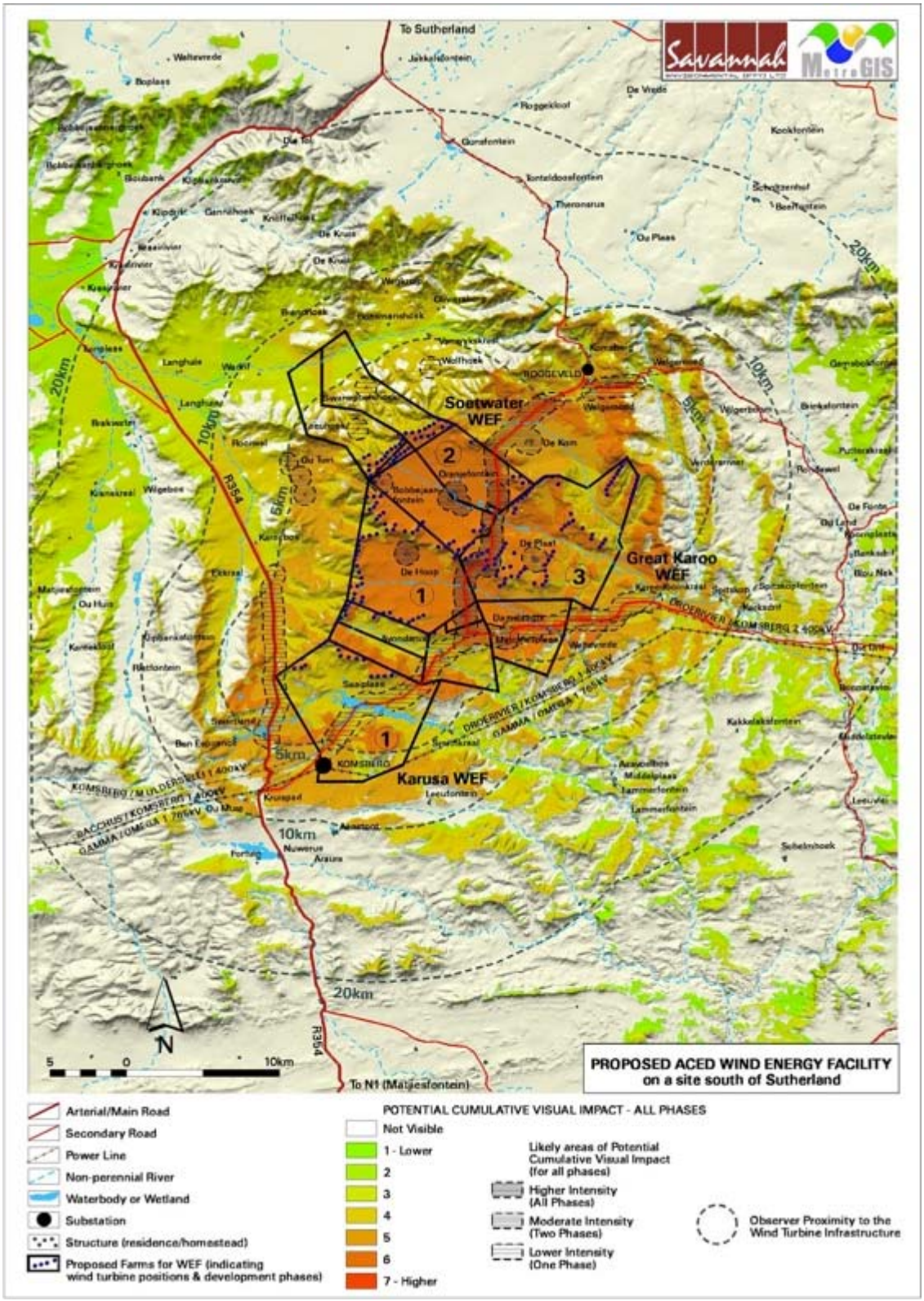
  Sensitive visual receptors likely to be exposed to high frequencies of visual exposure include a section of the R354 and secondary road to the north west of the site, and limited discontinuous stretches of secondary roads to the east. These receptors are likely to experience **low** visual impact. A number of settlements and homesteads are likely to experience a similar impact. These are located primarily in the north west of the zone.

  Affected homesteads and settlements include the following:

  - Matjiesfontein;
  - Kranskraal;
  - Langhuis;
  - Tuinplaas;
  - Wadrif;
  - Brandhoek;
  - Gemsbokfontein;
  - Putterskraal.

- In the longer distance (i.e. beyond the 20km radius), visual exposure is further reduced in both extent and magnitude. Visual impacts are likely to be **negligible**.

  Visual receptors include the area to the north west along the Tankwa river Valley and elevated ridges to the west, east and south east.



Map 12: Combined Visual Impact index for the three phases of the proposed Hidden Valley WEF.

5.6 Visual impact assessment: methodology

The previous section of the report identified specific areas where likely visual impacts would occur. This section will attempt to quantify these potential visual impacts in their respective geographical locations and in terms of the identified issues (see Chapter 3: SCOPE OF WORK) related to the visual impact.

The methodology for the assessment of potential visual impacts states the **nature** of the potential visual impact (e.g. the visual impact on users of major roads in the vicinity of the proposed facility) and includes a table quantifying the potential visual impact according to the following criteria:

- **Extent** - site only (very high = 5), local (high = 4), regional (medium = 3), national (low = 2) or international (very low = 1)[3].
- **Duration** - very short (0-1 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5).
- **Magnitude** - None (= 0), minor (= 2), low (= 4), medium/moderate (= 6), high (= 8) and very high (= 10)[4].
- **Probability** – very improbable (= 1), improbable (= 2), probable (= 3), highly probable (= 4) and definite (= 5).
- **Status** (positive, negative or neutral).
- **Reversibility** - reversible (= 1), recoverable (= 3) and irreversible (= 5).
- **Significance** - low, medium or high.

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

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

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

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

[4] This value is read from the visual impact index. Where more than one value is applicable, the higher of these will be used as a worst case scenario.

5.7 Visual impact assessment: primary impacts

5.7.1 The WEF

Potential visual impact on observers travelling along arterial and secondary roads in close proximity to the proposed WEF.

Potential visual impact on users of the R354 and secondary roads in close proximity of the proposed WEF (i.e. within 10km) is expected to be of **high** significance. No mitigation is possible.

Table 1: Impact table summarising the significance of visual impacts on observers travelling along arterial and secondary roads in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact on observers travelling along arterial and secondary roads in close proximity to the proposed WEF					
	Phase 1	***Phase 2***	***Phase 3***	***Combined WEF***	
	No mitigation				***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**	N/a
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	N/a
Magnitude	High **(8)**	Low **(4)**	Medium **(6)**	Very High **(10)**	N/a
Probability	Highly Probable **(4)**	Highly Probable **(4)**	Highly Probable **(4)**	Highly Probable **(4)**	N/a
Significance	High **(64)**	Medium **(48)**	Medium **(56)**	High **(72)**	N/a
Status (positive or negative)	Negative				N/a
Reversibility	Recoverable **(3)**				N/a
Irreplaceable loss of resources?	No				N/a
Can impacts be mitigated?	No				
Mitigation: None.					
Cumulative impacts: The construction of 207 wind turbines will increase the cumulative visual impact of industrial and / or power related infrastructure (such as power lines and substations) within the region.					
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.					

Potential visual impact on residents of settlements and homesteads in close proximity to the proposed WEF.

The potential visual impact on residents of settlements and homesteads within an 10km radius of the proposed WEF is expected to be of **moderate** to **high** significance. No mitigation is possible.

Table 2: Impact table summarising the significance of visual impacts on residents of settlements and homesteads in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact on residents of settlements and homesteads in close proximity to the proposed WEF					
	Phase 1	***Phase 2***	***Phase 3***	***Combined WEF***	
	No mitigation				***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**	N/a
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	N/a
Magnitude	Low **(4)**	Low **(4)**	Low **(4)**	Medium **(6)**	N/a
Probability	Highly Probable **(4)**	Highly Probable **(4)**	Highly Probable **(4)**	Highly Probable **(4)**	N/a
Significance	Medium **(48)**	Medium **(48)**	Medium **(48)**	High **(64)**	N/a
Status (positive or negative)	Negative				N/a
Reversibility	Recoverable **(3)**				N/a
Irreplaceable loss of resources?	No				N/a
Can impacts be mitigated?	No				
Mitigation: None.					
Cumulative impacts: The construction of 207 wind turbines will increase the cumulative visual impact of industrial and / or power related infrastructure (such as power lines and substations) within the region.					
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.					

Potential visual impact on sensitive visual receptors within the region.

The visual impact on the users of roads and the residents of settlements and homesteads within the region (i.e. beyond the 10km radius) is expected to be of **moderate** significance. No mitigation is possible.

Table 3: Impact table summarising the significance of visual impacts on sensitive visual receptors within the region.

Nature of Impact: Potential visual impact on sensitive visual receptors within the region.					
	Phase 1	***Phase 2***	***Phase 3***	***Combined WEF***	
	No mitigation				***Mitigation considered***
Extent	Regional **(3)**	Regional **(3)**	Regional **(3)**	Regional **(3)**	N/a
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	N/a
Magnitude	Low **(4)**	Low **(4)**	Minor **(2)**	Medium **(6)**	N/a
Probability	Highly Probable **(4)**	Highly Probable **(4)**	Highly Probable **(4)**	Highly Probable **(4)**	N/a
Significance	Medium **(44)**	Medium **(44)**	Medium **(36)**	Medium **(52)**	N/a
Status (positive or negative)	Negative				N/a
Reversibility	Recoverable **(3)**				N/a
Irreplaceable loss of resources?	No				N/a
Can impacts be mitigated?	No				
Mitigation: None.					
Cumulative impacts: The construction of 207 wind turbines will increase the cumulative visual impact of industrial and / or power related infrastructure (such as power lines and substations) within the region.					
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.					

5.7.2. Ancillary infrastructure

Potential visual impact of internal access routes on observers in close proximity to the proposed WEF.

Within the WEF footprint, roads will be required to construct each turbine (construction phase) as well as to maintain the turbines (operational phase). Although existing roads will be used for the most part, these will require some upgrading and additional roads will need to be built. Such a network of roads has the potential of manifesting as landscape scarring, and thus a potential visual impact within the viewshed areas.

No dedicated viewshed has been generated for the access roads, but the area of potential visual exposure will lie within that of the turbines. They will not be as highly visible as the turbines, however, as they posses no height. This reduces the probability of this impact occurring. The table below illustrates the assessment of this anticipated impact, which is likely to be of **low** significance both before and after mitigation.

Table 4: Impact table summarising the significance of visual impact of internal access roads on observers in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact of internal access roads on observers in close proximity to the proposed WEF.					
	Phase 1	***Phase 2***	***Phase 3***	***Combined WEF***	
	No mitigation				***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**	Low **(4)**	Low **(4)**	Low **(4)**
Probability	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Improbable **(2)**	Very Improbable **(1)**
Significance	Low **(24)**	Low **(24)**	Low **(24)**	Low **(24)**	Low **(12)**
Status (positive or negative)	Negative				Negative
Reversibility	Recoverable **(3)**				Recoverable **(3)**
Irreplaceable loss of resources?	No				No
Can impacts be mitigated?	Yes				

Mitigation:

Planning:

- Make use of existing roads wherever possible and plan the roads and infrastructure with due cognisance of the topography to limit cut and fill requirements.
- Plan roads to avoid / minimise clearing of vegetation.
- Retain and maintain natural / cultivated vegetation in all areas outside of the development footprint.

Construction:

- Rehabilitate all construction areas.
- Ensure that vegetation is not cleared unnecessarily to make way for the access roads.

Operation:

- Maintain roads to avoid erosion and suppress dust.

Decommissioning:

- Remove of infrastructure and roads not required for post decommissioning use and rehabilitate all cleared footprint areas.
- Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Cumulative impacts:

The construction of access roads will contribute to the cumulative visual impact of road infrastructure within the region.

Residual impacts:

The visual impact will be removed after decommissioning, provided the access roads are removed and rehabilitated. Failing this, the visual impact will remain.

Potential visual impact of the overhead power lines and on-site substations on observers in close proximity to the proposed WEF.

The construction of the overhead power lines and substations could represent a visual impact, albeit a very localised impact (i.e. primarily contained within the WEF development site). The greatest visual impact is expected to occur where the substation and power line infrastructure may be visible from the secondary road traversing (between the Eskom Komsberg and Roggeveld substations) the proposed development site. The power lines and substation infrastructure will however not be viewed in isolation, but together with the much larger wind turbine structures.

Map 1 indicates the overhead power line and substation alternatives.

The preferred option (for all development phases) includes:

- The Soetwater and Great Karoo 132kV substations, the Hidden Valley 400kV substation and three power lines totalling 24.5km (two of which comprise monopole structures running adjacent to each other).

The alternative option (for all development phases) includes:

- Three alternative 132kV substations and three 132kV overhead power lines totalling 32.5km arranged to form a triangular connection between the substations.

From a visual perspective the *preferred option* above, besides being almost 8km shorter, serves better to consolidate the linear infrastructure on the site. This option is assessed below. The anticipated visual impact resulting from the new overhead power lines and substations is likely to be of **moderate** significance both before and after mitigation.

Table 5: Impact table summarising the significance of visual impact of the overhead power lines and substations on observers in close proximity thereto.

Nature of Impact: Potential visual impact of the overhead power lines and substations on observers in close proximity thereto.					
	Phase 1	***Phase 2***	***Phase 3***	***Combined WEF***	
	No mitigation				***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Low **(4)**	Low **(4)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**
Probability	Improbable **(2)**	Probable **(3)**	Probable **(3)**	Probable **(3)**	Probable **(3)**
Significance	Low **(24)**	Moderate **(36)**	Moderate **(42)**	Moderate **(42)**	Moderate **(42)**
Status (positive or negative)	Negative				Negative
Reversibility	Recoverable **(3)**				Recoverable **(3)**
Irreplaceable loss of resources?	No				No
Can impacts be mitigated?	Yes				

Mitigation:

Planning:

- Retain and maintain natural / cultivated vegetation in all areas outside of the development footprint.

Construction:

- Rehabilitate all construction areas and servitudes.
- Ensure that vegetation is not cleared unnecessarily to make way for the power line and servitude.

Operation:

- Maintain servitudes to avoid erosion and suppress dust.

Decommissioning:

- Remove infrastructure not required for post decommissioning use and rehabilitate all cleared footprint areas.

Cumulative impacts:

The construction of the power lines and substations will contribute to the cumulative visual impact of electrical infrastructure such as existing Eskom power lines and substations (Komsberg and Roggeveld) within the region.

Residual impacts:

The visual impact will be removed after decommissioning, provided the power lines and substations are removed. Failing this, the visual impact will remain.

5.7.3. Shadow flicker

Potential visual impact of shadow flicker on visual receptors in close proximity to the proposed WEF.

Shadow flicker occurs when the sky is clear, and when the rotor blades of the wind turbine are between the sun and the receptor (i.e. when the sun is low). De Gryse in Scenic Landscape Architecture (2006) found that "*most shadow impact is associated with 3-4 times the height of the object*". Based on this research, a 400m buffer along the edge of the facility is submitted as the zone within which there is a risk of shadow flicker occurring.

In this respect, only the following receptors may possibly experience visual impact as a result of shadow flicker due to their proximity to turbine structures (<1km):

Phase 1: None.
Phase 2: Bobbejaanfontein and a 1km section of secondary road south east of Oranjefontein.
Phase 3: De Plaat and a 3km section of secondary road to the west of this homestead.

The anticipated impact is expected to be **very low** for the abovementioned settlements since they are at least 400m removed from the nearest turbines.

5.7.4. Lighting impacts

Potential visual impact of operational, safety and security lighting of the facility at night on observers in close proximity to the proposed WEF.

The area immediately surrounding the proposed facility has a relatively low incidence of receptors and light sources, so light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contribute to the increase in sky glow.

This anticipated impact is likely to be of **moderate** significance, and may be mitigated to **low**.

Table 6: Impact table summarising the significance of visual impact of lighting at night on visual receptors in close proximity to the proposed WEF

Nature of Impact: Potential visual impact of lighting at night on visual receptors in close proximity to the proposed WEF.					
	Phase 1	***Phase 2***	***Phase 3***	***Combined WEF***	
	No mitigation				***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**
Magnitude	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**
Probability	Probable **(3)**	Probable **(3)**	Probable **(3)**	Probable **(3)**	Improbable **(2)**
Significance	Moderate **(42)**	Moderate **(42)**	Moderate **(42)**	Moderate **(42)**	Low **(28)**
Status (positive or negative)	Negative				Negative
Reversibility	Recoverable **(3)**				Recoverable **(3)**
Irreplaceable loss of resources?	No				No
Can impacts be mitigated?	Yes				

Mitigation:

Planning & operation:

- Limit aircraft warning lights for the proposed Hidden Valley WEF to the turbines on the perimeter, thereby reducing the overall requirement.
- Shield the sources of light by physical barriers (walls, vegetation, or the structure itself).
- Limit mounting heights of lighting fixtures, or alternatively use foot-lights or bollard level lights.
- Make use of minimum lumen or wattage in fixtures.
- Make use of down-lighters, or shielded fixtures.
- Make use of Low Pressure Sodium lighting or other types of low impact lighting.
- Make use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.

Cumulative impacts:

The construction of 207 wind turbines with their aircraft warning lights, and ancillary infrastructure with security and after hours lighting will increase the cumulative visual impact of lighting within the region.

Residual impacts:

None. The visual impact of lighting will be removed after decommissioning and the removal of the wind turbines.

Potential visual impact of operational, safety and security lighting of the facility at night on observers within the region, with specific reference to the South African Large Telescope (SALT) near Sutherland.

The SALT is situated at the South African Astronomical Observatory (SAAO) field station 14km east of the town of Sutherland. This site, in the arid Karoo region, was established in the early 1970's and was chosen for its dark and clear skies and good weather conditions. The site is 35km to the north east of the proposed WEF and lies on an elevated plateau.

The SALT lies on the plateau at an elevation of 1755m ASL. The highest turbine elevations are expected to be at approximately 1500m ASL (height of hub of most elevated turbines).

While light trespass and glare from the security and after-hours operational lighting for the facility will have some significance for visual receptors in close proximity, it is not possible to see these lights from the SALT due to elevated topography which limits visibility to 10km to the north east.

Another source of glare light, albeit not as intense as flood lighting, is the aircraft warning lights mounted on top of the hub of the wind turbines. These lights are less aggravating due to the toned-down red colour, but have the potential to be visible from a great distance. The Civil Aviation Authority (CAA) prescribes these warning lights and the potential to mitigate their visual impacts is low. The furthest extent of direct visibility of turbine hubs and lights in the direction (NE) of the SALT is 10km.

Last is the potential lighting impact known as sky glow. Sky glow is the condition where the night sky is illuminated when light reflects off particles in the atmosphere such as moisture, dust or smog. The sky glow intensifies with the increase in the amount of light sources. Each new light source, especially upwardly directed lighting, contribute to the increase in sky glow. This impact is the only light impact with the potential to affect the SALT.

The intensity of light generated by the WEF is expected to be of a lower order than that generated by the urban area of Sutherland due to the dispersed nature of the turbines.

The distance of the SALT from the WEF and the elevated position of the SALT reduce the significance of this impact to **insignificant.**

5.7.5. Construction impacts

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

During the construction period, there will be a noticeable increase in heavy vehicles utilising the roads to the development site that may cause, at the very least, a visual nuisance to other road users and land owners in the area. Dust from construction work could also result in potential visual impact. This anticipated impact is likely to be of **moderate** significance, and may be mitigated to **low**.

Table 7: Impact table summarising the significance of visual impact of construction on visual receptors in close proximity to the proposed WEF.

Nature of Impact: Potential visual impact of construction on visual receptors in close proximity to the proposed WEF.					
	Phase 1	***Phase 2***	***Phase 3***	***Combined WEF***	
	No mitigation				***Mitigation considered***
Extent	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**	Local **(4)**
Duration	Very short term **(1)**	Very short term **(1)**	Very short term **(1)**	Very short term **(1)**	Very short term **(1)**
Magnitude	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**	Moderate **(6)**
Probability	Probable **(3)**	Probable **(3)**	Probable **(3)**	Probable **(3)**	Improbable **(2)**
Significance	Moderate **(33)**	Moderate **(33)**	Moderate **(33)**	Moderate **(33)**	Low **(22)**
Status (positive or negative)	Negative				Negative
Reversibility	Recoverable **(3)**				Recoverable **(3)**
Irreplaceable loss of resources?	No				No
Can impacts be mitigated?	Yes				

Mitigation:

Planning:

- Retain and maintain natural vegetation in all areas outside of the development footprint.

Construction:

- Ensure that vegetation is not unnecessarily removed during the construction period.
- Reduce the construction period through careful logistical planning and productive implementation of resources.
- Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.
- Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
- Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.
- Reduce and control construction dust using approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).
- Restrict construction activities to daylight hours in order to reduce lighting impacts.
- Rehabilitate all disturbed areas immediately after the completion of construction works.

Cumulative impacts:

None.

Residual impacts:

None.

5.8 Visual impact assessment: secondary impacts

5.8.1 The WEF and ancillary infrastructure

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

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

A visual impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light. Specific aspects contributing to the sense of place of this region include un-impacted picturesque landscapes, dramatic mountains and isolation.

The visual impact on the visual character of the Karoo landscape and sense of place of the region is expected to be of **moderate** to **high** significance. No mitigation is possible.

Table 8: Impact table summarising the significance of visual impacts on the visual character of the Karoo landscape and sense of place of the region.

Nature of Impact: Potential visual impact on the visual character of the Karoo landscape and sense of place of the region.					
	Phase 1	***Phase 2***	***Phase 3***	***Combined WEF***	
	No mitigation				***Mitigation considered***
Extent	Regional **(3)**	Regional **(3)**	Regional **(3)**	Regional **(3)**	N/a
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	N/a
Magnitude	Medium **(6)**	Medium **(6)**	Medium **(6)**	High **(8)**	N/a
Probability	Highly Probable **(4)**	Highly Probable **(4)**	Probable **(3)**	Highly Probable **(4)**	N/a
Significance	Medium **(52)**	Medium **(52)**	Medium **(52)**	High **(60)**	N/a
Status (positive or negative)	Negative				N/a
Reversibility	Recoverable **(3)**				N/a
Irreplaceable loss of resources?	No				N/a
Can impacts be mitigated?	No				
Mitigation: None.					
Cumulative impacts: The construction of 207 wind turbines will increase the cumulative visual impact of industrial and / or power related infrastructure (such as power lines and substations) within the region.					
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.					

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

While the area surrounding the site is itself not a major tourist attraction, the R354 is a primary tourism route for visitors to the town of Sutherland and its attractions.

The visual impact on the R354 is expected to be of **low** to **moderate** significance. No mitigation is possible.

Table 9: Impact table summarising the significance of visual impacts on the R354 tourist route within the region.

Nature of Impact: Potential visual impact on the R354 tourist route within the region.					
	Phase 1	***Phase 2***	***Phase 3***	***Combined WEF***	
	No mitigation				***Mitigation considered***
Extent	Regional **(3)**	Regional **(3)**	Regional **(3)**	Regional **(3)**	N/a
Duration	Long term **(4)**	Long term **(4)**	Long term **(4)**	Long term **(4)**	N/a
Magnitude	Low **(4)**	Minor **(2)**	Minor **(2)**	Medium **(6)**	N/a
Probability	Highly Probable **(4)**	Highly Probable **(4)**	Probable **(3)**	Highly Probable **(4)**	N/a
Significance	Medium **(44)**	Medium **(36)**	Low **(27)**	Medium **(52)**	N/a
Status (positive or negative)	Negative				N/a
Reversibility	Recoverable **(3)**				N/a
Irreplaceable loss of resources?	No				N/a
Can impacts be mitigated?	No				
Mitigation: None.					
Cumulative impacts: The construction of 207 wind turbines will increase the cumulative visual impact of industrial and / or power related infrastructure (such as power lines and substations) within the region.					
Residual impacts: The visual impact will be removed after decommissioning, provided the facility and ancillary infrastructure is removed. Failing this, the visual impact will remain.					

5.9. The potential to mitigate visual impacts

The primary visual impact, namely the appearance of the Wind Energy Facility (the wind turbines) is not possible to mitigate. The functional design of the turbines cannot be changed in order to reduce visual impacts.

Alternative colour schemes (i.e. painting the turbines sky-blue, grey or darker shades of white) are not permissible as the CAA's *Marking of Obstacles* expressly states, "*Wind turbines shall be painted bright white to provide the maximum daytime conspicuousness*".

Failure to adhere to the prescribed colour specifications will result in the fitting of supplementary daytime lighting to the wind turbines, once again aggravating the visual impact.

The overall potential for mitigation is therefore generally low or non-existent. The following mitigation is, however possible:

- It is recommended that vegetation cover (i.e. either natural or cultivated) be maintained in all areas outside of the actual development footprint, both during construction and operation of the proposed facility. This will minimise visual impact as a result of cleared areas, power line servitudes and areas denuded of vegetation.

- Existing roads should be utilised wherever possible. New roads should be planned taking due cognisance of the topography to limit cut and fill requirements. Construction / upgrade of roads should be undertaken properly, with adequate drainage structures in place to forego potential erosion problems.

- In terms of on site ancillary buildings, it is recommended that the substation and workshop be planned so that clearing of vegetation is minimised. This implies consolidating this infrastructure as much as possible and making use of already disturbed areas rather than undisturbed sites wherever possible.

- No mitigation is possible for visual impacts associated with the on site monitoring and telecommunications masts.

- The Civil Aviation Authority (CAA) prescribes that aircraft warning lights be mounted on the turbines. However, it is possible to mount these lights on the turbines representing the outer perimeter of the facility. In this manner, fewer warning lights can be utilised to delineate the facility as one large obstruction, thereby lessening the potential visual impact.

- Mitigation of other lighting impacts includes the pro-active design, planning and specification lighting for the facility. The correct specification and placement of lighting and light fixtures for the proposed WEF and ancillary infrastructure will go far to contain rather than spread the light. Mitigation measures include the following:

    - Shielding the sources of light by physical barriers (walls, vegetation, or the structure itself);
    - Limiting mounting heights of lighting fixtures, or alternatively using foot-lights or bollard level lights;
    - Making use of minimum lumen or wattage in fixtures;
    - Making use of down-lighters, or shielded fixtures;

  - Making use of Low Pressure Sodium lighting or other types of low impact lighting.
  - Making use of motion detectors on security lighting. This will allow the site to remain in relative darkness, until lighting is required for security or maintenance purposes.

- Mitigation of visual impacts associated with the construction phase, albeit temporary, would entail proper planning, management and rehabilitation of the construction site. Recommended mitigation measures include the following:

  - Ensure that vegetation is not unnecessarily cleared or removed during the construction period.
  - Reduce the construction period through careful logistical planning and productive implementation of resources.
  - Plan the placement of lay-down areas and any potential temporary construction camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.
  - Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.
  - Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.
  - Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).
  - Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.
  - Rehabilitate all disturbed areas, construction areas, roads, slopes etc immediately after the completion of construction works. If necessary, an ecologist should be consulted to assist or give input into rehabilitation specifications.

- During operation, the maintenance of the turbines and ancillary structures and infrastructure will ensure that the facility does not degrade, thus aggravating visual impact.

- Roads must be maintained to forego erosion and to suppress dust, and rehabilitated areas must be monitored for rehabilitation failure. Remedial actions must be implemented as a when required.

- Once the facility has exhausted its life span, the main facility and all associated infrastructure not required for the post rehabilitation use of the site should be removed and all disturbed areas appropriately rehabilitated. An ecologist should be consulted to give input into rehabilitation specifications.

- All rehabilitated areas should be monitored for at least a year following decommissioning, and remedial actions implemented as and when required.

- Secondary impacts anticipated as a result of the proposed WEF (i.e. visual character and sense of place) are not possible to mitigate. There is also no mitigation to ameliorate the negative visual impacts on tourist routes, tourist destinations and conservation areas within the region.

Where sensitive visual receptors are likely to affected, it is recommended that the developer enter into negotiations regarding the potential screening of visual impacts at the receptor site. This may entail the planting of vegetation, trees or event the construction of screens. Ultimately, visual screening is most effective when placed at the receptor itself.

Good practice requires that the mitigation of both primary and secondary visual impacts as listed above be implemented and maintained on an ongoing basis.

6. PHOTO SIMULATIONS

Photo simulations were undertaken (in addition to the above spatial analyses) in order to illustrate the potential visual impact of the proposed Hidden Valley WEF within the receiving environment.

The purpose of the photo simulation exercise is to support the findings of the VIA, and is not an exercise to illustrate what the facility will look like from all directions.

The photo simulations indicate the anticipated visual alteration of the landscape from various sensitive visual receptors located at different distances from the facility. The simulations are based on the wind turbine dimensions and layout as indicated on **Map 1**.

The photograph positions are indicated on **Map ?** below and should be referenced with the photo simulation being viewed in order to place the observer in spatial context.

The simulated views show the placement of the wind turbines during the longer-term operational phase of the facility's lifespan. It is assumed that the necessary post-construction phase rehabilitation and mitigation measures, as proposed by the various specialists in the environmental impact assessment report, have been undertaken.

It is imperative that the natural vegetation be restored to its original (current) status for these simulated views to ultimately be realistic. These photographs can therefore be seen as an ideal operational scenario (from a visual impact point of view) that should be aspired to. The additional infrastructure (e.g. the proposed power lines, substation, access roads, etc.) associated with the facility is not included in the photo simulations.

Each photographic simulation is preceded by a panoramic overview of the landscape from the specified viewpoint being discussed. The panoramic overview allows for a more realistic viewer scale that would be representative of the distance over which the turbines are viewed. Where relevant, each panoramic overview indicates the section that was enlarged to show a more detailed view of the WEF.

The simulated wind turbines, as shown on the photographs, were adapted to the atmospheric conditions present when the original photographs were taken. This implies that factors such as haze and solar glare were also simulated in order to realistically represent the observer's potential view of the facility.

The following technical data are of relevance:

- The camera used to take the initial photographs is a standard Canon EOS 1000D with an 18-55mm lens. Photos intended for panoramas are taken with focal length at 55mm to minimize edge distortion and to facilitate the panoramic software's stitching process.

- Canon's stitching software (Photostitch v3.1.21) is used to create the panoramas. This software automatically compensates for slight variations in the focal length on each photo used in the panorama (i.e. the camera model, focal length, F-number, etc are embedded into each photo, so the software recognizes these parameters and adjusts the output image accordingly).

- The photo simulation process begins with the DTM, as this is effectively the "ground surface" of the virtual environment. The accuracy of the DTM in representing the Earth's surface is very much dependent on the quality of available contour data as this is what it is derived from. The raster DTM that is used to show shaded relief in a map is usually the same dataset that is used as the virtual ground surface.

- The DTM is visualised in 3D with an application called ArcScene. ArcScene works in much the same way as ArcMap except that the geometry and attributes of shapefiles cannot be edited, and of course, that is displayed in a Cartesian plane. Any existing shapefile can be added into the 3D environment and will automatically be displayed in its correct geographic position. Shapes that do not contain Z-values (height above mean sea level) can be assigned height values using the DTM. Point shapefiles, for example, will typically already have X/Y coordinates but can be placed at the virtual ground level, or at any height above ground level as specified in the attribute table. Lines and polygons work in the same way, thus enabling any vector shapefile to be "draped" onto the 3D terrain surface.

- 3D models from such applications as 3D StudioMax or Sketchup are compatible with the ArcScene environment and work by assigning a model to be rendered at points geographically specified by a point shapefile. Each model itself consists of many polygons, and depending on the number of models used, can impact severely on a computer's performance in displaying the virtual environment.

- For the purposes of placing wind turbines onto a virtual landscape, a layout of the exact turbine positions is required in the form of a point shapefile. This shapefile is added three times to the environment. The first instance is displayed as a point at ground level to indicate where the turbine tower meets the ground level. The second instance is extruded to half the height of the tower and displayed in a certain colour. The third instance is extruded from half to the full height of the tower and displayed in a different colour. Thus, from any virtual viewpoint on the landscape, it can be determined which turbines will be in full view and which will be partially obscured by undulations of the terrain. The terrain can also be made semi-transparent to check whether anything is completely obscured.

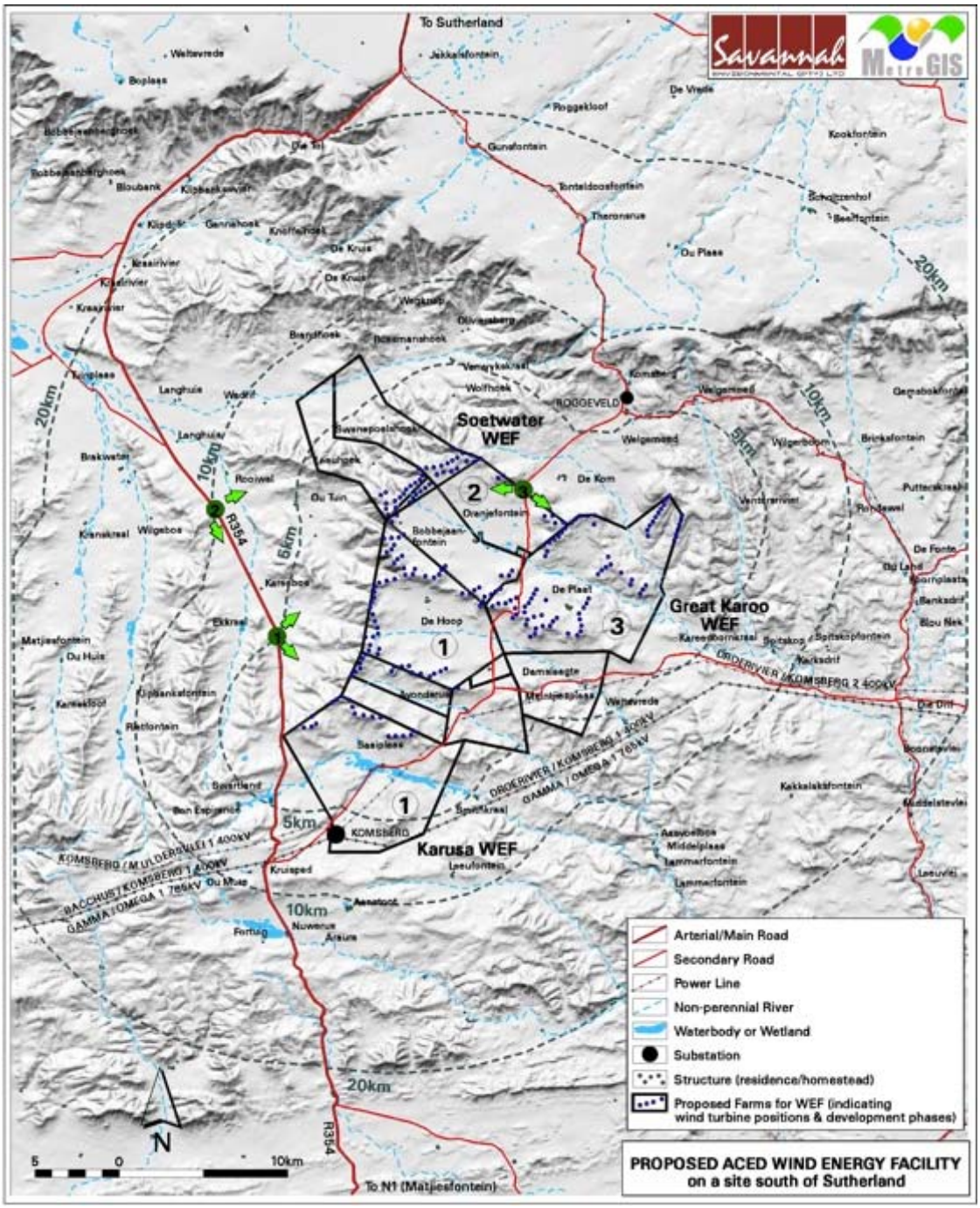
- Each photo viewpoint is then recreated within the virtual environment by setting the "camera" coordinates to those of the GPS coordinates logged when each photo was taken. Several other data may be added for landmark purposes, such as roads, rivers, power lines, or even trees if they can be accurately digitized. The virtual output is then rendered at a focal length matching that of the photos originally used to create the

panoramas (using a field-of-view calculator that also compensates for the digital equivalent of 35mm film cameras). Several virtual "snapshots" are taken in sequence in the same manner as for the panoramic photos as the virtual output suffers from the same edge distortion as a photo. These are then stitched in the same manner as the photographs.

- Both the panoramic photos and the virtual simulation output are now graphic formats that are loaded into Adobe Photoshop. Some enhancements of the panoramas may be necessary as weather conditions tend to adversely affect image quality. The horizon and landscape of the virtual viewpoint is then matched up to what can be seen in the panoramas and sample images of the wind turbines are then overlaid where the extruded points are visible. Scaling is maintained since the top and mid-point of the tower are usually visible, so the ground point can be established even though it may be obscured by the landscape. Some graphic editing is usually necessary to address such things intervening vegetation or power lines as well as sufficient blurring to mimic the effect of distance.

- The scene is then typically rendered twice as "before" and "after" views.

The photo simulations below indicate the pre-construction landscape with no wind turbines at all, followed by a simulation showing the proposed Hidden Valley WEF turbines (all three phases).



Map 13: Photograph positions for Photo Simulations.

6.1 View 1

Viewpoint 1 is located on the arterial R354 to the west of the proposed WEF. The point is located approximately 5km away from the closest turbine of the Karusa WEF. The viewing direction is easterly and is representative of a short distance view that residents of local homesteads and visitors to the area will experience while travelling this road between Sutherland and Matjiesfontein. Approximately **35** turbines are fully or partially visible in the landscape.

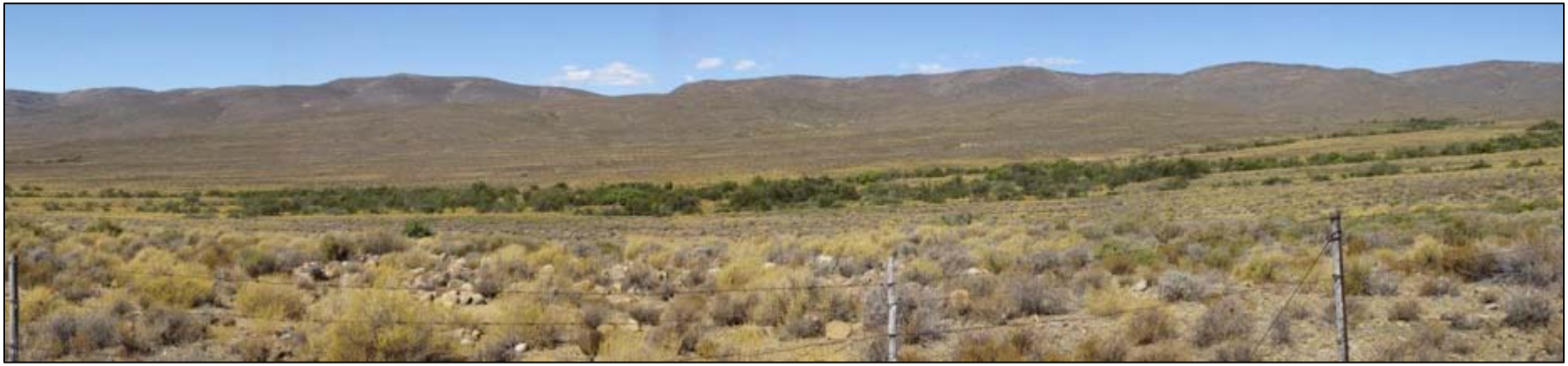


Figure 12a: Pre construction panoramic overview from Viewpoint 1.

Figure 12b: Post construction panoramic overview from Viewpoint 1 (indicating enlarged photo sections).

Figure 12c: Enlarged photo section 1a.

Figure 12d: Enlarged photo section 1b.

6.2 View 2

Viewpoint 2 is located on the arterial R354 to the west of the proposed WEF, a short distance north of viewpoint 2. The point is located approximately 10km away from the closest turbine of the Soetwater WEF. The viewing direction is south easterly and is representative of a medium distance view that residents of local homesteads and visitors to the area will experience while travelling this road between Sutherland and Matjiesfontein. Approximately **71** turbines are fully or partially visible in the landscape.

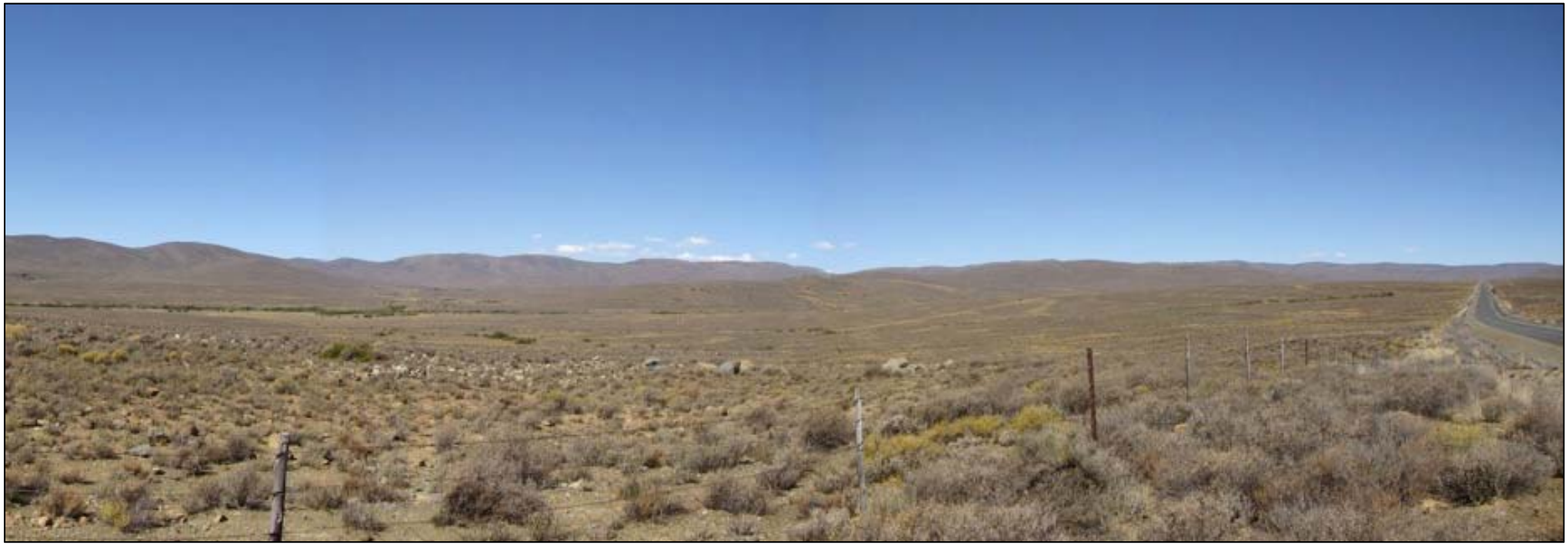


Figure 13a: Pre construction panoramic overview from Viewpoint 2.

Figure 13b: Post construction panoramic overview from Viewpoint 2 (indicating enlarged photo sections).

Figure 13c: Enlarged photo section 2a.

Figure 13d: Enlarged photo section 2b.

6.3 View 3

Viewpoint 3 is located on the secondary road which traveses the proposed Hidden Valley WEF, running from the R354 in the south west to the Roggeveld Substation to the north east of the site. The point is located on the boundary of the proposed Soewater WEF approximately less than 1km away from the closest turbine. The viewing direction is south westerly and is representative of a short distance view that residents of local homesteads and visitors to the area will experience while travelling along this secondary road. Approximately **95** turbines are fully or partially visible in the landscape.

Figure 14a: Pre construction panoramic overview from Viewpoint 3.

Figure 14b: Post construction panoramic overview from Viewpoint 3 (indicating enlarged photo sections).

7. CONCLUSION AND RECOMMENDATIONS

Conclusions and recommendations are made for the three separate phases of the Hidden Valley WEF as well as for the combined facility.

The proximity of the three phases to one another within a somewhat self contained valley means that the impacts generated are very similar for each phase. Further to this the impacts for the combined phases of the WEF are only slightly greater than those for the individual phases. The following table summarises the anticipated visual impacts on sensitive receptors for each phase and the combined facility.

Number of visually affected receptors		**Karusa WEF**	**Soetwater WEF**	**Great Karoo WEF**	**Combined Hidden Valley WEF**
High Visual Impact	Settlements affected	7	8	6	11
Moderate Visual Impact	Settlements affected	9	9	6	14
Low Visual Impact	Settlements affected	7	5	2	8

7.1 Karusa Wind Farm

The construction and operation of the proposed Karusa Wind Energy Facility and its associated infrastructure will have a visual impact on the visual environment especially within, but not limited to the area within 8km of the proposed facility. Beyond this visual impact is reduced by the screening effects of the rugged topography and the contained nature of the site. The exception to this is a corridor of visual intrusion up the Tankwa River valley, however there are very few visual receptors in this area.

The low density of visual receptors in the study area results in a low intensity of visual impact, however the significance of the impacts is moderate to high as a result of undeveloped character of the landscape.

The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The facility further has a generally unfamiliar novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants.

However, these positive aspects should not distract from the fact that the facility would be visible within an area that incorporates certain sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive. Such visual receptors include people travelling along roads, residents of rural homesteads and settlements and tourists passing through or holidaying in the region.

The study area has harsh, rugged character with vast expanses of natural and undeveloped landscape. Views are wide open and expansive, and unimpeded by

development. The character of the site will be altered by the presence of the WEF.

A number of mitigation measures have been proposed (section 5.9), which, if implemented and maintained, will reduce the significance of the certain visual impacts associated with the proposed Wind Energy Facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. The anticipated visual impacts of high significance (i.e. where high frequencies of visual exposure correspond with sensitive visual receptors) are quite limited in extent.

As such, the facility would be considered to be acceptable from a visual perspective.

7.2 Soetwater Wind Farm

The construction and operation of the proposed Soetwater Wind Energy Facility and its associated infrastructure will have a visual impact on the visual environment especially within, but not limited to the area within 10km of the proposed facility. Beyond this visual impact is reduced by the screening effects of the rugged topography and the contained nature of the site. The exception to this is a corridor of visual intrusion up the Tankwa River valley, however there are very few visual receptors in this area. Visual impact in this area is also greatly reduced by distance from the site

The low density of visual receptors results in a low intensity of visual impact, however the significance of the impacts is moderate to high as a result of undeveloped character of the landscape.

The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The facility further has a generally unfamiliar novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants.

However, these positive aspects should not distract from the fact that the facility would be visible within an area that incorporates certain sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive. Such visual receptors include people travelling along roads, residents of rural homesteads and settlements and tourists passing through or holidaying in the region.

The study area has harsh, rugged character with vast expanses of natural and undeveloped landscape. Views are wide open and expansive, and unimpeded by development. The character of the site will be altered by the presence of the WEF.

A number of mitigation measures have been proposed (section 5.9), which, if implemented and maintained, will reduce the significance of the certain visual impacts associated with the proposed Wind Energy Facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. The anticipated visual impacts of high significance (i.e. where high frequencies of visual exposure correspond with sensitive visual receptors) are quite limited in extent.

As such, the facility would be considered to be acceptable from a visual perspective.

7.1 Great Karoo Wind Farm

The construction and operation of the proposed Great Karoo Wind Energy Facility and its associated infrastructure will have a visual impact on the visual environment especially within, but not limited to the area within 10km of the proposed facility. Beyond this visual impact is reduced by the screening effects of the rugged topography and the contained nature of the site. Visual impact to the north and west is limited to an extent of 8-10km by the screening effect of the surrounding topography. To the south and east visual impacts are insignificant due to the absence of sensitive receptors in areas of visual influence.

The low density of visual receptors results in a low intensity of visual impact, however the significance of the impacts is moderate to high as a result of undeveloped character of the landscape.

The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The facility further has a generally unfamiliar novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants.

However, these positive aspects should not distract from the fact that the facility would be visible within an area that incorporates certain sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive. Such visual receptors include people travelling along roads, residents of rural homesteads and settlements and tourists passing through or holidaying in the region.

The study area has harsh, rugged character with vast expanses of natural and undeveloped landscape. Views are wide open and expansive, and unimpeded by development.

A number of mitigation measures have been proposed (section 5.9), which, if implemented and maintained, will reduce the significance of the certain visual impacts associated with the proposed Wind Energy Facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. The anticipated visual impacts of high significance (i.e. where high frequencies of visual exposure correspond with sensitive visual receptors) are quite limited in extent.

As such, the facility would be considered to be acceptable from a visual perspective.

7.4 Combined Hidden Valley Wind Energy Facility

The combined phases of the Hidden Valley WEF and its associated infrastructure will have a visual impact on the visual environment especially within, but not limited to the area within 10km of the proposed facility. Beyond this visual impact is reduced by the screening effects of the rugged topography and the contained nature of the site. The exception to this is a corridor of visual intrusion up the Tankwa River valley, however there are very few visual receptors in this area and the impact is mitigated by distance.

The combined visual impact of all three phases, while being greater than the impacts of individual components, is not significantly greater than that of any of the phases as a result of many the sensitive receptors being visible to multiple phases. This is a function of the contained nature of the site.

The intensity of visual impact (number of turbines visible) to exposed receptors located within the site, and those within a 5km radius, is however greater than it would be for a single phase.

The significance of the impacts is moderate to high as a result of undeveloped character of the landscape.

The facility utilises a renewable source of energy (considered as an international priority) to generate power and is therefore generally perceived in a more favourable light. It does not emit any harmful by-products or pollutants and is therefore not negatively associated with possible health risks to observers.

The facility further has a generally unfamiliar novel and futuristic design that invokes a curiosity factor not generally present with other conventional power generating plants.

However, these positive aspects should not distract from the fact that the facility would be visible within an area that incorporates certain sensitive visual receptors who would consider visual exposure to this type of infrastructure to be intrusive. Such visual receptors include people travelling along roads, residents of rural homesteads and settlements and tourists passing through or holidaying in the region.

The study area has harsh, rugged character with vast expanses of natural and undeveloped landscape. Views are wide open and expansive, and unimpeded by development. The character of the site will be altered by the WEF, however the alteration of character achieved by a single phase or all three phases is not significantly different.

A number of mitigation measures have been proposed (section 5.9), which, if implemented and maintained, will reduce the significance of the certain visual impacts associated with the proposed Wind Energy Facility.

If mitigation is undertaken as recommended, it is concluded that the significance of most of the anticipated visual impacts will remain at or be managed to acceptable levels. The anticipated visual impacts of high significance (i.e. where high frequencies of visual exposure correspond with sensitive visual receptors) are quite limited in extent and are not seen as being significantly greater than would occur if only a single phase was developed.

As such, the combined facility would be considered to be acceptable from a visual perspective.

8. IMPACT STATEMENT

The finding of the Visual Impact Assessment undertaken for the Proposed Hidden Valley Wind Energy Facility is that the visual environment surrounding the site, especially within an 8-10km radius, will be visually impacted upon for the anticipated operational lifespan of the facility (i.e. 20 - 30 years).

This impact is applicable to the individual phases of the proposed WEF and to the combined WEF, with only the intensity of impacts being greater for the combined facility. This is due to the individual phases being clustered together in a somewhat contained series of valleys.

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

- The potential visual impact of the facility on observers travelling along arterial and secondary roads in close proximity to the proposed facility (i.e. within 10km) will be of **high** significance.

- The anticipated visual impact on residents of settlements and homesteads within an 10km radius of the proposed facility will be of **moderate** to **high** significance.

- Within the greater region (i.e. beyond 10km from the proposed facility), the potential visual impact on sensitive visual receptors (i.e. users of roads and residents of settlements and homesteads) will be of **moderate** significance.

- In terms of ancillary infrastructure, the anticipated visual impact of the access roads and workshop will be of **low** significance.

- The anticipated visual impact resulting from the new overhead power lines and substations is likely to be of **moderate** significance both before and after mitigation.

- Anticipated visual impacts related to shadow flicker will be of **very low** significance.

- Anticipated visual impacts on observers in close proximity related to lighting will be of **low** significance, while the impact of lighting on the SALT will be **insignificant**.

- Anticipated visual impacts of construction on observers in close proximity will be of **low** significance.

- In terms of secondary visual impacts, the significance of the anticipated impact on the visual character and sense of place of the region will be of **moderate** to **high** significance, while the anticipated impact on tourist routes will be **moderate** to **low**.

The anticipated visual impacts listed above (i.e. post mitigation impacts) are mostly of moderate or low significance. Anticipated visual impacts on sensitive receptors in close proximity to the proposed facility remain high, but are, nonetheless not considered to be fatal flaws for the proposed Wind Energy Facility.

The main consideration in this regard is the overall contained extent of potential visual impact within the region, and the fact that limited sensitive receptors and tourist routes are likely to be affected.

In addition, the anticipated visual impacts of high significance (i.e. where high frequencies of visual exposure correspond with sensitive visual receptors) are quite limited in extent.

Considering all factors, it is recommended that the development of the facility as proposed be supported, subject to the implementation of the recommended mitigation measures (Chapter 5.9) and management programme (Chapter 9).

Where sensitive visual receptors are likely to be affected (i.e. residents of homesteads and settlements in close proximity), it is recommended that the developer enter into negotiations regarding the potential screening of visual impacts at the receptor site. This may entail the planting of vegetation, trees or event the construction of screens. Ultimately, visual screening is most effective when placed at the receptor itself.

9. MANAGEMENT PROGRAMME

The management programme tables aim to summarise the key findings of the visual impact report and to suggest possible management actions in order to mitigate the potential visual impacts.

Table 10: Management Programme – Planning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the planning of the Proposed Hidden Valley Wind Energy Facility.		
Project Component/s	The WEF and ancillary infrastructure (i.e. turbines, access roads, substation, workshop, masts and power lines).	
Potential Impact	Primary visual impact of the facility due to the presence of the turbines and associated infrastructure as well as the visual impact of lighting at night.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site (i.e. within 10 km of the site) as well as within the region.	
Mitigation: Target/Objective	Optimal planning of infrastructure to minimise visual impact.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Retain and maintain natural and / or cultivated vegetation in all areas outside of the development footprint.	ACED RENEWABLES/ design consultant	Early in the planning phase.
Make use of existing roads wherever possible and plan the layout and construction of roads and infrastructure with due cognisance of the topography to limit cut and fill requirements.	ACED RENEWABLES/ design consultant	Early in the planning phase.
Plan all roads, ancillary building and ancillary infrastructure in such a way that clearing of vegetation is minimised. Consolidate infrastructure and make use of already disturbed sites rather than undisturbed areas.	ACED RENEWABLES/ design consultant	Early in the planning phase.
Consult a lighting engineer in the design and planning of lighting to ensure the correct specification and placement of lighting and light fixtures for the WEF and the ancillary infrastructure. The following is recommended: o Limit aircraft warning lights for the proposed Hidden Valley WEF to the turbines on the perimeter, thereby reducing the overall requirement. o Shield the sources of light by physical barriers (walls, vegetation, or the structure itself); o Limit mounting heights of fixtures, or use foot-lights or bollard lights; o Make use of minimum lumen or wattage in fixtures; o Making use of down-lighters or shielded fixtures; o Make use of Low Pressure Sodium lighting or other low impact lighting. o Make use of motion detectors on security lighting, so allowing the site to remain in darkness until lighting is required for security or maintenance purposes.	ACED RENEWABLES/ design consultant	Early in the planning phase.
Performance Indicator	Minimal exposure of ancillary infrastructure and lighting at night to observers on or near the site (i.e. within 10 km) and within the region.	
Monitoring	Not applicable.	

Table 11: Management programme – Construction.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the construction of the Proposed Hidden Valley Wind Energy Facility.		
Project Component/s	Construction site	
Potential Impact	Visual impact of general construction activities, and the potential scarring of the landscape due to vegetation clearing and resulting erosion.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Minimal visual intrusion by construction activities and intact vegetation cover outside of immediate works areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Ensure that vegetation is not unnecessarily cleared or removed during the construction period.	ACED RENEWABLES/ contractor	Early in the construction phase.
Reduce the construction period through careful logistical planning and productive implementation of resources.	ACED RENEWABLES/ contractor	Early in the construction phase.
Plan the placement of lay-down areas and temporary construction equipment camps in order to minimise vegetation clearing (i.e. in already disturbed areas) wherever possible.	ACED RENEWABLES/ contractor	Early in and throughout the construction phase.
Restrict the activities and movement of construction workers and vehicles to the immediate construction site and existing access roads.	ACED RENEWABLES/ contractor	Throughout the construction phase.
Ensure that rubble, litter, and disused construction materials are appropriately stored (if not removed daily) and then disposed regularly at licensed waste facilities.	ACED RENEWABLES/ contractor	Throughout the construction phase.
Reduce and control construction dust through the use of approved dust suppression techniques as and when required (i.e. whenever dust becomes apparent).	ACED RENEWABLES/ contractor	Throughout the construction phase.
Restrict construction activities to daylight hours in order to negate or reduce the visual impacts associated with lighting.	ACED RENEWABLES/ contractor	Throughout the construction phase.
Rehabilitate all disturbed areas, construction areas, servitudes etc immediately after the completion of construction works. If necessary, an ecologist should be consulted to assist or give input into rehabilitation specifications.	ACED RENEWABLES/ contractor	Throughout and at the end of the construction phase.
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact (i.e. full cover as per natural vegetation within the environment) with no evidence of degradation or erosion.	
Monitoring	Monitoring of vegetation clearing during construction (by contractor as part of construction contract). Monitoring of rehabilitated areas quarterly for at least a year following the end of construction (by contractor as part of construction contract).	

Table 12: Management programme – Operation.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the operation of the Proposed Hidden Valley Wind Energy Facility.		
Project Component/s	The WEF and ancillary infrastructure (i.e. turbines, access roads, substation, workshop, masts and power lines).	
Potential Impact	Visual impact of facility degradation and vegetation rehabilitation failure.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Well maintained and neat facility.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Maintain the general appearance of the facility as a whole, including the turbines, servitudes and the ancillary buildings.	ACED RENEWABLES/ operator	Throughout the operational phase.
Maintain roads and servitudes to forego erosion and to suppress dust.	ACED RENEWABLES/ operator	Throughout the operational phase.
Monitor rehabilitated areas, and implement remedial action as and when required.	ACED RENEWABLES/ operator	Throughout the operational phase.
Performance Indicator	Well maintained and neat facility with intact vegetation on and in the vicinity of the facility.	
Monitoring	Monitoring of the entire site on an ongoing basis (by operator).	

Table 13: Management programme – Decommissioning.

OBJECTIVE: The mitigation and possible negation of visual impacts associated with the decommissioning of the Proposed Hidden Valley Wind Energy Facility.		
Project Component/s	The WEF and ancillary infrastructure (i.e. turbines, access roads, substation, workshop, masts and power lines).	
Potential Impact	Visual impact of residual visual scarring and vegetation rehabilitation failure.	
Activity/Risk Source	The viewing of the above mentioned by observers on or near the site.	
Mitigation: Target/Objective	Only the infrastructure required for post decommissioning use of the site retained and rehabilitated vegetation in all disturbed areas.	
Mitigation: Action/control	**Responsibility**	**Timeframe**
Remove infrastructure not required for the post-decommissioning use of the site. This may include the turbines, substation, power lines, ancillary buildings, masts etc.	ACED RENEWABLES/ operator	During the decommissioning phase.
Rehabilitate access roads and servitudes not required for the post-decommissioning use of the site. If necessary, an ecologist should be consulted to give input into rehabilitation specifications.	ACED RENEWABLES/ operator	During the decommissioning phase.
Monitor rehabilitated areas quarterly for at least a year following decommissioning, and implement remedial action as and when required.	ACED RENEWABLES/ operator	Post decommissioning.
Performance Indicator	Vegetation cover on and in the vicinity of the site is intact (i.e. full cover as per natural vegetation within the environment) with no evidence of degradation or erosion.	
Monitoring	Monitoring of rehabilitated areas quarterly for at least a year following decommissioning.	

10. REFERENCES / DATA SOURCES

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