



VISUAL ASSESSMENT FOR THE PROPOSED BOIKARABELO POWER LINE

LEDJADJA COAL (PTY) LTD.

NOVEMBER 2012

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Report Title: Visual Assessment for the Proposed Boikarabelo Power line

Project Number: LED1873

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EXECUTIVE SUMMARY

Ledjadja Coal (Pty) Ltd (hereafter Ledjadja Coal) proposes to construct a 132KV line from the Eskom substation located on portion 2 of Vangpan 294LQ to the Boikarabelo Coal Mine substation which is located on the farm Kruishout 271LQ in order to support the 30MVA power allocation that Eskom granted for the operation of the Boikarabelo Coal Mine. Ledjadja Coal appointed Digby Wells Environmental (hereafter Digby Wells) to undertake the visual impact assessment for the proposed Power line Project, which includes a proposed power line route, and two route alternatives; alternative 1 and alternative 2.

In order to adequately identify the potential visual impacts associated with the Power line Project, the baseline visual environmental conditions were defined by referencing relevant literature and photographs of the area; the visual specialist has also spent a fair amount of time in, and is therefore familiar with, the area. Relevant visual aspects (landscape character, visual resource and scenic quality, sense of place, sensitivity of receptors, potential visibility and visual intrusion visual absorption capacity) were analysed.

A digital elevation model (DEM) was created using the ArcGIS Spatial Analyst Extension, with contour relief data as an input. This resultant topographical model was used to create a slope model and viewshed models for the proposed power lines and the two alternatives. These theoretical viewshed models were then scrutinised and practical viewshed models were determined that incorporated contextual vegetation height and visual exposure factors.

The proposed Ledjadja Power line Project is situated in the Waterberg Coalfield area. This region is currently characterised by game farming and grazing agriculture. The area has, however, been earmarked for development and there is ever-increasing visual evidence of developmental activities. The wider study area slopes gently towards the Limpopo River. The topographical model indicates that the elevation of the study area decreases from 946 metres above mean sea level (m.a.m.s.l) in the south-east to 860 m.a.m.s.l in the north-west. The majority of the study area has slopes of between 0% and 2%; the topography of the general area is therefore relatively flat. The bushveld vegetation in the area is quite dense, with an average vegetation height of approximately 4 metres.

It was deduced that the practical viewsheds for the proposed power lines and the alternatives will cover a much smaller area than the theoretical viewsheds; the area that is likely to experience the highest probability of a visual is the area within 500m of the proposed power line and the alternatives.

Based on the practical viewsheds, alternative 2 is likely to be visible by the highest number of potential receptors, while the proposed power lines and alternative 1 are likely to be visible by a similar number of potential visual receptors. The visual sensitivity of the identified receptors is variable; places of worship, houses, farm residences and game lodges are likely have a moderate to high visual sensitivity, while schools, shops and roads are likely to have a moderate to low sensitivity.

The design that has been chosen for the proposed power lines will likely reduce the visual exposure of the infrastructure since a thin monopole, stayed angle strain structure has been chosen. The visual exposure of the proposed lines will also be further reduced by atmospheric haze that occurs in the Waterberg area.

The sense of place of the landscape in which the power lines are situated is fast being transformed from one that is influenced most heavily by the bushveld, agricultural and hunting activities to a mining and development hub; however, since these activities are still currently separated by bushveld in areas away from Lephalale, the visual sensitivity of the landscape is still perceived, at this stage as being fairly high.

The receiving environment of the proposed Power line Project has a moderate to high VAC because there will be extensive screening provided by the bushveld vegetation, while the project will likely have a moderate to low visual intrusion in the developmental context of the area, especially in light of the fact that the lines will likely run alongside the railway line.

The activities associated with the construction, operation and decommissioning of the proposed Boikarabelo Power lines will not be significant. However, the cumulative impacts associated with development in the Waterberg area will likely lead to a change in the landscape and aesthetic character and an alteration to the sense of place. Corridor sharing (with the Boikarabelo Railway line and MBET Pipeline) should be implemented so to reduce the likelihood of excessive vegetation clearing, since the vegetation in the area acts as a visual screen.

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1 INTRODUCTION

Ledjadja Coal (Pty) Ltd (hereafter Ledjadja Coal) proposes to construct a 132KV line from the Eskom substation located on portion 2 of Vangpan 294LQ to the Boikarabelo Coal Mine substation which is located on the farm Kruishout 271LQ in order to support the 30MVA power allocation that Eskom granted for the operation of the Boikarabelo Coal Mine. The proposed power line will run adjacent to the proposed Boikarabelo railway line and will therefore fall within the railway line servitude that has already been assessed by specialists (including a visual specialist). As per legal requirements, one proposed power line route and two alternatives have been decided upon and described in the Basic Assessment Report (BAR) and will be assessed.

2 TERMS OF REFERENCE

Ledjadja Coal Gold has appointed Digby Wells Environmental (hereafter Digby Wells) to undertake the visual impact assessment for the proposed Power line Project.

3 KNOWLEDGE GAPS

Although findings from studies pertaining to perceptions and psychology can be applied, the nature and severity of a visual impact is intrinsically subjective. It is dependent on the subject who is viewing it. For example for some people infrastructure may be indicative of urbanisation and, consequently, economic uplift in an area; this would result in a positive visual impact for the viewer. Some people may not be concerned by the erection of new power lines due to the social, economic or other environmental surroundings in which they have grown up. In contrast, other people may value the rural character of an area and as such the presence of power lines within a sight-line may be perceived as 'damaging' to the visual character or fabric of the area in which they live or choose to spend leisure/relaxation time.

The results of the VIA are presented based on an expectation of social norms and should therefore encompass visual issues pertaining to, or potentially raised by, the majority of people within the defined study area. However, there is a possibility that the ideas, concerns or opinions of individual people living within the area (or who might experience a visual impact) could be excluded, since it is impossible to assess the potential impact to every individual receptor.

4 STUDY AREA

The proposed Boikarabelo Power line Project is situated in the Waterberg Coalfield area. This region is currently characterised by game farming and grazing agriculture. The area has, however, been earmarked for development and there is ever-increasing visual evidence of developmental activities. Plan 1 in Appendix A illustrates the regional setting of the proposed railway.

The proposed power line falls within the Lephalale Local Municipality and the Waterberg Magisterial District. The nearest settlement is Steenbokpan, situated south of the proposed

power lines and alternative 1, and through which alternative 2 runs. The nearest major town is Lephalale (formerly known as Ellisras), located 29.9 km east-south-east of the proposed route and the alternatives.

The nearest regional route is the R510 between Lephalale and Stockpoort east of the proposed power line. The proposed power line runs in a south-easterly direction from the proposed Boikarabelo Coal Mine power station to the substation located on the farm Vangpan 294 LQ. The proposed power line and alternative 1 cross the D175 secondary road north of Steenbokpan, they then run parallel to the D1675 secondary road for approximately 15 km before turning to join the substation. Alternative 2 runs in an easterly direction from the Boikarabelo power station to meet up with the D175, it then turns to run parallel with the D175 until it reaches Steenbokpan, after which it turns to run parallel with the D1675 until it reaches the substation. Plan 2 in Appendix A illustrates the local setting of the proposed power line.

The proposed power line falls within the Limpopo River Catchment Area. The Limpopo River is situated 6.2 km north-west of the proposed railway. The proposed routes do not cross any streams and the route of the proposed power line, and the alternatives, have been designed to avoid several pans.

The area consists mainly of undisturbed bushveld vegetation with the exception of a few areas cleared for grazing. Scattered farmhouses and game lodges occur within the area. The proposed power line and alternative 1 will both pass on the boundary of the Steenbokpan settlement, while alternative 2 passes through the middle. The details of the proposed power line route and the two alternatives are given below;

The proposed power line is approximately 20.5 km long. The co-ordinates for the proposed power line are 23° 37' 50.142" S & 27° 9' 56.177" E (start), 23° 40' 55.783" S & 27° 14' 3.698" E (middle) and 23° 41' 14.410" S & 27° 19' 19.120" E (end). The power line traverses farms Kruishout 271LQ, Bitterfontein 272 LQ, Groot-Zwart-Bult 290 LQ, Kamiesbult 291 LQ, Vangpan 294 LQ, Steenbokpan 295 LQ and Slangkop 296 LQ.

Proposed alternative 1 is approximately 20.3 km long. The co-ordinates for the proposed power line are 23° 37' 50.142" S & 27° 9' 56.177" E (start), 23° 40' 55.443" S & 27° 14' 7.254" E (middle) and 23° 41' 14.410" S & 27° 19' 19.120" E (end). The alternative traverses the same farms as the proposed power line.

Proposed alternative 2 is approximately 22.3 km long. The co-ordinates for the proposed power line are 23° 37' 50.142" S & 27° 9' 56.177" E (start), 23° 40' 5.712" S & 27° 14' 37.538" E (middle) and 23° 41' 14.410" S & 27° 19' 19.120" E (end). The alternative traverses farms Theunispan 293 LQ, Wildebeestvlakte 268 LQ, Kruishout 271 LQ, Bitterfontein 272 LQ, Groot-Zwart-Bult 290 LQ, Grootdoorn 292 LQ and Vangpan 294 LQ.

5 EXPERTISE OF THE SPECIALIST

A Curriculum Vitae (CV) and declaration of independence is attached in Appendix A.

6 AIMS AND OBJECTIVES

The objectives of the study were as follows;

- To identify the current natural and man-made visual aspects of the study area/ landscape that are relevant to the VIA;
- To analyse and characterise the associated topographical aspects of elevation and slope of the landscape using relevant GIS;
- To define the potential viewshed for the power lines using relevant GIS software;
- To identify potential receptors that will be impacted on by the proposed power lines, taking into account visibility and sensitivity aspects;
- To identify the impacts that the potential power lines will have on the visual landscape and to rate the scale, duration, severity and probability of the impacts occurring; and
- To provide recommendations and mitigation measures in an attempt to reduce the negative visual impacts that the proposed project will have.

7 METHODOLOGY

In order to adequately identify the potential visual impacts associated with the Power line Project, the baseline visual environmental conditions were defined. Relevant literature was reviewed (a visual assessment has been done for the railway line which is likely to share a servitude with the proposed power lines) and photographs were analysed in order to assess and define the visual elements of landscape character and land use, visual resource and scenic quality, sense of place, visual sensitivity and sensitive receptors, potential project visual exposure, Visual Absorption Capacity (VAC) and the potential visibility of the infrastructure (defined by slope, vegetation, buildings and landscape character) (Table 1).

The project activities and designs (stayed angle strain structure of the tower) were studied in order to identify the potential risk sources to these visual elements.

Table 1: Visual aspects

Visual Aspect	Description
Landscape Character	Sense that is evoked by the landscape depending on the landscape attributes; more natural looking landscapes are given a higher sensitivity score.
Visual Resource and Scenic Quality	Perceived visual quality of an area and the weighting that the visual quality holds as a resource. More natural looking areas are given a higher score.
Sense of Place	Based on the uniqueness of the area and its social attributes.
Sensitivity of Receptors	Based fairly heavily on sense of place but also on the social attributes of the landscape.

Visual Aspect	Description
Potential Visibility and Visual Intrusion	Based on the physical landscape attributes; visual shields are likely to occur in areas that are rife with taller vegetation.
Visual Absorption Capacity	The potential that the landscape has to conceal the proposed project.

A digital elevation model (DEM) was created using the ArcGIS Spatial Analyst Extension, with contour relief data as an input. This resultant topographical model was used to create a slope model.

The DEM was used as an input to create viewshed models using the ArcGIS Spatial Analyst Extension in order to establish the degree of visibility that the proposed power lines and the alternatives are likely to have. A height of 18.3m for the towers was given by the client and used as an input in the viewshed analyses (Figure 1; $21\text{m} - 2.7\text{m} = 18.3\text{m}$). Literature regarding theoretical visibility and proximity offsets was scrutinised to determine the zone of potential visual influence for the power lines since viewshed modelling in ArcGIS does not take this important aspect into account. Discussions with Fauna and Flora specialists were also carried out in order to gauge the likely influence that the vegetation in the area has on the visibility of objects. Based on the research carried out, and on the specialists personal experience in the Waterberg area, the viewshed area was further categorised into various distance proximities based on degrees of probable or potential visibility. The position of potential visual receptors, in relation to the various zones of visibility, was considered and displayed using ArcGIS.

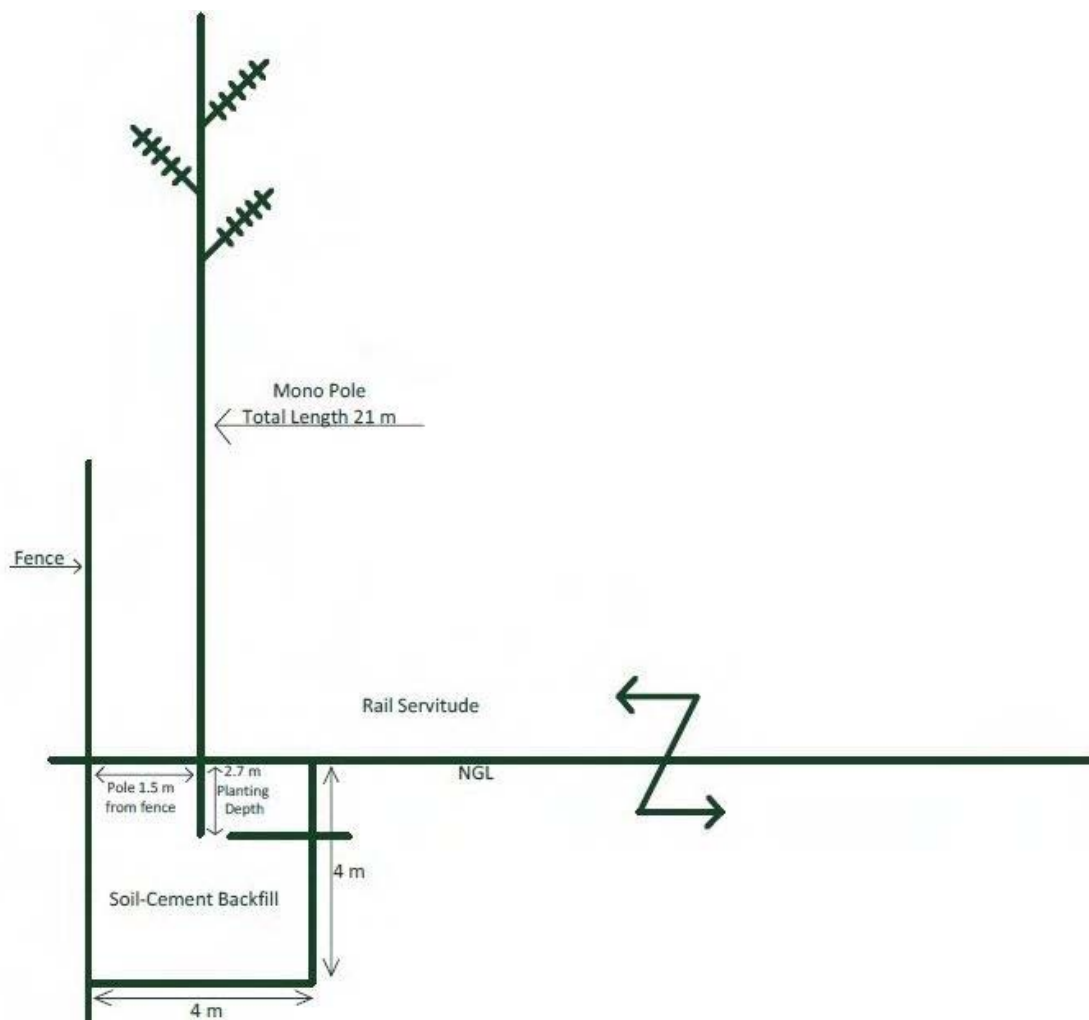


Figure 1: Conceptual design of the proposed power lines

The potential impacts associated with each of the project activities and risk sources that were identified were then assessed based on their severity, geographical scale, duration and probability. Mitigation measures were also stated in an attempt to reduce the visual impacts associated with the preferable corridors.

8 FINDINGS

8.1 Topography and Landscape / Aesthetic Character

The wider study area slopes gently towards the Limpopo River. The topographical model indicates that the elevation of the study area decreases from 946 metres above mean sea level (m.a.m.s.l) in the south-east to 860 m.a.m.s.l in the north-west (Plan 3 in Appendix A). The topographical profiles of the proposed power lines and the alternatives are shown in Figures 1 to 3 in Appendix B. The topographical profiles of the proposed power line and alternative 1 are very similar since they share a common route, except that the proposed power line travels on the western side of the pan that falls over farms Groot-Zwart Bult 290 LQ and Kamiesbult 291 LQ, while alternative 1 travels on the eastern edge of the pan. The

topographical profile of all of the power line options or alternatives depict a mild rise in elevation as the power line routes travel away from the Limpopo River floodplain. The elevation of the proposed power line and alternative 1 route rises approximately 50m over a distance of 20.5 km and 20.3 km respectively. The elevation of the proposed Alternative 2 route rises approximately 65m over a distance of 22.3 km.

The majority of the study area has slopes of between 0% and 2% (Plan 4 in Appendix A). Slopes of between 2% and 8% occur in an isolated area. The slope aspect/direction of the study area is generally in a northerly and north-westerly direction towards the Limpopo River.

The topography of the general study area and surrounds is relatively flat (Figure 2). It is expected that the topography alone will provide minimal screening of the proposed development. The receiving environment is characterised by natural bushveld vegetation with small settlements and isolated farmsteads and game lodges.



Figure 2: Flat topography of the general landscape

The natural vegetation of the receiving environment is bushveld which is comprises of grassland, bushes and trees (Figure 3). This bushveld vegetation is quite dense, with an average vegetation height of approximately 4 metres.



Figure 3 : Bushveld Vegetation

8.2 Visibility (Viewshed Model)

A viewshed is a geographical area, defined by the topography, within which a particular feature will be visible (Oberholzer, 2005). The topographical model was used to create a viewshed model using the Viewshed Tool of the ArcGIS 3D Analyst Extension. This is a theoretical viewshed model illustrating the areas from which the proposed project will potentially be visible. The concept of viewshed modelling is depicted in Figure 4.

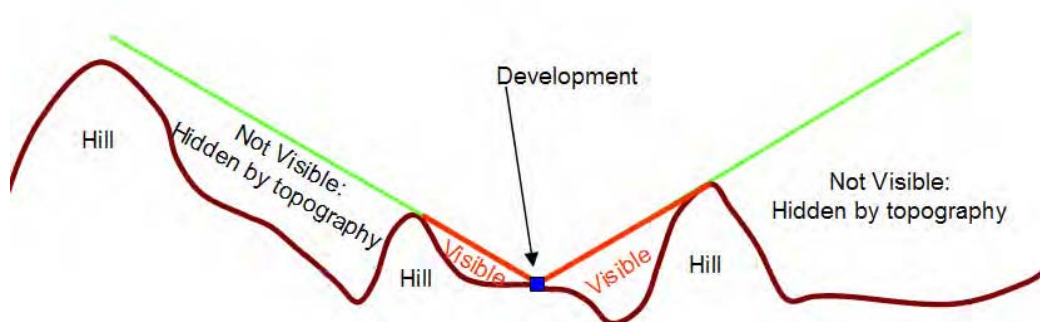


Figure 4: Conceptual illustration of viewshed modelling and visibility

The theoretical viewshed models for the proposed Power line Project depict the area from which the proposed power line will theoretically be visible, based only on the topography of the area. This *theoretical viewshed* is likely to cover an extensive area.

However, based on the experiences of the visual specialist in the field, it was deduced that the *practical viewshed* of the power lines is likely to be within a 1 km radius of the proposed power line and both of the alternatives due to the dense vegetation in the area. Lines of sight

from further distances away might possibly be introduced where the power lines run along a road which is straight for a fair distance. However, even in such instances, the road does not run in a completely straight line for a lengthy distance, so it is unlikely that the power lines will be seen from a distance further than approximately 2km away. The area that is likely to experience the highest probability of a visual is the area within 500m of the proposed power line and the alternatives. The practical viewsheds of the proposed power lines and the alternatives, that illustrate the relevant distance proximities that have been described, are depicted in Plans 5, 6 and 7 in Appendix A.

8.3 Sensitive Receptors

The tables below indicate the visual receptors that fall within the visibility proximities of the proposed power line and the two alternatives as defined in the “Visibility” section above. A “Y” indicates that an area of the land within a particular farm falls within that distance proximity stipulated in the tables to some extent, while an “N” indicates that no area of the farm falls within that particular distance proximity. Particular structures are also identified within each of the specified distance proximities.

Table 2: Farms falling within the distance proximities that define the practical viewshed of the proposed power lines

Farm	0 - 0.5 km	0.5 – 1 km	1 – 2 km
Zeekoevley 241 LQ	N	N	Y
Wildebeestvlakte 268 LQ	Y	Y	Y
Kleinpan 269 LQ	N	N	Y
Kruishout 271 LQ	Y	Y	1 house
Bitterfontein 272 LQ	Y	2 houses	Y
Vlugtkraal 273 LQ	N	N	Y
Vischpan 274 LQ	N	N	Y
Kalkpan 243 LQ	N	Y	Y
Groot-Zwart-Bult 290 LQ	1 house	Y	Y
Kamiesbult 291 LQ	1 house	2 houses	1 house
Grootdoorn 292 LQ	Y	3 houses	3 houses

Farm	0 - 0.5 km	0.5 – 1 km	1 – 2 km
Vangpan 294 LQ	1 house	3 houses	2 houses
Steenbokpan 295 LQ	4 houses, 1 store, 1 place of worship, 1 shop	1 school	Y
Slangkop 296 LQ	Y	Y	2 houses
Zandbult 300 LQ	Y	Y	1 house
Kameelbult 301 LQ	N	N	Y
Houwhoek 267 LQ	N	N	Y
Theunispan 293 LQ	N	N	Y
Dwars-In-De-Weg 289 LQ	Y	Y	Y

Table 3: Farms falling within the distance proximities that define the practical viewshed of power line alternative 1

Farm	0 - 0.5 km	0.5 – 1 km	1 – 2 km
Zeekoevley 241 LQ	N	N	Y
Wildebeestvlakte 268 LQ	Y	Y	Y
Kleinpan 269 LQ	N	N	Y
Kruishout 271 LQ	Y	Y	1 house
Bitterfontein 272 LQ	Y	2 houses	Y
Vlugtkraal 273 LQ	N	N	Y
Vischpan 274 LQ	N	N	Y
Kalkpan 243 LQ	N	Y	Y
Groot-Zwart-Bult 290	1 house	Y	Y

Farm	0 - 0.5 km	0.5 – 1 km	1 – 2 km
LQ			
Kamiesbult 291 LQ	1 house	1 house	2 houses
Grootdoorn 292 LQ	Y	3 houses	2 houses
Vangpan 294 LQ	1 house	3 houses	2 houses
Steenbokpan 295 LQ	4 houses, 1 store, 1 place of worship, 1 school	1 school	Y
Slangkop 296 LQ	Y	Y	2 houses
Zandbult 300 LQ	Y	Y	3 houses
Kameelbult 301 LQ	N	N	Y
Houwhoek 267 LQ	N	N	Y
Theunispan 293 LQ	N	N	Y
Dwars-In-De-Weg 289 LQ	Y	Y	Y

Table 4: Farms falling within the distance proximities that define the practical viewshed of power line alternative 2

Farm	0 - 0.5 km	0.5 – 1 km	1 – 2 km
Zeekoevley 241 LQ	N	N	Y
Wildebeestvlakte 268 LQ	Y	1 house	1 house
Kleinpan 269 LQ	Y	1 house	Y
Kruishout 271 LQ	Y	Y	Y
Bitterfontein 272 LQ	Y	Y	2 houses
Vischpan 274 LQ	N	N	Y

Farm	0 - 0.5 km	0.5 – 1 km	1 – 2 km
Kalkpan 243 LQ	N	Y	Y
Groot-Zwart-Bult 290 LQ	Y	1 house	Y
Grootdoorn 292 LQ	9 houses	Y	Y
Vangpan 294 LQ	3 houses	4 houses	Y
Steenbokpan 295 LQ	1 place of worship	2 schools, 3 houses, 1 store	1 house
Slangkop 296 LQ	N	N	Y
Zandbult 300 LQ	Y	Y	3 houses
Kameelbult 301 LQ	N	N	Y
Houwhoek 267 LQ	N	N	1 house
Swelpa 245 LQ	N	N	Y
Theunispan 293 LQ	10 houses, 2 stores, 1 post office	4 houses	3 houses, 1 school
Twistpan 265 LQ	N	N	Y

A summary of the identified structures is given below (including district roads). Alternative 2 is likely to be visible by the highest number of potential receptors, with a total of 28 potential receptors being identified to fall within the 0 to 0.5 km distance proximity, 19 potential receptors falling within the 0.5 to 1 km distance proximity and 14 potential receptors falling within the 1 to 2 km distance proximity.

A total of 12 receptors were identified within the 0 to 0.5 km distance proximity of the proposed power line, while 13 potential receptors fall within the 0.5 to 1 km distance proximity and 12 potential receptors fall within the 1 to 2 km distance proximity.

A total of 12 receptors were identified within the 0 to 0.5 km distance proximity of alternative 1, 12 potential receptors fall within the 0.5 to 1 km distance proximity and 14 potential receptors fall within the 1 to 2 km distance proximity.

A similar number of potential visual receptors will therefore be affected by the proposed power line and alternative 1.

Table 5: Identified structures / receptors associated with the proposed power line and the alternatives

Distance Proximities			
Option / Alternative	0 – 0.5 km	0.5 – 1 km	1 – 2 km
Proposed Power line	7 houses, 2 shops, 1 place of worship, D175 District Road, D1675 District Road	10 houses, 1 school, D175 District Road, D1675 District Road	10 houses, D175 District Road, D1675 District Road
Alternative 1	7 houses, 1 shop, 1 place of worship, 1 school, D175 District Road, D1675 District Road	9 houses, 1 school, D175 District Road, D1675 District Road	12 houses, D175 District Road, D1675 District Road
Alternative 2	22 houses, 2 shops, 1 place of worship, 1 post office, D175 District Road, D1675 District Road	14 houses, 2 schools, 1 store, D175 District Road, D1675 District Road	11 houses, 1 school, D175 District Road, D1675 District Road

9 RESULTS AND DISCUSSION

9.1 Visibility

The visibility of the project refers to the practical viewshed area. Oberholzer (2005) describes this as “the geographic area from which the project will be visible”. The visibility of the project is also related to the number of receptors affected. The proposed power lines, and the alternatives, have a **high theoretical visibility**.

However, the screening effect of the vegetation will decrease the area from which the proposed power lines will be visible substantially; in fact, in the context of the Waterberg area, the vegetation is likely to have a more substantial influence on the visibility of infrastructure than the topography of the landscape.

In the context of the Waterberg area and the vegetation that occurs there, all of the options or alternatives are likely to have a low visibility.

9.2 Visual Exposure

Visual exposure can be rated using the visibility proximities as increments of magnitude; according to Martin (2010) the visual significance of objects decreases so rapidly that at a distance further than 10 km away, the exposure is negligible. The distance at which the proposed power lines will be viewed from will affect the severity of the potential visual impact

that will be experienced. Due to the effects of haze, lighting and other weather conditions in a real-world, visual exposure can vary greatly from area to area or even from day to day (Malm 1999).

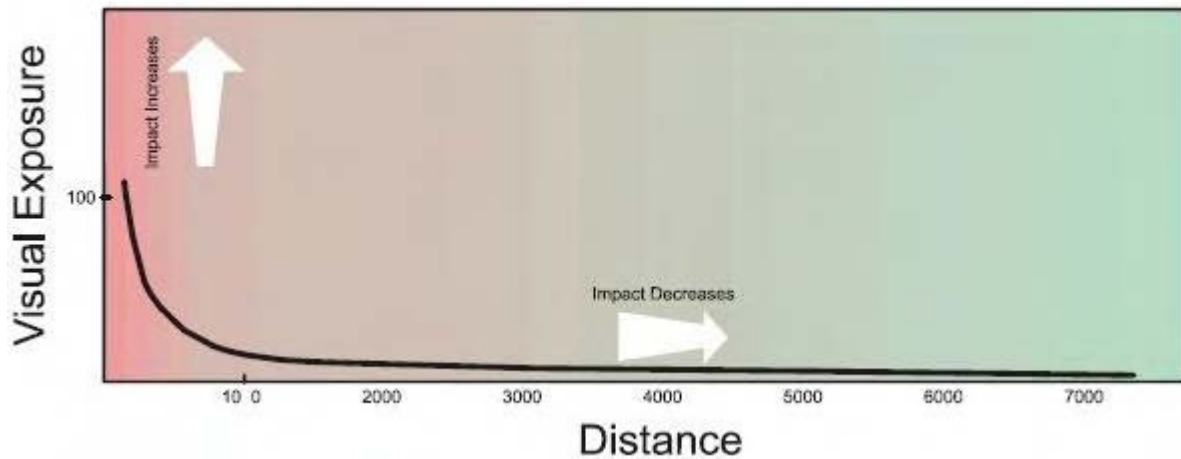


Figure 5: Effect of distance on visual exposure (Malm 1999)

The visual exposure of objects is also influenced by the design of the infrastructure itself; bulky objects or towers that are suspended above the ground in the landscape are likely to be more visually obtrusive than thin towers and lines since the latter are more likely to be subjected to a decrease in visual exposure caused by weather conditions and distance, and will not silhouette against the skyline. The design that has been chosen for the proposed power lines will likely reduce the visual exposure of the infrastructure since a thin monopole, stayed angle strain structure will likely be used (Figure 6).

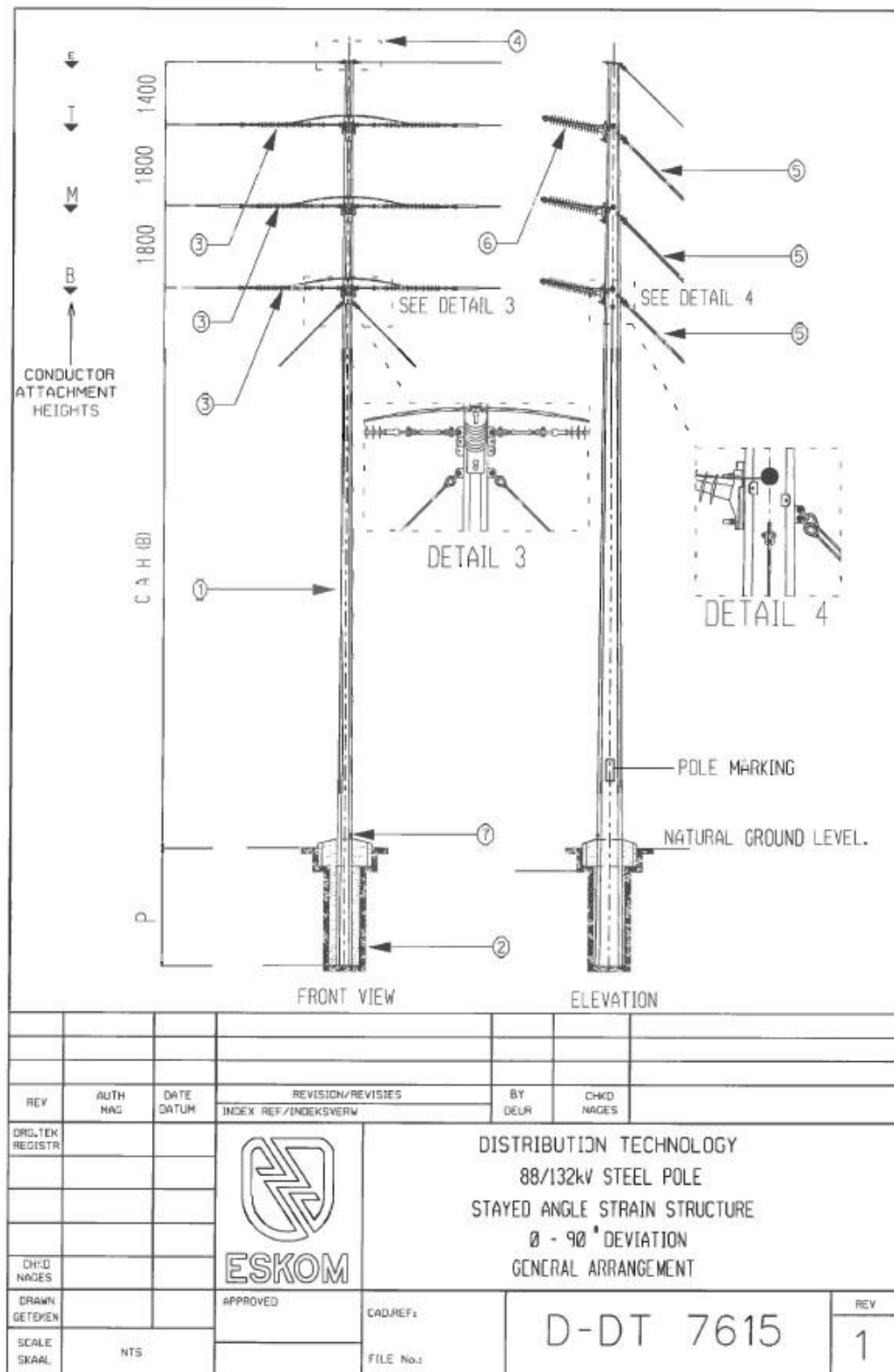


Figure 6: Stayed angle structure likely to be used for the proposed power lines

Considering the landscape and environment in which the proposed transmission power lines and substation will be constructed, it is possible that there will be an effect from atmospheric

haze on visibility, particularly during the winter months. Figure 7 shows a view of the Waterberg area and the presence of atmospheric haze; the visibility of objects decreases exponentially due to the effect of the atmospheric haze such that the Waterberg Mountains in the image are barely visible or recognisable against the rest of the sky.



Figure 7: Example of atmospheric haze in the Waterberg Area

Given the environmental and design context of the proposed power line project, it is likely that the power lines will have a moderate to low visual exposure.

9.3 Sense of Place and Visual Sensitivity of the Area

The sense of place of an area is described by Lynch (1992) as "...the extent to which a person can recognise or recall a place as being distinct from other places or as having a vivid, unique, or at least particular character of its own". It is, in a sense, a quality that is construed by taking into account visual factors such as the scale or magnitude of landscape elements, the colour, texture and landform of a landscape and, in particular, the predominant land use of the area. In summary, the sense of place can be described as a function of landscape attributes such as scenic quality and uniqueness of the natural, built and cultural landscape.

The visual sensitivity of the area refers to "the inherent visibility of the landscape, usually determined by a combination of topography, landform, vegetation cover and settlement pattern" (Oberholzer, 2005). The notions of sense of place and visual sensitivity of a landscape are therefore intrinsically connected and cultural and social features of a landscape are pertinent aspects to consider when determining the visual sensitivity of an area.

The sense of place of the landscape in which the power lines are situated is fast being transformed from one that is influenced most heavily by the bushveld, agricultural and hunting activities to a mining and development hub. The landscape is flat and fairly uniform with little visual diversity, but the ambience of the landscape in the past has been one of passive and wild Africa. However, there is a vast amount of development that is occurring in the Waterberg area. There are currently two large power stations located within the general landscape; Matimba which is currently operational and Medupi which is still being built, and a third power station will be built at the Boikarabelo Coal Mine, from which the proposed

power lines will travel. The visual sensitivity of the landscape is therefore rapidly decreasing as the tranquillity and intactness of the bushveld is being disrupted by mining and developmental activities. However, since these activities are still currently separated by bushveld in areas away from Lephalale, the visual sensitivity of the landscape is still perceived, at this stage as being fairly high.

9.4 Visual Sensitivity of the Receptors

The visual sensitivity of receptors is dependent on the nature of the receptors. Receptors in residential areas or nature reserves are likely to have a higher sensitivity, while receptors in industrial or mining areas are likely to have a lower sensitivity. The visual sensitivity of the identified receptors is variable; places of worship, houses, farm residences and game lodges are likely to have a moderate to high visual sensitivity, while schools, shops and roads are likely to have a moderate to low sensitivity. The sensitivity of most of these receptors is likely to be ever-decreasing as they become accustomed to the developmental and mining activities that are being carried out in the Waterberg area.

During this rapid and exponential developmental stage, the visual sensitivity of some of the receptors might increase since some of the people who live on farms nearby or utilise the transport routes (e.g. holiday makers) might place a high value on the wild ruggedness of the bushveld. The sensitivity of these receptors would increase as these people become increasingly frustrated and disheartened by the continuous developments in the area.

9.5 Visual Absorption Capacity

The visual absorption capacity (VAC) refers to “the potential of the landscape to conceal the proposed project” (Oberholzer, 2005) and is variable depending on the land use and landscape character. The receiving environment of the proposed Power line Project has a **moderate to high VAC** because there will be extensive screening provided by the bushveld vegetation.

9.6 Visual Intrusion

The visual intrusion of the project refers to “the level of compatibility or congruence of the project with the particular qualities of the area, or its sense of place”. Visual intrusion is “related to the idea of context and maintaining the integrity of the landscape or townscape” (Oberholzer, 2005). The proposed Power line Project will likely have a moderate to low visual intrusion in the developmental context of the area, especially in light of the fact that the lines will likely run alongside the railway line.

10 STUDY SUMMARY AND CONCLUSION

The proposed power lines are not bulky and will be erected in an area that provides extensive visual screening due to the dense bushveld vegetation; the practical visibility of the proposed power lines will therefore be minimal. The visual exposure of the lines will be further decreased by the atmospheric haze in the Waterberg area. The sensitivity of the potential visual receptors that have been identified is variable; receptors such as lodges,

houses, places of worship and holiday travel routes are likely to have a higher visual sensitivity, while the visual sensitivity of schools and shops is likely to be lower. The activities associated with the construction, operation and decommissioning of the proposed Boikarabelo Power lines will not be significant. However, the cumulative impacts associated with development in the Waterberg area will likely lead to a change in the landscape and aesthetic character and an alteration to the sense of place. Corridor sharing (with the Boikarabelo Railway line and MBET Pipeline) should be implemented so to reduce the likelihood of excessive vegetation clearing, since the vegetation in the area acts as a visual screen.

11 REFERENCES

CRONE, S. 2011. Visual Input for Resgen Rail. Visual Report Prepared by Digby Wells Environmental, Johannesburg, Gauteng, South Africa.

ESRI 2011. Using Viewshed and Observer Points for Visibility Analysis: ArcGIS 10.

MALM, W. 1999. Introduction to Visibility. Presentation Prepared by the Cooperative Institute for Research in the Atmosphere (CIRA). Colorado State, United States of America.

OBERHOLZER, B. 2005. Guideline for Involving Visual and Aesthetic Specialists in the EIA Processes; Edition 1. CSIR Report No. ENV-S-C 2005 053 F. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Developmental Planning, Cape Town.

Appendix A: Plans

Plan 1: Regional Setting

Plan 2: Locality Map – Power lines Overview

Plan 3: Topography

Plan 4: Slope

Plan 5: Proposed Power line Practical Viewshed

Plan 6: Alternative 1 Practical viewshed

Plan 7: Alternative 2 Practical viewshed

Boikarabelo 132 kV Powerline

Regional Setting

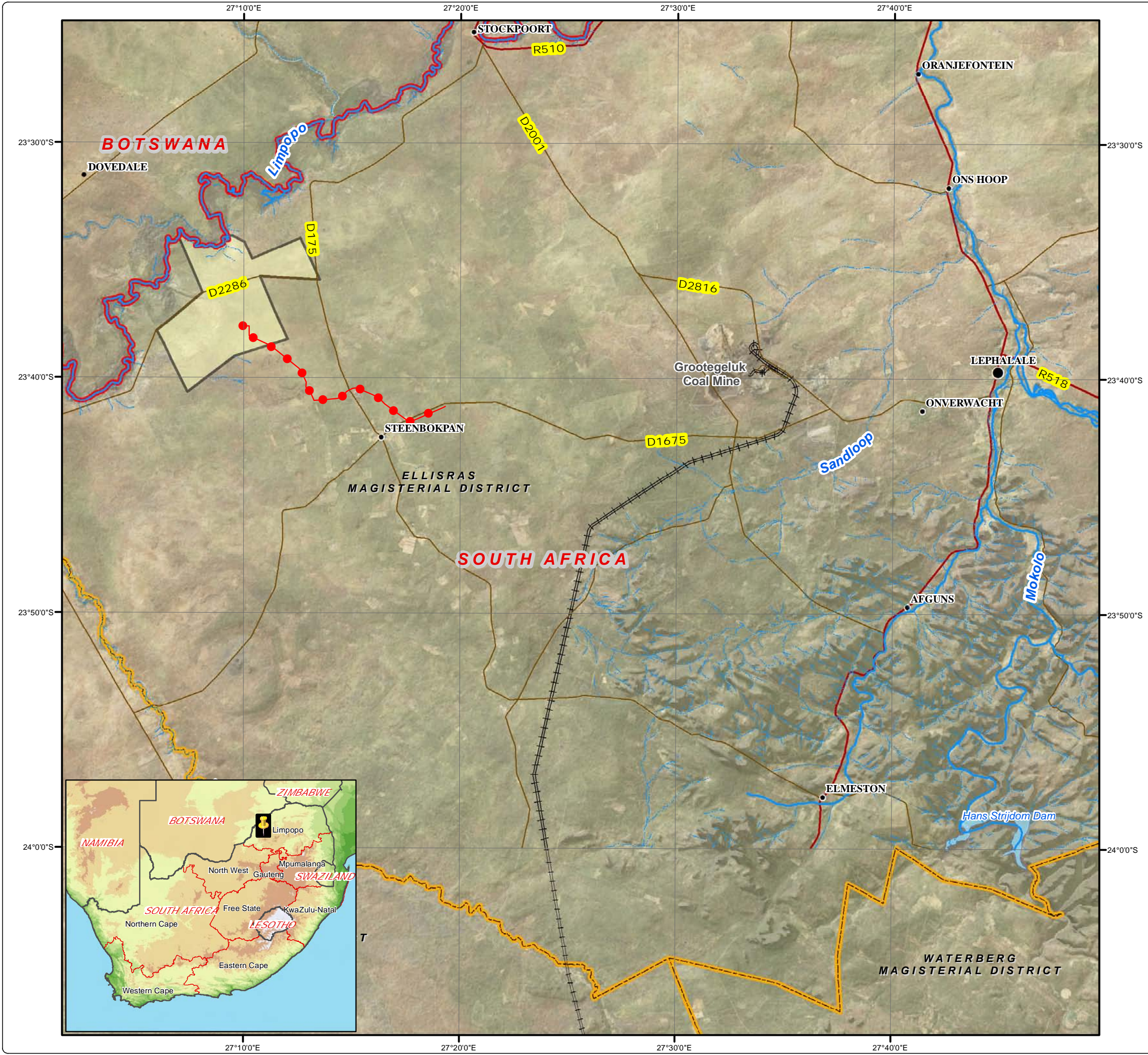
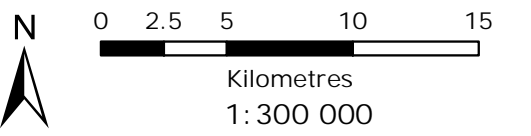
Legend

- Proposed 132kV Powerline
- Major Town
- Other Town
- Secondary Town
- Settlement
- Existing Railway Line
- Main Road
- Secondary Road
- Perennial Stream
- Non-Perennial Stream
- Dams
- Boikarabelo Mining Right Area
- International Boundary
- Magisterial District Boundary



Tel: +27 11 789 9495

Projection: Transverse Mercator Ref #: anp.LED1873.2012.069
Datum: Hartbeesthoek 1994 Revision Number: 1
Central Meridian: 27°E Date: 10/10/2012



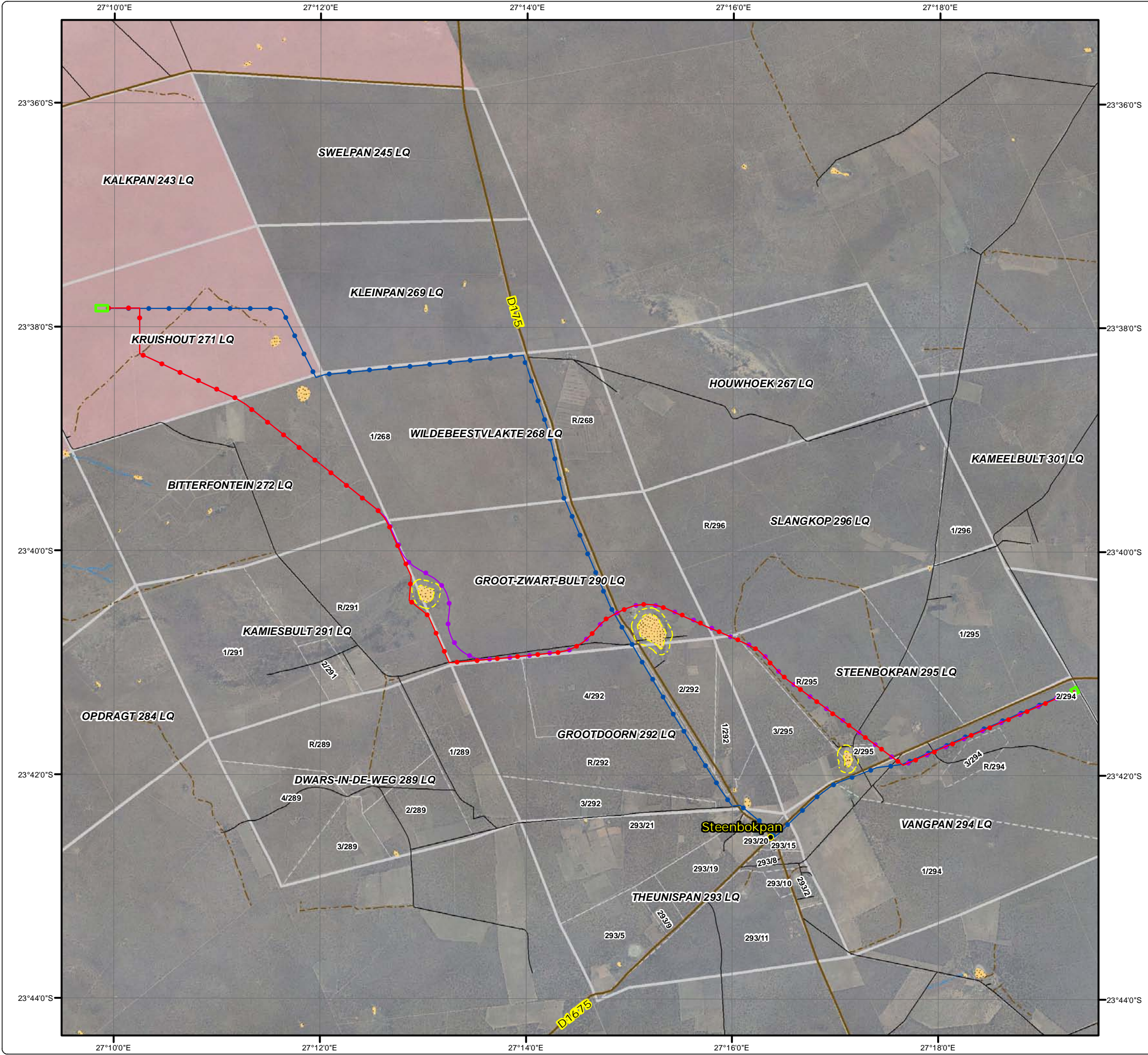
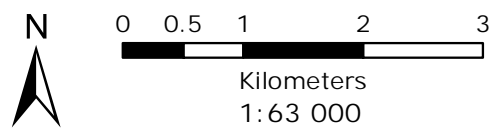
Boikarabelo 132 kV Powerline Locality Map Powerline and Alternatives Overview

Legend

- Settlement
- Proposed Powerline
- Powerline Alternative 1
- Powerline Alternative 2
- District Road
- Street
- - - Track / Footpath
- - - Non-Perennial Stream
- Perennial Stream
- ▭ Substations
- ▭ Farms Boundaries
- - - Farm Portions
- ▨ Non-Perennial Pan / Stream
- ▨ 100m Buffer around Pans
- ▨ Boikarabelo Coal Mine Mining Right Area



Projection: Transverse Mercator Ref #: amc.LED1873.201211.144
Datum: WGS 1984 Revision Number: 1
Central Meridian: 27°E Date: 21/11/2012



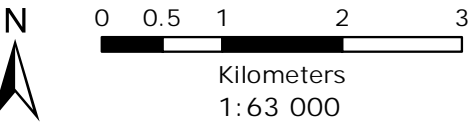
Boikarabelo 132 kV Powerline Topography

Legend

- Settlement
 - Proposed Powerline
 - Powerline Alternative 1
 - Powerline Alternative 2
 - District Road
 - Street
 - - - Track / Footpath
 - · - · - Non-Perennial Stream
 - Perennial Stream
 - ▭ Substations
 - ▭ Farms Boundaries
 - - - Farm Portions
 - ▨ Non-Perennial Pan / Stream
 - ▨ 100m Buffer around Pans
 - ▨ Boikarabelo Coal Mine Mining Right Area
- Elevation (m.a.m.s.l)
- High : 937
- Low : 836



Projection: Transverse Mercator Ref #: amc.LED1873.201211.146
Datum: WGS 1984 Revision Number: 1
Central Meridian: 27°E Date: 21/11/2012



Boikarabelo 132 kV Powerline

Slope

Legend

- Settlement
 - Proposed Powerline
 - Powerline Alternative 1
 - Powerline Alternative 2
 - District Road
 - Street
 - Track / Footpath
 - Non-Perennial Stream
 - Perennial Stream
 - ▭ Substations
 - ▭ Farms Boundaries
 - ▭ Farm Portions
 - ▭ Non-Perennial Pan / Stream
 - ▭ 100m Buffer around Pans
 - ▭ Boikarabelo Coal Mine Mining Right Area
- Slope of Topographical Model (% Rise)
- | |
|-------------|
| 0 - 1.7 |
| 1.8 - 7.3 |
| 7.4 - 18 |
| 18.1 - 33.5 |
| 33.6 - 71.9 |



Projection: Transverse Mercator Ref #: amc.LED1873.201211.147
Datum: WGS 1984 Revision Number: 1
Central Meridian: 27°E Date: 21/11/2012



Boikarabelo 132 kV Powerline

Proposed Powerline Practical
Viewshed and Potential Receptors

Legend

- Proposed Powerline
- Town
- Main Road
- Secondary Road
- Substations
- Farms Boundaries
- Farm Portions
- Boikarabelo Coal Mine Mining Right Area

Structures

- House
- Place of Worship
- Police Station
- Post Office
- Ruin
- School
- Store / Shop

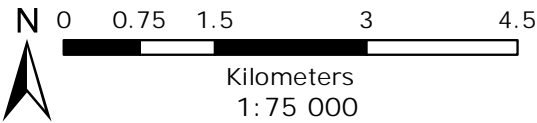
Powerline Practical Visibility

- Likely Visible : 0 - 0.5 km
- Maybe Visible : 0.5 - 1 km
- Unlikely Visible : 1 - 2 km



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Projection: Transverse Mercator Ref #: amc.LED1873.201211.137
Datum: WGS 1984 Revision Number: 1
Central Meridian: 27°E Date: 20/11/2012



Boikarabelo 132 kV Powerline

Alternative 1 Practical
Viewshed and Potential Receptors

Legend

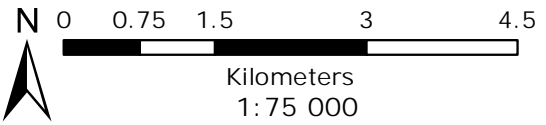
- Town
- Alternative 1
- Main Road
- Secondary Road
- Substations
- Farms Boundaries
- Farm Portions
- Boikarabelo Coal Mine Mining Right Area
- Structures
 - House
 - Place of Worship
 - Police Station
 - Post Office
 - Ruin
 - School
 - Store / Shop

Alternative 1 Practical Viewshed

- Likely Visible : 0 - 0.5 km
- Maybe Visible : 0.5 - 1 km
- Unlikely Visible : 1 - 2 km



Projection: Transverse Mercator Ref #: amc.LED1873.201211.138
Datum: WGS 1984 Revision Number: 1
Central Meridian: 27°E Date: 20/11/2012



Boikarabelo 132 kV Powerline

Alternative 2 Practical
Viewshed and Potential Receptors

Legend

- Powerline Alternative 2
 - Town
 - Main Road
 - Secondary Road
 - Substations
 - Farms Boundaries
 - Farm Portions
 - Boikarabelo Coal Mine Mining Right Area
- Structures
- House
 - Place of Worship
 - Police Station
 - Post Office
 - Ruin
 - School
 - Store / Shop

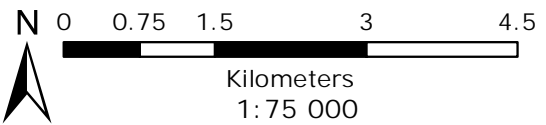
Alternative 2 Practical Viewshed

- Likely Visible : 0 - 0.5 km
- Maybe Visible : 0.5 - 1 km
- Unlikely Visible : 1 - 2 km



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Projection: Transverse Mercator Ref #: amc.LED1873.201211.138
Datum: WGS 1984 Revision Number: 1
Central Meridian: 27°E Date: 20/11/2012



Appendix B: Topographical Cross-Sections of the Power lines

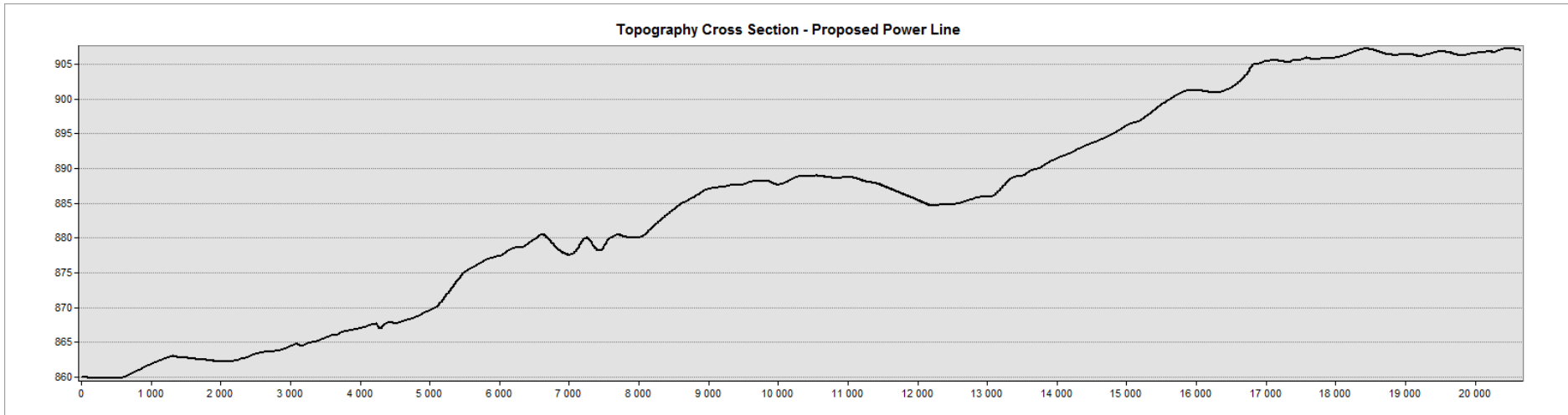


Figure 1: Topographical cross-section of the proposed powerline route

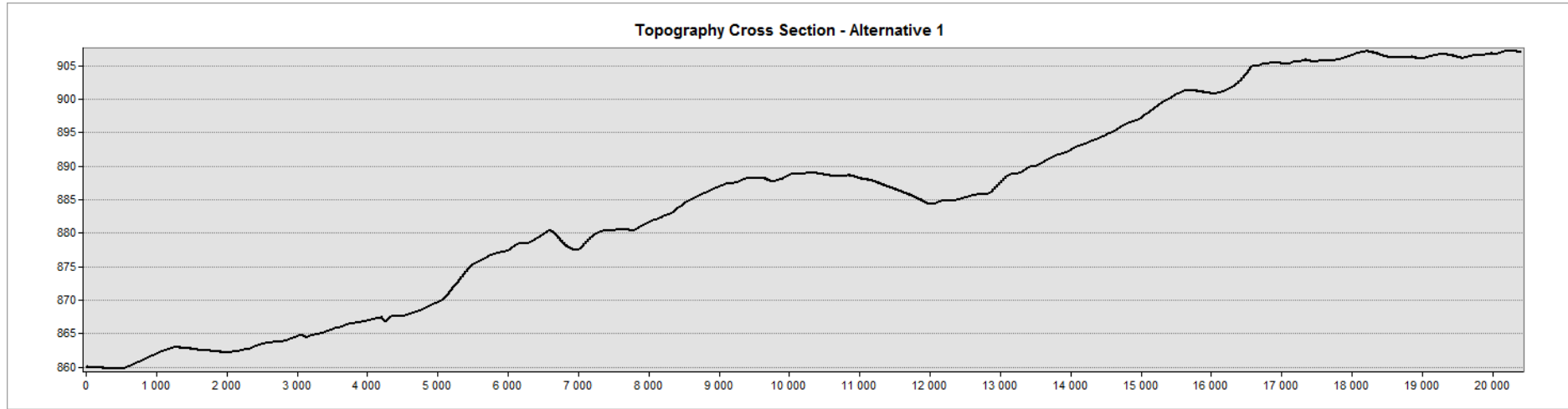


Figure 1: Topographical cross-section of powerline alternative 1

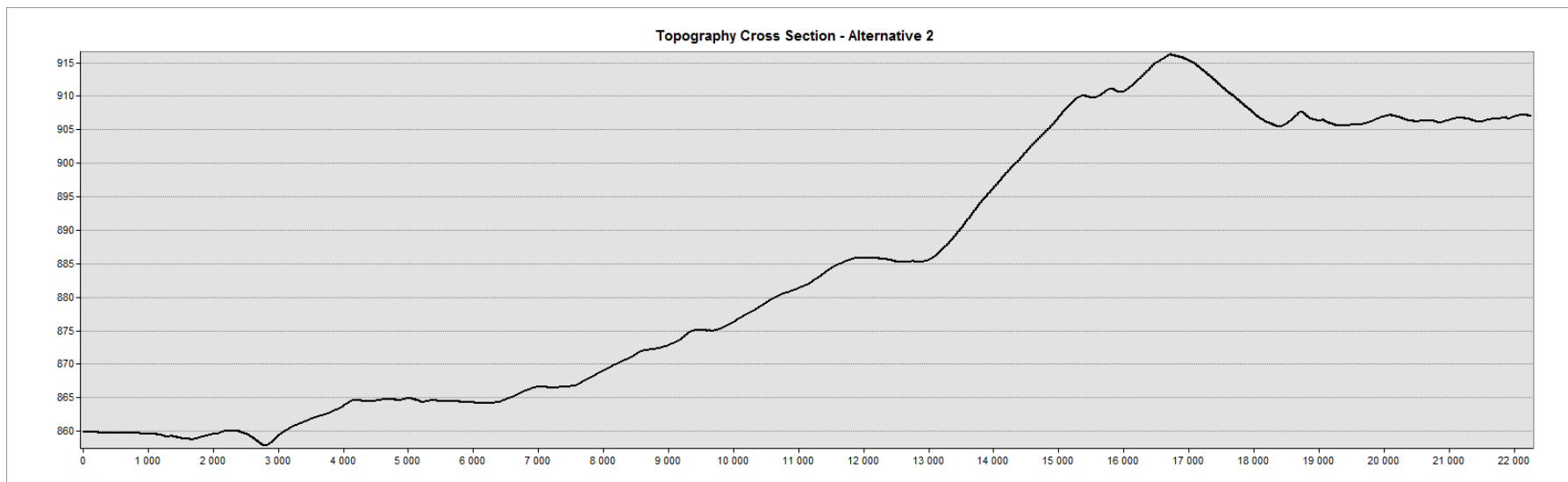


Figure 3: Topographical cross-section of powerline alternative 2

Appendix C: Curriculum Vitae of Specialist



DIGBY WELLS
ENVIRONMENTAL

ALICE MCCLURE

Miss Alice McClure

Specialist: Geographic Information Systems (GIS)

GIS & Air Quality Department

Digby Wells Environmental

1 EDUCATION

- 2005 - 2007: B.Sc Environmental Sciences: Majored in Environmental Science and Entomology (Rhodes University)
- 2008: B.Sc (Hons) Environmental Sciences: Courses in Conservation Planning, Rehabilitation Ecology, Non-timber Forest Product Uses, Geographic Information Systems (GIS), Environmental Impact Assessment (EIA) and a short course in statistics (Rhodes University)
- 2009 – 2010: M.Sc. Environmental Sciences: Proactive conservation planning with a strong social focus using GIS

2 LANGUAGE SKILLS

English, Afrikaans and limited Zulu

3 EMPLOYMENT

March 2011 to present Digby Wells Environmental

January 2009 – August 2010 Eden to Addo Corridor Initiative

4 EXPERIENCE

GIS specialist in the Geographic Information Systems (GIS) and Air Quality Department. Graduated with an MSc in Environmental Sciences. The research associated with my master's degree was carried out while I was employed at Eden to Addo and was utilised practically to begin the systematic design of a conservation corridor between Addo Elephant National Park and Tsitsikamma National Park. Special consideration was given to the high social sensitivity of the area and the controversy surrounding conservation in the area. I used GIS to explore the effect and outcomes of incorporating social data into systematic conservation planning using least-cost corridor models. Since employment at Digby Wells, my expertise in ArcGIS processes has grown exponentially and techniques to solve spatial, temporal and analytical problems have been refined.

Responsibilities at Digby Wells Environmental currently include but are not limited to:

- Generation of maps for company projects;

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Directors: AR Wilke, CD Wells, LF Koeslag, PD Tanner (British)*, AJ Reynolds (Chairman) (British)*, GE Trusler (C.E.O)

*Non-Executive

- Compilation of Visual Impact Assessments;
- Assist in the completion of Biodiversity Assessments;
- Assist in compiling Interactive Biodiversity and Land Management Plans
- Assist in the completion of Due Diligence Reports
- Assist in the development of a systematic and efficient tree-relocation plan;
- Assist in the maintenance of the GIS database by storing all electronic files in a well organised structure
- Assist in the completion of Closure Cost Assessments by solving the spatial and analytical queries involved
- Assist in the design and completion of Rehabilitation Plans
- Assist in carrying out air quality assessments
- Produce spatial information in map format; and
- Application of GPS technology, aerial photo and satellite images

5 PROJECT EXPERIENCE

Xstrata Hyperspectral Remote Sensing Project – Xstrata Coal

Date 2011:

Responsibilities

- Assist in the research for and completion of the Xstrata Hyperspectral Remote Sensing report

Xstrata Full GIS Upgrade – Xstrata Coal

Date 2011:

Responsibilities

- Assist in the compilation of the original dataset

Dennilton Transmission Project Basic Assessment Report – PBA International (SA) PTY Ltd. (for Eskom Holdings)

Date: 2011

Responsibilities:

- Assist in the completion of the Biodiversity Assessment

Temo Coal Mine Environmental Impact Assessment and Environmental Management Plan – Temo Coal (PTY) LTD.

Date: 2011

Responsibilities:

- Generate spatial data in the form of maps
- Assist in the Closure Costing by solving spatial queries
- Assist in air quality assessment

Boikarabelo Coal Mine and Rail Environmental Impact Assessment, Nema/NEMWA Application and Waste License Applications – Resource Generation

Date 2011

Responsibilities

- Generate spatial data in the form of maps
- Assist in the design of a Landfill Site

Protected Plants Management Plan - Resource Generation

Date: 2011/2012

- Generate spatial data in the form of maps
- Assist in generating a tree removal/relocation plan

Kangala Coal Mine Closure and Rehabilitation Plan – Universal Coal PLC.

Date 2011:

Responsibilities

- Generate spatial data in the form of maps
- Assist in the Rehabilitation design by solving spatial queries

Kibali River Hydro-Electric Power Stations – Randgold Resources

Date: 2011/2012

Responsibilities

- Generate spatial data in the form of maps
- Analyse spatial data to assist specialist studies
- Compile visual impact assessment report
- Compile topographic report

Continental Coal Due Diligence (Project Kabeljou) – Continental Coal (PTY) LTD.

Date 2011:

Responsibilities

- Assist in the completion of the due diligence report
- Assist in the management of the project

Acid Mine Drainage Project – BKS (PTY) LTD.

Date: 2012

Responsibilities

- Generate spatial data in the form of maps
- Analyse spatial data to assist specialist studies

BSGR Solar PV Project – BSGR Resources LTD.

Date: 2011/2012

Responsibilities

- Generate spatial data in the form of maps
- Analyse spatial data to assist specialist studies
- Compile visual impact assessment report
- Compile topographic report
- Assist in the sensitivity Analyses using spatial information

Geluksdal TSF and Pipeline Project – Rand Uranium

Date: 2012

Responsibilities

- Generate spatial data in the form of maps
- Analyse spatial data to assist specialist studies
- Compile visual impact assessment report
- Compile topographic report

Roodepoort Strengthening Project - Eskom Transmission Division

Date 2011/2012:

Responsibilities

- Generate spatial data in the form of maps
- Analyse spatial data to assist specialist studies
- Compile visual impact assessment report

Mmamabula Optimisation Project – CIC Mining Resources LTD.

Date: 2011/2012

Responsibilities

- Generate spatial data in the form of maps
- Analyse spatial data to assist specialist studies
- Compile visual impact assessment report

6 PROFESSIONAL AFFILIATIONS

Geographic Information Society of South Africa (GISSA)

International Association for Impact Assessment (IAIA)

7 PUBLICATIONS

McClure, A.P. 2011. Opportunity and Connectivity: Selecting Land Managers for Involvement in a Conservation Corridor Linking Two Protected Areas in the Langkloof Valley, South Africa. Dissertation submitted in fulfilment of the requirements for the degree Master of Science, Department of Environmental Science, Rhodes University, South Africa.

8 COURSES ATTENDED

- July 2011: Mining for Non-Miners. Presented by Snowden Group.