

MODDERFONTEIN WIND ENERGY PROJECT (PTY) LTD

**MODDERFONTEIN WIND ENERGY FACILITY, WITHIN THE UBUNTU AND
BEAUFORT WEST LOCAL MUNICIPALITIES, NORTHERN CAPE PROVINCE
PROPOSED AMENDMENT TO THE AUTHORISED TURBINE NUMBER, TURBINE
LOCATIONS AND TURBINE DIMENSIONS**

**ADDENDUM TO THE VISUAL IMPACT ASSESSMENT FOR THE PART 2
AMENDMENT APPLICATION**

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1 INTRODUCTION

1.1 TERMS OF REFERENCE

The Applicant would like to amend the environmental authorisation for the proposed Modderfontein Wind Energy Facility. Proposed amendments include a proposed change to the turbine specification and a change to the turbine layout.

The proposed amendment includes the possible use of larger, more powerful wind turbines than were anticipated in the original environmental application. Because each turbine will have increased power output, the proposed project will require fewer turbines than were originally anticipated.

In terms of layout, the authorised project incorporates 67 turbines and the proposed amended layout incorporates 34 turbines.

This addendum reviews the visual impact associated with the authorised turbine specification / layout and the proposed amended specification / layout. It has been prepared in a format that can be read with the findings of the original Visual Impact Assessment (VIA) (MetroGIS, March 2011).

In terms of the amended National Environmental Management Act (NEMA) Act No. 107 of 1998, the proposed amendment requires environmental authorisation. A key impact to be assessed comprises the visual impact that the facility will have on surrounding areas.

Work has been undertaken in accordance with;

- a) The Government of the Western Cape Guideline for Involving Visual and Aesthetic Specialists in EIA Processes, which is the only relevant local guideline, setting various levels of assessment subject to the nature of the proposed development and surrounding landscape and
- b) The Landscape Institute and Institute of Environmental Management and Assessment (UK) Guidelines for Landscape and Visual Impact Assessment which provides detail of international best practice (technical methodology).

The original VIA report is a Level 4 Assessment in accordance with the Western Cape Guidelines. The Addendum Report has been undertaken at the same level.

1.2 DOCUMENTATION

This document must be read with the original VIA for reference to the project location, background, analysis of the existing landscape, sensitive receptors, methodology and the original assessment of visual impacts associated with the original WEF proposal.

1.3 BACKGROUND OF SPECIALIST

Jon Marshall qualified as a Landscape Architect (Dip LA) at Cheltenham (UK) in 1979. He has been a chartered member of the Landscape Institute UK since 1986. He is also a Registered Landscape Architect and has had extensive experience as an Environmental Assessment Practitioner within South Africa.

During the early part of his career (1981 - 1990) he worked with Clouston (now RPS) in Hong Kong and Australia. During this period he was called on to prepare visual impact assessment (VIA) input to numerous environmental assessment processes for major

infrastructure projects. This work was generally based on photography with line drawing superimposed to illustrate the extent of development visible.

He worked in the United Kingdom (1990 - 1995) for major supermarket chains including Sainsbury's and prepared CAD based visual impact assessments for public enquiries for new store development. He also prepared the VIA input to the environmental statement for the Cardiff Bay Barrage for consideration by the UK Parliament in the passing of the Barrage Act (1993).

His more recent VIA work (1995 to present) includes a combination of CAD and GIS based work for a new international airport to the north of Durban, new heavy industrial operations, overhead electrical transmission lines, mining operations in West Africa and numerous commercial and residential developments.

VIA work undertaken during the last twelve months includes VIA input for numerous solar plant projects (CSP and PV), a new coal fired power station as well as electrical infrastructure.

A brief Curriculum Vitae outlining relevant projects is included as **Appendix I**.

1.4 PROCESS FOLLOWED

The following process was followed;

- The original VIA document was reviewed;
- A desktop analysis utilising aerial photography and the Global Mapper GIS system was conducted in order to familiarise the assessor with the site, visual receptors and sensitive landscapes;
- A new GIS analysis was undertaken in order to compare the visibility of the proposed wind turbines with the originally proposed wind turbines;
- 3D CAD modelling and preparation of simulations for the proposed wind turbines was undertaken in order to compare their visual impact with the originally proposed wind turbines; and
- This addendum report was then prepared.

2 PROJECT DESCRIPTION

In addition to the Modderfontein WEF, the current project authorisation includes an existing WEF (Nobelsfontein) on a site immediately to the west of Modderfontein as well as a section of Solar PV development which is proposed within the Nobelsfontein site.

The authorised grid connection infrastructure is not affected by new proposals.

2.1 AUTHORISED MODDERFONTEIN WEF

The current environmental authorisation includes the development of 67 turbines within the Modderfontein section of the projects.

Authorised turbines have a capacity of 3MW, a hub height between 80m to 125m and a rotor blade diameter between 90m to 100m.

This results in a maximum overall height of 175m.

2.2 PROPOSED PROJECT

The applicant now proposes the development of 34 wind turbines within the Modderfontein WEF.

Proposed turbines will have a capacity is 5.6MW, a hub height up to 119m and a rotor blade diameter up to 162m.

This results in a maximum overall turbine height of 200m.

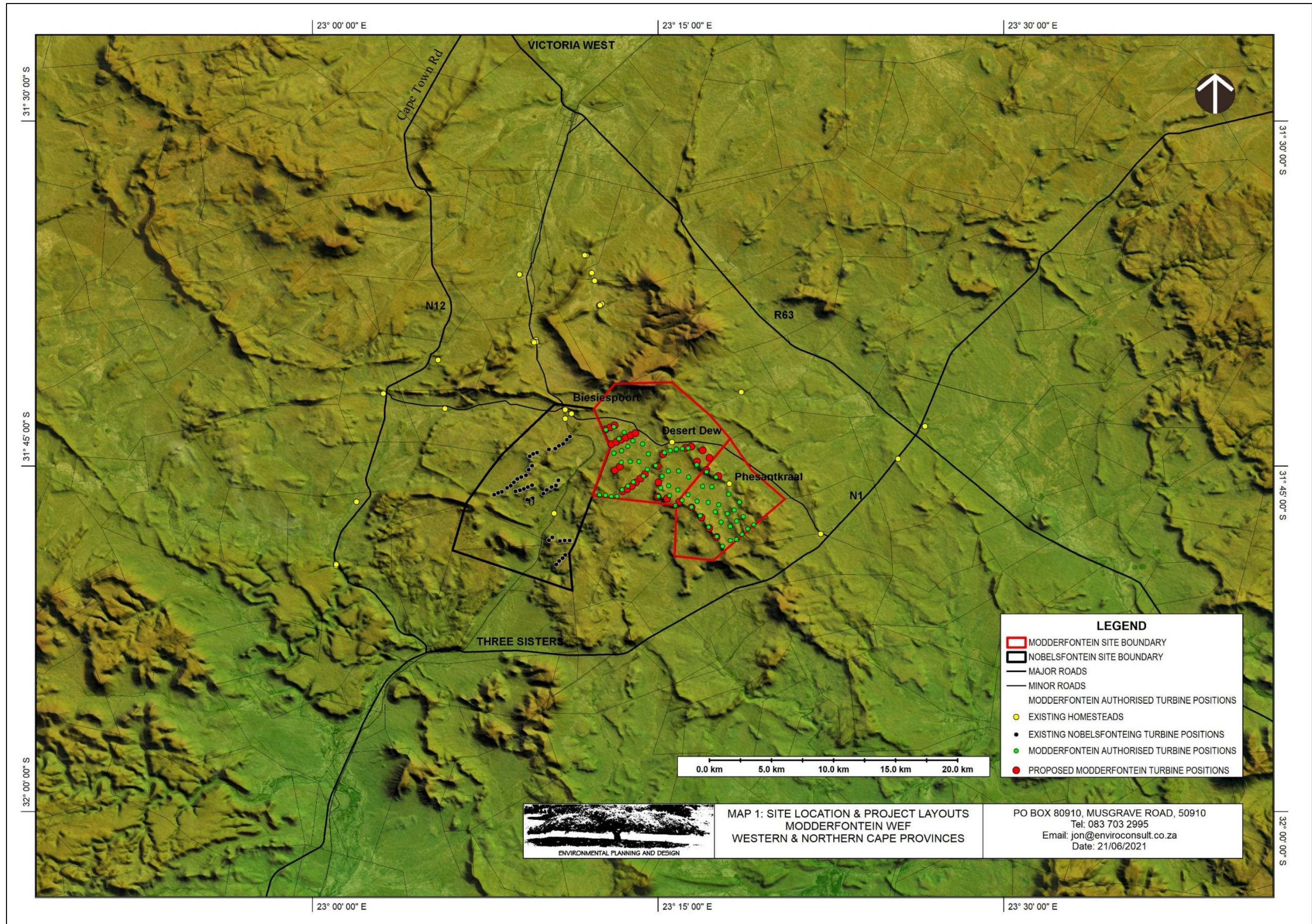
The authorised and the currently proposed layouts are indicated on Map 1.

2.2 POSSIBLE LANDSCAPE AND VISUAL IMPLICATIONS OF THE PROPOSED AMENDMENT

Possible landscape and visual implications include:

- a) Due to the larger size of turbines, it is possible that they may be visible over a wider area than the smaller authorised structures;
- b) Due to the larger size of turbines, it is possible that they may more obvious than the smaller authorised structures;
- c) Due to the larger size of turbines, it is possible that they may increase the risk of shadow flicker when compared with the smaller authorised structures;

The general construction methodology, associated infrastructure and phasing will all be as described in the original VIA.



3 VISABILITY

3.1 APPROXIMATE LIMIT OF VISIBILITY AND VISUAL PROMINENCE

The affected landscape is comprised of the area over which the development will be visible. In order to provide an initial focus for the updated assessment an approximate limit of visibility has been defined based on the height of turbines in order to determine their visual horizon that is limited by the curvature of the earth.

This has been calculated using a universally accepted navigational calculation (refer to **Appendix II**). Using this formula the distance within which the structures might be visible or the Approximate Limit of Visibility (**ALV**) within a flat landscape is indicated in the table below:

Table 1 – Approximate Limit of Visibility

STRUCTURE	ALV
Original Turbine Height 175m	47.2km
Proposed Turbine Height 200m	50.5km

It is acknowledged that the landscape within which the development is proposed is not flat. However, the nature of the structures being a relatively slim and light coloured is such that they are likely to be indiscernible from its background well within these distances.

It is difficult to be precise about the exact area of visual influence as in reality visibility could be affected by:

- Weather conditions that limit visibility including hazy conditions during fine weather as well as mist and rain; and
- Scale and colour of individual elements making it difficult to differentiate structures from background.
- The fact that as a viewer approaches the limit of visibility only a small portion of the development will be visible to the extent that it is likely to be indiscernible to the human eye.

Internationally research has been undertaken by planning authorities to help guide the development of Wind Energy Facilities (WEFs). In Scotland, which is a country that has extensive natural upland areas that have been subject to large scale WEF development, the Scottish Executive, Development Department have published numerous Planning Advisory Notes (PANs) to help guide this type of development. Their PAN 45, describes public perceptions towards WEFs based on distance. These perceptions are indicated in the table below:

Table 2 - General Perception of a Wind Farm in an Open Landscape

Distance	Visual Perception of Turbines
Up to 4 km (Short Distance)	Likely to be a prominent feature
4-10 km (Mid Distance)	Relatively prominent
10-20 km (Long Distance)	Only prominent in clear visibility – seen as part of the wider landscape

Distance	Visual Perception of Turbines
20-30+ km	Only seen in very clear visibility – a minor element in the landscape

(Extract from Scottish Executive PAN 45)

PAN 45 clearly indicates that whilst a WEF may be visible over an extensive area, it is only mid to short distance views (up to 10km) over which they are generally prominent.

3.2 ZONES OF THEORETICAL VISIBILITY

Zones of Theoretical Visibility (ZTV) are defined as “a map usually digitally produced showing areas of land within which a development is theoretically visible”¹.

ZTVs of the authorised and proposed developments have been assessed using Global Mapper GIS.

The detailed location of the authorised and proposed Modderfontein turbines have been provided by the Environmental Assessment Practitioner.

In order to generate the ZTV for the authorised and proposed projects, points were set at the each turbine location with an offset equal to the overall height of the authorised and proposed structures.

A 2.0m offset has been used in the analysis in order to approximate the eye level of receptors.

Whilst the ZTV has been calculated from terrain data only, existing vegetation may have a modifying effect on the areas indicated. It should be noted however that the landscape within which the project is set is relatively barren and it is likely that the landform will be the main constraint in terms of visibility.

Map 2 indicates the ZTV of the existing Nobelsfontein WEF. This provides an indication of the section of the landscape that is already affected by views of wind turbines and associated infrastructure.

Map 3 provides a comparison of the overall ZTV of the authorised and proposed turbines.

Map 4 provides a comparison of the mid to short range (10km) ZTVs of the authorised and proposed turbines.

In order to highlight additional areas of impact, the ZTV of the authorised and proposed turbine layouts have been overlaid on both Maps 2 and 3. The ZTV of the authorised turbines are represented in red and the ZTV of the proposed turbines is indicated in blue.

Whilst the proposed turbine layout extends over a similar section of the landscape, because it includes fewer turbines, the development footprint is significantly smaller.

Even though the proposed turbine structures are taller than the authorised, because they are positioned over a similar extent of the landscape as the turbines associated with the

¹ UK Guidelines

authorised layout, whilst they may be slightly more obvious over a greater distance, their ZTV generally falls within the ZTV of the authorised project.

The ZTV of the proposed turbine layout has been located over that of the authorised project. Where the ZTV of the proposed project can be seen in isolation on the mapping, this illustrates the additional area over which the authorised project is likely to be visible relative to the proposed project.

The ALV of the proposed turbines compared with the ALV of the authorised turbines highlights the fact that due to their additional height, the proposed turbines are likely to be visible over a slightly greater distance. However, because the authorised project covers the same general area, this additional distance is relatively small.

It is also obvious from the analysis that whilst the additional size of the proposed turbines being higher than the authorised turbines may make them slightly more obvious and visible over a marginally greater area. However, in general terms the proposed project will be seen from a very similar area as the authorised project.

3.3 THE INFLUENCE OF INCREASED HEIGHT OF WINDTURBINES ON VIEWS

Figure 1 (Apparent Reduction in Scale of Structures with Distance), indicates the way that the relative scale of proposed structures will reduce with distance. From reference to this diagram, it is suggested that the proposed structures are likely to be more imposing in the landscape within 10km. At greater distances the apparent difference is likely to be negligible.

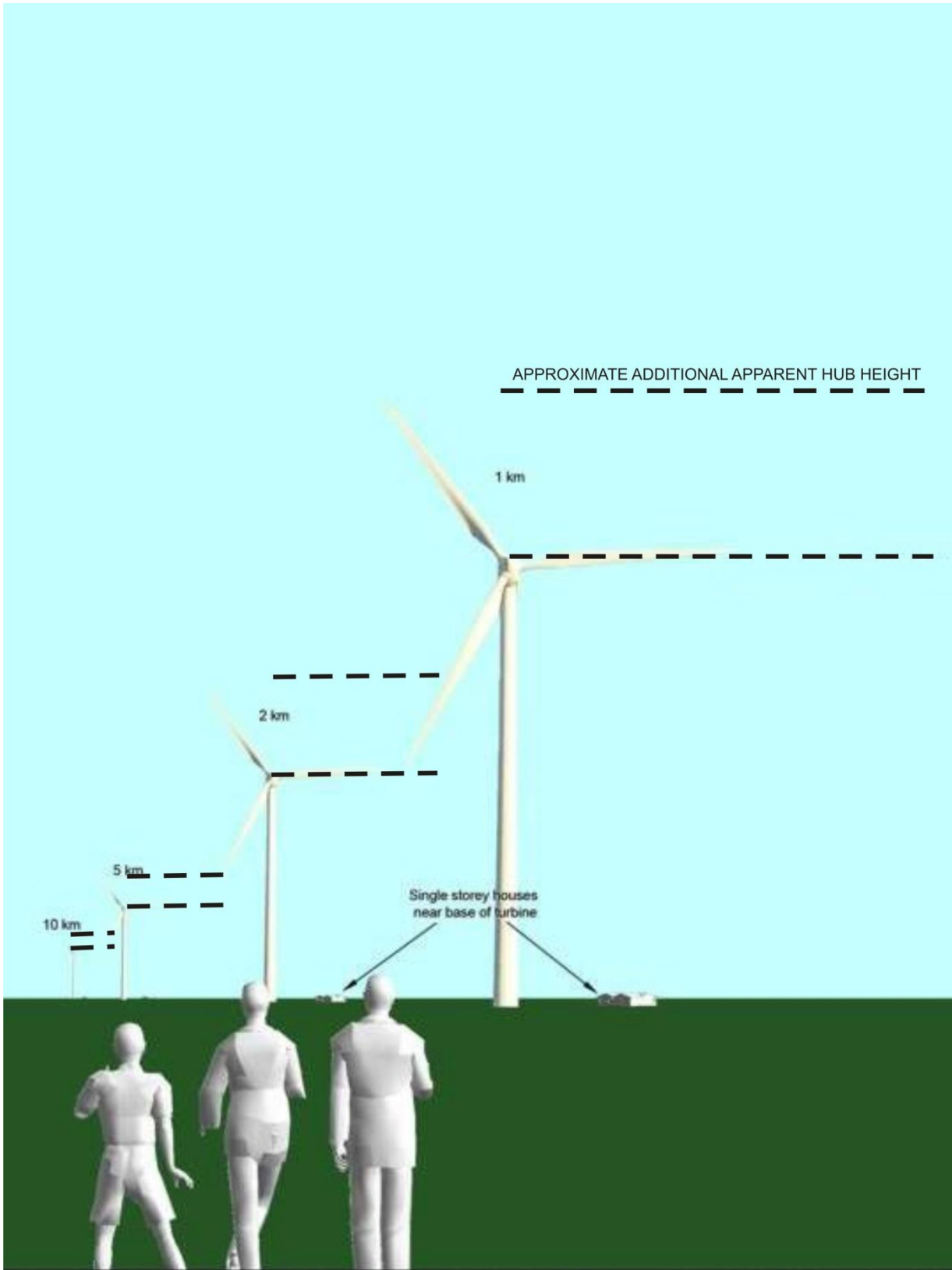
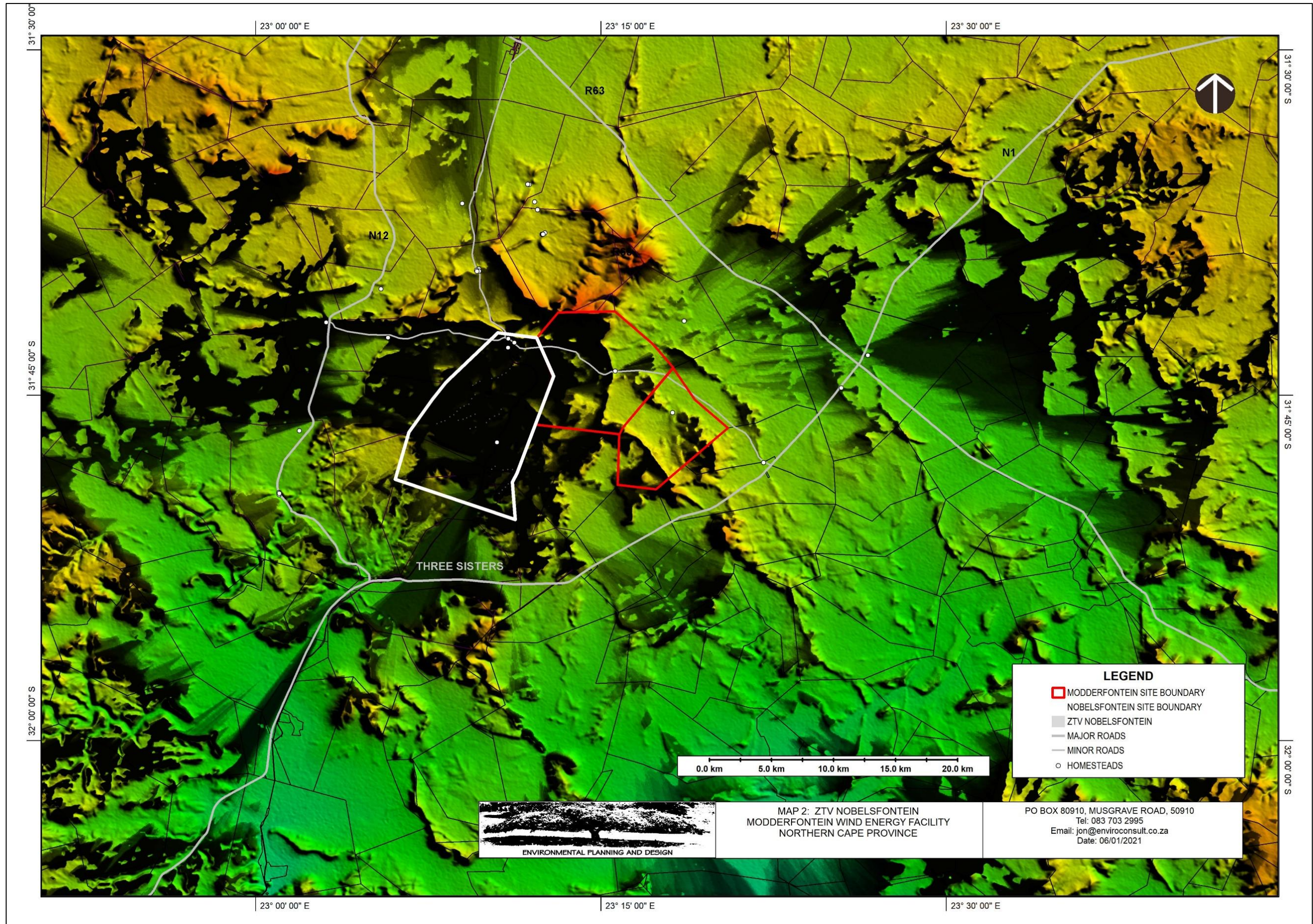
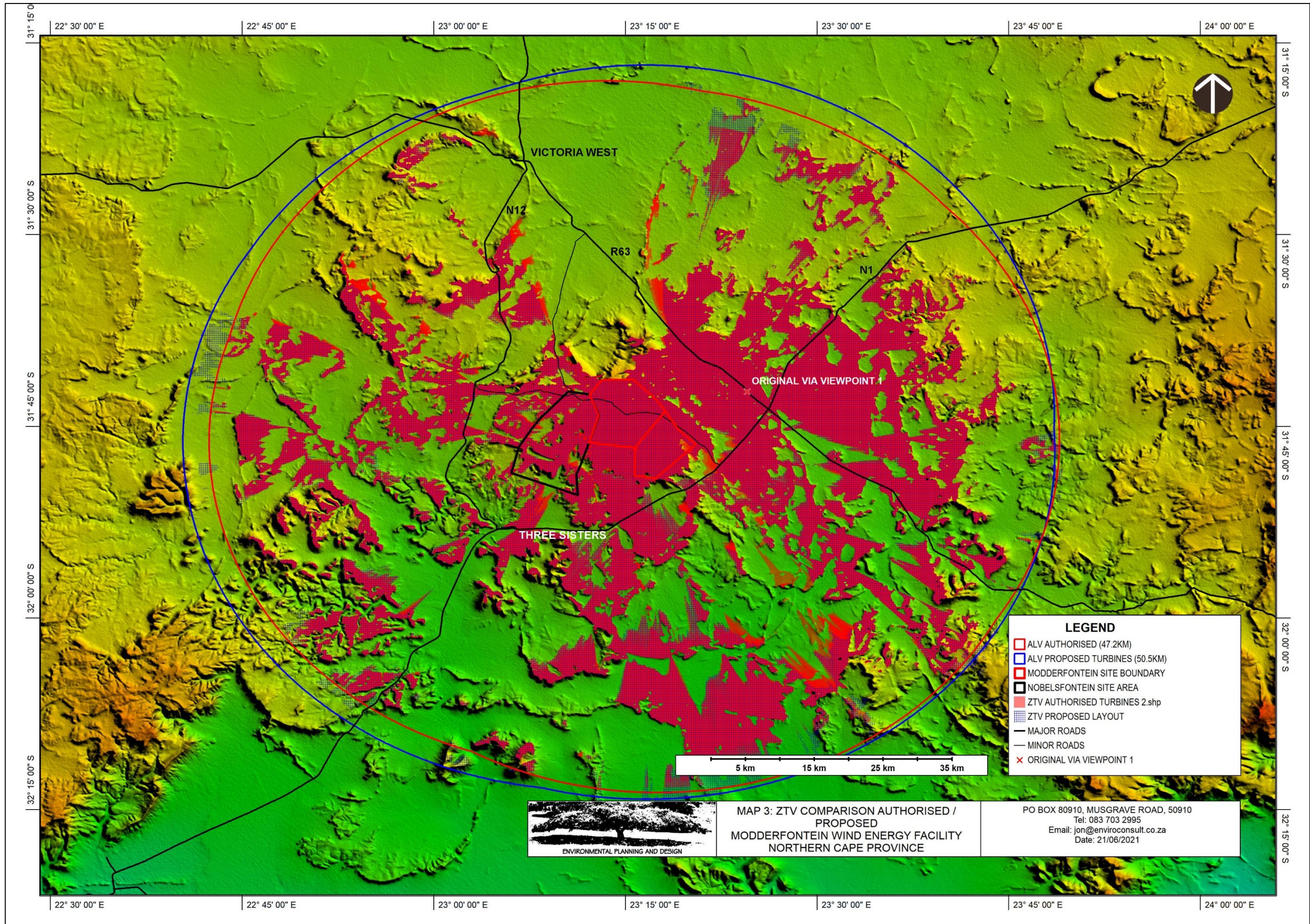


FIGURE 1, APPARENT REDUCTION IN SCALE OF STRUCTURES WITH DISTANCE

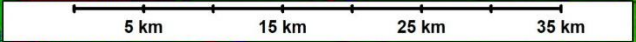
The original Visual Impact Assessment identified a **High Impact Zone** within 5km and a **Moderate Impact Zone** within 10km of the authorised turbines. This tends to reinforce the general guideline provided by PAN 45.





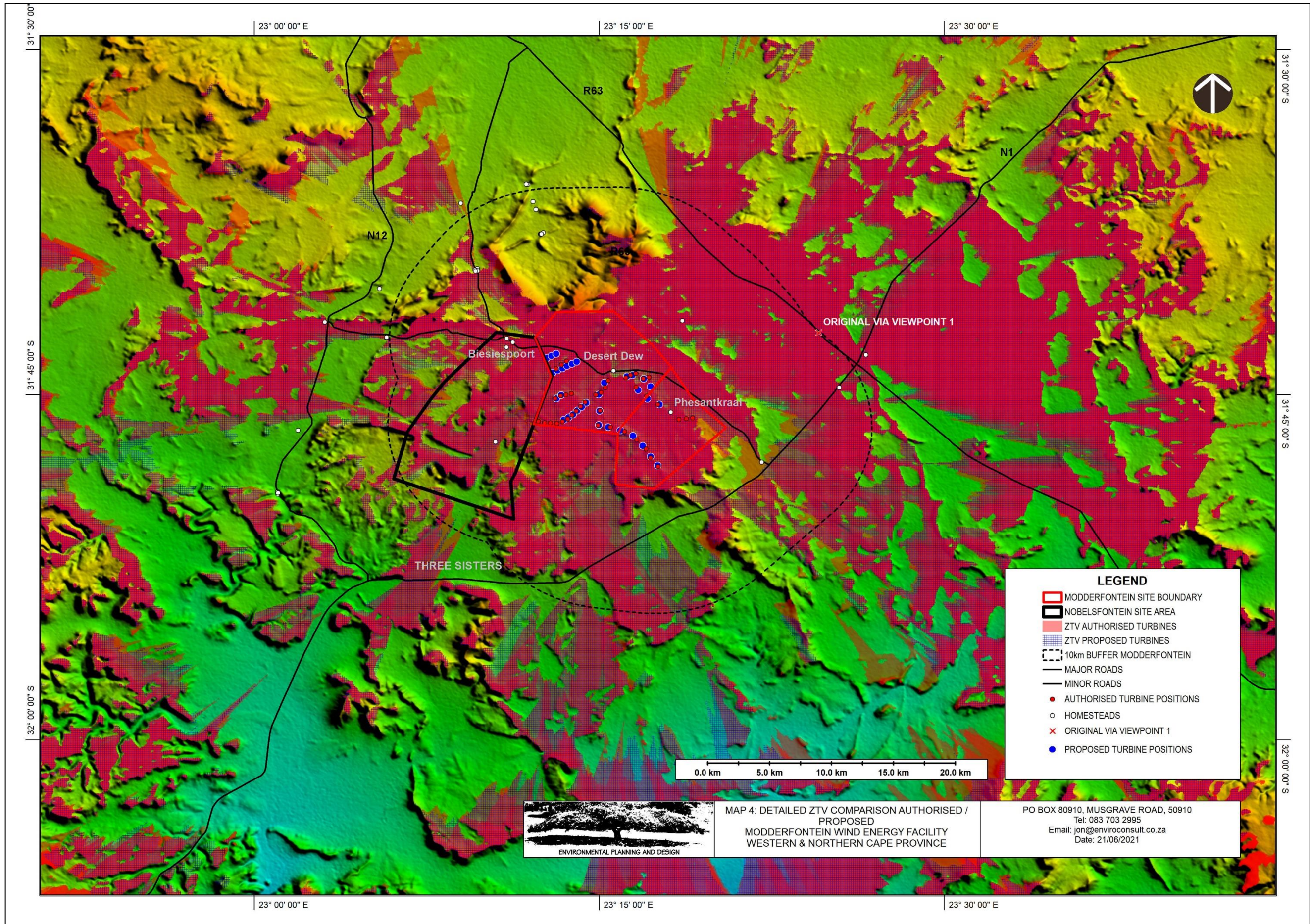
LEGEND

- ALV AUTHORISED (47.2KM)
- ALV PROPOSED TURBINES (50.5KM)
- MODDERFONTEIN SITE BOUNDARY
- NOBELSFONTEIN SITE AREA
- ZTV AUTHORISED TURBINES 2.shp
- ZTV PROPOSED LAYOUT
- MAJOR ROADS
- MINOR ROADS
- ORIGINAL VIA VIEWPOINT 1



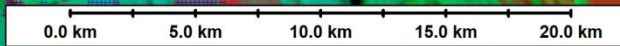
MAP 3: ZTV COMPARISON AUTHORISED / PROPOSED
 MODDERFONTEIN WIND ENERGY FACILITY
 NORTHERN CAPE PROVINCE

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LEGEND

- MODDERFONTEIN SITE BOUNDARY
- NOBELSFONTEIN SITE AREA
- ZTV AUTHORISED TURBINES
- ZTV PROPOSED TURBINES
- 10km BUFFER MODDERFONTEIN
- MAJOR ROADS
- MINOR ROADS
- AUTHORISED TURBINE POSITIONS
- HOMESTEADS
- × ORIGINAL VIA VIEWPOINT 1
- PROPOSED TURBINE POSITIONS



MAP 4: DETAILED ZTV COMPARISON AUTHORISED / PROPOSED
 MODDERFONTEIN WIND ENERGY FACILITY
 WESTERN & NORTHERN CAPE PROVINCE

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The original VIA included an assessment of the Nobelsfontein WEF / Solar PV section of the project with the Modderfontein WEF section of the project. It didn't assess them as individual projects.

The original VIA provided three simulations, one of which focused on the Modderfontein section of the project (Viewpoint 1) and two of which focused on the Nobelsfontein section of the project (viewpoints 2 and 3).

From reference to Map 2 which indicated the ZTV of the existing Nobelsfontein turbines, it is obvious that this section of the project is largely visible to the west and towards the N12. The ZTV indicates occasional views of the Nobelsfontein project are possible to the east. However, from the site visit, the project is not obvious from this direction.

From reference to Map 3 which indicates a comparison between the authorised and proposed turbines associated with the Modderfontein section of the project, it is obvious that the authorised and proposed turbine layouts are likely to be visible over a similar area. It also indicates that this section of the project is likely to be visible mainly to the east of the project towards the R63 with occasional views of the upper sections of a small number of turbines being visible to the west towards the N12.

It can also be noted from these ZTV maps that the rugged landscape to the north and south of the project, provides significant screening from these directions to the extent that all views of existing, authorised and proposed turbines are screened from the north and to the south only occasional views of small sections of the existing project are likely to be visible through minor valleys towards the N1.

In order to ensure that simulations are directly comparable, views are taken from Viewpoint 1 and are presented in the same format as the original VIA. This means that a broad panorama indicating views of the authorised and proposed amended scheme are presented from this viewpoint (Figures 2 and 3 respectively).

In order that the full visual implications are obvious, enlargements are then presented of each panorama in Figures 4 and 5 which indicate the southernmost section of the simulations and figures 6 and 7 which indicate the northernmost section of the simulations of the authorised and proposed amended scheme respectively.

From the simulations, the turbine structures associated with the proposed amended project are obviously slightly taller than those associated with the authorised project but a greater number of turbines are

it is also obvious that the apparent extent of the turbine field associated with the proposed amended project is similar to the authorised project. However, the authorised project will result in a greater number of turbines being visible.



Figure 2, Authorised Modderfontein section of the project as seen from Viewpoint 1

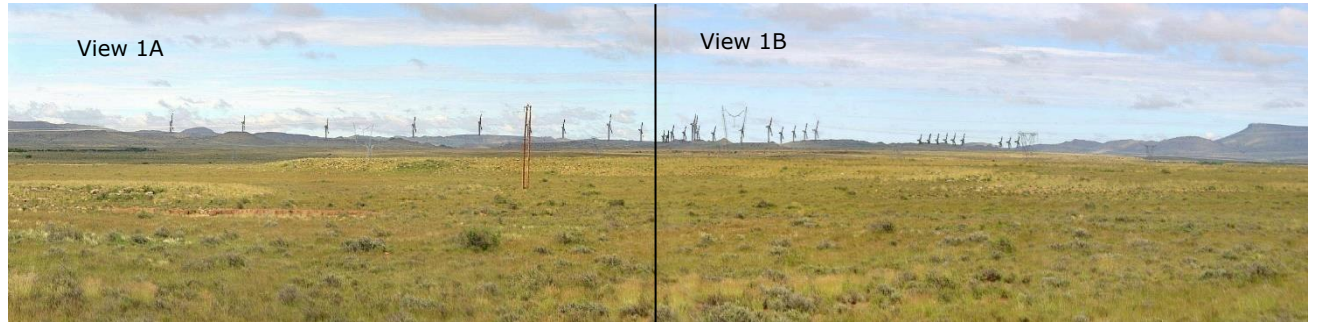


Figure 3, Proposed amended Modderfontein section of the project as seen from Viewpoint 1



Figure 4, View 1A of the authorised Modderfontein section of the project

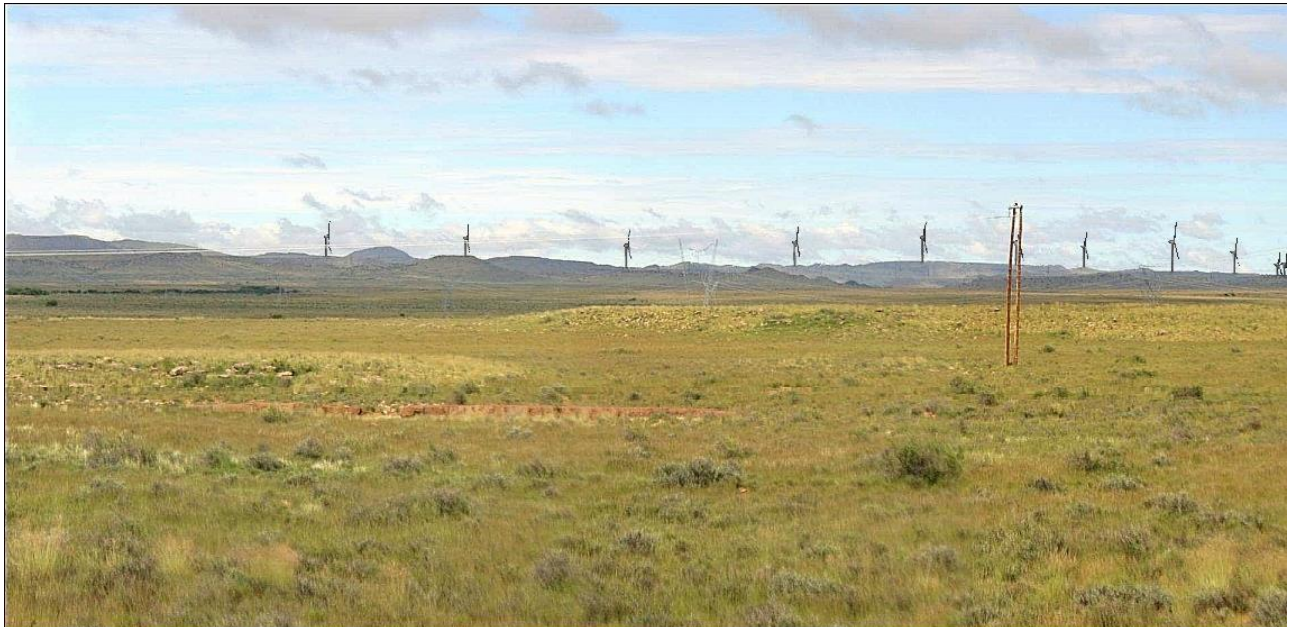


Figure 5, View 1A of the proposed amended Modderfontein section of the project



Figure 6, View 1B of the authorised Modderfontein section of the project



Figure 7, View 1B of the proposed amended Modderfontein section of the project

4 SHADOW FLICKER

the original via provided the following description and analysis of areas that are likely to be affected by shadow flicker:

Shadow flicker occurs when the sky is clear and when rotor blades of a wind turbine are between the sun and the receptor (i.e. when the sun is low). As the rotor blades move, the receptor will experience a flicker of light and shadow as the blade passes in front of the sun. The flicker of shadow and light could be experienced as disturbing and irritating.

De Gryse in Scenic Landscape Architecture (2006) found that "most shadow impact is associated with 3-4 times the height of the object". Based on this research, a 500m buffer along the edge of the facility is submitted as the zone within which there is a risk of shadow flicker occurring.

Given the proposed increased height of the turbine structures this buffer should increase to 800m.

5 REVIEW OF ORIGINAL ASSESSMENT

This section reviews the original VIA assessment based on the analysis of the potential change in view of the wind turbines and shadow flicker associated with the proposed specification and layout amendment.

In order that the reports can be directly compared, the sub-headings are as indicated in the original VIA.

Because the original VIA considered the Nobelsfontein WEF, Solar PV development as well as the Modderfontein section of the project, this section provides a comparison of the potential visual impacts associated with the authorised and the proposed change in the Modderfontein WEF section of the project. It does not re-assess the other sections of the project.

5.1 PRIMARY IMPACTS

All impacts are as listed in the original VIA.

The no-go alternative assumes that the authorised WEF layout will be implemented.

5.1.1 Potential visual impact on users of national, arterial and secondary roads in close proximity (within 5km) to the facility.

The original VIA indicates that:

Potential visual impact on users of major and secondary roads in close proximity to the proposed facility is expected to have a high significance both before and after mitigation.

There is only one minor unsurfaced road (Biesiespoort Road) within 5km of the authorised and proposed Modderfontein sections of the project.

The authorised Modderfontein layout has 33 turbines within 5km of the road. The proposed layout has 27 turbines within 5km of the road.

The authorised turbines are likely to be obvious from more than 20km of this road. The proposed turbines are likely to be visible from approximately the same length of this road.

When the reduced number of turbines that will be visible is also taken into account, it seems likely that the proposed amendment will result in a reduction in the level of visual impact.

IMPACT NATURE	Impact – Nature of Impact	STATUS	POSITIVE/NEGATIVE
Impact Description	Visual impact on users of major and secondary roads in close proximity		
Impact Source(s)	The proposed project will result in fewer, larger turbines being visible to approximately the same section of the Biesiespoort Road as the authorised project.		
Receptor(s)	View of turbines		
	Motorists and pedestrians on the Biesiespoort Road.		

PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	3
	No-Go Alternative:	4	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	4	Preferred Alternative:	4
	No-Go Alternative:	4	No-Go Alternative:	4
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-2	Preferred Alternative:	-2
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	-64 (Medium)	Preferred Alternative:	-48 (Medium)
	No-Go Alternative:	-64 (Medium)	No-Go Alternative:	-48 (Medium)
CUMULATIVE IMPACTS	Cumulative impacts relate to the users of this road being subjected to two WEF projects including the existing Nobelsfontein project and the proposed Modderfontein project being visible for approximately the entire 35km of the road. The Modderfontein project will largely be visible from the eastern section of the road and the Nobelsfontein project from the western section of the road.			
CONFIDENCE	High			
MITIGATION MEASURES	<ul style="list-style-type: none"> Complete clearance and removal of infrastructure during decommissioning. 			

5.1.2 Potential visual impact on residents of settlements and homesteads on and in close proximity (within 5km) to the facility.

The original VIA indicates that:

The visual impact of the proposed facility on settlements and homesteads within 5km of the site is expected to be of high significance before and after mitigation.

There are no settlements within 5km of either the authorised or the proposed Modderfontein turbine layouts.

There are six homesteads within 5km of the authorised Modderfontein turbine layout and five homesteads within 5km of the proposed turbine layout.

The closest homestead (Desert Dew Guest House) is within 0.6km of the closest turbine associated with the authorised project and 1km of the closest turbine associated with the

proposed amended turbine layout. This homestead is located within a river gorge and is likely to be screened to a degree from direct views of the majority of turbines associated with both the authorised and proposed turbine layouts. Even though the homestead is partially screened from the project, twelve (12) turbines associated with the authorised turbine layout and sixteen (16) turbines associated with the proposed amended turbine layout are likely to be visible from the property.

The second closest homestead (Phesantkraal) is also within approximately 1km of the proposed amended turbine layout and approximately 800m of the authorised turbine layout. Forty four (44) turbines associated with the authorised turbine layout and eighteen (17) turbines associated with the proposed amended layout will be visible from this homestead.

At Biesiespoort there is a group of three homesteads. From this area 33 turbines associated with the authorised project and 25 turbines associated with the proposed project will be visible. This area is also close to Nobelsfontein and is likely to be affected to a greater degree by this project.

It is therefore likely in general terms a greater number of smaller turbines will be visible to homesteads should the authorised project be implemented and a smaller number of larger turbines will be visible should the proposed amended project be implemented.

It therefore appears likely that in general terms the level of visual impact experienced from homesteads will be similar.

IMPACT NATURE	Impact – Nature of Impact Views of turbines from homesteads and settlements in close proximity		STATUS	POSITIVE/N EGATIVE
Impact Description	The proposed project will generally result in fewer, larger turbines being visible to approximately the same homesteads that are likely to be impacted by the authorised WEF.			
Impact Source(s)	View of turbines			
Receptor(s)	Residents of homesteads.			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	3
	No-Go Alternative:	4	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	4	Preferred Alternative:	5
	No-Go Alternative:	4	No-Go Alternative:	5

INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-2	Preferred Alternative:	-2
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	-64 (Medium)	Preferred Alternative:	-48 (Medium)
	No-Go Alternative:	-64 (Medium)	No-Go Alternative:	-48 (Medium)
CUMULATIVE IMPACTS	Cumulative impacts are likely due to homesteads being subjected to views of two WEF projects as is likely to occur at Biesiespoort. including the existing Nobelsfontein project and the proposed Modderfontein project being visible for approximately the entire 35km of the road. The Modderfontein project will largely be visible from the eastern section of the road and the Nobelsfontein project from the western section of the road.			
CONFIDENCE	High			
MITIGATION MEASURES	<ul style="list-style-type: none"> Complete clearance and removal of infrastructure during decommissioning. 			

5.1.3 Potential visual impact on visual receptors (users of roads and residents of settlements and homesteads) within the region.

The original VIA indicates that:

The visual impact of the proposed facility on visual receptors (users of roads and residents of settlements and homesteads) within the region (i.e. beyond 5km radius) is expected to be of moderate significance both before and after mitigation.

The project will not be visible to settlements.

The proposed project is also likely to be most visible to the east as views from other directions are largely screened by landform.

The only regional road that is likely to be impacted to any degree is the R63.

IMPACT NATURE	Impact – Nature of Impact Views of turbines from homesteads and roads in the region		STATUS	POSITIVE/ NEGATIVE
Impact Description	Views of turbines from roads and homesteads in the region			
Impact Source(s)	View of turbines			
Receptor(s)	Residents of homesteads and people walking and driving on the R63.			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE

EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	3
	No-Go Alternative:	4	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-1	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	-24 (Low)	Preferred Alternative:	-18 (Low)
	No-Go Alternative:	-24 (Low)	No-Go Alternative:	-18 (Low)
CUMULATIVE IMPACTS	Cumulative impacts are likely due to homesteads and road users being subjected to views of two WEF projects. However this is highly unlikely due to screening provided by landform.			
CONFIDENCE	High			
MITIGATION MEASURES	<ul style="list-style-type: none"> Complete clearance and removal of infrastructure during decommissioning. 			

5.1.4 Potential visual impact of substations on observers in close proximity to the facility.

The original VIA indicates that these elements are likely to have a **visual impact of low significance**.

The proposed amendment will have no effect on the location or appearance of these elements. Therefore, there will be no difference in the level of visual impact due to the proposed amendment to the project.

5.1.5 Potential visual impact of the power lines on observers in close proximity to the facility.

The original VIA indicates that these elements are likely to have a **visual impact of low significance**.

The proposed amendment will have no effect on the location or appearance of these elements. Therefore, there will be no difference in the level of visual impact due to the proposed amendment to the project.

5.1.6 Potential visual impact of lighting at night on observers in close proximity to the facility.

The original VIA indicates that these elements are likely to have a **visual impact of moderate significance without mitigation and low significance with mitigation**.

The proposed amendment will reduce the number of turbines that will be fitted with red aircraft warning lights.

Lighting requirements for other sections of the project will remain as considered by the original VIA.

It is likely therefore that the proposed amendment may result in a marginal reduction in lighting impacts.

IMPACT NATURE	Impact – Nature of Impact		STATUS	POSITIVE/NEGATIVE
Impact Description	Lighting Impacts View of night time lighting including aircraft warning lights and lighting of the facility			
Impact Source(s)	View of turbines			
Receptor(s)	Residents and road users			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	3	Preferred Alternative:	2
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1.5	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	-27 (Low)	Preferred Alternative:	-12 (Low)
	No-Go Alternative:	-36 (Low)	No-Go Alternative:	-12 (Low)
CUMULATIVE IMPACTS	Cumulative impacts are likely due to homesteads and road users being subjected to views of lighting from two WEF projects (Nobelsfontein and Modderfontein). However this is generally unlikely due to screening provided by landform.			
CONFIDENCE	High			
MITIGATION MEASURES	<ul style="list-style-type: none"> • Pro-active lighting design and planning; • Possible use of pilot activated warning lights. 			

5.1.7 Potential visual impact of internal access roads on observers in close proximity to the facility.

The original VIA indicates that these elements are likely to have a **visual impact of moderate significance without mitigation and low significance with mitigation.**

Due to the reduced project footprint, the proposed amendment should reduce the extent of internal access roads that will be required.

It is therefore possible that the proposed amendment could reduce visual impacts associated with internal access roads.

IMPACT NATURE	Impact – Nature of Impact Views of roads as seen by observers in close proximity to the WEF.		STATUS	POSITIVE/NEGATIVE
Impact Description	Disturbance of the landscape due to cut and fill slopes associated with road construction. This is particularly likely in areas where roads run along and through ridgelines.			
Impact Source(s)	Disturbance of the natural landscape / landform			
Receptor(s)	Residents and road users			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	2
	No-Go Alternative:	1	No-Go Alternative:	2
DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	3	Preferred Alternative:	2
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1.5	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	-27 (Low)	Preferred Alternative:	-12 (Low)
	No-Go Alternative:	-36 (Low)	No-Go Alternative:	-12 (Low)
CUMULATIVE IMPACTS	Cumulative impacts are likely due to homesteads and road users being subjected to views of internal access roads on two WEF projects (Nobelsfontein and Modderfontein). However this is highly unlikely due to screening provided by landform.			
CONFIDENCE	High			
MITIGATION MEASURES	<ul style="list-style-type: none"> • Pro-active road / earthworks design and planning; • Rehabilitation; 			

	<ul style="list-style-type: none"> Total removal and rehabilitation on decommissioning
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5.1.8 Shadow Flicker.

The original VIA indicates that shadow flicker could impact on the Phesantkraal and Biesiespoort. The assessment indicates that impacts on these homesteads are improbable and are likely to have an **impact of low significance with and without mitigation.**

Biesiespoort is located to the north of the existing Nobelsfontein section of the project. Neither the authorised or proposed amended Modderfontein section of the project will impact on this area.

Phesantkraal is within approximately 1000m of the proposed amended turbine layout and approximately 800m of the authorised Modderfontein turbine layout. Given the parameters for shadow flicker detailed in the original VIA, the proposed amended turbine layout is likely to further reduce the risk of impact on this homestead.

It is possible that shadow flicker could also affect the **Desert Dew Guest House**. The authorised project sees a turbine within approximately 600m of this homestead whereas the proposed amendment would result in the closest turbine being approximately 1000m from the homestead. The proposed amendment should therefore reduce the risk of shadow flicker impacting this homestead.

IMPACT NATURE	Impact – Nature of Impact		STATUS	POSITIVE/NEGATIVE
	Shadow flicker			
Impact Description	Shadow flicker affecting residents of homesteads.			
Impact Source(s)	Shadow cast by revolving turbine blades particularly when the sun is low in the sky during early mornings and late afternoons.			
Receptor(s)	Residents			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	0
	No-Go Alternative:	-1.5	No-Go Alternative:	0

SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	-3 (Low)	Preferred Alternative:	0 (Low)
	No-Go Alternative:	-4.5 (Low)	No-Go Alternative:	0 (Low)
CUMULATIVE IMPACTS	Cumulative impacts are unlikely due to the low risk of shadow flicker affecting homesteads.			
CONFIDENCE	High			
MITIGATION MEASURES	<ul style="list-style-type: none"> Shut turbines that are causing shadow flicker down during high risk periods. 			

5.1.9 Construction.

The original VIA indicates that the impacts of construction on visual receptors are likely to have a **moderate significance without mitigation and a low significance with mitigation**. This assessment did consider the construction of a larger project including a solar PV project as well as the Nobelsfontein WEF in addition to Modderfontein.

As the proposed Modderfontein turbine layout includes a significantly reduced number of turbines over a smaller footprint area, the proposed amendment is likely to reduce the level of construction impacts that were anticipated in the original VIA.

Residents close to the site and users of the adjacent Biesiespoort Road are likely to be affected.

IMPACT NATURE	Impact – Nature of Impact		STATUS	POSITIVE/NEGATIVE
	Construction impacts			
Impact Description	Views of construction activities, materials and equipment storage, and landscape disturbance			
Impact Source(s)	Construction of WEF			
Receptor(s)	Local residents and users of the Biesiespoort Road			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
PROBABILITY (C)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1.5	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-1

SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	-4.5 (Low)	Preferred Alternative:	-3 (Low)
	No-Go Alternative:	-6 (Low)	No-Go Alternative:	-3 (Low)
CUMULATIVE IMPACTS	Cumulative impacts are unlikely			
CONFIDENCE	High			
MITIGATION MEASURES	<ul style="list-style-type: none"> Minimise disturbance of vegetation; Undertake rehabilitation; Site storage and contractor's camp away from the road. 			

5.2 SECONDARY IMPACTS

5.2.1 Potential visual impact of the proposed facility on visual character and sense of place within the region.

The original VIA indicates that the authorised project is likely to have an **impact of moderate significance** with and without mitigation.

The proposed amendment will significantly reduce both the number of turbines and the development footprint. However, the proposed amended project is likely to affect a similar landscape area as the authorised project

IMPACT NATURE	Impact – Nature of Impact		STATUS	POSITIVE/NEGATIVE
	Change of landscape character			
Impact Description	Industrialisation of views over a relatively natural Karoo landscape			
Impact Source(s)	Views of turbines and associated development			
Receptor(s)	Local residents, visitors to the area and road users.			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	3
	No-Go Alternative:	4	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-2	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-1

SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	-48 (Medium)	Preferred Alternative:	-18 (Low)
	No-Go Alternative:	-48 (Medium)	No-Go Alternative:	-18 (Low)
CUMULATIVE IMPACTS	Cumulative impacts relate to the possibility of being impacted by more than one project particularly the Nobelsfontein project in conjunction with Modderfontein.			
CONFIDENCE	High			
MITIGATION MEASURES	<ul style="list-style-type: none"> Minimise disturbance of vegetation; Undertake rehabilitation; Complete removal of infrastructure and additional rehabilitation on decommissioning. 			

5.2.2 Potential visual impact of the proposed facility on tourist routes and tourism potential within the region.

The original VIA indicates that the authorised project is likely to have an **impact of low significance** with and without mitigation.

This is due to the fact that it was found that:

- The authorised project will not impact on views of the local landmark known as the Three Sisters. This is a range of three hills to the south of the N1; and
- The authorised project also has limited impact on the N1 and N12 that are considered to be tourism routes.

However the authorised and proposed amended project will also impact on the Desert Dew Guest House.

Map 4 highlights the fact that both the authorised and the proposed amended Modderfontein section of the project will be visible over a similar section of the N1.

The existing Nobelsfontein WEF is the section of the project that is mainly visible from the N12 Neither the authorised nor the proposed amended Modderfontein section of the project will have a significant impact on this section of the road.

The proposed amendment to the Modderfontein section of the project is therefore unlikely to change visual impact on tourism routes and tourism potential within the region when compared with the authorised project.

IMPACT NATURE	Impact – Nature of Impact Reduction in tourists visiting the area		STATUS	POSITIVE/ NEGATIVE
Impact Description	Views of industrialised landscape being obvious within views of natural landscape areas that are popular with tourists			
Impact Source(s)	Views of turbines and associated development from tourist routes and attractions			
Receptor(s)	Local people who rely on tourism income and visitors to / travelling through the area.			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE

EXTENT (A)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	3
	No-Go Alternative:	4	No-Go Alternative:	3
PROBABILITY (C)	Preferred Alternative:	3	Preferred Alternative:	3
	No-Go Alternative:	3	No-Go Alternative:	3
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-1	No-Go Alternative:	-1
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	-24 (Low)	Preferred Alternative:	-18 (Low)
	No-Go Alternative:	-24 (Low)	No-Go Alternative:	-18 (Low)
CUMULATIVE IMPACTS	Cumulative impacts relate to the possibility of being impacted by more than one project particularly the Nobelsfontein project in conjunction with Modderfontein. However this is highly unlikely to occur			
CONFIDENCE	High			
MITIGATION MEASURES	<ul style="list-style-type: none"> • Minimise disturbance of vegetation; • Undertake rehabilitation; • Complete removal of infrastructure and additional rehabilitation on decommissioning. 			

6 SUMMARY AND CONCLUSION

The applicant wishes to amend the environmental authorisation for the Modderfontein WEF. The Modderfontein Wind Energy Facility (WEF) was authorised as part of the Karoo Renewable Energy Facility which also includes the Nobelsfontein WEF which has been constructed immediately to the west of the proposed Modderfontein facility as well as a solar PV facility also on the Nobelsfontein site.

The original Visual Impact Assessment was undertaken by MetroGIS (March 2011).

The current environmental authorisation allows the development of 67 wind turbines with a maximum overall height of 175m

The proposed amendment to the authorisation would allow development of 34 wind turbines with an overall maximum height of 200m.

Whilst the proposed turbine layout extends over a similar section of the landscape, because it includes fewer turbines, the development footprint is significantly smaller.

Even though the proposed turbine structures are taller than the authorised, because they are positioned over a similar extent of the landscape as the turbines associated with the authorised layout, they may be slightly more obvious over a greater distance but their ZTV generally falls within the ZTV of the authorised project.

The review indicates that the proposed amendment to the layout and turbine specification will not increase levels of visual impacts assessed by the original VIA.

Therefore, from a visual impact perspective, there is no reason why the proposed amendment to the Modderfontein WEF should not be authorised.

REFERENCES

Landscape Institute and Institute of Environmental Management Assessment. 2013. *Guidelines for landscape and visual impact assessment*. Oxon, UK:

Oberholzer, B., 2005. *Guidelines for involving visual and aesthetic specialists in EIA processes*: Edition 1. (CSIR Report No. ENV-S-C 2005 053 F). Cape Town, South Africa: Provincial Department of the Western Cape, Department of Environmental Affairs & Development Planning.

MetroGIS (Pty) Ltd. Karoo Renewable Energy Facility, Visual Impact Assessment, March 2011.

De Gryse, Scenic Landscape Architecture (2006). Cullerin Range Wind Farm: Visual Impact Assessment. Unpublished Report.

Scottish Executive, Development Department, Planning Advice Note 45, Revised 2002.

APPENDIX I – ASSESSOR’S BRIEF CURRICULUM VITAE



ENVIRONMENTAL PLANNING AND DESIGN

Name JONATHAN MARSHALL

Nationality British

Year of Birth 1956

Specialisation Landscape Architecture / Landscape & Visual Impact Assessment / Environmental Planning / Environmental Impact Assessment.

Qualifications

Education Diploma in Landscape Architecture, Gloucestershire College of Art and Design, UK (1979)
Environmental Law, University of KZN (1997)

Professional Registered Professional Landscape Architect (SACLAP)
Chartered Member of the Landscape Institute (UK)
Member of the International Association of Impact Assessment, South Africa

Languages

<u>English</u> -	Speaking	-	Excellent
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General

Jon qualified as a Landscape Architect (Dip LA) at Cheltenham (UK) in 1979. He has been a chartered member of the Landscape Institute UK since 1986. He is also a Registered Landscape Architect and has had extensive experience as an Environmental Assessment Practitioner within South Africa.

During the early part of his career (1981 - 1990) He worked with Clouston (now RPS) in Hong Kong and Australia. During this period he was called on to undertake visual impact assessment (VIA) input to numerous environmental assessment processes for major infrastructure projects. This work was generally based on photography with line drawing superimposed to illustrate the extent of development visible.

He has worked in the United Kingdom (1990 - 1995) for major supermarket chains including Sainsbury's and prepared CAD based visual impact assessments for public enquiries for new store development. He also prepared the VIA input to the environmental statement for the Cardiff Bay Barrage for consideration by the UK Parliament in the passing of the Barrage Act (1993).

His more recent VIA work (1995 to present) includes a combination of CAD and GIS based work for a new international airport to the north of Durban, new heavy industrial operations, overhead electrical transmission lines, mining operations in West Africa and numerous commercial and residential developments.

VIA work undertaken during the last twelve months includes wind energy projects, numerous solar plant projects (CSP and PV) and electrical infrastructure.

Select List of Visual Impact Assessment Projects

- **Geelkop Solar PV projects** – Landscape and Visual Impact Assessment for seven proposed solar PV projects near Upington in the Northern Cape Province for Atlantic Renewable Energy Partners.
- **Makapanstad Agri- Hub** – Landscape and Visual Impact Assessment for proposed Agri-Hub development at Makapanstad in the North West Province for the Department of Rural Development and Land Reform.
- **Madikwe Sky Bubble** - Landscape and Visual Impact Assessment for proposed development of up-market accommodation at the Molori concession within the Madikwe Game Reserve.
- **Hartebeest Wind Energy Facility** – Landscape and Visual Impact Assessment Addendum Report for the proposed upgrading of turbine specifications for an authorised WEF near MoOrreesburg in the Western Cape Province for a private client.
- **Selati Railway Bridge** - Landscape and Visual Impact Assessment for proposed development of up-market accommodation on a railway bridge at Skukuza in the Kruger Park.
- **Kangala Mine Extension** - Landscape and Visual Impact Assessment for a proposed extension to the Kangala Mine in Mpumalanga for Universal Coal.
- **Khunab Solar Developments** – Landscape and Visual Impact Assessment for four proposed solar PV projects near Upington in the Northern Cape Province for a private client.
- **Sirius Solar Developments** – Landscape and Visual Impact Assessment for four proposed solar PV projects near Upington in the Northern Cape Province for Sola Future Energy.
- **Aggeneys Solar Developments** – Landscape and Visual Impact Assessment for two proposed solar PV projects near Aggeneys in the Northern Cape Province for a private client.
- **Hyperion Solar Developments** – Landscape and Visual Impact Assessment for four proposed solar PV projects near Kathu in the Northern Cape Province for Building Energy South Africa.
- **Eskom Combined Cycle Power Plant** - Landscape and Visual Impact Assessment for proposed gas power plant in Richards Bay, KwaZulu Natal Province.
- **N2 Wild Coast Toll Road, Mineral Sources and Auxiliary Roads** – VIA for the Pondoland Section of this project for the South African National Roads Agency.
- **Mpushini Park Ashburton** – VIA for a proposed amendment to an authorised development plan which included residential, office park and light industrial uses to logistics and warehousing.
- **Moedeng PV Solar Project** - VIA for a solar project near Vrybury in the North West Province for a private client.
- **Establishment of Upmarket Tourism Accommodation on the Selati Bridge, Kruger National Park** – Assessment of visual implications of providing tourism accommodation in 12 railway carriages on an existing railway bridge at the Skukuza Rest Camp in the Kruger Park.
- **Jozini TX Transmission Tower** – Assessment of visual implications of a proposed MTN transmission tower on the Lebombo ridgeline overlooking the Pongolapoort Nature reserve and dam.
- **Bhangazi Lake Development** – Visual Impact Assessment for a proposed tourism development within the iSimangaliso Wetland Park World Heritage Site.
- **Palesa Power Station** - VIA for a new 600MW power station near Kwamhlanga in Mpumalanga for a private client.
- **Heuningklip PV Solar Project** – VIA for a solar project in the Western Cape Province for a private client.
- **Kruispad PV Solar Project** – VIA for a solar project in the Western Cape Province for a private client.
- **Doornfontein PV Solar Project** – VIA for a solar project in the Western Cape Province for a private client.
- **Olifantshoek Power Line and Substation** – VIA for a new 10MVA 132/11kV substation and 31km powerline, Northern Cape Province, for Eskom.
- **Noupoort Concentrating Solar Plants** - Scoping and Visual Impact Assessments for two proposed

parabolic trough projects.

- **Drakensberg Cable Car** – Preliminary Visual Impact Assessment and draft terms of reference as part of the feasibility study.
- **Paulputs Concentrating Solar Plant (tower technology)** – Visual Impact Assessment for a new CSP project near Pofadder in the Northern Cape.
- **Ilanga Concentrating Solar Plants 1, 2, 3, 4 & 5** – Scoping and Visual Impact Assessments for the proposed extension of five authorised CSP projects including parabolic trough and tower technology within the Karoshoek Solar Valley near Upington in the Northern Cape.
- **Ilanga Concentrating Solar Plants 1, 2, 3, 4 & 5 Shared Infrastructure** – Visual Impact Assessment for the necessary shared infrastructure including power lines, substation, water pipeline and roads for these projects.
- **Ilanga Concentrating Solar Plants 7, 8 & 9** - Scoping and Visual Impact Assessments for three new CSP projects including parabolic trough and tower technology within the Karoshoek Solar Valley near Upington in the Northern Cape.
- **Sol Invictus Solar Plants** - Scoping and Visual Impact Assessments for three new Solar PV projects near Pofadder in the Northern Cape.
- **Gunstfontein Wind Energy Facility** – Scoping and Visual Impact Assessment for a proposed WEF near Sutherland in the Northern Cape.
- **Moorreesburg Wind Energy Facility** – Visual Impact Assessment for a proposed WEF near Moorreesburg in the Western Cape.
- **Semonkong Wind Energy Facility** - Visual Impact Assessment for a proposed WEF near Semonkong in Southern Lesotho.
- **Great Karoo Wind Energy Facility** – Addendum report to the Visual Impact Assessment Report for amendment to this authorised WEF that is located near Sutherland in the Northern Cape. Proposed amendments included layout as well as rotor diameter.
- **Perdekraal East Power Line** – Visual Impact Assessment for a proposed power line to evacuate power from a wind energy facility near Sutherland in the Northern Cape.
- **Tshivhaso Power Station** – Scoping and Visual Impact Assessment for a proposed new power station near Lephalale in Limpopo Province.
- **Saldanha Eskom Strengthening** – Scoping and Visual Impact Assessment for the upgrading of strategic Eskom infrastructure near Saldanha in the Western Cape.
- **Eskom Lethabo PV Installation** - Scoping and Visual Impact Assessment for the development of a solar PV plant within Eskom's Lethabo Power Station in the Free State.
- **Eskom Tuthuka PV Installation** - Scoping and Visual Impact Assessment for the development of a solar PV plant within Eskom's Thutuka Power Station in Mpumalanga.
- **Eskom Majuba PV Installation** - Scoping and Visual Impact Assessment for the development of a solar PV plant within Eskom's Majuba Power Station in Mpumalanga.
- **Golden Valley Power Line** - Visual Impact Assessment for a proposed power line to evacuate power from a wind energy facility near Cookhouse in the Eastern Cape.
- **Mpophomeni Shopping Centre** – Visual impact assessment for a proposed new shopping centre close to the southern shore of Midmar Dam in KwaZulu Natal.
- **Rheebokfontein Power Line** - Addendum report to the Visual Impact Assessment Report for amendment to this authorised power line alignment located near Darling in the Western Cape.
- **Woodhouse Solar Plants** – Scoping and Visual Impact Assessment for two proposed solar PV projects near Vryburg in the North West Province.
- **AngloGold Ashanti, Dokyiwa (Ghana)** – Visual Impact Assessment for proposed new Tailings Storage Facility at a mine site working with SGS as part of their EIA team.
- **Gateway Shopping Centre Extension (Durban)** – Visual Impact Assessment for a proposed shopping centre extension in Umhlanga, Durban.

- **Kouroussa Gold Mine (Guinea)** – Visual impact assessment for a proposed new mine in Guinea working with SGS as part of their EIA team.
- **Mampon Gold Mine (Ghana)** - Visual impact assessment for a proposed new mine in Ghana working with SGS as part of their EIA team.
- **Telkom Towers** – Visual impact assessments for numerous Telkom masts in KwaZulu Natal.
- **Eskom Isundu Substation** – Visual Impact Assessment for a proposed major new Eskom substation near Pietermaritzburg in KwaZulu Natal.
- **Eskom St Faiths Power Line and Substation** – Visual Impact Assessment for a major new substation and associated power lines near Port Shepstone in KwaZulu Natal.
- **Eskom Ficksburg Power Line** – Visual Impact Assessment for a proposed new power line between Ficksburg and Cocolan in the Free State.
- **Eskom Matubatuba to St Lucia Power Line** – Visual Impact Assessment for a proposed new power line between Mtubatuba and St Lucia in KwaZulu Natal.
- **Dube Trade Port, Durban International Airport** – Visual Impact Assessment
- **Sibaya Precinct Plan** – Visual Impact Assessment as part of Environmental Impact Assessment for a major new development area to the north of Durban.
- **Umdloti Housing** – Visual Impact Assessment as part of Environmental Impact Assessment for a residential development beside the Umdloti Lagoon to the north of Durban.
- **Tata Steel Ferrochrome Smelter** - Visual impact assessment of proposed new Ferrochrome Smelter in Richards Bay as part of EIA undertaken by the CSIR.
- **Durban Solid Waste Large Landfill Sites** – Visual Impact Assessment of proposed development sites to the North and South of the Durban Metropolitan Area. The project utilised 3d computer visualisation techniques.
- **Hillside Aluminium Smelter, Richards Bay** - Visual Impact Assessment of proposed extension of the existing smelter. The project utilised 3d computer visualisation techniques.
- **Estuaries of KwaZulu Natal Phase 1** – Visual character assessment and GIS mapping as part of a review of the condition and development capacity of eight estuary landscapes for the Town and Regional Planning Commission. The project was extended to include all estuaries in KwaZulu Natal.
- **Signage Assessments** – Numerous impact assessments for proposed signage developments for Blast Media.
- **Signage Strategy** – Preparation of an environmental strategy report for a national advertising campaign on National Roads for Visual Image Placements.
- **Zeekoegatt, Durban** - Computer aided visual impact assessment. EDP acted as advisor to the Province of KwaZulu Natal in an appeal brought about by a developer to extend a light industrial development within a 60 metre building line from the National N3 Highway.
- **La Lucia Mall Extension** - Visual impact assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed extension to shopping mall for public consultation exercise.
- **Redhill Industrial Development** - Visual impact assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed new industrial area for public consultation exercise.
- **Avondale Reservoir** - Visual impact assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed hilltop reservoir as part of Environmental Impact Assessment for Umgeni Water.
- **Hammersdale Reservoir** - Visual impact assessment using three dimensional computer modelling / photo realistic rendering and montage techniques for proposed hilltop reservoir as part of Environmental Impact Assessment for Umgeni Water.
- **Southgate Industrial Park, Durban** - Computer Aided Visual Impact Assessment and Landscape Design for AECL.
- **Sainsbury's Bryn Rhos** - Computer Aided Visual Impact Assessment/ Planning Application for the

development of a new store within the Green Wedge North of Swansea.

- **Ynyston Farm Access** - Computer Aided Impact Assessment of visual intrusion of access road to proposed development of Cardiff for the Land Authority for Wales.
- **Cardiff Bay Barrage** – Preparation of the Visual Impact Statement for inclusion in the Impact Statement for debate by parliament (UK) prior to the passing of the Cardiff Bay Barrage Bill.
- **A470, Cefn Coed to Pentrebach** - Preparation of landscape frameworks for the assessment of the impact of the proposed alignment on the landscape for The Welsh Office.
- **Sparkford to Ilchester Bye Pass** - The preparation of the landscape framework and the draft landscape plan for the Department of Transport.
- **Green Island Reclamation Study** - Visual Impact Assessment of building massing, Urban Design Guidelines and Masterplanning for a New Town extension to Hong Kong Island.
- **Route 3** - Visual Impact Assessment for alternative road alignments between Hong Kong Island and the Chinese Border.
- **China Border Link** - Visual Impact Assessment and initial Landscape Design for a new border crossing at Lok Ma Chau.
- **Route 81, Aberdeen Tunnel to Stanley** - Visual Impact Assessment for alternative highway alignments on the South side of Hong Kong Island.

APPENDIX II
FORMULA FOR DERIVING THE APPROXIMATE VISUAL HORIZON

The Mathematics behind this Calculation

This calculation should be taken as a guide only as it assumes the earth is a perfect ball 6378137 metres radius. It also assumes the horizon you are looking at is at sea level. A triangle is formed with the centre of the earth (C) as one point, the horizon point (H) is a right angle and the observer (O) the third corner. Using Pythagoras's theorem we can calculate the distance from the observer to the horizon (OH) knowing CH is the earth's radius (r) and CO is the earth's radius (r) plus observer's height (v) above sea level.

Sitting in a hotel room 10m above sea level a boat on the horizon will be 11.3km away. The reverse is also true, whilst rowing across the Atlantic, the very top of a mountain range 400m high could be seen on your horizon at a distance of 71.4 km assuming the air was clear enough.

