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Enviro INSIGHT
environmental impact assessments

Appendix D7:
Visual Impact Assessment

ENVIRONMENTAL & ENGINEERING

REPORT

ENVIRO-INSIGHT (PTY) LTD

VISUAL AND SHADOW FLICKER IMPACT ASSESSMENT

REPORT REF: 22-1731

PROPOSED DE RUST SOUTH WIND ENERGY FACILITY – NORTHERN CAPE PROVINCE

17 May 2023

VERSION - Final

Updated- 17/5/2023

Document and Quality Control:

Document No:	22-1731 (Proposed De Rust South Wind Energy Facility)			
AA – draft	13/04/2023	Nakéla Naidoo		First draft for review / comments
AA – draft	13/04/2023	Neel Breitenbach		Technical Review
CC– draft				Quality review
DD– draft				Client review
EE - draft				Final Review
Approved for Distribution:				
0.0	17/05/2023	Neel Breitenbach		Final report

Quality Control by:

Nature of Signoff:	Responsible Person:	Role / Responsibility	Qualification
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EXECUTIVE SUMMARY

FE De Rust proposes the development of a Wind Energy Facility and associated infrastructure (hereafter De Rust South WEF) located approximately 18 kilometres south of Pofadder in the Northern Cape province of South Africa. within the Khâi-Ma Local Municipality which forms part of the Namakwa District Municipality, in the Northern Cape Province of South Africa.

The proposed project will have a generation capacity of up to 240 Megawatts which will feed into the National Grid. The WEF will consist of up to 32 wind turbines, with a generation capacity of up to 7.5 MW per turbine, depending on the available technology at the time. Each turbine will have a hub height of up to 150 meters and a rotor diameter of up to 175 m. The final turbine model to be utilised will only be determined closer to the time of construction, depending on the technology available at the time. Additional ancillary infrastructure to the WEF would include underground and above-ground cabling between project components, onsite substation/s, Battery Energy Storage Systems, foundations to support turbine towers, internal/ access roads (up to 10 m in width during the construction phase) linking the wind turbines and other infrastructure on the site, and permanent workshop area and office for control, maintenance and storage. As far as possible, existing roads will be utilised and upgraded (where needed) with the relevant stormwater infrastructure and gates constructed as required. The perimeter of the proposed WEF may be enclosed with suitable fencing. A formal laydown area for the construction period, containing a temporary maintenance and storage building along with a guard cabin will also be established.

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) and the Environmental Impact Assessment (EIA) Regulations (2014, as amended), promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017, a full Scoping and EIA (S&EIA) Process is required for the construction of the proposed project. Enviro-Insight CC have been appointed to undertake the S&EIA process for the WEF, on behalf of the applicant. Furthermore, the proposed project may have adverse effects on the visual characteristics of the surrounding environment therefore, Enviro-Insight have appointed Eco Elementum (Pty) Ltd to undertake a Visual and Shadow Flicker Impact Assessment for the proposed project.

The scope of work for this Visual and Flicker Impact Assessment included the following:

1. Describing the existing visual characteristics of the proposed site and its environment;
2. A viewshed and viewing distance determination using Geographic Information System analysis up to 15 Kilometres (km) from the proposed structures;
3. A visual exposure analysis;
4. A shadow flicker analysis;
5. Identifying and rating of potential visual and shadow flicker impacts; and
6. Recommending mitigation measures for the identified visual and shadow flicker impacts.

Summary of Findings

The above assessment analysed the potential visual impacts and shadow flicker impacts that the proposed WEF may have on the surrounding identified receptors. From a visual perspective, the results indicates that the proposed WEF and associated infrastructure will create a moderate negative visual impact on the surrounding areas during each phase of the activity. These moderate impacts can be reduced to a low visual impact after the recommended mitigation measures are implemented for the construction and decommissioning phases. However, the overall visual impact will remain as a moderate negative impact during the operational phase of the project, following mitigation.

The construction phase of the proposed project is expected to be visible from the surrounding areas however, the time of exposure to these activities will be short. Therefore, the impacts on the sensitive receptors are expected to be lower after the mitigation measures have been implemented. For the operational phase, the visual impact of the WEF and construction vehicles can be reduced after the recommended mitigation measures are implemented however, the visual impact will remain as moderate. This is mostly due to the time of exposure to these activities being long-term and to the extreme height of the proposed wind turbines. During the closure phase of the project, all moderate visual impacts can be lowered to a low negative impact.

From a cumulative visual impact perspective, moderate levels of cumulative visual impacts are expected during the operational phase of the project. The level of visual impact can be reduced after the implementation of the recommended mitigation measures however, the impact will remain as a moderate negative impact due to the extreme height of the wind turbines, the inability of the landscape to completely screen the wind turbines, the proximity of the surrounding renewable energy facilities, the long-term nature of the projects and the alteration in the areas sense of place.

Cumulatively, the proposed WEF and surrounding renewable energy developments are expected to cause cumulative visual impacts and alter the study areas current sense of place and visual character. However, it is anticipated that the identified cumulative visual impacts can be lowered to acceptable levels provided that the recommended mitigation measures mentioned in this report and within the surrounding project's VIA's be adhered to.

Furthermore, the shadow flicker analysis results indicated that no shadow flicker impacts from the proposed WEF are expected on the identified receptors. It was noted that motorists travelling on the road network may experience momentary shadow flicker impacts. However, as there are no areas of tourism or protected areas present within the study area, the volume of traffic on the road network is expected to be low therefore, the level of shadow flicker impacts is expected to be minor/insignificant. Cumulative shadow flicker impacts from the surrounding approved WEF's and the proposed WEF are also not expected.

Mitigation measures for the proposed WEF have also been recommended and should be adhered to in order to lessen the identified visual and shadow flicker impacts.

Overall, the proposed WEF is expected to alter the study areas current sense of place. However, considering the municipality's objectives and the surrounding approved wind and solar projects, an alteration to the area's current sense of place is expected. Therefore, the proposed WEF is expected to blend in with the areas future sense of place, which is expected to include additional renewable energy projects.

Considering the above analysis, including the results of the viewshed and visual exposure analysis, shadow flicker analysis, impact assessments, future land use trends and low density of identified sensitive receptors, the proposed De Rust South WEF project can proceed from a visual and shadow flicker perspective provided that the recommended mitigation measures are adhered to.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DEFINITION OF TERMS

Assessment	A systematic, independent and documented review of operations and practises to ensure that relevant requirements are met.
Construction	The time period that corresponds to any event, process, or activity that occurs during the Construction phase (e.g., building of site, buildings, and processing units) of the proposed project. This phase terminates when the project goes into full operation or use.
Critical viewpoints	Important points from where viewers will be able to view the proposed or actual development and from where the development may be significant.
Cumulative Impacts	The summation of the effects that result from changes caused by a development in conjunction with the other past, present or reasonably foreseen actions (The landscape Institute, Institute of Environmental Management & Assessment. 2002).
Decommissioning	To remove or retire (a mine, etc.) from active service.
Environmental Component	An attribute or constituent of the environment (i.e., air quality; marine water; waste management; geology, seismicity, soil, and groundwater; marine ecology; terrestrial ecology, noise, traffic, socio-economic) that may be impacted by the proposed project.
Environmental Impact	A positive or negative condition that occurs to an environmental component as a result of the activity of a project or facility. This impact can be directly or indirectly caused by the project's different phases (i.e., Construction, Operation, and Decommissioning).
Field of view	The field of view is the angular extent of the observable world that is seen at any given moment. Humans have an almost 180º forward-facing field of view. Note that human stereoscopic (binocular) vision only covers 140º of the field of view in humans; the remaining peripheral 40º have no binocular vision due to the lack of overlap of the images of the eyes. The lower the focal length of a lens, the wider the field of view.
Landscape Integrity	Landscape integrity are visual qualities, which enhance the visual and aesthetic experience of the area.
Mitigation	In the context of Visual Impact Assessments - Any action taken or not taken in order to avoid, minimise, rectify, reduce, eliminate, or compensate for actual or potential adverse visual impacts.
Operation	The time period that corresponds to any event, process, or activity that occurs during the Operation (i.e., fully functioning) phase of the proposed project or development. (The Operation phase follows the Construction phase, and then terminates when the project or development goes into the Decommissioning phase).
Scenic value	Degree of visual quality resulting from the level of variety, harmony and contrast among the basic visual elements.
Sense of place	The character of a place, whether natural, rural or urban, it is allocated to a place or area through cognitive experience by the user.

Shadow Flicker	The flickering effect caused when rotating wind turbine blades periodically cast shadows through constrained openings such as the windows of neighbouring properties
Shadow Receptor	Households or other occupied structures which may receive shadow flicker impacts
Solar Disk	The circular visible surface of the sun.
Viewshed	The theoretical area within which an observer is likely to see a specific structure or area in the landscape. It is generated from a digital terrain model (DTM) made up of 3D contour lines of the landform. Intervening objects, structures or vegetation will modify the view shed at ground level.
Visual Absorption Capacity	The ability of elements of the landscape to "absorb" or mitigate the visibility of an element in the landscape. Visual absorption capacity is based on factors such as vegetation height (the greater the height of vegetation, the higher the absorption capacity), structures (the larger and higher the intervening structures, the higher the absorption capacity) and topographical variation (rolling topography presents opportunities to hide an element in the landscape and therefore increases the absorption capacity).
Visual character	The overall impression of a landscape created by the order of the patterns composing it; the visual elements of these patterns are the form, line, colour and texture of the landscape's components. Their interrelationships are described in terms of dominance, scale, diversity and continuity. This characteristic is also associated with land use.
Visual Exposure	Visual exposure is based on distance from the project to selected viewpoints. Visual exposure or visual impact tends to diminish exponentially with distance. 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 mine activities and associated infrastructure were not visible, no visual impact would occur. Visual exposure is determined by the Viewshed or the view catchment being the area within which the proposed development will be visible.
Visual sensitivity	Visual sensitivity can be determined by several factors in combination, such as prominent topographic or other scenic features, including high points, steep slopes and axial vistas.

ACRONYMS AND ABBREVIATIONS

DTM	Digital Terrain Model
DSM	Digital Surface Model
Enviro-Insight	Enviro Insight (Pty) Ltd
FE De Rust	FE De Rust (Pty) Ltd
GIIP	Good International Industry Practice
GIS	Geographic Information System
IDP	Integrated Development Plan
Km	Kilometre
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
I&AP's	Interested and Affected Parties
Mamsl	Meters Above Mean Sea Level
MRA	Mining Right Area
VAC	Visual Absorption Capacity
VIA	Visual Impact Assessment
WEF	Wind Energy Facility
WTG	Wind Turbine Generator
ZVI	Zone of Visual Influence

PROJECT INFORMATION

Table 1-1: Applicant Details

Name of Applicant:	FE De Rust (Pty) Ltd
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Table 1-3: Specialist Details

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Website:	www.ecoe.co.za

SPECIALIST DECLARATION OF INDEPENDENCE

In support of an application in terms of the National Environmental Management Act 107 of 1998 (GNR983, GNR984 and GNR985, GG38282 of 4 December 2014 ("Listed Activities") that will require an environmental authorisation if triggered. As amended by GNR 327, GNR 325 and GNR 324.

I, **Nakéla Naidoo** as specialist, has been appointed in terms of regulation 12(1) or 12(2), and can confirm that I shall —

a. Be independent;
b. have expertise in undertaking specialist work as required, including knowledge of the Act, these Regulations and any guidelines that have relevance to the proposed activity;
c. ensure compliance with these Regulations;
d. perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application'
e. take into account, to the extent possible, the matters referred to in regulation 18 when preparing the application and any report, plan or document relating to the application;
f. disclose to the proponent or applicant, registered interested and affected parties to the proponent or applicant, registered interested and affected parties and the competent authority all material information in the possession of the EAP and, where applicable, the specialist, that reasonably has or may have the potential of influencing –
g. any decision to be taken with respect to the application by the competent authority in terms of these Regulations; or
h. the objectivity of any report, plan or document to be prepared by the EAP or specialist, in terms of these Regulations for submission to the competent authority; and
i. Unless access to that information is protected by law, in which case it must be indicated that such protected information exists and is only provided to the competent authority.

Nakéla Naidoo
Candidate Natural Scientist
Registration Number: 120896

Name and Surname	Signature
17/05/2023	**Sunninghill**
Date	Signed at

Note: Refer to Appendix A for the CV'S of the specialists involved in preparing this report.

1. INTRODUCTION

FE De Rust (the applicant) proposes the development of a Wind Energy Facility (WEF) and associated infrastructure (hereafter De Rust South WEF) located approximately 18 kilometres (km) south of Pofadder in the Northern Cape province of South Africa. within the Khâi-Ma Local Municipality (KLM) which forms part of the Namakwa District Municipality (NDM), in the Northern Cape Province of South Africa (SA) (refer to Figure 1.1 overleaf).

The proposed project will have a generation capacity of up to 240 Megawatts (MW) which will feed into the National Grid. The WEF will consist of up to 32 wind turbines, with a generation capacity of up to 7.5 MW per turbine, depending on the available technology at the time. Each turbine will have a hub height of up to 150 meters (m) and a rotor diameter of up to 175 m. The final turbine model to be utilised will only be determined closer to the time of construction, depending on the technology available at the time. Additional ancillary infrastructure to the WEF would include underground and above-ground cabling between project components, onsite substation/s, Battery Energy Storage Systems (BESS), foundations to support turbine towers, internal/ access roads (up to 10 m in width during the construction phase) linking the wind turbines and other infrastructure on the site, and permanent workshop area and office for control, maintenance and storage. As far as possible, existing roads will be utilised and upgraded (where needed) with the relevant stormwater infrastructure and gates constructed as required. The perimeter of the proposed WEF may be enclosed with suitable fencing. A formal laydown area for the construction period, containing a temporary maintenance and storage building along with a guard cabin will also be established.

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) and the Environmental Impact Assessment (EIA) Regulations (2014, as amended), promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017, a full Scoping and EIA (S&EIA) Process is required for the construction of the proposed project. Enviro-Insight CC (Enviro-Insight) have been appointed to undertake the S&EIA process for the WEF, on behalf of the applicant. Furthermore, the proposed project may have adverse effects on the visual characteristics of the surrounding environment therefore, Enviro-Insight have appointed Eco Elementum (Pty) Ltd (EcoE) to undertake a Visual and Shadow Flicker Impact Assessment for the proposed project.

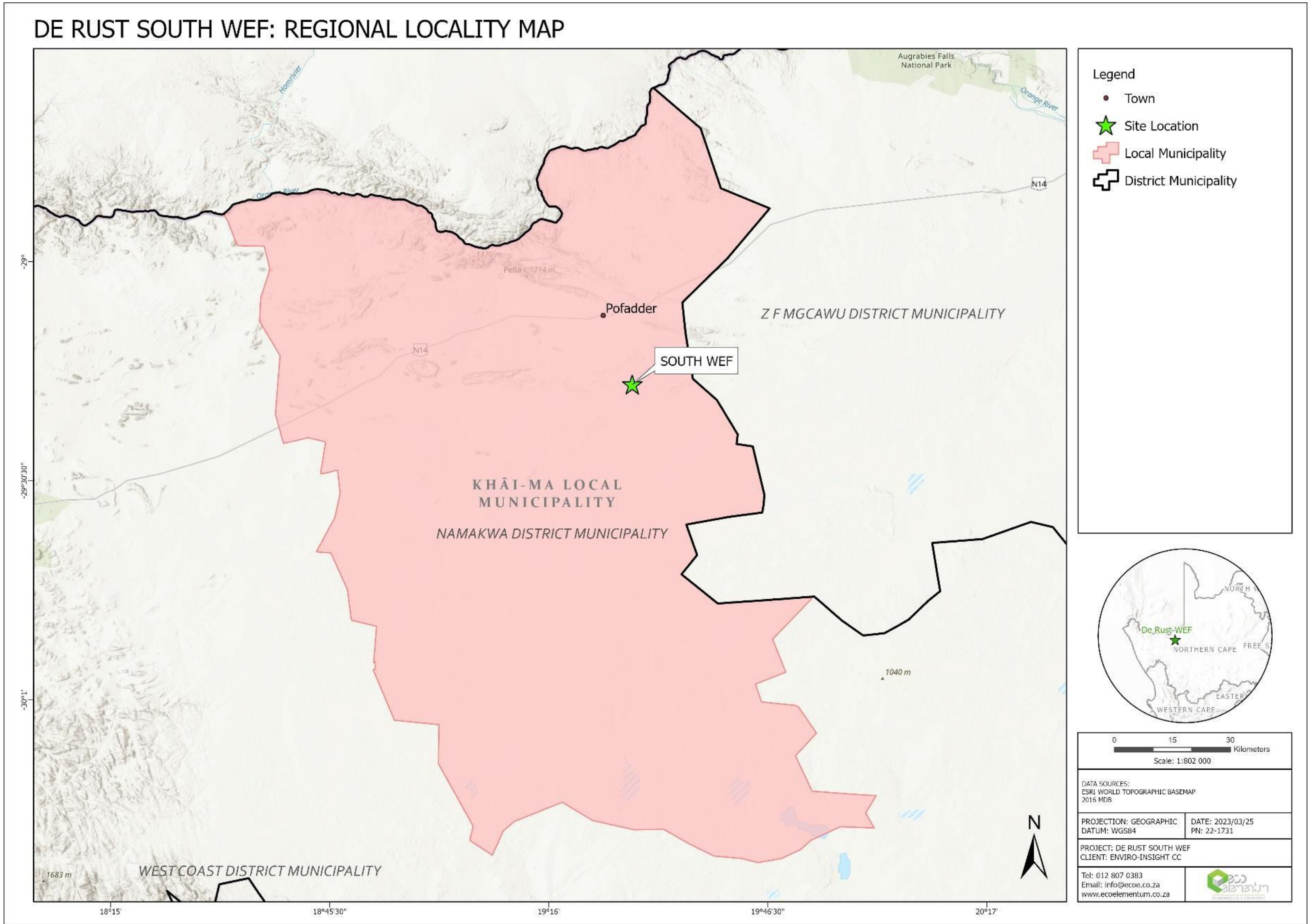

Figure 1.1: Regional Locality Map

2. SCOPE OF WORK

The scope of work for this Visual and Shadow Flicker Analysis will include the following:

1. Describing the existing visual characteristics of the proposed site and its environment;
2. Viewshed and viewing distance determination using Geographic Information System (GIS) analysis up to 15 Kilometres (km) from the proposed structures.
3. Visual Exposure Analysis comprising the following aspects:

Terrain Slope;

- Slope angle is determined from the Digital Surface Model (DSM) and the location of the proposed structures given a ranking depending on the steepness of the slope.

Aspect of structure location;

- Aspect of the slope where the structures are to be built, are calculated from the DSM and given a ranking determined by the sun angle.

Landforms;

- Landform of the location of the proposed structures are determined from the DSM and ranked according to the type of landform. Structures built on certain landforms, e.g. ridges, will be more visible than structures built in valleys.

Slope Position of structure;

- Using GIS analysis, the position of the proposed structure is determined and ranked according to the position on the slope the structure is to be built.

Relative elevation of structure;

- Using the DSM, the elevation of the proposed structures relative to the surrounding elevation is determined and ranked according to the difference in height of the surrounding areas.

Terrain Ruggedness;

- The terrain ruggedness is determined from the DSM and given a ranking based on the homogeneousness of the terrain.

Viewer Sensitivity;

- The viewer sensitivity ranking of the surrounding areas is determined using various land cover and land use datasets and ranked according to the sensitivity of the related structures to the environment.

Overall Visual Impact;

- Combing all the above datasets, a final visual impact of the proposed structures is calculated.

4. Shadow Flicker Analysis using a shadow flicker calculation tool in WindPro 3.5 for up to approximately 2 km from the proposed structures.
   - The shadow flicker analysis will calculate the potential maximum shadow (worst-case) impact on the surrounding area.
   - Graphical calendars will be produced, showing when (hours, days and months) and from which structures shadow flickering may occur.
5. Impact Identification and Ratings
6. Mitigation of Identified Visual and Shadow Flicker Impacts

3. PROJECT DESCRIPTION

The proposed De Rust South WEF will consist of up to 32 wind turbines. The proposed WEF will have a generation capacity of up to 7.5 MW per turbine, depending on the available technology at the time. Each turbine will have a hub height of up to 150 m and a rotor diameter of up to 175 m. The final turbine model to be utilised will only be determined closer to the time of construction, depending on the technology available at the time. The optimal positioning (taking into account the energy generating potential) for each turbine will be determined once all the environmental sensitivities have been determined in the EIA phase. The final layout design and development footprint will be included in the EIA report.

The components of the WEF and associated infrastructure are as follows:

- Up to 32 wind turbines, with a generation capacity of up to 7.5 MW per turbine (depending on the available technology at the time),
- Turbines will have a hub height of up to 150m and a rotor diameter of up to 175m. The final turbine model to be utilised will only be determined closer to the time of construction (depending on the technology available at the time),
- Onsite substation/s of 100mX100m (33/132kV) to facilitate the connection between the WEF and Korana substation,
- A BESS,
- Concrete foundations to support turbine towers,
- Cabling between turbines, to be laid underground where practical,
- Internal/ access roads (up to 10 m in width during the construction phase) linking the wind turbines and other infrastructure on the site,
- Permanent workshop area and office for control, maintenance and storage, and
- Temporary laydown areas during the construction phase (which will be rehabilitated).

Table 3-1 below shows the heights of the proposed infrastructure used in the visual analysis.

Table 3-1: Heights of the modelled infrastructure

Proposed Infrastructure	Assumed Height (m)
BESS	3
Onsite Substation	10
Workshop and Office	3
Proposed Infrastructure	**Known Height (m)**
Wind Turbines	237.5

Figure 3.1 and Figure 3.2 respectively shows the basic structure and locations of the proposed wind turbines.

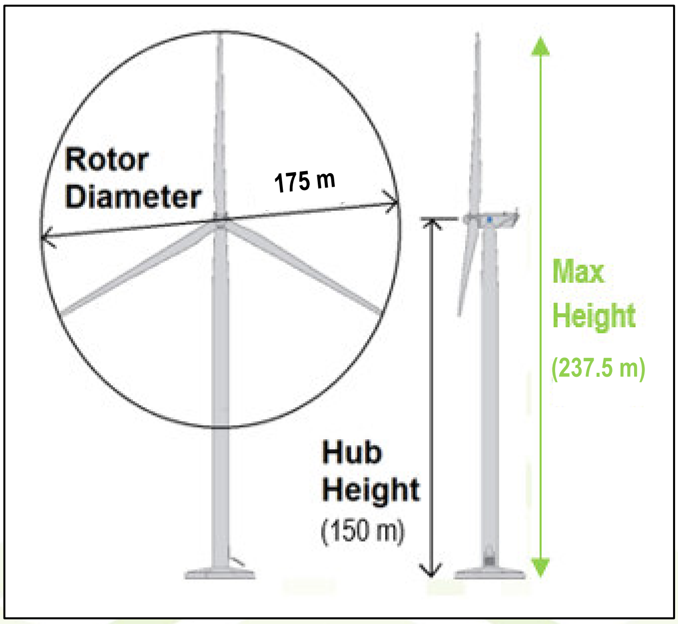

Figure 3.1: Proposed Height of the Wind Turbines

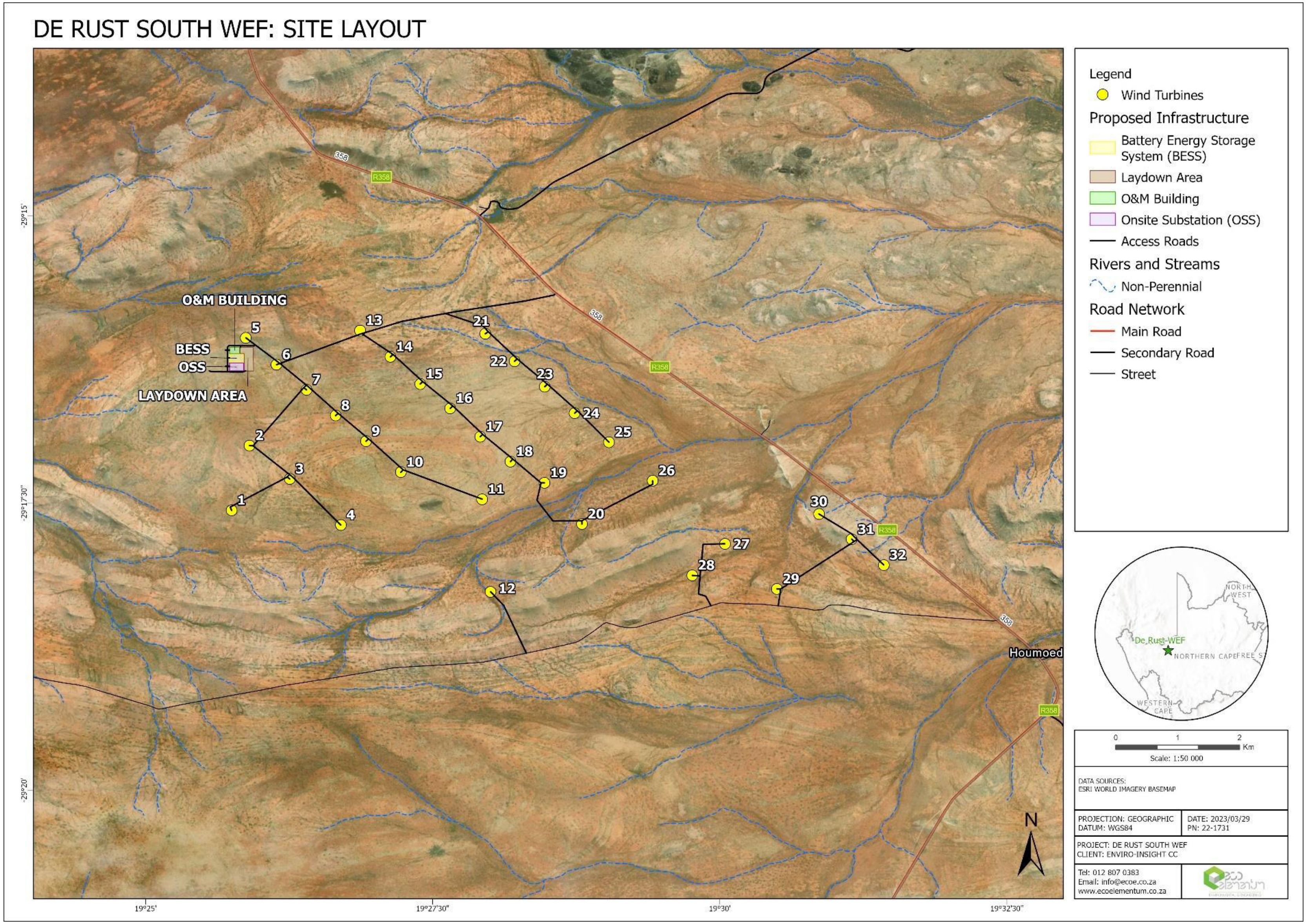

Figure 3.2: Site Layout

4. DESCRIPTION OF THE AFFECTED AREA AND ENVIRONMENT

This section describes the status of the receiving environment and will serve as a baseline for the assessment of the proposed infrastructure. Various data sources are referenced in the desktop analysis of the receiving environment. Findings from the site visit, held on the 10th of March 2023, will be used where possible to verify the desktop findings.

4.1 TOPOGRAPHY

The general topography of the study area can be described as a relatively flat terrain with ridges and koppies occurring within 15 km of the study area. Overall, the surface elevation varies between 921 meters above mean sea level (mamsl) and 1 158 mamsl within 15 km of the proposed project area. Figure 4.1 indicates the topography of the proposed site. Figure 4.2 thereafter indicates the study areas topography using images captured from the site visit.

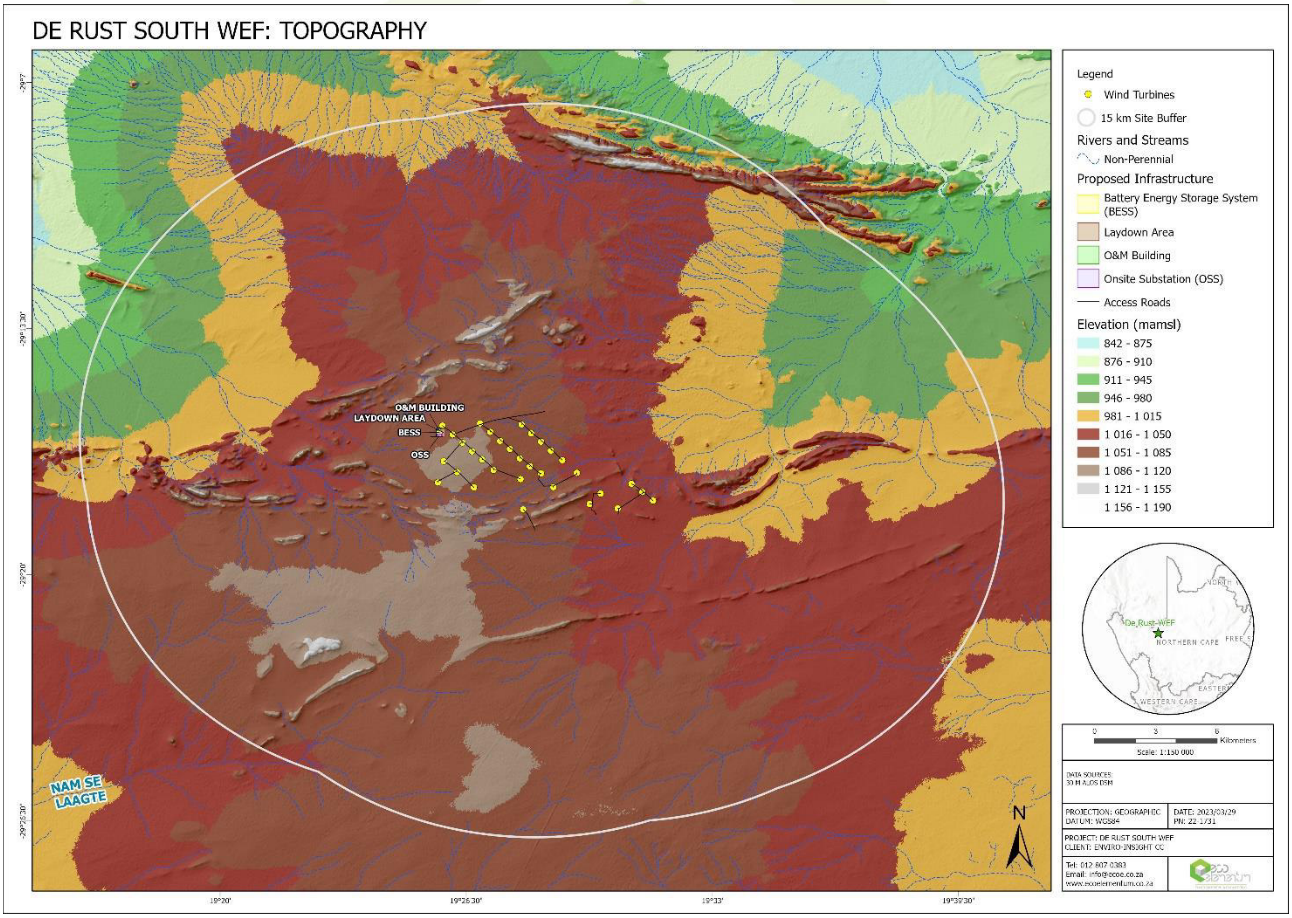

Figure 4.1: Topography

Figure 4.2: Surrounding Topography

4.2 VEGETATION

Figure 4.3 below shows the 2018 national vegetation of the study area. The figure indicates that the proposed wind turbines and associated infrastructure are located within the Aggeneys Gravel Vryheid, Bushmanland Arid Grassland and the Bushmanland Inselberg Shrubland vegetation types. The majority of the surrounding area is covered by the Bushmanland Arid Grassland vegetation type, with the Bushmanland Inselberg Shrubland vegetation type covering the identified small hills and koppies.

The Bushmanland Arid Grassland vegetation and landscape features can be described as extensive to irregular plains on slightly sloping plateaus, sparsely vegetated by grasslands (Mucina et al., 2006). The Bushmanland Inselberg Shrubland is a group of prominent solitary mountains (inselbergs) and smaller koppies towering over surrounding flat plains in northern Bushmanland in the Aggeneys and Pofadder regions (Mucina et al., 2006). Mucina et al. (2006) further describes the Aggeneys Gravel Vygieveld vegetation type as plains at foothills or on peneplains of inselbergs in northern Bushmanland scattered between Pofadder and Aggeneys and further westwards to the edges of the Namaqualand granite hill ridges.

Figure 4.4 overleaf indicates the study areas vegetation from the site visit.

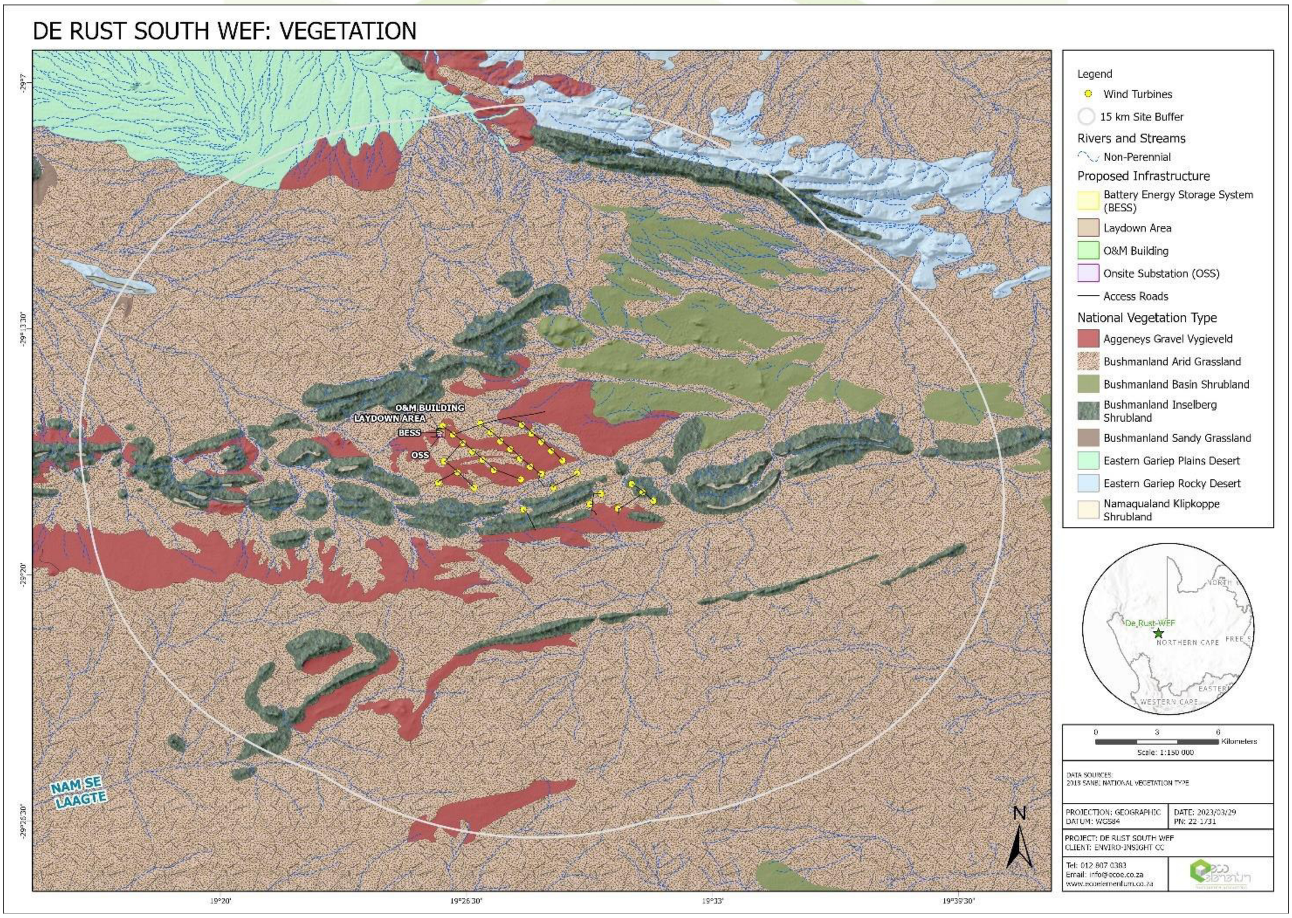

Figure 4.3: Vegetation

Figure 4.4: Surrounding Vegetation

4.3 LANDCOVER

Figure 4.5 below shows the surrounding landcover of the study area. The landcover type within 15 km of the proposed project is dominated by low shrubland and other bare areas. Mining areas are also present along the R358 however, from the site visit it was noted that these areas are old borrow pits remaining from the road construction (refer to Figure 4.6 overleaf). Scattered and dense villages are also present within the study area (refer to Figure 4.7 overleaf).

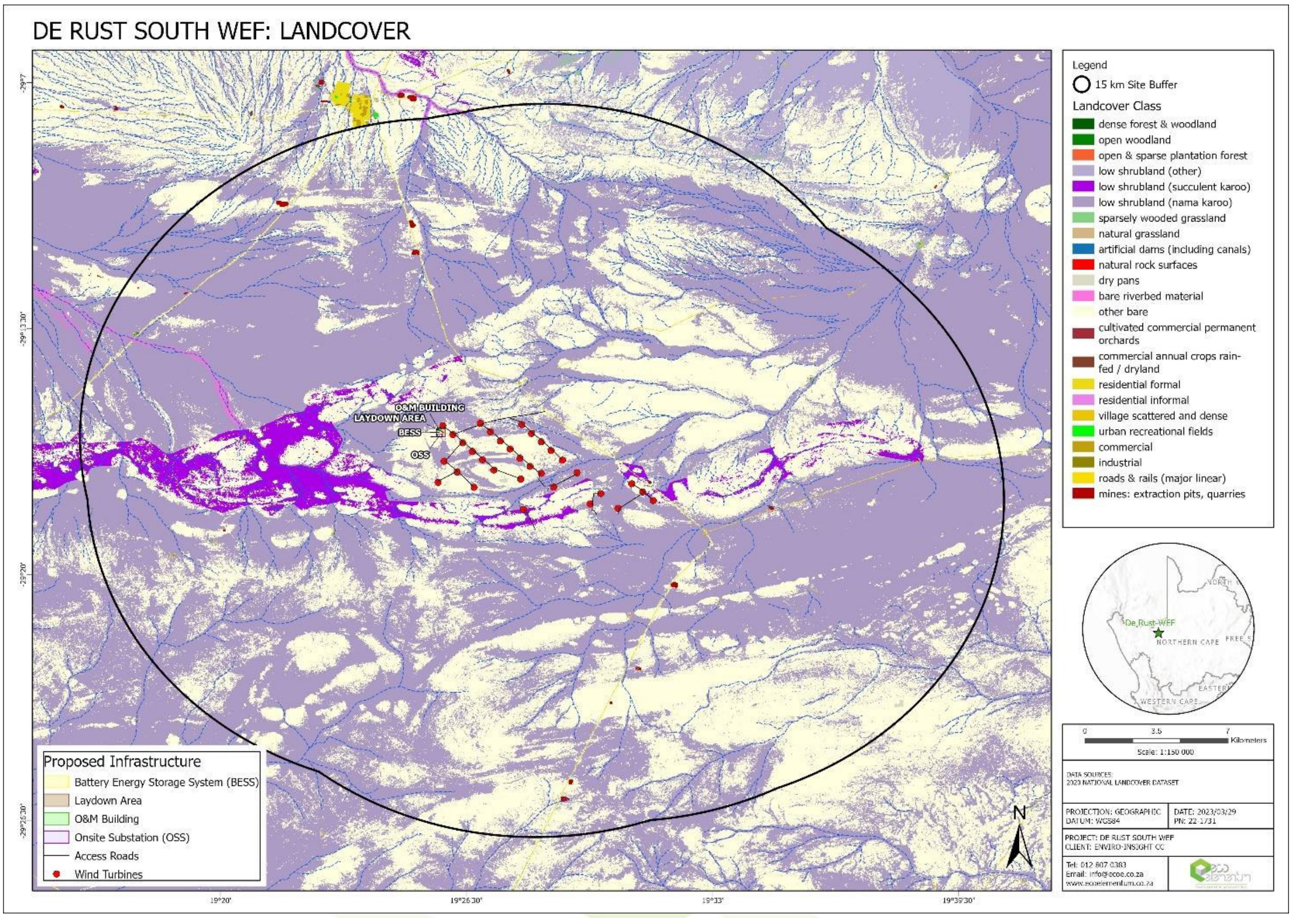

Figure 4.5: Landcover

Figure 4.6: Borrow pit remaining from the road construction

Figure 4.7: Households along the R358

4.4 Visual Absorption Capacity

Visual Absorption Capacity (VAC) is the capacity of the landscape/receiving environment to absorb the potential visual impact of the proposed infrastructure. The VAC can be a function of the surrounding vegetation, topography and landcover. For instance, a study areas VAC will be high if the vegetation is tall, dense and continuous. Conversely, low growing, sparse and patchy vegetation will have a low VAC. Oberholzer (2005) categorizes VAC as follows:

- High VAC – e.g. effective screening by topography and vegetation;
- Moderate VAC - e.g. partial screening by topography and vegetation;
- Low VAC - e.g. little screening by topography or vegetation.

Considering the nature of the proposed project and the above analysis of the receiving environment, the VAC of the study area can be categorized as low. This is mainly due to the extreme height of the wind turbines, which makes it difficult for the receiving environment to conceal the proposed structures.

4.5 Sensitive Receptors

From a desktop study of satellite imagery and available national data, potential sensitive receptors were identified within 15 km of the proposed operations and are presented in Figure 4.8 overleaf. Using satellite imagery, any homesteads; schools; recreational facilities and tourist destinations were identified as potential sensitive receptors to the proposed project. It should be noted that the sensitive receptors in the area may differ from those identified as not all areas may have been identified from the imagery successfully.

From the satellite imagery, 55 homesteads/households were identified throughout the study area. The identified households are sparsely distributed and occur in clusters mainly along the road network. Figure 4.9 shows some of the households viewed during the site visit.

The residents and tourists using the road networks surrounding the study area are also considered as sensitive receptors due to their potential momentary views of the proposed development. The identified road network includes the R358 (east of the site) and several secondary roads and streets servicing the identified sensitive receptors. No areas of tourism or protected areas are present within the study area. However, the R358 may be utilized by tourists to reach their destinations.

The identified households are expected to experience higher levels of visual impacts due to their static views of the proposed development, as compared to travellers using the road networks who are expected to experience lower levels of visual impacts due to their momentary views of the proposed development.

The sensitive receptors were also considered in relation to existing infrastructure within the study area. The only infrastructure noted from the desktop analysis is a powerline traversing the study area from east-west. Refer to Figure 4.10 which shows a portion of the powerline viewed from the R358. From the site visit, wooden utility poles were noted along the R358 (Figure 4.11).

Overall, the sensitivity of the identified sensitive receptors can be categorized as moderate, due to the nature of the project and relatively low density of the sensitive receptors.

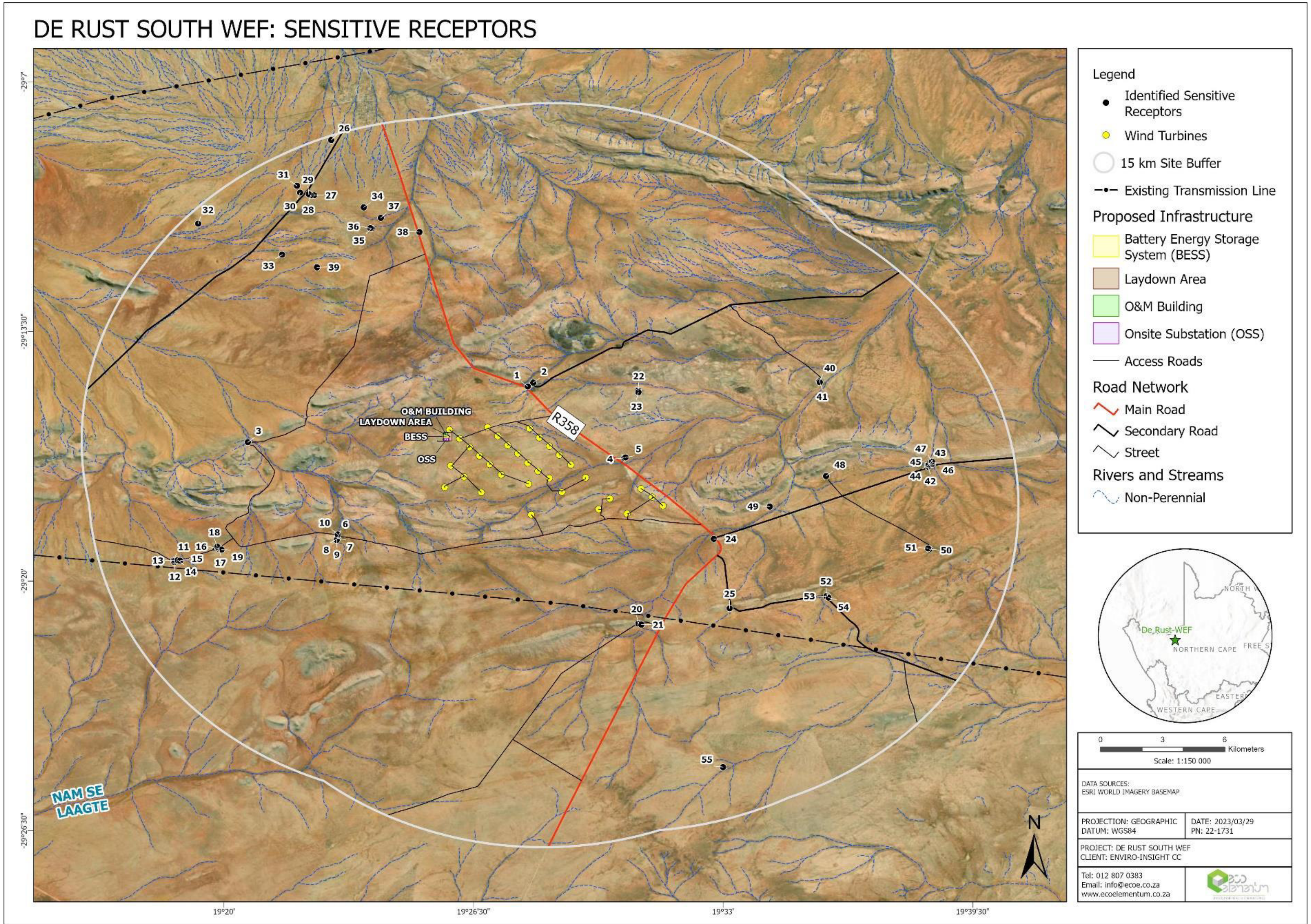

Figure 4.8: Sensitive Receptors

Figure 4.9: Households

Figure 4.10: Powerline viewed from the R358

Figure 4.11: Wooden utility poles along the R358

4.6 Sense Of Place

The concept of "a Sense of Place" does not equate simply to the creation of picturesque landscapes or pretty buildings, but to recognize the importance of a sense of belonging. Embracing uniqueness, as opposed to standardization, attains quality of place. In terms of the natural environment, it requires the identification, a response to and the emphasis of the distinguishing features and characteristics of landscapes. Different natural landscapes suggest different responses. The areas current sense of place was extracted from the Khâi-Ma Local Municipality (KLM) 2022/23 - 2026/27 Draft Integrated Development Plan (IDP) and findings from the site visit.

The study areas current sense of place can be described as an open and mostly undeveloped landscape. Current visual disturbances include the identified powerline and utility poles within the study area. However, the visual quality of the study area is still considered high, mainly due to the area's unspoilt natural beauty.

The study areas sense of place further interlinks with the level of visual intrusion expected from the proposed project. Visual intrusion refers to the level of compatibility of the project with the particular qualities of the area, which is related to the idea of context and maintaining integrity of the landscape (Oberholzer, 2005). Considering the study areas current sense of place, the proposed project is expected to have a high level of visual intrusion where the proposed WEF will result in in a noticeable change or is discordant with the surroundings; (Oberholzer, 2005).

From the Draft KLM IDP (2022), the following was noted with regards to renewable energy:

- One of the objectives developed as a result of the KLM's intention to address the needs of its residents includes local economic development which further entails assisting with economic interventions in sector development (agricultural, mining, tourism and renewable energy);
- The Draft IDP was further aligned and informed by the National Development Plan (IDP). A development objective that has been adopted to give effect to the NDP includes the following:
    - The country would need an additional 29 000 MW of electricity by 2030. About 10 900 MW of existing capacity is to be retired, implying new build of more than 40 000 MW. At least 20 000 MW of this capacity should come from renewable sources.
- The mayor further indicated that together with the development of more renewable energy sites and other developments, the municipality is looking forward to more inhabitants being employed and boosting the economy;
- Several existing solar energy plants occur within the study area, with more applications for solar and wind energy plants being submitted to the Department of Energy; and
- Renewable energy was identified as one of the strengths of the municipality.

The study areas sense of place was further assessed in relation to the status of current renewable energy projects within 30 km of the site (refer to Figure 4.12 overleaf). The figure shows the 2022 Quarter 4 SA Renewable Energy EIA Application Database, available from the Department of Forestry, Fisheries and the Environment. The data indicates that approved wind and solar farms are located west and north of the proposed WEF.

Overall, the proposed WEF is expected to alter the study areas current sense of place. However, considering the municipality's objectives and the approved wind and solar projects, an alteration to the area's current sense of place is expected. Therefore, the proposed WEF is expected to blend in with the areas future sense of place, which is expected to include additional renewable energy projects.

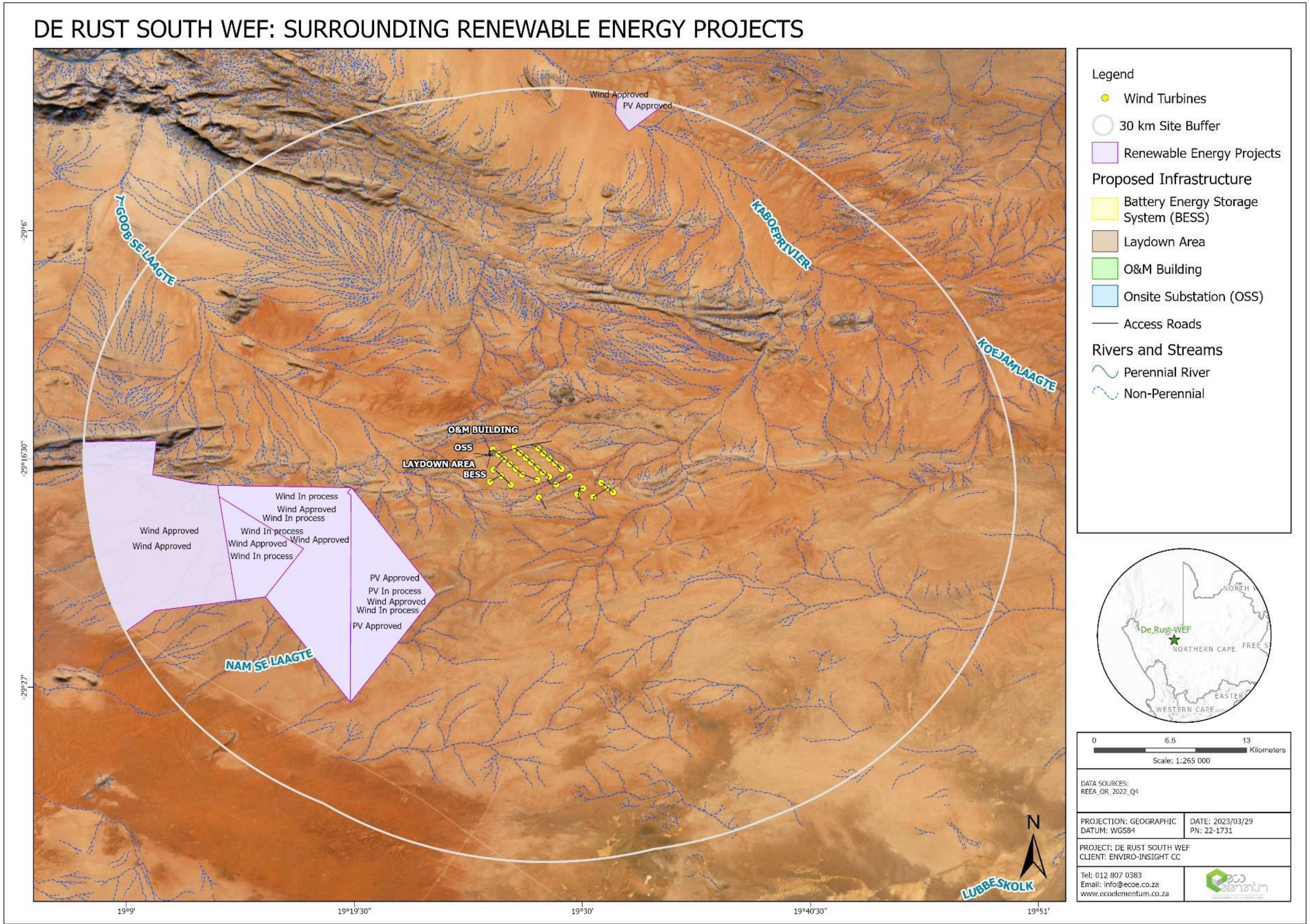

Figure 4.12: Status of renewable energy projects within 30 km of the site

5. SITE SENSITIVITY VERIFICATION

This section addresses the site sensitivity verification requirements as per Government Gazette 433110 dated 20 March 2020. The Screening Tool Report determined the following sensitivities specific to this VIA:

- Relative Flicker Theme Sensitivity: Very High Sensitivity due to the following:
  - Potential temporarily or permanently inhabited residence
  - Inside the boundaries of a town
- Relative Landscape (Wind) Theme Sensitivity: Very High Sensitivity due to the following:
  - Mountain tops and high ridges
  - Slope more than 1:4
  - Within 2 km of a town or village

Table 5-1: Site Sensitivity Verification

Requirement	Comment
1.1. The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist.	The verification was undertaken by the project team.
1.2. The site sensitivity verification must be undertaken through the use of:	
(a) a desktop analysis, using satellite imagery;	Refer to Section 4.
(b) a preliminary on-site inspection;	A site visit was undertaken on the 10th of March 2023.
(c) any other available and relevant information.	Refer to Section 4 and to Figure 4.1 to Figure 4.11.
1.3. The outcome of the site sensitivity verification must be recorded in the form of a report that--	
(a) confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc	Refer to Section 4.3 which shows the study areas landcover as per the desktop analysis and site images. Flicker Sensitivity: Refer to Section 4.5 which shows the identified sensitive receptors. Potential temporarily or permanently inhabited residence are located within the study area therefore lending to the very high sensitivity. The proposed project does not lie inside the boundaries of a town. Landscape Sensitivity: Refer to Section 4.1 and 4.5 which shows the study areas topography and sensitive receptors as per the desktop analysis and site images. The site is located within 2 km of households/homesteads and has a relatively flat terrain with mountain tops, high ridges and koppies occurring within 15 km of the study area. The proposed project is not located within 2 km of a town

Requirement	Comment
	or village. The landscape sensitivity can therefore be described as high, due to the low number of sensitive receptors within 2 km of the site and the mostly flat terrain.
(b) contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity	Refer to Figure 4.1 to Figure 4.11.
(c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations1 (EIA Regulations).	This report complies with Appendix 6 of the EIA Regulations of 2014 (as amended).

6. METHODOLOGY

The following methodology was followed to quantify the potential visual and shadow flicker impacts of the proposed WEF.

6.1 Visual Impact Methodology

1. Viewshed and viewing distance was modelled using GIS analysis up to 15 km from the proposed structures utilizing ArcGIS Pro 2.9.3 and Spatial Analyst Extension.

2. In order to model the decreasing visual impact of the structures, concentric radii zones of 1 km to 15 km from the proposed mine activities were superimposed on the viewshed to determine the level of visual exposure. The closest zone to the proposed structures indicates the area of most significant impact, and the zone further than 10 km from the structures indicates the area of least impact. The visual ratings of the zones have been defined as follows:
   - < 1 km (very high);
   - 1 - 2 km (high);
   - 2 - 5 km (moderate);
   - 5 - 10 km (low);
   - 10 - 15 km (very low); and
   - > 15 km (insignificant).

3. A visual exposure analysis was conducted which included the following parameters:

– Terrain Slope
   - Slope angle was determined from the Digital Surface Model (DSM) and the location of the proposed structures given a ranking depending on the steepness of the slope;
   - Structures built on steep slopes are assumed to be more visible and exposed than those on flat surfaces.

– Aspect of structure location
   - Aspect of the slope where the structures are to be built, were calculated from the DSM and given a ranking determined by the sun angle.
   - Structures on flat surface are illuminated by the sun the whole day and thus visible from all directions. In the southern hemisphere structures on north facing slopes are less visible from the south, structures on east and west facing slopes are only illuminated during half of the day thus less visible where structures on the southern slopes are mostly in the shade.

– Landforms
   - Landform of the location of the proposed structures were determined from the DSM and ranked according to the type of landform. Structures built on certain landforms, e.g. ridges, will be more visible than structures built in valleys.

– Slope Position of structure
   - Using GIS analysis, the position of the proposed structures were determined and ranked according to the position on the slope the structure are to be built.

- Relative elevation of structures
  - Using the DSM, the elevation of the proposed structure relative to the surrounding elevation is determined and ranked according to the difference in height of the surrounding areas. Structures built on higher ground are more visible than those built in low lying areas.
- Terrain Ruggedness
  - The terrain ruggedness is determined from the DSM and given a ranking based on the homogeneousness of the terrain. Rugged terrain has a tendency to increase the visual absorption characteristics of the terrain.
- Visual Absorption Capacity (VAC)
  - To simulate the VAC of the landscape, land cover data of the area was assigned a VAC ranking. The visual exposure results and VAC rankings of the landscape were use in an algorithm to determine a quantitative visual exposure for each sensitive receptor.
- Overall Visual Impact
  - Combing all the above datasets, a final visual exposure ranking was determined for each of the identified sensitive receptor areas.

6.2 Shadow Flicker Analysis Methodology

Shadow Flicker is the flickering effect caused when rotating wind turbine blades periodically cast shadows through constrained openings such as the windows of neighbouring properties. The expected shadow flicker impact of the proposed WEF was quantified by applying the following methodology:

1. The calculation of the potential shadow flicker impact on the identified shadow receptors (identified homesteads) was carried out by simulating the situation using WindPro 3.6.
2. The following information and parameters were used in the calculation:

- The position of the proposed wind turbines as provided by the client
- A DSM to account for topographic features and elevation differences
- The hub height and rotor diameter of the proposed wind turbines
  - WindPro contains a Wind Turbine Generator (WTG) catalogue comprising of several wind turbine models. For this assessment, the NORDEX N163/5.X WTG (with a hub height set at 148 m) was selected.
- The position of the shadow receptors as provided by the client and verified using satellite imagery
- The size and orientation of the windows
  - Within this calculation, the shadow receptors were represented by windows.
  - The default parameters of 1 m height and 1 m width window, 1m above the ground level can be considered as a standard description of typical windows and was used in this analysis.
  - The orientation of the windows were allocated as a “greenhouse mode” where the windows do not face any particular direction and are perpendicular to all the proposed wind turbines. This was applied as the actual properties of the shadow receptors were unknown at the time of the study and there are wind turbines located on more than one side of some of the homesteads.
- The geographic position, time zone and daylight-saving time information as per WindPro 3.6
- A simulation model, which holds information about the earth’s orbit and rotation to the sun as per WindPro 3.6

3. The abovementioned parameters were inputted into the shadow flicker tool. The tool was run as a worst-case scenario based on the following assumptions:
    - The sun is shining all day, from sunrise to sunset
    - The rotor plane is always perpendicular to the line from the proposed WTG to the sun.
    - The proposed WTG is always operating
4. Prior to the shadow flicker calculation, the shadow flicker tool calculated a Zone of Visual Influence (ZVI) which indicates the proposed WTG which are not visible to the shadow receptors hence will not contribute to shadow flicker. The ZVI is calculated based on the DSM inputted into the tool.
5. At present, only Germany have detailed guidelines on the limits and conditions regarding shadow flicker impacts. According to these guidelines, the limit of the shadow is set by two factors i.e., the angle of the sun over the horizon must be at least 3 degrees and the blades of the WTG must cover at least 20 % of the sun. Using these conditions, along with the proposed wind turbines blade width, WindPro calculated the maximum distance from the proposed wind turbines where shadow flickering impacts must be calculated. Beyond this distance, the turbine will not contribute to shadow flickering impacts. By default, this distance was calculated from the blade width such as at least 20% of the sun disc is covered by the blade. The calculation resulted in 1 786 m being the maximum distance between the proposed wind turbines and each shadow receptor after which the shadow flicker is not considered.

6.3 Assumptions

- The core study area for the visual assessment can be defined as an area with a radius of not more than 10 km from the structures and a total study area with a radius of 15 km from the structures. This is because the visual impact of structures beyond a distance of 10 km would be so reduced that it can be considered negligible even if there is direct line of sight.
- The shadow flicker analysis was run as a worst-case scenario which assumed that the sun is shining all day, the wind turbines are always operating, the rotor plane is always perpendicular to the sensitive receptors and at least one window is always orientated to the sun.
- Refer to Appendix B for detailed assumptions applied during the shadow flicker assessment.
- Currently, there is no maximum threshold of shadow flicker from wind turbines recommended for South Africa. The World Bank Group's Environmental, Health, and Safety Guidelines for Wind Energy (EHS) (2015), recommends that the predicted duration of shadow flicker effects experienced at a sensitive receptor not exceed 30 hours per year and 30 minutes per day on the worst affected day, based on a worst-case scenario. Therefore, this threshold was applied for the current proposed WEF.
- It is assumed that there are no alternative locations for the structures and that the assessment, therefore, assessed only the proposed site.
- The assessment was undertaken during the planning stage of the project and is based on the information available at that time.
- The heights of the ancillary infrastructure were assumed for the visual analysis as the heights were not available at the time of the study.

6.4 Limitations

- Visual perception is by nature a subjective experience, as it is influenced largely by personal values. For instance, what one viewer experiences as an intrusion in the landscape, another may regard as positive. Such differences in perception are greatly influenced by culture, education and socio-economic background. A degree of subjectivity is therefore bound to influence the rating of visual impacts. In order to limit such subjectivity, a combination of quantitative and qualitative assessment methods were used. A high degree of reliance has been placed on GIS-based analysis viewsheds, visibility analyses, shadow flicker analysis and on making transparent assumptions and value judgements, where such assumptions or judgements are necessary.

- The results generated in GIS cannot be guaranteed as 100% accurate. Some viewpoints, which are indicated on the viewshed as being inside of the viewshed, can be outside of the viewshed. This is due to the change of the natural environment by surrounding activities as well as natural vegetation that play a significant role and can have a positive or negative influence on the viewshed.
- The modelling of visibility is merely conceptual. Being based on the ALOS DSM and land cover data, it does not fully take into account the real-world effect of buildings, trees etc. that could shield the structures from being visible or could have changed over time. The viewshed analysis therefore signifies a worst-case scenario.
- When addressing cumulative visual impacts, not all visual reports of the surrounding renewable energy developments were available at the time of this study, therefore some sources were limited to amendment reports, EIA reports, draft Environmental Management Programmes (EMP's) and draft Environmental Authorisation (EA) amendment reports.
- The shadow flicker analysis was run as a worst-case scenario and does not account for the actual number and orientation of the windows, the weather conditions such as cloud cover and wind or the non-operational hours of the proposed wind turbines.
- The heights of the ancillary infrastructure were assumed for the visual analysis as the heights were not available at the time of the study.
- The sensitive receptors in the area may differ from those identified as not all areas may have been identified from the imagery successfully.

6.5 Legal Requirements

There are no specific legal requirements for visual and shadow flicker impact assessments in South Africa. These impacts are, however required to be assessed by implication when the provisions of relevant acts governing environmental impacts management are considered.

At present, there are EHS guidelines providing general and industry-specific examples of Good International Industry Practice (GIIP) when working on a project. These guidelines will be applied in this study regarding shadow flicker. As suggested in the guidelines, if it is not possible to locate a WEF such that sensitive receptors experience no shadow flicker effects, it is recommended that the predicted duration of shadow flicker effects experienced at a sensitive receptor not exceed 30 hours per year and 30 minutes per day on the worst affected day, based on a worst-case scenario (EHS, 2015).

7. CRITERIA USED IN THE ASSESSMENT OF IMPACTS

7.1 View Points And View Corridors

Viewpoints/sensitive receptors have been selected based on prominent viewing positions in the area. The selected viewpoints and view corridors were used as a basis for determining potential visual and shadow flicker impacts of the proposed structures.

7.2 Visual Exposure and Shadow Flicker

Both visual exposure and shadow flicker are based on distance from the project to selected viewpoints. Visual exposure and shadow flicker impact tends to diminish exponentially with distance. The visibility of any structure or activity is the point of departure for the visual impact assessment. It stands to reason that if the proposed structures were not visible, no visual impact would occur. Visual exposure was determined by the following variables:

- Slope angle;
- Aspect of slope;
- Landforms;
- Slope Position of structure;
- Relative elevation of structures; and
- Terrain ruggedness.

Shadow flicker was determined by the following variables:

- Hub height and rotor diameters of the proposed wind turbines;
- Relative elevation of the proposed wind turbines;
- Rotor plane angle relative to the proposed wind turbines;
- Operational hours of the proposed wind turbines;
- Relative elevation of the shadow receptors/windows;
- Size and slope of the shadow receptors/windows;
- Zone of Visual Influence (ZVI)

7.3 Landscape Integrity

Landscape integrity are visual qualities represented by the following qualities, which enhance the visual and aesthetic experience of the area:

- Intactness of the natural and cultural landscape;
- Lack of visual intrusions or incompatible structures; and
- Presence of a 'sense of place'.

7.4 Determine The Visual Absorption Capacity

Topography and built forms have the capacity to 'absorb' visual impact. The digital surface model utilised in the calculation of the visual exposure of the facility does not fully incorporate potential visual absorption capacity. It is therefore necessary to determine the VAC by means of the interpretation of the vegetation cover, landcover, topography and structures. Land cover was used in the ranking of the VAC for this study.

8. VIEWSHED AND VISUAL EXPOSURE RESULTS AND DISCUSSION

Figure 8.1 to Figure 8.7 shows the viewshed results for the proposed WEF.

8.1 Terrain Slope

Figure 8.1 below shows the slope angles of the terrain within the 15 km buffer area surrounding the proposed project. The results indicate that the proposed project will be built on a flat surface, with an average slope of 1.61 degrees. Steeper slopes occur north and south of the site. Overall, the total study area has an average slope of 1.67 degrees. Due to the proposed project's position on a flat surface, it is expected that the structures may be less exposed to surrounding areas.

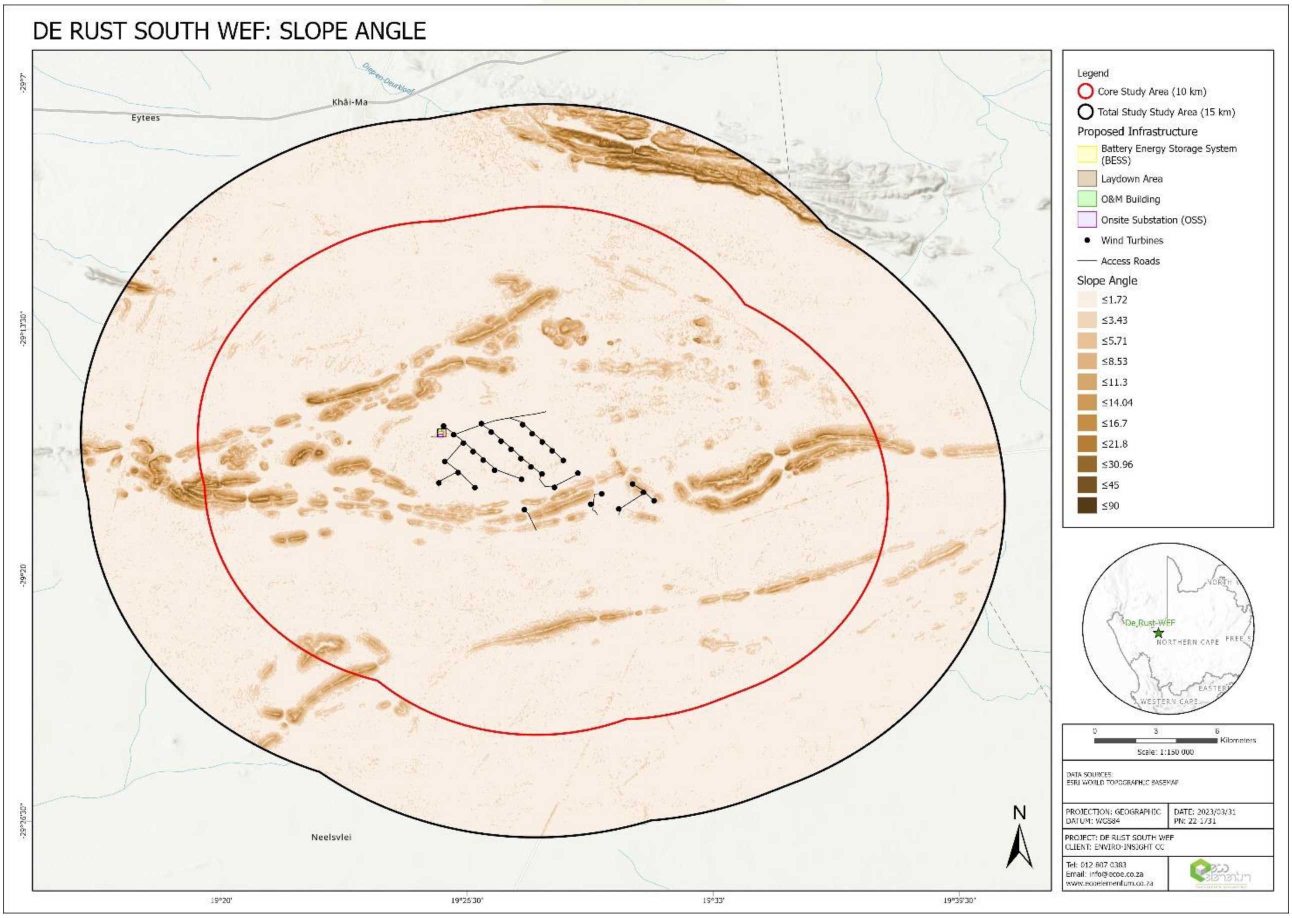

Figure 8.1: Slope Angles

8.2 Aspect Of The Slope

Figure 8.2 shows the slope aspect of the terrain within the 15 km buffer area surrounding the proposed project. The results indicate that the average slope aspect of the site is an east facing slope. However, since the site is located on a flat surface, the proposed infrastructure is expected to be illuminated from sunrise to sunset and thus visible from all directions.

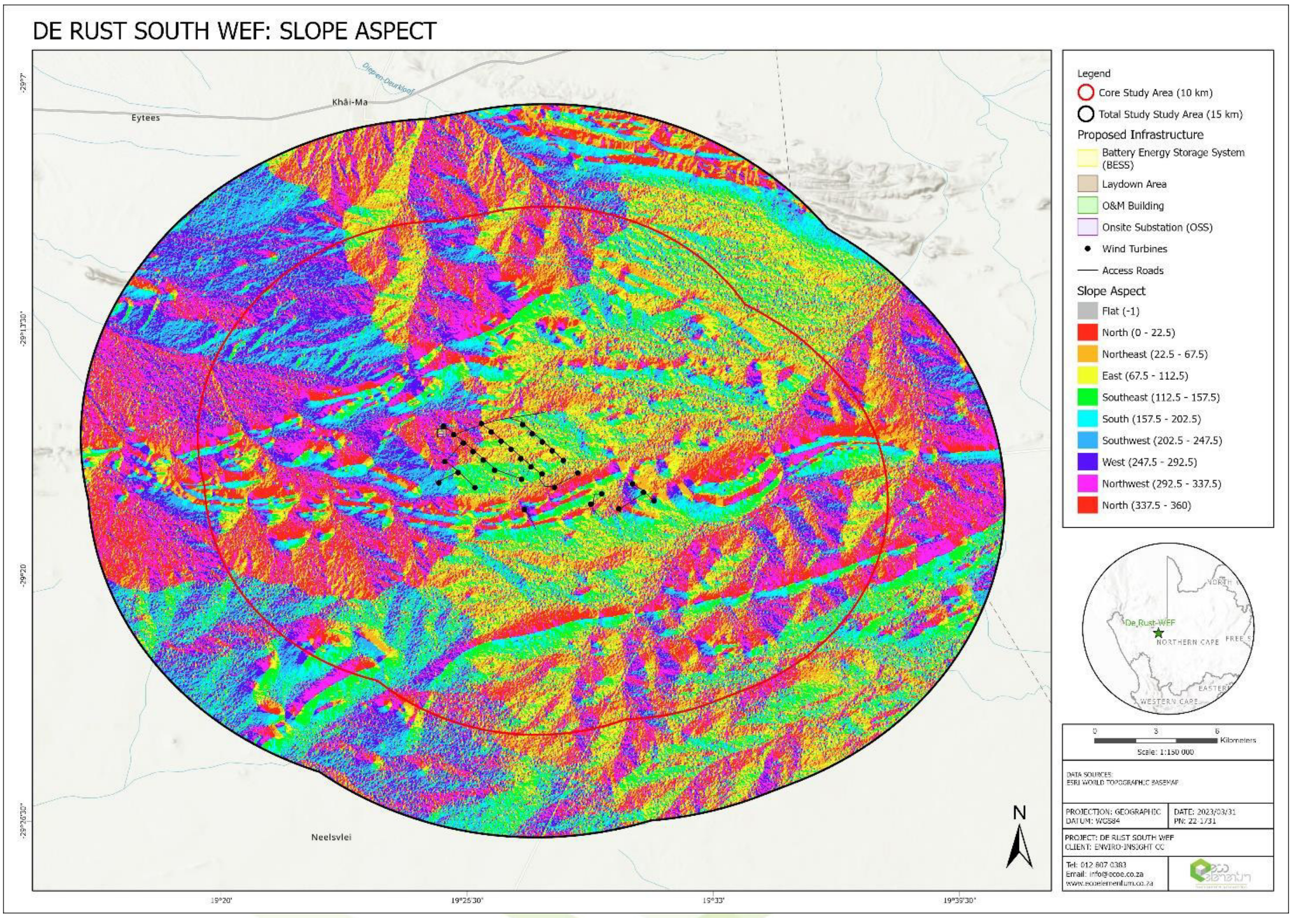

Figure 8.2: Slope Aspect

8.3 TERRAIN RUGGEDNESS

The results of the terrain ruggedness shows that the overall total study area has a low level of ruggedness. This may have the tendency to decrease the VAC characteristics of the terrain. The terrain ruggedness is higher along the identified ridges, hills and koppies. Figure 8.3 shows the terrain ruggedness within 15 km of the proposed project area.

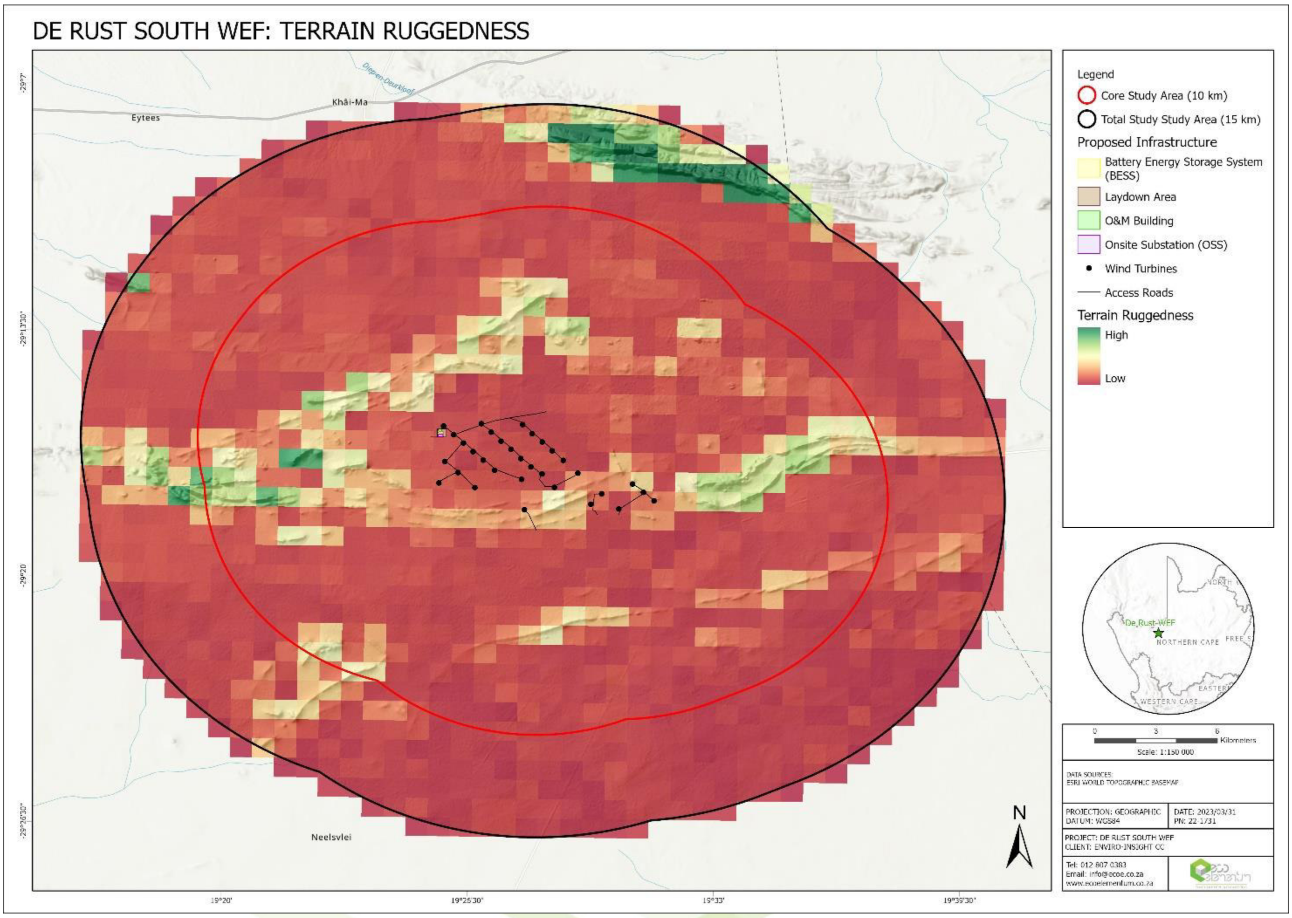

Figure 8.3: Terrain Ruggedness

8.4 Relative Elevation

The results of the relative elevation shows that most of the proposed wind turbines will be built on low-medium lying areas. Therefore, the structures are expected to be more visible to surrounding areas than if it were built on lower lying areas. The high lying areas located north and south of the site may assist in screening the proposed infrastructure from surrounding areas. Figure 8.4 shows the relative elevation within 15 km of the proposed project.

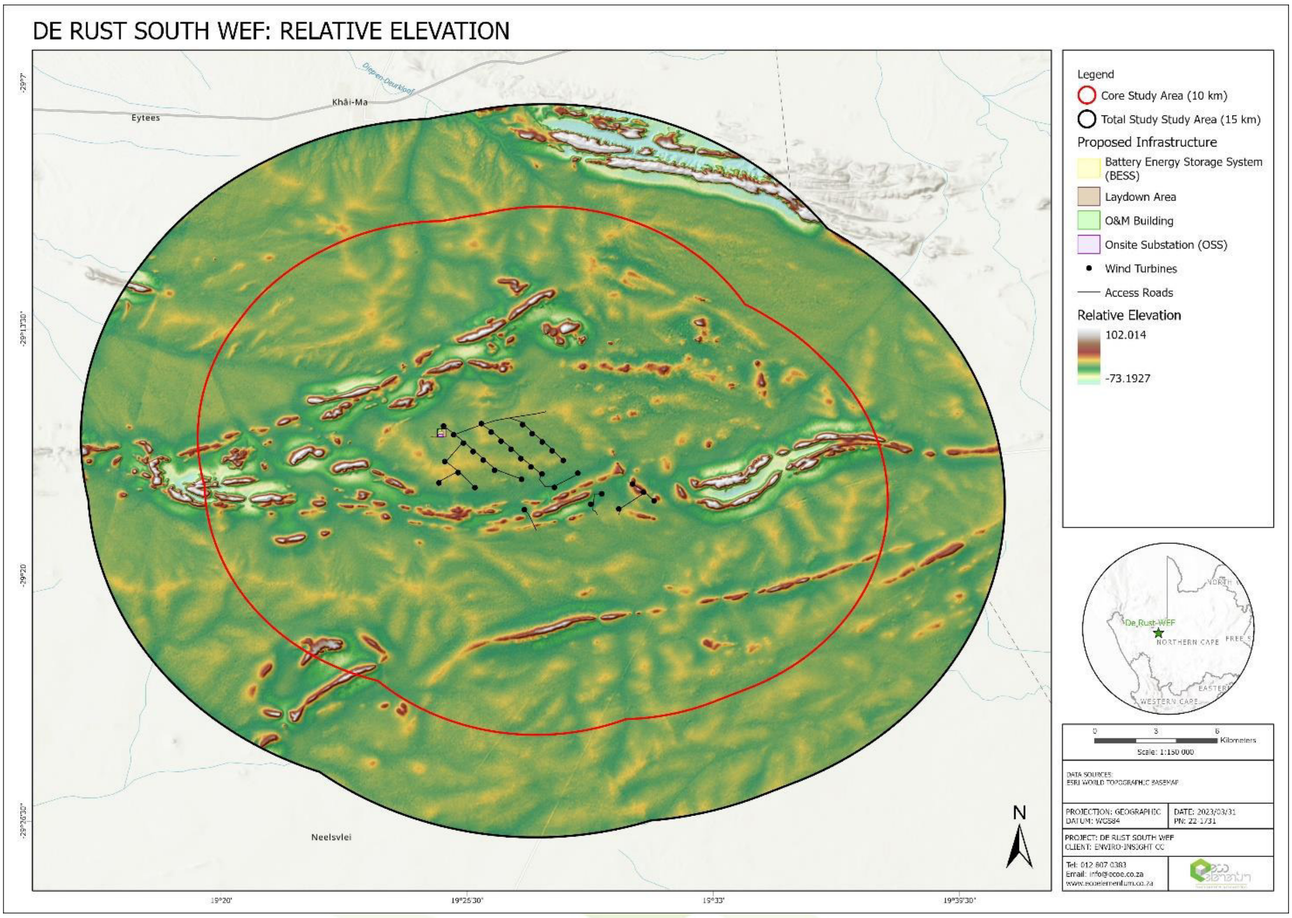

Figure 8.4: Relative Elevation

8.5 LANDFORMS

Figure 8.5 below indicates the landforms of the surrounding study area. The results indicate that most of the proposed infrastructure will be built on plains. Mountain tops/high ridges are present north, south, west and further northeast of the site and may offer visual screening to the areas beyond these topographical features.

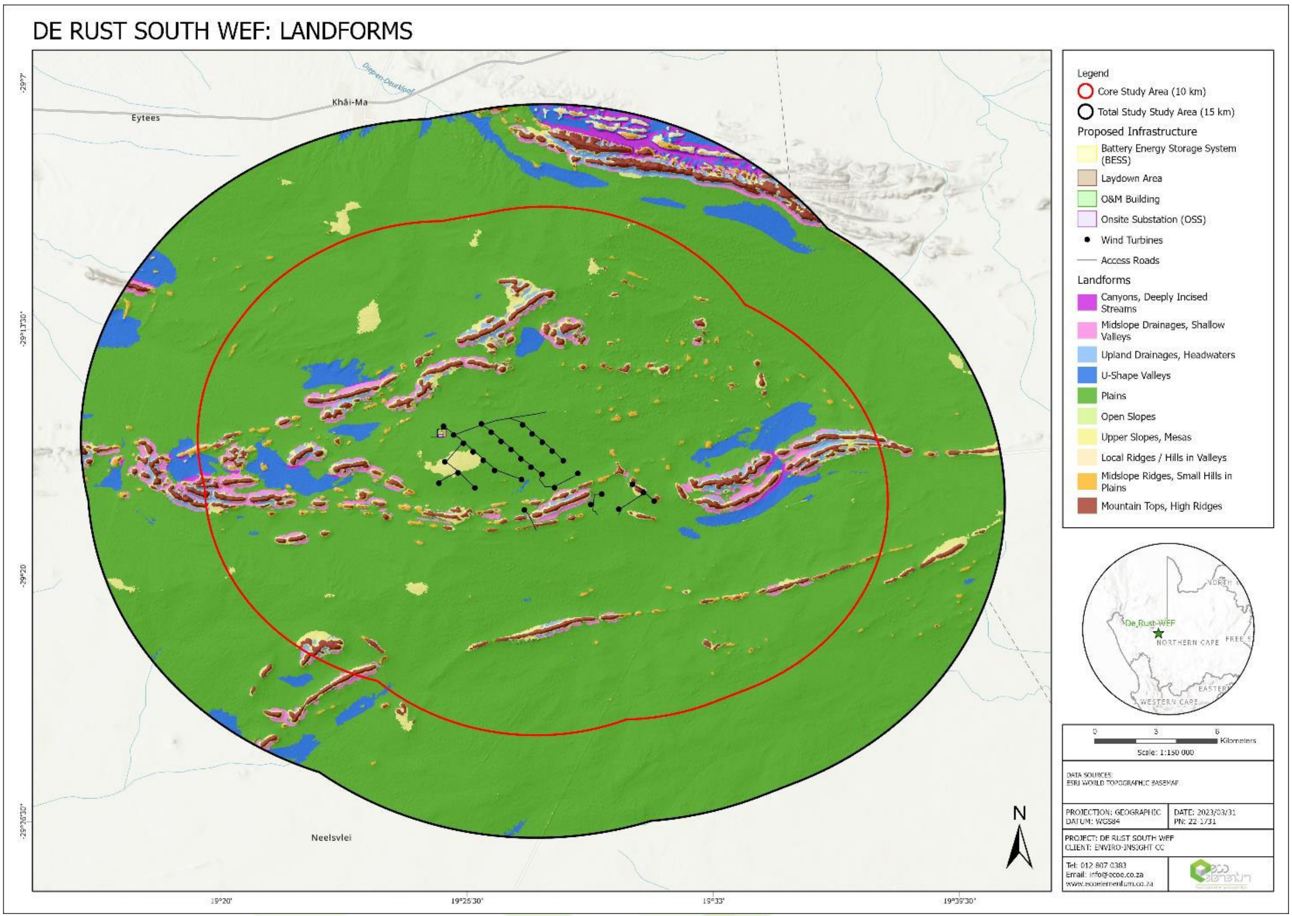

Figure 8.5: Landforms

8.6 Slope Position

The results of the slope position shown in Figure 8.6 below shows that the surrounding area lies within valleys/cliff bases with flat areas, mid slopes, upper slopes and ridges. The figure indicates that the majority of the proposed wind turbines will be constructed within valleys/cliff bases and a few on mid slopes, upper slopes and ridges. The structures built within valleys/cliff bases are expected to be less visible than those built on mid slopes, upper slopes and ridges.

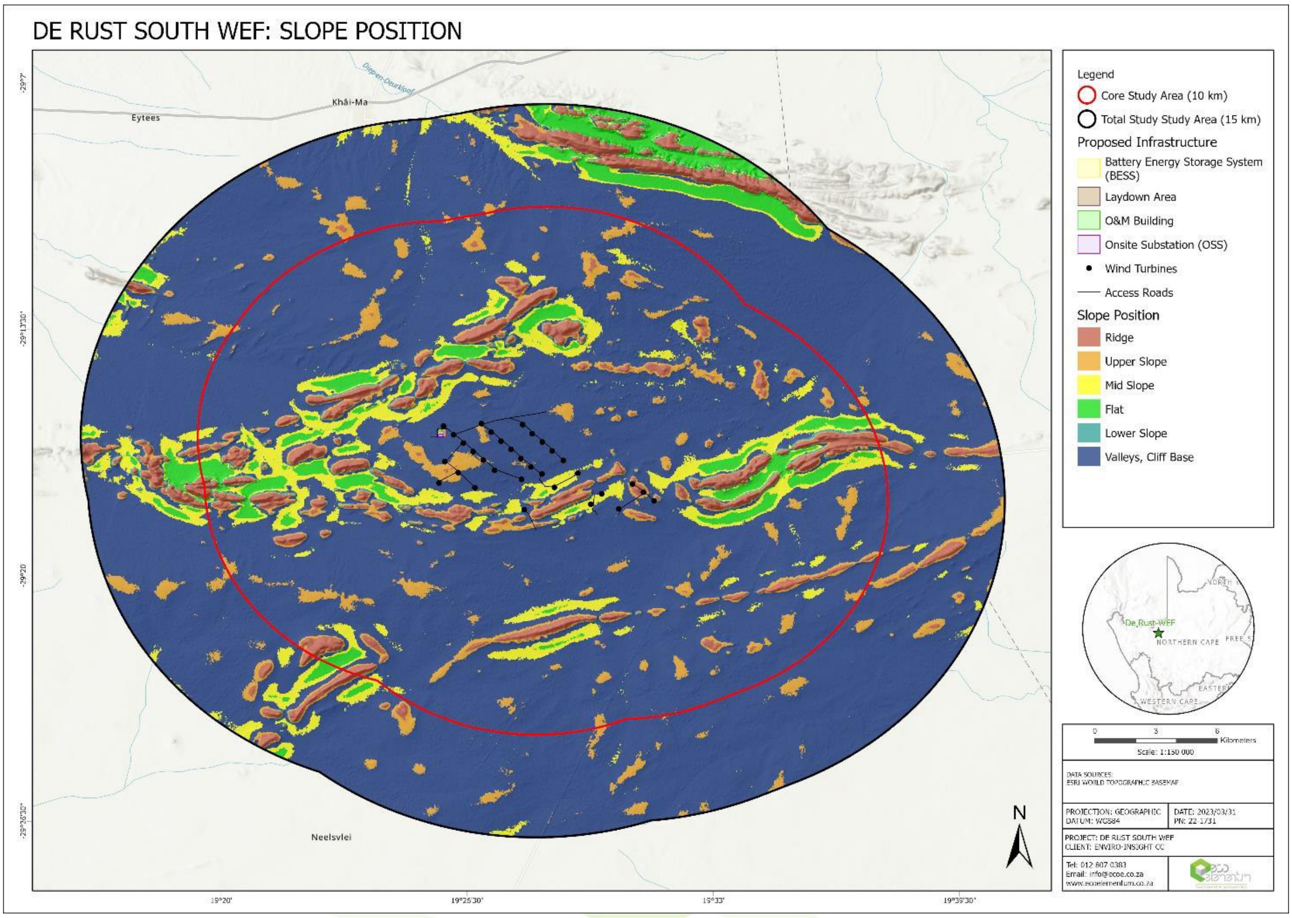

Figure 8.6: Slope Positions

8.7 LANDCOVER VAC

Figure 8.7 indicates the possible VAC of the study area calculated using the surrounding landcover. The results indicate that the study area has a low VAC therefore, the proposed infrastructure is expected not to blend in with the surroundings.

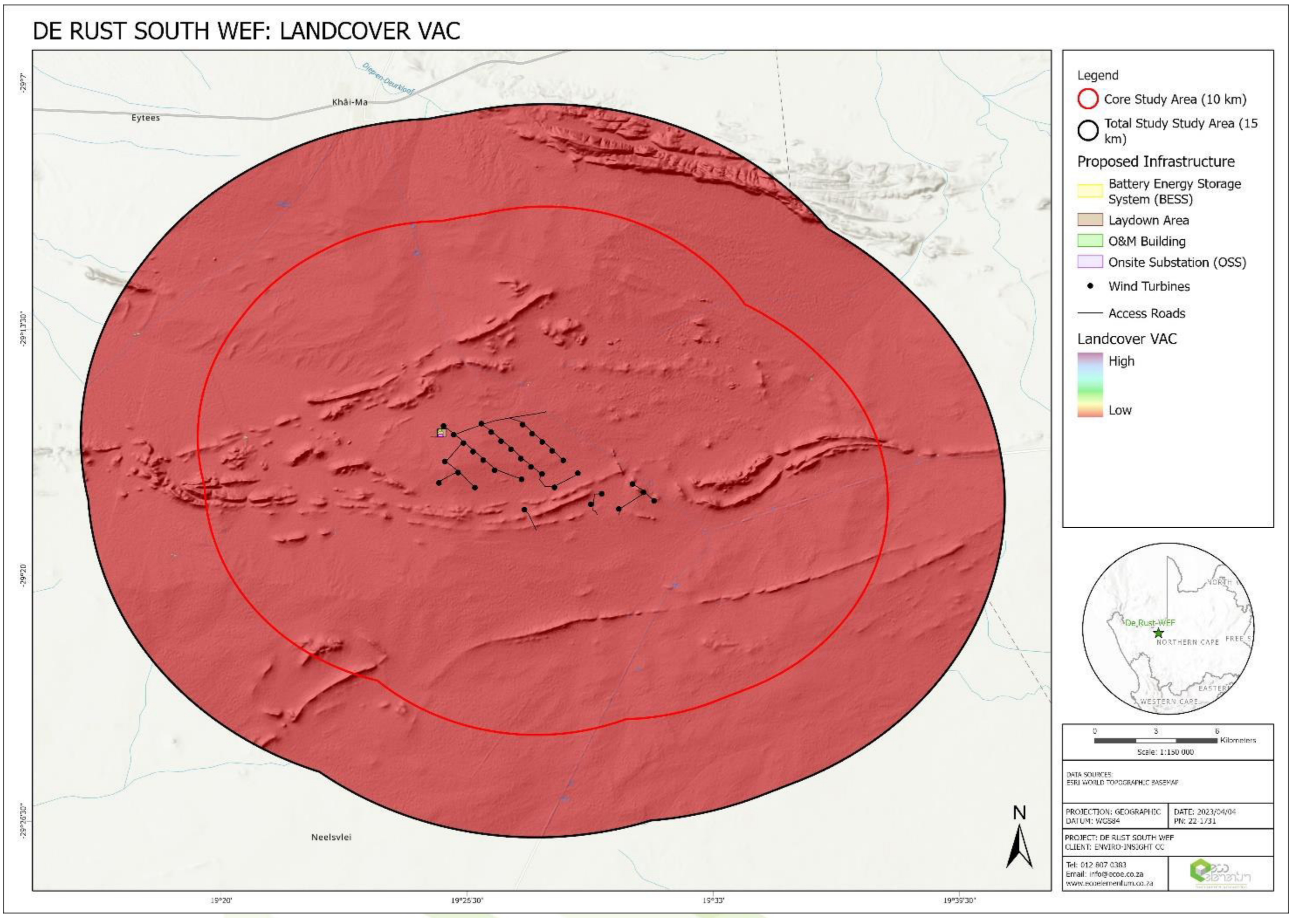

Figure 8.7: Potential VAC

8.8 Viewshed Visibility

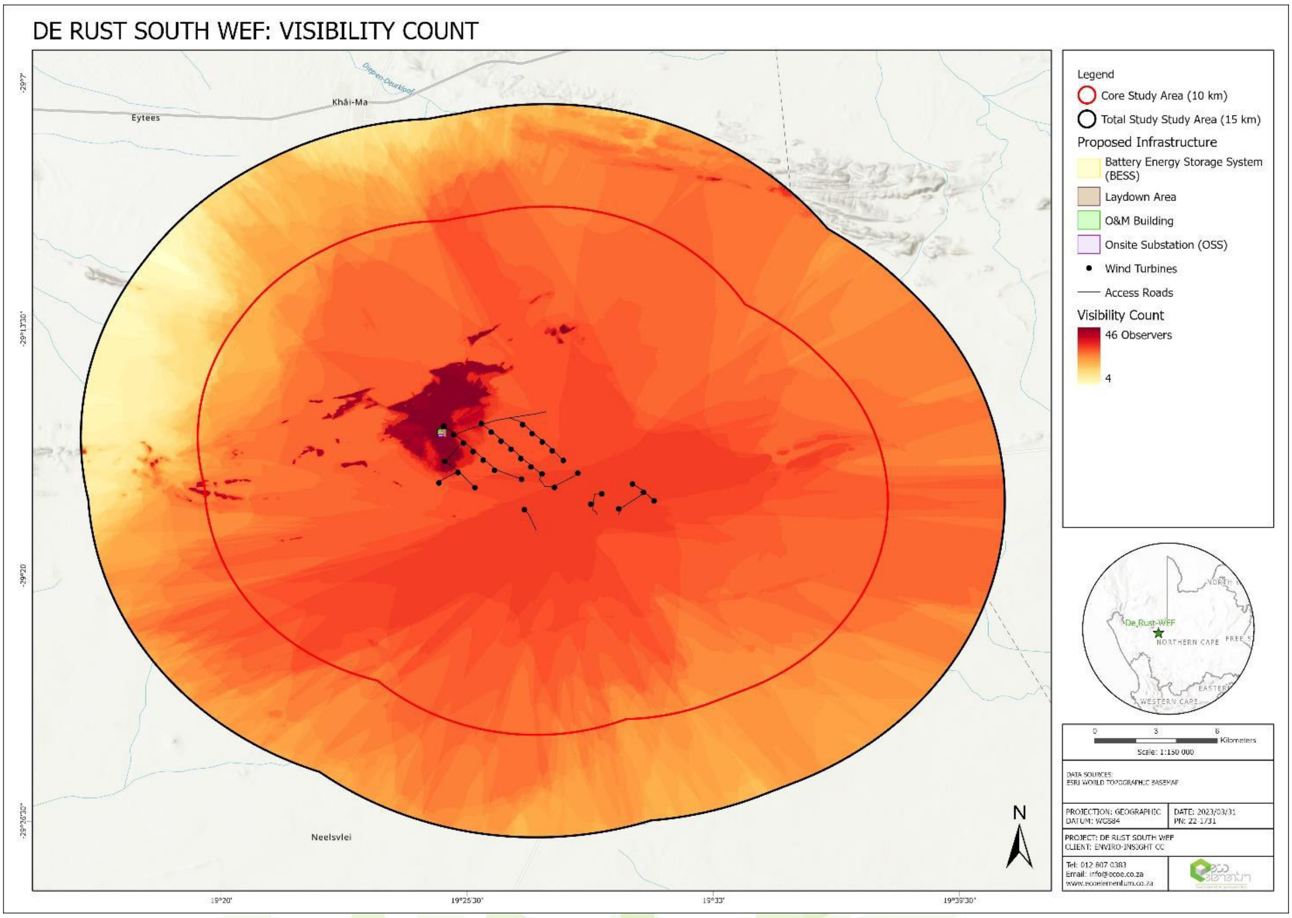

Figure 8.8: Viewshed Visibility Count – showing the number of observer points that may be visible from within 15 km of the proposed site

For the assessment of the visibility of the area, the number and location of the proposed wind turbines were used as the observer points. The ancillary infrastructure was also allocated 15 observer points. The viewshed shows the number of observer points that may be seen from any point within 15 km of the proposed WEF.

Figure 8.8 above indicates that 46 observer points will be visible from all areas within the total study area. The highest number of observer points will be visible from northwest of the site. Overall, it is expected that the proposed infrastructure may be visible from anywhere within total study area.

8.9 VIEWSHED VISIBILITY – DISTANCE RANKING

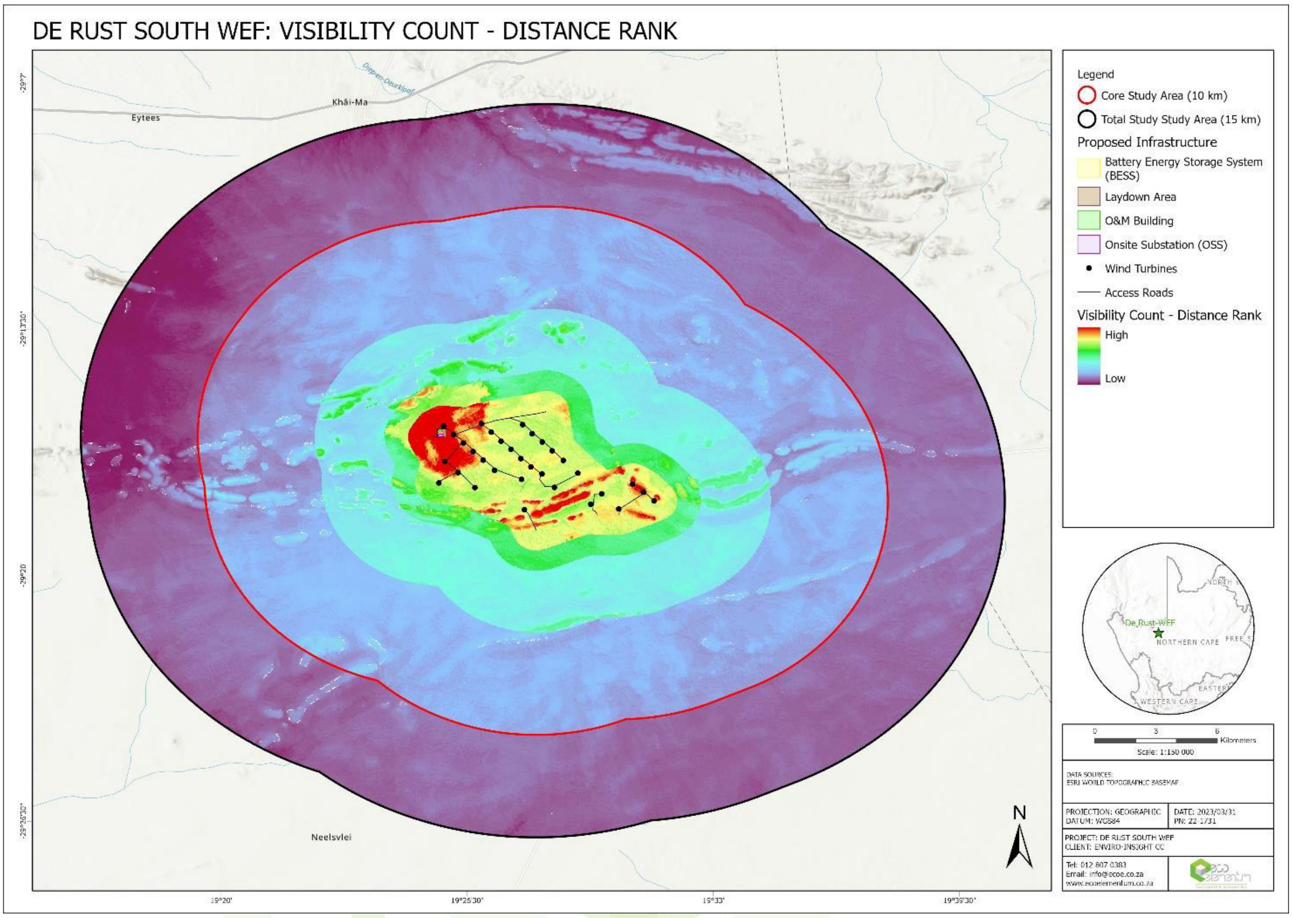

Figure 8.9: Visibility Count Distance Rank – showing the number of observer points that may be visible from within 15 km of the proposed site, ranked according to the distance from the proposed infrastructure

The results from the viewshed visibility are further ranked based on the distance from the centre of the proposed site. The distances are ranked according to Table 8-1 below.

Table 8-1: Visibility Rating

12 – 15 km	Very Low
9 – 12 km	Low
6 – 9 km	Medium
3 – 6 km	High
0 – 3 km	Very High

The results in Figure 8.9 shows that the visibility of the proposed infrastructure will be highest from the north-western area of the site and from the ridges south of the site. The visibility impact decreases as the distance from the site increases.

8.10 Visual Exposure Ranking

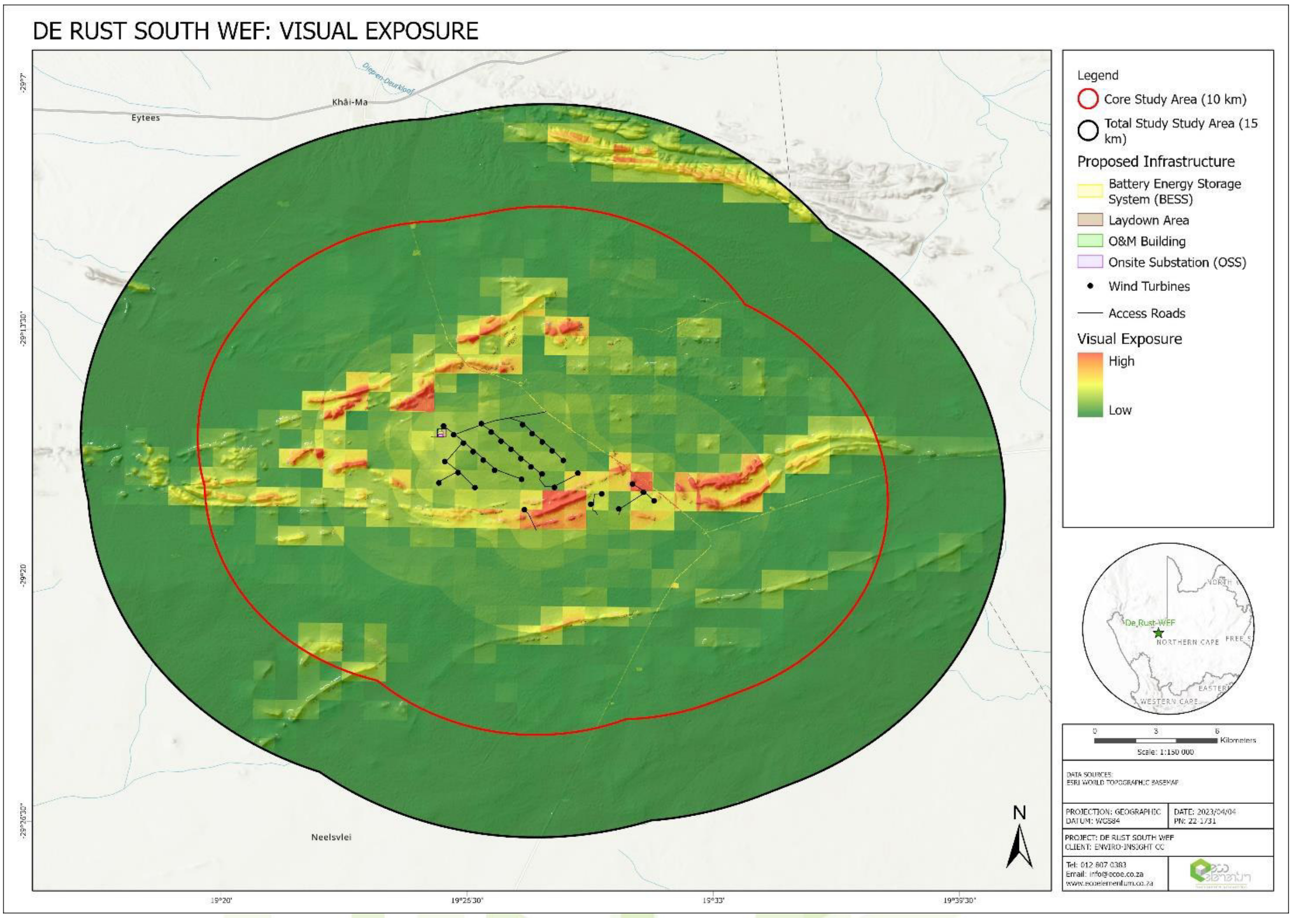

Figure 8.10: Visual exposure – showing the level of visual exposure which may be experienced within 15 km of the proposed site

The viewshed visibility and distance ranking is combined with the slope angle, slope aspect, slope position, ruggedness, relative elevation, landforms and landcover VAC to obtain a quantitative visual exposure ranking of all areas where the proposed infrastructure may potentially be visible from. Table 8-2 below indicates the visual exposure ranking.

Table 8-2: Visual Exposure Ranking

1 - 2	Very Low
3 - 4	Low
5 - 6	Medium
7 - 8	High
9 - 10	Very High

The overall visual exposure (refer to Figure 8.10 above) indicates that 100% of the total study area will experience some level of visual impact from the proposed WEF. The highest levels of visual exposure are expected from the ridges, hills and koppies located north, northwest, west, south, southeast and further northeast of the proposed site. The majority of the remaining areas are expected to experience low to medium levels of visual exposure.

8.11 VIEWPOINTS

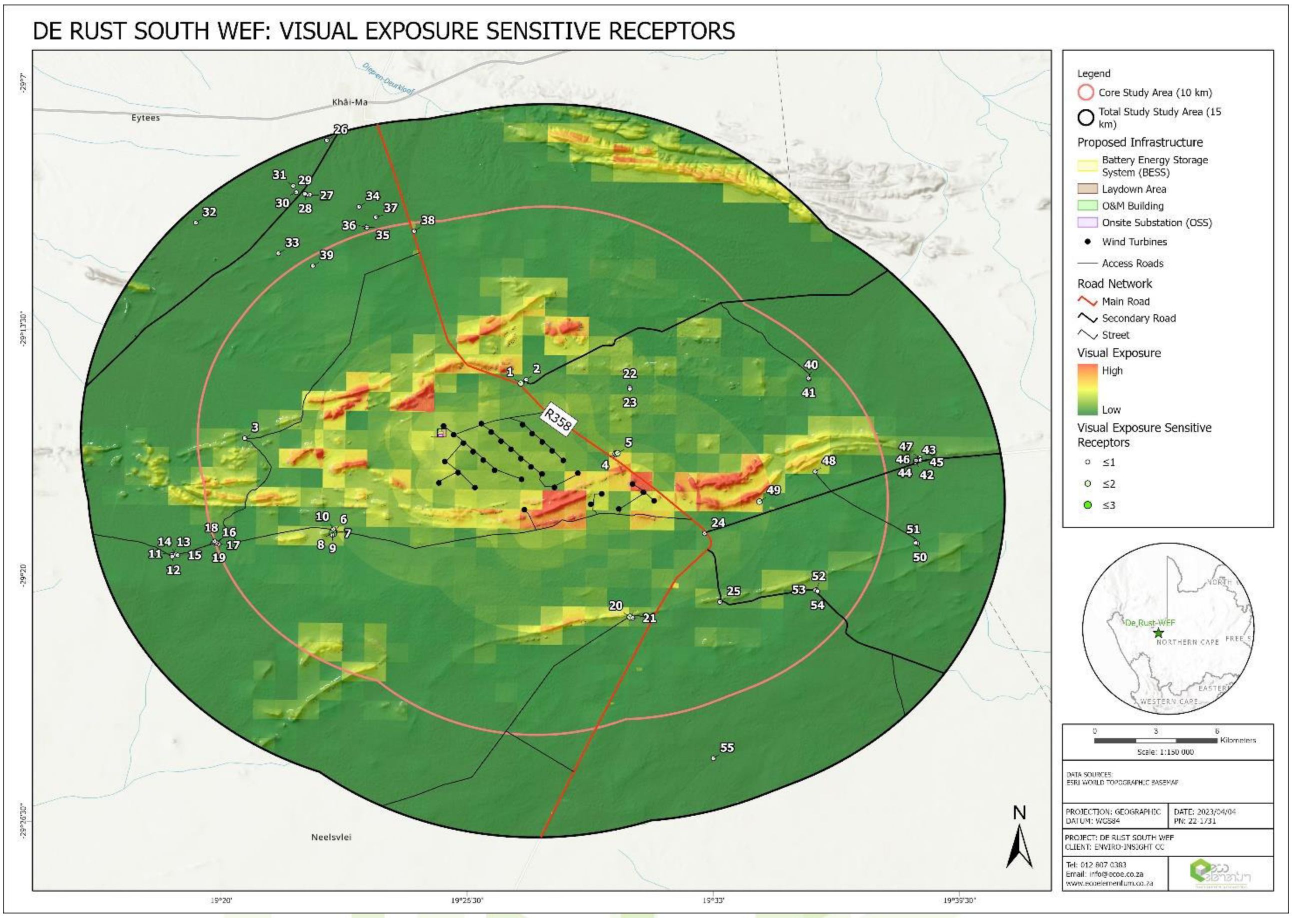

Figure 8.11: Visual exposure and sensitive receptors – showing the level of visual exposure potentially experienced by identified sensitive receptors

Each identified sensitive receptor is then overlaid on the visual exposure ranking. The corresponding visual exposure ranking value is assigned to each sensitive receptor to quantify the visual impact potentially experienced by the identified sensitive receptor. It is important to note that the GIS tools used to quantify the overall visual exposure levels potentially experienced by the identified sensitive receptors only incorporates the variables as described in this report. Factors such as real time and micro scale vegetation are not considered, thus the actual level of visual exposure may be lower or higher depending on the updated land use in the vicinity or latest vegetation growth or height on a micro and macro scale. The results are by no means a rating of visual quality; it is rather used to determine the likelihood of the proposed infrastructure being visible from the viewpoint receptors.

Figure 8.11 above indicates that all identified sensitive receptors are expected to experience visual impacts from the proposed WEF. The identified homesteads and most of the road network users are expected to experience low levels of visual exposure. Higher levels of visual exposure are expected along a portion of the R358, directly northwest and southeast of the site and along a portion of the street running south of the site.

Overall, the proposed WEF is expected to have a low visual impact on the identified sensitive receptors however, the proposed WEF will be visible from the entire study area.

9. SHADOW FLICKER RESULTS

9.1 Worst-Case Scenario

Figure 9.1 below shows the results of the shadow flicker analysis. The results indicate that only receptors 4 and 5, along with a portion of the road network lies within the maximum distance for shadow flicker influence (1 786 m). The main results of the analysis further indicates that receptors 4 and 5 are not expected to experience shadow flicker impacts from the proposed WEF. A detailed report of the main results of the shadow flicker analysis is presented in Appendix B. Motorists travelling on the road network may also experience momentary shadow flicker impacts. However, as there are no areas of tourism or protected areas present within the study area, the volume of traffic on the road network is expected to be low therefore, the level of shadow flicker impacts is expected to be minor/insignificant.

In terms of the EHS (2015) guidelines regarding the limits of shadow flicker impacts experienced at a sensitive receptor, the proposed WEF is below the limit of 30 hours of shadow flicker per year and 30 minutes of shadow flicker per day.

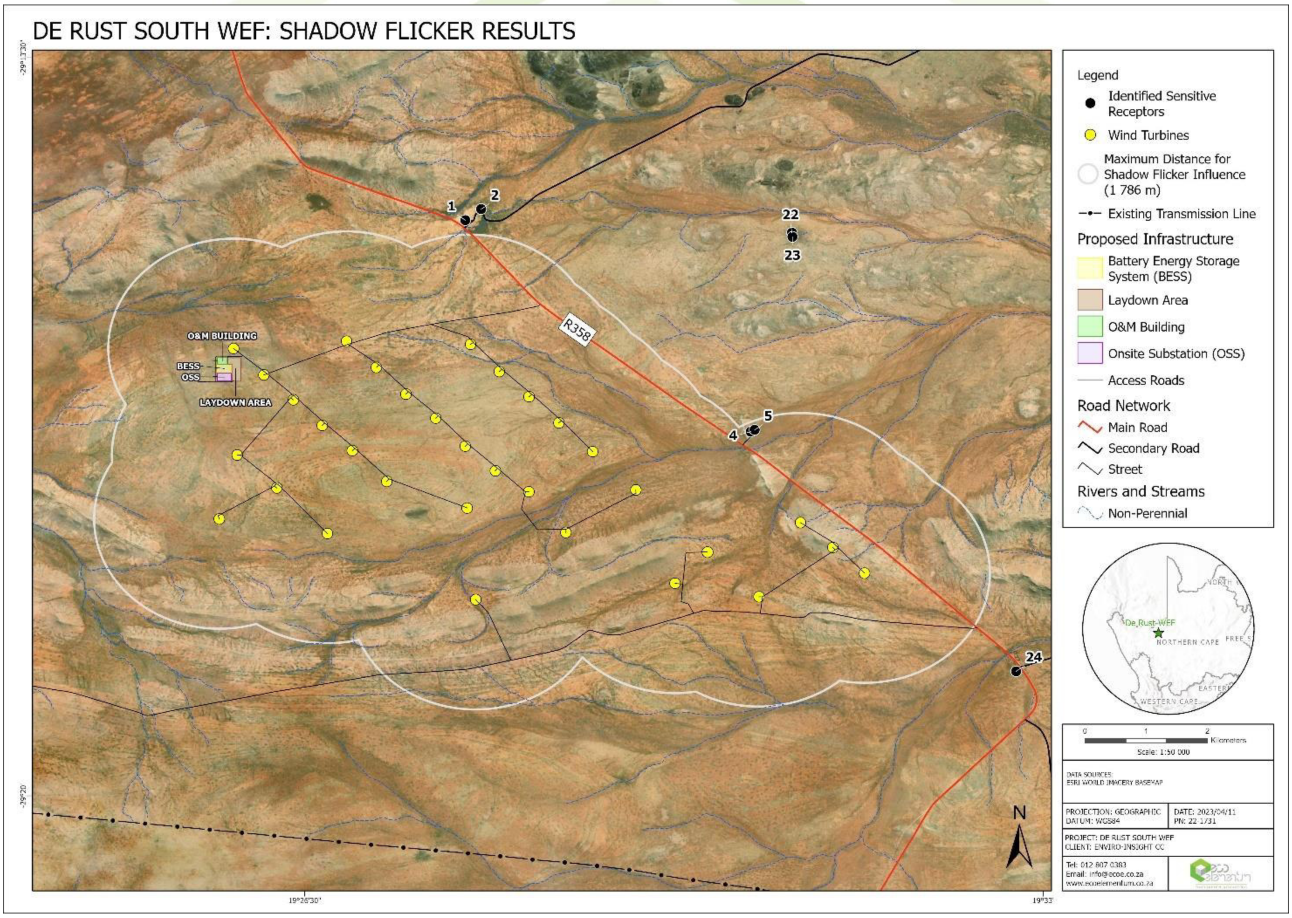

Figure 9.1: Shadow Flicker Results

10. VISUAL AND SHADOW FLICKER IMPACT ASSESSMENT

10.1 Impact Criteria

The level of detail as depicted in the EIA regulations were fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project.

The impact assessment criteria used to determine the impact of the proposed development are as follows:

1. ***Severity*** of the impact;
1. **Spatial Scale** - The physical and spatial scale of the impact;
2. ***Duration*** - The lifetime of the impact, measured in relation to the lifetime of the proposed development;
3. ***Frequency of the Activity*** – How often do the activity take place;
4. ***Frequency of the incident/impact*** – How often does the activity impact on the environment;
5. ***Legal Issues*** – How is the activity governed by legislation; and
6. ***Detection*** – How quickly/easily the impacts/risks of the activity be detected on the environment, people and property.

To ensure uniformity, the assessment of potential impacts will be addressed in a standard manner so that a wide range of impacts is comparable. For this reason a clearly defined rating scale is provided for the specialist to assess impacts associated with the investigation.

Table 10-1: Assessment Criteria

SEVERITY	
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful / within a regulated sensitive area	5
SPATIAL SCALE	
Area specific (at impact site)	1
Whole site (entire surface right)	2
Local (within 5 km)	3
Regional / neighboring areas (5 km to 50 km)	4
National	5
DURATION	
One day to one month (immediate)	1
One month to one year (Short term)	2
One year to 10 years (medium term)	3
Life of the activity (long term)	4
Beyond life of the activity (permanent)	5
FREQUENCY OF THE ACTIVITY	
Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5
FREQUENCY OF THE INCIDENT/IMPACT	
Almost never / almost impossible / >20%	1

Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5
LEGAL ISSUES	
No legislation	1
Fully covered by legislation	5
DETECTION	
Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development.

10.1.1 Consequence

Consequence is determined by the following equation after the assessment of each impact.

Consequence = Severity + Spatial Scale + Duration

10.1.2 Likelihood

The Likelihood of the activity is then calculated based on frequency of the activity and impact, how easily it can be detected and whether the activity is governed by legislation. Thus:

Likelihood = Frequency of activity + frequency of impact + legal issues + detection

10.1.3 Risk

The risk is then based on the consequence and likelihood.

Risk = Consequence x likelihood

10.1.4 Impact Ratings

The impact is then rated according to the following table:

Table 10-2: Impact Rating Table

Rating	Class
1-55	(L) Low Risk
56-169	(M) Moderate Risk
170-300	(H) High Risk

10.2 Visual Impact Assessment

This section will attempt to quantify the potential visual impacts on the identified sensitive receptors. The potential visual impacts and visual impact ratings consider the viewshed and visual exposure results along with the potential visual impact on the study areas current sense of place.

10.2.1 Potential Construction Phase Visual Impacts

Table 10-3: Construction Phase Visual Impact Assessment

Nature of impacts:

- Visual intrusion due to the removal of vegetation, temporary soil stockpiling, movement of construction vehicles and heavy machinery, presence of laydown areas and site clearance.
- Light pollution due to night lighting.
- Dust pollution due to site clearance and movement of construction vehicles and heavy machinery.

		Unmitigated	Mitigated
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**3**	**2**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	**2**	**1**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**2**	**2**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**5**	**5**
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**3**	**2**
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	**1**	**1**
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	**3**	**3**
Consequence	Severity + Spatial Scale + Duration	**7**	**5**
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	**12**	**11**
Risk	Consequence * Likelihood	**MODERATE (84)**	**LOW (55)**

Mitigation:

- Limit the construction footprint to only the development area.
- Ensure ongoing housekeeping.
- Carefully plan to minimize the construction duration.
- Inform receptors of the construction programme and schedule.
- Regulate the speed of vehicles on and off site.
- Use existing roads where possible.
- Limit the number of construction vehicles travelling to and from site.
- Implement dust suppression activities.

Nature of impacts:	
- Visual intrusion due to the removal of vegetation, temporary soil stockpiling, movement of construction vehicles and heavy machinery, presence of laydown areas and site clearance. - Light pollution due to night lighting. - Dust pollution due to site clearance and movement of construction vehicles and heavy machinery.	
	- Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. - Remove vegetation in a phased manner. - Choose lighting types that reduce spill light and glare. - Only focus light where it is needed.

10.2.2 Potential Operational Phase Visual Impacts

Table 10-4: Operational Phase Visual Impact Assessment

Nature of impacts:			
- Change in visual/landscape character and sense of place due to the presence of the wind turbines and ancillary infrastructure. - Visual intrusion from the wind turbines dominating the skyline in a largely natural area. - Visual intrusion from the movement of construction vehicles and heavy machinery - Dust pollution from operation and maintenance vehicles. - Light pollution due to night lighting, security lighting and navigational lighting - Visual impact on the identified sensitive receptors			
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**4**	**3**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	**4**	**4**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**4**	**4**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**5**	**5**
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**4**	**4**
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	**1**	**1**
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	**1**	**1**
Consequence	Severity + Spatial Scale + Duration	**12**	**11**
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	**11**	**11**
Risk	Consequence * Likelihood	**MODERATE (132)**	**MODERATE (111)**

Nature of impacts:	
- Change in visual/landscape character and sense of place due to the presence of the wind turbines and ancillary infrastructure. - Visual intrusion from the wind turbines dominating the skyline in a largely natural area. - Visual intrusion from the movement of construction vehicles and heavy machinery - Dust pollution from operation and maintenance vehicles. - Light pollution due to night lighting, security lighting and navigational lighting - Visual impact on the identified sensitive receptors	
Mitigation:	- Retain and maintain natural vegetation within and around the development footprint where possible. - Wind turbines should not be brightly coloured or have logos. - Natural colours should be used on ancillary infrastructure so that they blend into the surrounding landscape. - If a wind turbine/s needs replacement, it should be replaced with a turbine of the same model/height to maintain uniformity. - Non-reflective surfaces should be utilized where possible. - Implement dust suppression activities. - All inoperable wind turbines should be repaired as soon as possible. - All infrastructure should be always kept in a presentable condition. - Regulate the speed of vehicles on and off site. - Use existing roads where possible. - Ensure ongoing housekeeping. - Choose lighting types that reduce spill light and glare. - Only focus light where it is needed

10.2.3 Potential Decommissioning Phase Visual Impacts

Table 10-5: Decommissioning Phase Visual Impact Assessment

Nature of impacts:			
- Change in landscape character due to the removal of infrastructure. - Visual intrusion due to the removal of infrastructure, movement of construction vehicles and heavy machinery and presence of laydown areas. - Light pollution due to night lighting. - Dust pollution due to infrastructure removal and movement of construction vehicles and heavy machinery.			
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**3**	**2**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	**2**	**1**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**2**	**2**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**5**	**5**

Nature of impacts: - Change in landscape character due to the removal of infrastructure. - Visual intrusion due to the removal of infrastructure, movement of construction vehicles and heavy machinery and presence of laydown areas. - Light pollution due to night lighting. - Dust pollution due to infrastructure removal and movement of construction vehicles and heavy machinery.			
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**3**	**2**
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	**1**	**1**
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	**3**	**3**
Consequence	Severity + Spatial Scale + Duration	**7**	**5**
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	**12**	**11**
Risk	Consequence * Likelihood	**MODERATE (84)**	**LOW (55)**
Mitigation:	- Limit the decommissioning footprint to only the development area. - Carefully plan to minimize the decommissioning duration. - Inform receptors of the decommissioning programme and schedule. - Regulate the speed of vehicles on and off site. - Use existing roads where possible. - Limit the number of vehicles travelling to and from site. - Implement dust suppression activities. - Ensure ongoing housekeeping. - Revegetate areas with suitable indigenous vegetation. - Where possible, reshape the area so that the resembles the pre-construction landscape. - Remove as much infrastructure as possible. - Ensure that residual infrastructure remains in good condition. - Choose lighting types that reduce spill light and glare. - Only focus light where it is needed. - Ensure monitoring of rehabilitated areas for at least a year after decommissioning activities are completed.		

10.2.4 Cumulative Visual Impacts

Cumulative visual impacts can result from additional changes to the landscape/visual amenity caused by the proposed development in conjunction with other existing developments (associated with or separate to it), or by actions that occurred in the past, present or are likely to occur in the foreseeable future. Cumulative effects can also arise from the inter-visibility (visibility) of a range of developments and/or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effects on visual receptors within their combined visual envelopes. Inter-visibility depends upon general topography, aspect, tree cover, elevation and distance, as this affects visual acuity, which is also influenced by weather and light conditions. (Institute of Environmental Assessment and The Landscape Institute, 1996).

Considering the above, should additional renewable energy facilities be constructed within the broader study area, the potential cumulative visual impacts needs to be addressed as several of these facilities within the same area can significantly alter the areas current sense of place. Table 10-6 overleaf indicates the status of renewable energy developments within 30 km of the proposed development (as shown earlier in Figure 4.12 within Section 4.6). Fifteen renewable energy developments were identified, 4 of which are Solar Energy Facilities (SEF's) and the remaining 11 are WEF's. Furthermore, 6 of the applications are in process and 9 of the projects have been approved. It is important to note that duplicate projects are included in the database therefore, Figure 10.1 visually depicts the status of the surrounding renewable energy projects. Furthermore, it should be noted that from the satellite imagery, construction of the approved facilities has not yet begun.

Table 10-6: Status of renewable energy developments within 30 km of the proposed WEF

No	Project Title	Technology	Project Status
1	The Proposed Construction Of A Solar Energy Facility And Associated Infrastructure On Portion 1 (Remaining Extent) Of Farm 209 (Poortje) And On Portions 1 And 2 Of Farm 212 (Namies South) On South West Of Pofadder, Northern Cape Province	PV	Approved
2	Proposed wind energy facility and associated infrastructure on Namies wind farm (Pty) Ltd, near Aggeneys, Northern Cape Province	Wind	Approved
3	Proposed 140MW Khai-Mai wind energy facility near Pofadder	PV	Approved
4	Proposed 140MW Poortjies Wind energy facility, near Pofadder in the Northern Cape Province	Wind	Approved
5	Proposed 140MW Korana wind energy near Pofadder in the Khai-Mai Local Municipality in the Northern Cape Province	Wind	Approved
6	The establishment of the 140MW Korona wind energy facility on portion 1 and 2 of farm namies south 212 and portion 1 of farm poortjie 209 near pofadder within the Khai-Ma Local Municipality in the Northern Cape Province	Wind	Approved
7	Proposed 75MW Korana Wind energy facility, near Poffader in the Northern Cape Province	Wind	Approved
8	Proposed 140MW Khai-Mai wind energy facility near Pofadder	PV	In process
9	Proposed 100MW Poortjies Wind energy facility, near Pofadder in the Northern Cape Province	Wind	In process
10	The construction of a 140MW Korona wind energy facility on portion 1 and 2 of the farm Namies South 212 and portion 1 of the farm Poortjies 209 located near Pofadder, within the Khai-Ma local municipality in the Northern Cape Province	Wind	In process
11	Proposed 140MW Korana wind energy near Pofadder in the Khai-Mai Local Municipality in the Northern Cape Province	Wind	In process
12	The construction of the 140MW Korana WEF on portion 1 & 2 of the farm Namies South 212 and portion 1 of the farm Poortjie 209, Near Pofadder, Northern Cape Province	Wind	In process
13	Proposed 75MW Korana solar energy facility, near Poffader in the Northern Cape Province	Wind	In process
14	Proposed construction of PV solar power plants on site 1 (Konkoonsies) and site 2 (Kleinzwart) near Kenhard, Northern Cape Province	PV	Approved
15	Proposed 300 MW Paulputs Wind Energy Facility (WEF) and Associated 132 kV Grid Connection, Northern Cape Province	Wind	Approved

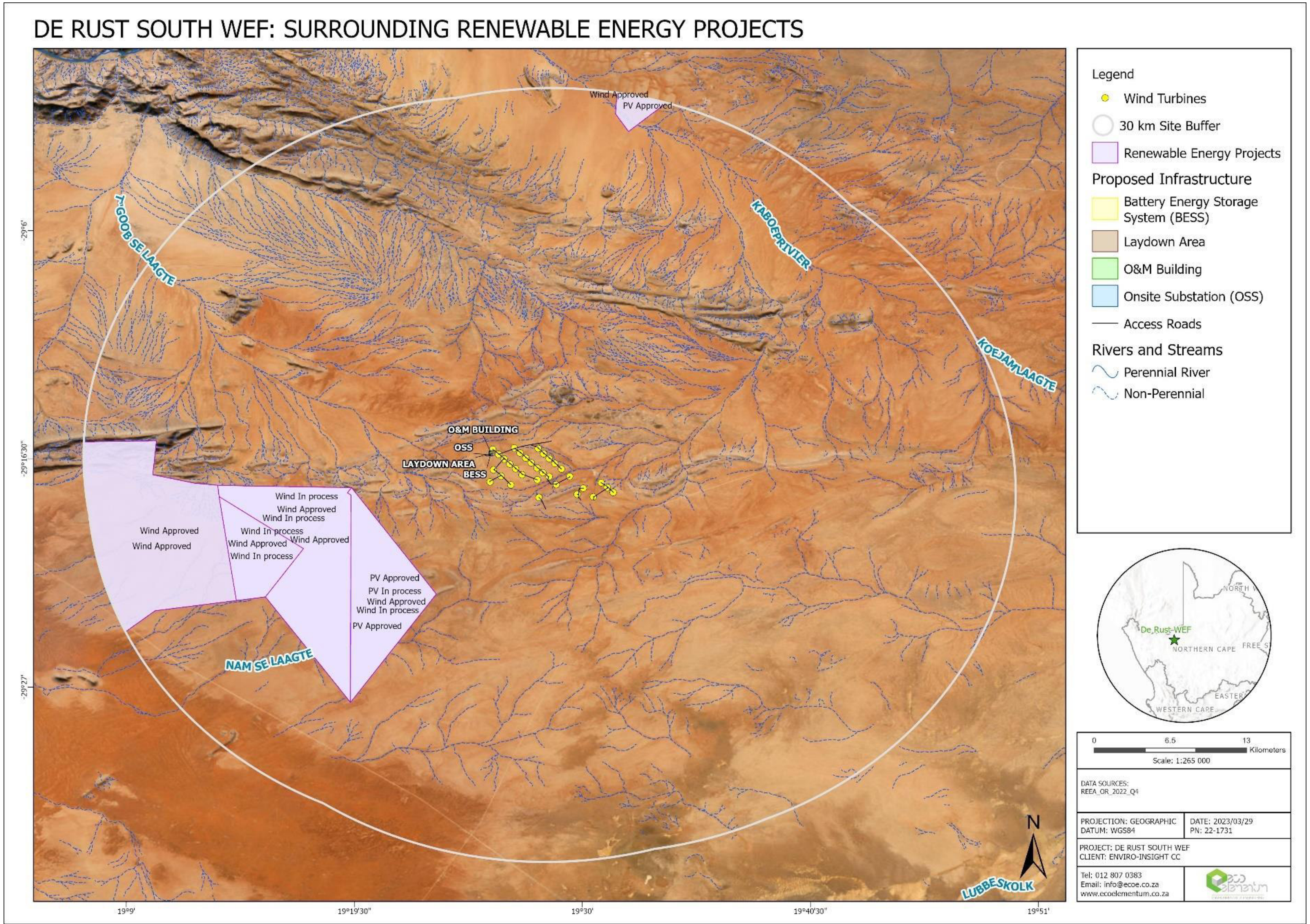

Figure 10.1: Renewable energy projects within 30 km of the site

Figure 10.2 overleaf shows the visual exposure results for the current application in relation to the surrounding renewable energy projects. The figure includes 15 km buffers surrounding the identified renewable energy projects. A 15 km site buffer was used as the total study area for comparative purposes, in keeping with the 15 km total study area applied for the current visual analysis. It is assumed that the surrounding WEF's will have a viewshed which covers the entire 15 km buffer, due to the extreme height of the wind turbines. The figure further shows the level of visual exposure expected from the proposed WEF on the identified sensitive receptors as per the visual analysis results. From a cumulative visual impact perspective, the figure indicates that portions of the road network and 44% of the identified homesteads lie within the 15 km buffers of the proposed and surrounding renewable energy projects and are therefore expected to experience cumulative visual impacts. Furthermore, approximately 9% of the land, within 30 km of the proposed WEF, is expected to be transformed by the proposed and current surrounding renewable energy projects.

In addition, the findings from the VIA's of the surrounding renewable energy projects were considered in the cumulative visual impact analysis. It is important to note that not all reports were available at the time of this study, and some sources were limited to amendment reports, EIA reports, draft Environmental Management Programmes (EMP's) and draft Environmental Authorisation (EA) amendment reports. Overall, the reports indicated similar findings and impact ratings as identified for the current WEF and recommended that the proposed projects go ahead provided that the mitigation measures are implemented. Furthermore, the studies shared similar sentiments in that the remoteness of the site, the absence of any major scenic resources or protected areas, the low density of visual receptors and the fact that the area could be seen as a renewable energy node would reduce the significance of the project's visual impacts and cumulative visual impacts.

Considering the above, Table 10-7 thereafter rates the potential cumulative visual impacts and provides suitable mitigation measures. The potential cumulative visual impact was rated only for the operational phase of the facilities as it is unlikely that the construction and decommissioning phase of each project will occur simultaneously. Where the visual assessments were available for the identified projects, the recommendations, mitigation measures and conclusions deduced from the approved and in process applications were also considered in the impact rating. Furthermore, the cumulative visual impacts were rated on the assumption that the recommended mitigation measures from the surrounding renewable energy projects will be implemented once the respective facilities are operational.

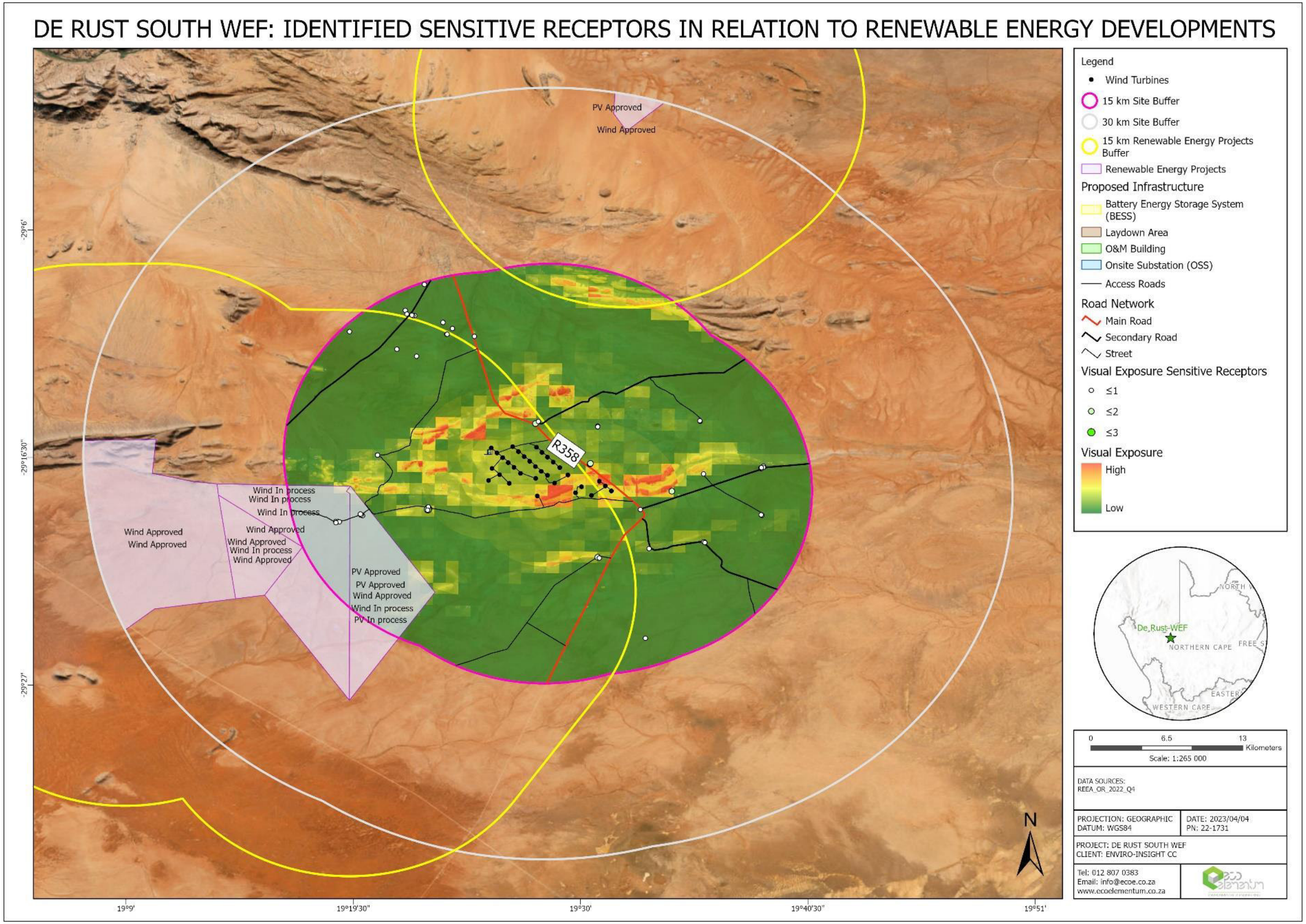

Figure 10.2: Identified sensitive receptors visual exposure in relation to surrounding renewable energy projects

Table 10-7: Cumulative Visual Impact Assessment

Nature of impacts:

- Change in visual/landscape character and sense of place, due to the presence of additional renewable energy facilities, from a largely undeveloped landscape to a more industrial type of landscape.
- Additional levels of visual intrusion due to the presence of additional renewable energy facilities and from the movement of additional maintenance vehicles and heavy machinery.
- Additional dust pollution due to increased traffic.
- Additional light pollution due to additional night lighting, security lighting and navigational lighting.
- Increased visual impact on the identified sensitive receptors.

		Unmitigated	Mitigated
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	4	3
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5 km to 50 km) (4); National (5)]	4	4
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	4	4
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	5	5
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	5	4
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	1	1
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	1	1
Consequence	Severity + Spatial Scale + Duration	12	11
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	12	11
Risk	Consequence * Likelihood	**MODERATE (144)**	**MODERATE (111)**

Mitigation:	- The recommended mitigation measures for the operational phase visual impacts, provided in Table 10-4, should be implemented. - Where necessary, liaise with the neighbouring renewable energy facility's management to mutually decrease visual impacts on visually impacted sensitive receptors.

10.2.5 Summary of The Visual Impact Assessment

The impact assessments in Table 10-3 to Table 10-5 above indicates that the proposed WEF and associated infrastructure will create a moderate negative visual impact on the surrounding areas during each phase of the activity. These moderate impacts can be reduced to a low visual impact after the recommended mitigation measures are implemented for the construction and decommissioning phases. However, the overall visual impact will remain as a moderate negative impact during the operational phase of the project, following mitigation.

The construction phase of the proposed project is expected to be visible from the surrounding areas however, the time of exposure to these activities will be short. Therefore, the impacts on the sensitive receptors are expected to be lower after the mitigation measures have been implemented. For the operational phase, the visual impact of the WEF and construction vehicles can be reduced after the recommended mitigation measures are implemented however, the visual impact will remain as moderate. This is mostly due to the time of exposure to these activities being long-term and to the extreme height of the proposed wind turbines. During the closure phase of the project, all moderate visual impacts can be lowered to a low negative impact.

Table 10-7 indicates that moderate levels of cumulative visual impacts are expected during the operational phase of the project. The level of visual impact can be reduced after the implementation of the recommended mitigation measures however, the impact will remain as a moderate negative impact due to the extreme height of the wind turbines, the inability of the landscape to completely screen the wind turbines, the proximity of the surrounding renewable energy facilities, the long-term nature of the projects and the alteration in the areas sense of place.

From a cumulative visual impact perspective, the proposed WEF and surrounding renewable energy developments are expected to cause cumulative visual impacts and alter the study areas current sense of place and visual character. However, it is anticipated that the identified cumulative visual impacts can be lowered to acceptable levels provided that the recommended mitigation measures mentioned in this report and within the surrounding project's VIA's be adhered to.

Overall, the potential visual impacts of the proposed WEF can be lowered if the recommended mitigation measures are implemented however, the operation of the proposed WEF will have a moderate negative impact on the surrounding area.

10.2.6 No-Go/Without project option

There will be no additional/new visual impact should the proposed project not proceed. The expected visual impacts from the surrounding approved renewable energy facilities will occur once they are constructed. The cumulative visual impacts will not increase on account of the proposed WEF however, a change in sense of place and cumulative visual impacts are still expected from the surrounding renewable energy facilities.

10.2.7 Visual Impact Mitigation Measures

Mitigation measures may be considered in two categories:

- Primary measures that intrinsically comprise part of the development design through an iterative process. Mitigation measures are more effective if they are implemented from project inception when alternatives are being considered.
- Secondary measures designed to specifically address the remaining negative effects of the final development proposals.

Primary measures that will be implemented will mainly be measures that will minimise the potential visual impact by softening the visibility of the structures by "blending" with the surrounding areas. Such measures will include rehabilitation of the structures by re-vegetation. Secondary measures will include final rehabilitation, after care and maintenance of the vegetation and to ensure that the final landform is maintained.

It is important to note that for this specific study, the extreme height of the wind turbines makes it difficult to completely screen the structures. However, general mitigation measures have been recommended and should be adhered to in order to lessen the visual impact as far as possible.

From a cumulative visual impact perspective, it is further recommended that should the construction phase and decommissioning phases of the surrounding projects occur simultaneously, the implementation of the mitigation measures provided in Table 10-3 and Table 10-5 should still be adhered to in order to reduce cumulative visual impacts.

Considering the viewshed and visual exposure results and the visual impact assessment, the recommended WEF can proceed from a visual perspective provided that the recommended mitigation measures are adhered to.

10.3 Shadow Flicker Impact Assessment

No shadow flicker impacts are expected on the identified receptors therefore, an impact assessment is not required.

10.3.1 Cumulative Shadow Flicker Impacts

Figure 10.3 below shows the expected cumulative shadow flicker impacts from the surrounding approved WEF's on the identified receptors. A conservative maximum distance for shadow flicker influence of 2 km was applied for the surrounding approved WEF's. The figure indicates that no cumulative shadow flicker impacts are expected on the identified receptors.

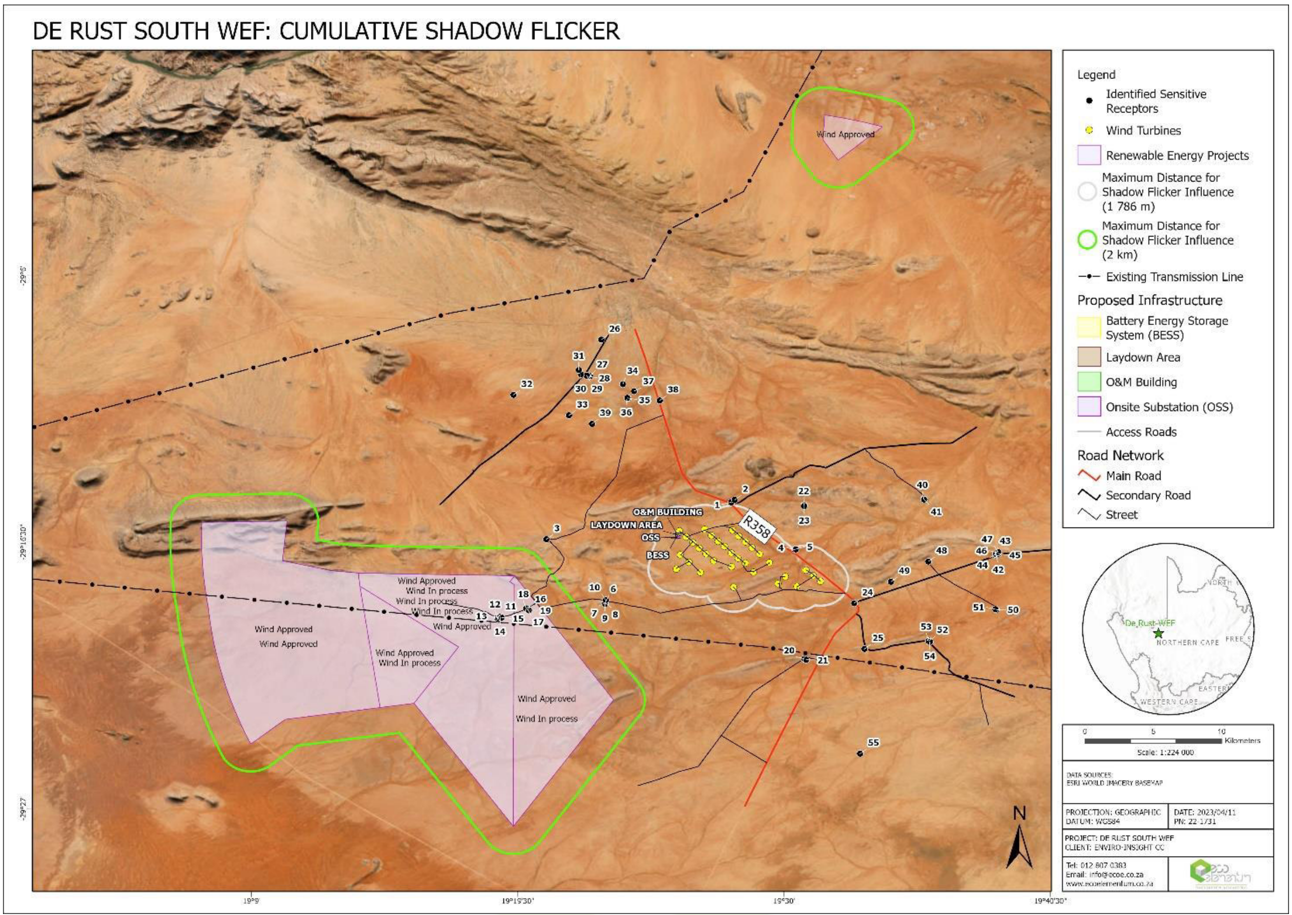

Figure 10.3: Cumulative Shadow Flicker Impacts

10.3.2 Shadow Flicker Impact Mitigation Measures

The shadow flicker results indicated that no shadow flicker impacts are expected on the identified receptors therefore, no mitigation measures are recommended. However, should shadow flicker impacts become problematic on the surrounding road users, it is recommended that that suitable vegetation be planted and maintained between the wind turbine/s causing shadow flicker and the affected portion of the road network in attempt to diffuse the shadow flicker impacts.

Shadow flicker impact mitigation measures are relatively easy to implement and once implemented, the impacts will be minimal or removed entirely. Therefore, if the abovementioned recommendations and mitigation measures are adhered to, the proposed WEF can proceed from a shadow flicker perspective.

10.3.3 No-Go/Without project option

There will be no additional/new shadow flicker impacts should the proposed project not proceed.

11. CONCLUSION

The above assessment analysed the potential visual impacts and shadow flicker impacts that the proposed WEF may have on the surrounding identified receptors. From a visual perspective, the results indicates that the proposed WEF and associated infrastructure will create a moderate negative visual impact on the surrounding areas during each phase of the activity. These moderate impacts can be reduced to a low visual impact after the recommended mitigation measures are implemented for the construction and decommissioning phases. However, the overall visual impact will remain as a moderate negative impact during the operational phase of the project, following mitigation.

The construction phase of the proposed project is expected to be visible from the surrounding areas however, the time of exposure to these activities will be short. Therefore, the impacts on the sensitive receptors are expected to be lower after the mitigation measures have been implemented. For the operational phase, the visual impact of the WEF and construction vehicles can be reduced after the recommended mitigation measures are implemented however, the visual impact will remain as moderate. This is mostly due to the time of exposure to these activities being long-term and to the extreme height of the proposed wind turbines. During the closure phase of the project, all moderate visual impacts can be lowered to a low negative impact.

From a cumulative visual impact perspective, moderate levels of cumulative visual impacts are expected during the operational phase of the project. The level of visual impact can be reduced after the implementation of the recommended mitigation measures however, the impact will remain as a moderate negative impact due to the extreme height of the wind turbines, the inability of the landscape to completely screen the wind turbines, the proximity of the surrounding renewable energy facilities, the long-term nature of the projects and the alteration in the areas sense of place.

Cumulatively, the proposed WEF and surrounding renewable energy developments are expected to cause cumulative visual impacts and alter the study areas current sense of place and visual character. However, it is anticipated that the identified cumulative visual impacts can be lowered to acceptable levels provided that the recommended mitigation measures mentioned in this report and within the surrounding project's VIA's be adhered to.

Furthermore, the shadow flicker analysis results indicated that no shadow flicker impacts from the proposed WEF are expected on the identified receptors. It was noted that motorists travelling on the road network may experience momentary shadow flicker impacts. However, as there are no areas of tourism or protected areas present within the study area, the volume of traffic on the road network is expected to be low therefore, the level of shadow flicker impacts is expected to be minor/insignificant. Cumulative shadow flicker impacts from the surrounding approved WEF's and the proposed WEF are also not expected.

Mitigation measures for the proposed WEF have also been recommended and should be adhered to in order to lessen the identified visual and shadow flicker impacts.

Overall, the proposed WEF is expected to alter the study areas current sense of place. However, considering the municipality's objectives and the surrounding approved wind and solar projects, an alteration to the area's current sense of place is expected. Therefore, the proposed WEF is expected to blend in with the areas future sense of place, which is expected to include additional renewable energy projects.

Considering the above analysis, including the results of the viewshed and visual exposure analysis, shadow flicker analysis, impact assessments, future land use trends and low density of identified sensitive receptors, the proposed De Rust South WEF project can proceed from a visual and shadow flicker perspective provided that the recommended mitigation measures are adhered to.

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APPENDIX A – SPECIALIST CV'S

GIS TECHNICIAN

ENVIRONMENTAL & ENGINEERING

Nakéla Naidoo

ABOUT

Nakéla has six years of work experience, and more than four years of that comprises of GIS experience. Nakéla gained valuable skills in applications for Environmental Authorisations, Integrated Water and Waste Management Plans and Basic Assessment Reports, and progressed to a GIS Consultant to expand her skills with Visual Impact Assessments, Viewshed Analyses, data processing and map outputs. She is currently registered with SACNASP as a Cand.Sci.Nat and is working towards her professional accreditation.

GIS CAREER HISTORY

GIS Technician
Eco Elementum (Pty) Ltd
Pretoria
September 2021 - present

Role:
Compiling map sets for various disciplines, data acquisition, data analysis, data processing, database management, Visual Impact Assessments and attending to daily ad hoc GIS requests.

GIS Consultant
Groundwater Consulting Services:
Pretoria
June 2018 to August 2021

Role:
Map outputs, Visual Impact Assessments, GIS with specialist data, data acquisition, data analysis, data processing, volumetric calculations, Water Use Licence Applications, Applications for Environmental Authorisations for several mining and housing projects.

QUALIFICATIONS

BSc Honours: Environmental Science
University of KwaZulu-Natal
2016

BSc: Environmental Science
University of KwaZulu-Natal
2013 - 2015

EXPERTISE AND SKILLS

Skills include, but are not limited to:

- Global Mapper; ArcGIS Pro and ArcGIS Online;
- Visual Impact Assessments;
- Database Management (data acquisition, updating databases, data processing and data interpretation);
- Managing Budgets and monitoring workloads;
- Invoicing;
- Microsoft Office;
- SPSS Software – Basic skill level; and
- Verbal and written communication skills and;
- Academic report writing skills.

REGISTRATIONS

Professional Registrations

- Golden Key Association (2014), **Reg, No. 11966485.**
- Geo-Information Society of South Africa (GISSA) (2019), **Reg. No. JSXW-0336.**
- SACNASP - Cand.Sci.Nat (2019), **Reg. No. 120896.**

PROJECT EXPERIENCE RELATED TO VISUAL IMPACT ASSESSMENTS

Year	Project Name	Role
2023	Kopermyn Opencast Pit	Visual Impact Assessment
2023	Hillside Siding Washplant	Visual Impact Assessment
2023	Umzimkhulu River Weir & Pipeline Project	Visual Impact Assessment
2023	Decommissioning of the Komati Power Station	Visual Impact Assessment
2022	Ferrum-Upington 400kV Powerline Project	Visual Impact Assessment
2022	Mzimkhulu Expansion	Visual Impact Assessment
2022	Nndanganeni Colliery	Visual Impact Assessment
2022	Paradise Solar PV Project	Visual Impact Assessment
2022	Roodepoort Coal	Visual Impact Assessment
2022	Parys Solar PV Project	Visual Impact Assessment
2022	Red Sands Wind Farm	Visual Impact Assessment
2022	SRK Amandelbult Complex	Visual Impact Assessment
2021	Lephalale Solar Plant	Visual Impact Assessment
2020	Kareerand VIA	Visual Impact Assessment
2020	Tendele Coal	Visual Impact Assessment
2019	Tendele Coal	Visual Impact Assessment
2019	Buffalo Coal Powerline Phase 2	Visual Impact Assessment
2018	Buffalo Coal Powerline Phase 1	Visual Impact Assessment

ENVIRONMENTAL SCIENTIST

NEEL BREITENBACH

ABOUT

Neel is a GIS and Air Quality Specialist with more than 12 years' experience in the GIS, Air Quality and Visual Impact industry. His key experience includes GIS support for the Environmental Science sector and Air Quality Impact Assessments for dust and particulate matter as well as Visual Impact Assessments.

Neel has experience in Software development for the Environmental Science sector including Python, JavaScript web applications, and various Databases, including Firebase and Sql.

CAREER HISTORY

Senior Air Quality Specialist
Eco Elementum (Pty) Ltd
Pretoria
2016 – Present

Role:
Project management and co-ordination of multidisciplinary Air Quality and Visual Impact related projects. He has extensive experience in GIS.

Project Manager
SME
Pretoria
2012 – 2014

Role:
Project management and co-ordination of multidisciplinary projects.

QUALIFICATIONS

B.Sc. (Geography)
University of Pretoria
2008

Senior Certificate Matric
Higher Technical School John Vorster
2002

EXPERIENCE

Experience include:

ASC 1.1 2016 to Date Eco-Elementum, Air Quality, Visual Impact and GIS Specialist.

ASC 1.2 2012 to 2014 SME –Project manager, ISO 9001 implementation.

SKILLS

Skills include, but are not limited to:

ASC 1.5 Key experience include project co-ordination of multidisciplinary air quality

neel@ecoe.co.za | 083 419 2249 | 361 Oberon Ave, Glenfield Office Park, Nika Building, 1st Floor, Faerie Glen, Pretoria, 0081 | www.ecoe.co.za

PROJECT EXPERIENCE RELATED TO VISUAL IMPACT ASSESSMENTS

Year	Project Name	Role
2017	Ergosat	Visual Impact Assessment
2018	Mahikeng Substation and Powerline	Visual Impact Assessment
2018	Kleinfontein	Visual Impact Assessment
2018	Glenover Phosphate	Visual Impact Assessment
2018	Welgedacht	Visual Impact Assessment
2018	Mookodi-Mahikeng Powerline	Visual Impact Assessment
2018	Bloemendal	Visual Impact Assessment
2019	Rondevlei	Visual Impact Assessment
2019	Emkhiweni Powerline	Visual Impact Assessment
2019	Windsor TSF	Visual Impact Assessment
2019	Dunbar	Visual Impact Assessment
2019	Wildebeestfontein	Visual Impact Assessment
2019	Weltevreden	Visual Impact Assessment
2019	Blesboklaagte	Visual Impact Assessment
2019	Isiko Malt	Visual Impact Assessment
2019	South 32	Visual Impact Assessment
2019	Beryl	Visual Impact Assessment
2020	Van Oudshoornstroom	Visual Impact Assessment
2020	Sylvania Lanex	Visual Impact Assessment
2020	Sylvania Tweefontein	Visual Impact Assessment
2020	Bronberg Development	Visual Impact Assessment
2020	Salene Manganese	Visual Impact Assessment
2020	Mooinooi	Visual Impact Assessment
2020	Roossenekal	Visual Impact Assessment
2020	Tiara Granville	Visual Impact Assessment
2021	Lakeside Leeuwfontein	Visual Impact Assessment
2021	Koppie	Visual Impact Assessment
2021	Streamliner	Visual Impact Assessment
2021	Straffontein	Visual Impact Assessment
2021	Sere Solar PV	Visual Impact Assessment
2021	Safari Lomonde	Visual Impact Assessment
2021	Paardeplaats	Visual Impact Assessment
2022	Kleinwater Doornrug	Visual Impact Assessment
2022	Amandelbult	Visual Impact Assessment
2022	Altina Solar PV	Visual Impact Assessment

APPENDIX B – SHADOW FLICKER ANALYSIS MAIN RESULTS AND ASSUMPTIONS

Licensed user:
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361 Oberon Ave
ZA-PRETORIA Pretoria
0834192249
Nakela / nakela@ecoe.co.za
Calculated:
2023/04/06 11:18/3.6.366

SHADOW - Main Result

Calculation: South WEF - Worst Case

Assumptions for shadow calculations

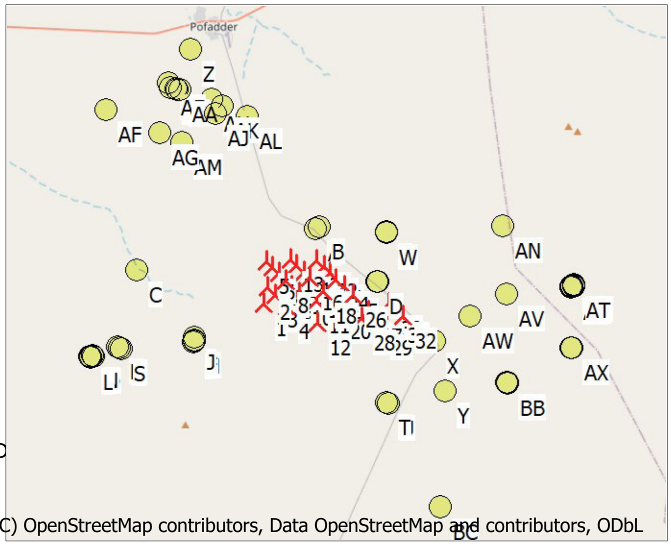
Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Elevation Grid Data Object: SouthWEF_20230406_EMD
Receptor grid resolution: 1.0 m
Topographic shadow included in calculation

All coordinates are in
Geo [deg]-WGS84



Scale 1:500 000
New WTG   Shadow receptor

WTGs

					WTG type						Shadow data	
	Longitude	Latitude	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	19.429152° E	-29.292716° N	1 087.3	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
2	19.431752° E	-29.283325° N	1 093.5	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
3	19.437578° E	-29.288157° N	1 095.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
4	19.445015° E	-29.294839° N	1 081.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
5	19.431218° E	-29.267682° N	1 075.8	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
6	19.435665° E	-29.271579° N	1 083.2	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
7	19.440016° E	-29.275226° N	1 088.9	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
8	19.444235° E	-29.278970° N	1 092.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
9	19.448658° E	-29.282679° N	1 090.1	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
10	19.453701° E	-29.287182° N	1 080.2	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
11	19.465499° E	-29.291130° N	1 064.3	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
12	19.466739° E	-29.304557° N	1 071.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
13	19.447797° E	-29.266617° N	1 083.7	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
14	19.452188° E	-29.270450° N	1 082.7	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
15	19.456518° E	-29.274387° N	1 080.7	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
16	19.460877° E	-29.277909° N	1 075.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
17	19.465229° E	-29.282030° N	1 072.1	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
18	19.469626° E	-29.285639° N	1 067.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
19	19.474547° E	-29.288732° N	1 058.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
20	19.479990° E	-29.294707° N	1 056.7	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
21	19.465973° E	-29.267084° N	1 069.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
22	19.470220° E	-29.271070° N	1 065.5	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
23	19.474597° E	-29.274774° N	1 059.7	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
24	19.478940° E	-29.278601° N	1 056.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
25	19.483914° E	-29.282843° N	1 050.3	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
26	19.490248° E	-29.288435° N	1 046.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
27	19.500753° E	-29.297584° N	1 042.2	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
28	19.496005° E	-29.302159° N	1 045.9	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
29	19.508301° E	-29.304131° N	1 043.0	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
30	19.514402° E	-29.293261° N	1 044.3	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
31	19.519142° E	-29.296886° N	1 050.4	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7
32	19.523805° E	-29.300655° N	1 038.3	NORDEX N163/5.X 57...	Yes	NORDEX	N163/5.X-5 700	5 700	163.0	148.0	1 786	10.7

SHADOW - Main Result

Calculation: South WEF - Worst Case

Shadow receptor-Input

No.	Longitude	Latitude	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
A	19.465214° E	-29.248853° N	1 065.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
B	19.467546° E	-29.247246° N	1 062.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
C	19.343720° E	-29.273067° N	1 010.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
D	19.507103° E	-29.279896° N	1 033.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
E	19.507677° E	-29.279639° N	1 030.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
F	19.382640° E	-29.314413° N	1 067.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
G	19.382576° E	-29.314746° N	1 068.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
H	19.382444° E	-29.314936° N	1 067.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
I	19.382275° E	-29.315532° N	1 067.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
J	19.382739° E	-29.313119° N	1 064.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
K	19.311545° E	-29.324432° N	1 062.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
L	19.311754° E	-29.325116° N	1 062.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
M	19.312022° E	-29.324451° N	1 061.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
N	19.313292° E	-29.324233° N	1 061.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
O	19.314277° E	-29.324552° N	1 063.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
P	19.330790° E	-29.319230° N	1 074.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
Q	19.331231° E	-29.319078° N	1 074.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
R	19.330428° E	-29.318495° N	1 072.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
S	19.332285° E	-29.319668° N	1 074.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
T	19.513248° E	-29.351765° N	1 037.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
U	19.514485° E	-29.352259° N	1 036.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
V	19.513137° E	-29.250692° N	1 026.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
W	19.513213° E	-29.251313° N	1 025.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
X	19.546027° E	-29.315064° N	1 014.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
Y	19.552801° E	-29.345148° N	1 032.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
Z	19.379856° E	-29.141933° N	1 009.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AA	19.372426° E	-29.165937° N	1 034.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AB	19.370966° E	-29.165937° N	1 032.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AC	19.370181° E	-29.165494° N	1 032.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AD	19.366369° E	-29.164753° N	1 032.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AE	19.365037° E	-29.161858° N	1 034.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AF	19.322085° E	-29.178210° N	975.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AG	19.358558° E	-29.191702° N	1 012.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AH	19.394018° E	-29.171133° N	1 045.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AI	19.397382° E	-29.180297° N	1 038.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AJ	19.396920° E	-29.180219° N	1 038.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AK	19.401391° E	-29.175716° N	1 035.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AL	19.418253° E	-29.181845° N	1 031.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AM	19.373722° E	-29.197175° N	1 028.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AN	19.591768° E	-29.246717° N	970.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AO	19.591990° E	-29.247054° N	968.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AP	19.638931° E	-29.283646° N	996.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AQ	19.638888° E	-29.283023° N	996.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AR	19.639128° E	-29.282754° N	995.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AS	19.640871° E	-29.282546° N	996.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AT	19.640714° E	-29.281976° N	995.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AU	19.640719° E	-29.281543° N	995.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AV	19.594747° E	-29.287718° N	1 006.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AW	19.570289° E	-29.300941° N	1 002.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AX	19.639568° E	-29.319433° N	1 027.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AY	19.638913° E	-29.319138° N	1 027.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AZ	19.595290° E	-29.339757° N	1 035.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BA	19.594834° E	-29.339951° N	1 035.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BB	19.595754° E	-29.340493° N	1 036.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BC	19.549931° E	-29.414008° N	1 058.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0

SHADOW - Main Result

Calculation: South WEF - Worst Case

Calculation Results

Shadow receptor

	Shadow, worst case		
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
A	0:00	0	0:00
B	0:00	0	0:00
C	0:00	0	0:00
D	0:00	0	0:00
E	0:00	0	0:00
F	0:00	0	0:00
G	0:00	0	0:00
H	0:00	0	0:00
I	0:00	0	0:00
J	0:00	0	0:00
K	0:00	0	0:00
L	0:00	0	0:00
M	0:00	0	0:00
N	0:00	0	0:00
O	0:00	0	0:00
P	0:00	0	0:00
Q	0:00	0	0:00
R	0:00	0	0:00
S	0:00	0	0:00
T	0:00	0	0:00
U	0:00	0	0:00
V	0:00	0	0:00
W	0:00	0	0:00
X	0:00	0	0:00
Y	0:00	0	0:00
Z	0:00	0	0:00
AA	0:00	0	0:00
AB	0:00	0	0:00
AC	0:00	0	0:00
AD	0:00	0	0:00
AE	0:00	0	0:00
AF	0:00	0	0:00
AG	0:00	0	0:00
AH	0:00	0	0:00
AI	0:00	0	0:00
AJ	0:00	0	0:00
AK	0:00	0	0:00
AL	0:00	0	0:00
AM	0:00	0	0:00
AN	0:00	0	0:00
AO	0:00	0	0:00
AP	0:00	0	0:00
AQ	0:00	0	0:00
AR	0:00	0	0:00
AS	0:00	0	0:00
AT	0:00	0	0:00
AU	0:00	0	0:00
AV	0:00	0	0:00
AW	0:00	0	0:00
AX	0:00	0	0:00
AY	0:00	0	0:00
AZ	0:00	0	0:00
BA	0:00	0	0:00
BB	0:00	0	0:00
BC	0:00	0	0:00

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]
1	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (1)	0:00
2	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (2)	0:00

To be continued on next page...

Licensed user:
Eco Elementum Intelligence (Pty) Ltd
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Calculated:
2023/04/06 11:18/3.6.366

SHADOW - Main Result

Calculation: South WEF - Worst Case

...continued from previous page

No.	Name	Worst case [h/year]
3	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (3)	0:00
4	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (4)	0:00
5	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (5)	0:00
6	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (6)	0:00
7	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (7)	0:00
8	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (8)	0:00
9	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (9)	0:00
10	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (10)	0:00
11	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (11)	0:00
12	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (12)	0:00
13	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (13)	0:00
14	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (14)	0:00
15	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (15)	0:00
16	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (16)	0:00
17	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (17)	0:00
18	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (18)	0:00
19	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (19)	0:00
20	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (20)	0:00
21	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (21)	0:00
22	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (22)	0:00
23	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (23)	0:00
24	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (24)	0:00
25	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (25)	0:00
26	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (26)	0:00
27	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (27)	0:00
28	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (28)	0:00
29	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (29)	0:00
30	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (30)	0:00
31	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (31)	0:00
32	NORDEX N163/5.X 5700 163.0 !O! hub: 148.0 m (TOT: 229.5 m) (32)	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.