ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED MATIMBA-WITKOP NO. 2 400 kV TRANSMISSION LINE, NORTHERN PROVINCE

SPECIALIST STUDY – VISUAL IMPACT ASSESSMENT

APPENDIX I

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ANNEXURE A: VISUAL IMPACT MAPS

1. INTRODUCTION AND AIMS

1.1. Purpose of this Report

The establishment of a new Transmission line visually impact on the surrounding area. This report assesses the potential visual impact of the proposed development using desktop GIS methods.

The objectives of the assessment are to:

- produce maps identifying areas of potential visual impact;
- indicate views and viewers which will be affected;
- comment on the visual intrusiveness of the feature; and
- comment on resultant impacts on character or quality of views.

1.2. Landscape Characteristics of the Study Area

Important topographic features affecting the visual impact of the proposed Transmission line are:

- high relief in the Witkop Substation area, Masebe Nature Reserve, Moepel Farms and within the Waterberg Biosphere Reserve;
- granite koppies in the vicinity of Pudiyakgopa; and
- low relief surrounding Ellisras and Matimba Powerstation.

These features can be identified on the basemap of the study area (refer to Figure 1 in Annexure A). The vegetation in the study area can be described as sparse Savannah woodland. The eastern part of the study area is densely settled by rural communities with associated degradation of the landscape. Masebe Nature Reserve, Moepel Farms and the Waterberg Biosphere Reserve are densely vegetated, resulting in limited visibility when on the ground. Land use west of the R518 is mainly agricultural. A number of nature reserves exist in the study area, including Percy Fyfe, Witvinger, Masebe, Moepel Farms, Waterberg Biosphere Reserve and D'Nyala Nature Reserve. A number of hunting and tourism-orientated lodges have been established in the study area, and may be impacted on by the proposed development.

2. METHODOLOGY

2.1 Viewshed Calculations

"Viewsheds" indicate positions within a study area from which a development feature is visible. They are useful for analysing the visual impact of point features (such as towers) and linear developments (such as roads or powerlines). A single viewshed is calculated from a digital elevation model (DEM) for a point feature, and it will provide an indication of positions within the study area from which the point feature is visible.

Linear features are more complex. The approach followed by this study is to calculate viewsheds at intervals (i.e. points) along the proposed Transmission line corridor, and then to combine these to provide a graduated scale of potential visual impact. The interval depends on the input-feature data. If point co-ordinates along the linear feature are provided (for instance, the tower positions of a powerline), these can be used, otherwise points are calculated at regular intervals along the feature. The graduated scale reflects the number of points along the feature which are visible from any specific location within the study area. This approach is applicable to features such as powerlines where the towers are usually more visible than the actual conductors, and so provide a series of points for which viewsheds can be calculated. In this study, an interval of 1 km was used and the towers were assumed to be 36 m high (as for the cross-rope suspension tower type, Clara, 2001).

The graded or classified viewshed is a raster image where every pixel value indicates the number of points (towers) along the feature (powerline) which are visible from the geographic position of the pixel. In order to make quantitative inferences, it is necessary to convert the viewshed raster or image into a vector object, and this is done by contouring the image.

In the contouring process, isolines are created indicating a constant value of the underlying spatial data. Along that line the variable under investigation is constant. In the case of a graded viewshed, this variable is the number of towers visible from points within the study area. Contours created from a graded viewshed will indicate lines along which a constant number of towers are visible. A contour line of value 5 will indicate geographic locations within the study area from which five towers are visible.

The number of towers used in this study is arbitrary - but consistent for all the related impact surveys. This study made use of towers being positioned at 1 km intervals along each of the corridors. Provided the same spacing is used for the towers for each corridor, are comparable.

The resultant maps can then be described in terms of a qualitative, rather than a quantitative scale. For this reason, the term "potential visual impact" is used.

In order to reduce the contour data to manageable proportions and create a visually acceptable product, algorithms are used to smooth the contours which are interpolated from the raster data. This reduces detail to provide a map that can be readily interpreted.

Areas on the visual impact maps that are not coloured (or white) indicate areas of very low impact or no impact at all. In some instances, even where a tower is present, the impact map may still show white, which indicates that only a single tower would be visible from these points, rather than indicating no towers are visible at all.

2.2 Visual Impact Maps

Visual impact maps take into consideration further variables such as distance from the feature, urban development or other factors that can influence the impact (e.g. the influence of density/height of vegetation). The visual impact maps for the proposed Matimba-Witkop No 2 400 kV Transmission line extends the visibility maps to include a weighting value for distance from the line, as well as a weighting value for distance of the powerline from settlements. A third weighting was used to include nature reserves in the analysis. It is assumed for this study that proximity of the Transmission line to settlements will increase the visual impact, and this produces a bias towards members of the public who live in communities near the line.

The visual impact maps were produced by creating "buffer zones" at 10 km, 5 km, 2 km, 1 km and 500 m around proposed Transmission line corridors, and then adding a constant value to pixels in the graded viewsheds which fall within a "buffer zone". By doing this for each "buffer zone" the effect is to raise impact values with increasing proximity to the Transmission line. The resultant weighted viewsheds were then contoured, and potential visual impact maps were produced. These visual impact maps provide a means to assess the potential visual impact the Transmission line will have on the surrounding area.

2.3. Considerations and Limitations

Viewsheds are only an indication of potential visual impact. Their effectiveness is constrained by the accuracy and resolution of available digital topographic data which controls the scale and resolution of the DEM or contour base data.
Other factors which may have an influence on visual impact, such as vegetation or man-made features, are not included in the calculations, as no accurate data relating to these factors was available at the time of the study. They include:

- Natural features such as vegetation or ridges may obscure the feature from view. It is also possible that the vegetation backdrop may be such that it camouflages the feature and reduces its visibility.
- Existing man-made features, such as high buildings may obscure the feature. An already developed area would also have a poor 'view quality' value and would therefore not be as severely impacted by further development. For instance, existing powerlines will lessen the impact of new lines.
- The nature of the Transmission line towers are such that they are not readily viewed from a distance. The feature may be some distance from the viewpoint so as to be invisible to the human eye. The viewshed will still indicate that the feature is visible. It is possible to create "buffer zones" around the feature to indicate a reduction in impact related to distance.

3. VISUAL IMPACT ASSESSMENT

3.1 Introduction

The significance of the impact will be influenced by the nature or "quality" of the affected landscape and by the degree of change in the landscape that the development brings about. Visual implications are likely to be highest in areas of public access: paths, roads, view points, parks. The concerns of permanent residents in the area should also be considered.

According to Hankinson (1999), impacts can be categorised according to the following criteria:

- visual intrusiveness of the development;
- degree of view obstruction, character;
- character, quality or value of the existing view or viewpoint;
- scale of the development relative to local elements; and

- timescale (impacts may change over time).

3.1.1. Visual Intrusiveness of the Development

The study used the number of towers (points) which would be visible from an area as a measure of the visual intrusiveness of the proposed development. This approach was deemed to be most suitable for the following reasons:

- some part of the development would be visible from most parts of the study area;
- the degree of the impact would be variable, but could be 'quantified' in terms of the number of towers visible from any one point; and
- topography in some sections of the study area is low-lying, and views are more extensive. This allows for the sighting of many features, including Transmission line towers except where obscured by high-lying land, or intermittent ridges.

3.1.2. Degree of View Obstruction

The tower structures are regarded as being the most visually intrusive component of Transmission lines. The steel frame structure of the towers (especially the cross-rope suspension type) presents a low degree of view obstruction, and readily allows for blending with background colour/pattern, particularly where vegetation is dense (such as in the Waterberg Biosphere Reserve area). In addition, as towers are erected a couple of hundred meters apart a Transmission line is not viewed as a continuous structure (as, for example, a wall would be). Shortly after erection, once natural weathering of the steel frame has occurred, the towers are typically marginally shiny and reflective.

3.1.3. Character, Quality or Value of the Existing View or Viewpoint

The study area is impacted by existing developments and infrastructure such as mining operations, urban and rural settlements, roads, railroads, and existing powerline and substation infrastructure, especially in the Ellisras/Matimba Powerstation area. In more than half of the study area, settlements are extensive and extensive degradation of the landscape and vegetation has occurred here (north west of Witkop Substation, extending to the eastern Waterberg Biosphere boundary, and north of Masebe Nature Reserve. The area between Moepel Farms and Masebe Nature Reserve is densely vegetated, and the areas west of the nature reserves and up to the R518 are occupied by game farms and other tourist attractions.

3.1.4. Scale of the Development Relative to Local Elements

The height of the towers and length of the feature in this particular topographical setting makes the potential visual impact of the development significant. However, the scale will be influenced greatly by the position of the viewer relative to the development feature.

3.1.5. Timescale

The timescale, in this case, plays a minor role as the feature itself will not change significantly once constructed, nor will natural features of the landscape change sufficiently to diminish the impact over time. Shortly after erection, however, once natural weathering of the steel frame has occurred, the towers are typically marginally shiny and reflective.

3.2. Results

The predicted visibility of each of the proposed corridors is provided in Figures 2 to 5 in Annexure A.

Visual impact will be discussed in terms of areas that have been identified as "sensitive". In the case of this study, these are nature reserves, tourist attractions and settlements situated within the study area.

3.2.1. Nature Reserves, Tourism and Game Farming

- *D'Nyala Nature Reserve:*

  This reserve is located in a low relief area and shows a medium to high potential impact for the northern part of the reserve for all four corridors. The reserve is more than 5 km from the proposed Transmission line corridors, but most of the land use between the reserve and the line is agricultural. The nature of the agricultural activities in this area may not result in reduced visibility. However, distance from the development will greatly minimise the potential visual impact. Therefore, this potential impact is anticipated to be of low significance.

- *Waterberg Biosphere Reserve:*

  Corridor 1 will be visible from a large portion of the Waterberg Biosphere Reserve, but the impact will potentially be low to very low, mainly as a result of the local topography. A narrow zone of medium to high impact is apparent in close proximity to the line. This potential impact will be minimised by the presence of the existing 400 kV Transmission line in this area.

  Corridors 2, 3 and 4 show a similar impact through the Waterberg Biosphere Reserve area, with a larger area within the high impact zone. Therefore, the visual impact associated with these corridors through the Biosphere area is considered to be of a higher significance than that associated with corridor 1.

- *Moepel Farms Nature Reserve:*

  Corridor 1 creates the highest potential impact for this reserve (along the northern boundary) as it is the only corridor which passes in close proximity to this reserve. High trees and the high relief in the northern part of the reserve will obscure the line to some extent. A mottled vegetation background to the proposed line from the road, will also lower the impact (see Plate 1 and 2, and site 12 on map). In addition, the existing Matimba-Witkop No 1 400 kV Transmission line passes through this area and has an existing visual impact. The potential impact associated with the establishment of the new Transmission line within corridor 1 through this area is not anticipated to add significantly to this existing impact.

  Corridors 2, 3 and 4 will have a negligible impact on Moepel Farms nature reserve as these are removed from this area.

- *Masebe Nature Reserve:*

  Corridor 1 will potentially have a low impact on most of Masebe Nature Reserve, as this corridor follows the boundary of the reserve. However, some high to very high impact is anticipated along the southern boundary of the reserve. As for Moepel Farms, vegetation and relief will provide some softening of the impact. In addition, the existing Matimba-Witkop No 1 400 kV Transmission line passes through this area and has an existing visual impact. The potential impact associated with the establishment of the new Transmission line within corridor 1 through this area is not anticipated to add significantly to this existing impact.

Corridors 2, 3 and 4 will have a high to very high impact along the eastern and northern boundaries of this reserve. In addition, due to the presence of the existing 400 kV Transmission line on the southern side of the reserve, the construction of the proposed new Transmission line within corridors 2, 3 or 4 would result in the reserve being visually impacted on to the south, east and north, and effectively being surrounded, or "boxed-in" by Transmission line developments.

Plate 1 Tower of the existing 400 kV Transmission line against a mottled, vegetation backdrop near Moepel Farms

Plate 2 Towers of the existing 400 kV Transmission line in the distance is camouflaged by a mottled backdrop, and are not readily visible from the road between Moepel Farms and the Masebe Nature Reserve

- *Witvinger Reserve:*

  Potential visual impact on this reserve is medium to high. The reserve is located in a high relief area, which provides many vantage points from which large sections of the proposed Transmission line will be visible. However, this reserve is located approximately 5 km from the proposed corridor, and therefore the potential visual impact will be greatly minimised as a result of distance from the development.

- *Percy Fyfe Nature Reserve:*

  this reserve is located approximately 8 - 10 km from the proposed corridor, and therefore the potential visual impact is anticipated to be low to very low.

- *Other tourism-related areas and game farms:*

  Such activities are predominantly located in the area west of Moepel Farms up to the area close to Ellisras (i.e. the western section of the study area).

  Corridor 1 shows the lowest potential impact for this area as this corridor follows the existing Matimba-Witkop No 1 400 kV Transmission line. As this existing line was constructed in the 1970s, it is considered reasonable to assume that tourism-related operations have been planned away from this existing line.

  Corridors 2 and 4 are anticipated to have a similar impact, with large areas in the high impact zone. The visual impact on smaller tourism-related activities and game farms along this corridor is anticipated to be higher than on the larger farms located mainly within corridor 1, as it is more difficult to plan activities away from the line on these smaller farms.

  Corridor 3 shows high to very high impact on tourism-related facilities and game farms between Marken and Overyssel. This impact is considered to be highly significant as this area is not currently impacted on by linear infrastructure.

- *Summary:*

  Order of preference:

  * Corridor 1 - lowest overall impact for sensitive areas such as conservation and tourism-related areas
  * Corridors 2, 3 and 4 - higher impact overall.

3.2.2. Built-up Areas and Settlements

- *Witkop Substation to Diretsaneng:*

  This section of the study area is traversed by all four proposed corridors, and the potential visual impact is, on average, in the low to very low zone. High impact occurs around settlements east and north-east of Pudiyakgopa. It is clear from Plate 3 that these are situated on koppies, with an extensive view of a large part of the existing and proposed Transmission line. Uninterrupted vista with low vegetation promotes visibility of the towers. The vegetation is low thorn bush (sickle bush), which creates a mottled backdrop which mitigates the impact of the line somewhat.

Plate 3 Existing 400 kV Transmission line near Pudiyakgopa. Uninterrupted vista with low vegetation promotes visibility of the towers

Further north-west from this point, the relief and vegetation changes to koppies and some trees (Plate 4) amongst the settlements. In some areas the existing Transmission line is well camouflaged by the mottled background created by the nature of the vegetation and topography in the area (Plate 5).

Plate 4 Change in vegetation and relief, from low bushes and flat topography to trees and higher relief reduces the potential for visual impact from a distance (existing 400 kV Transmission line tower)

Plate 5 Mottled backdrop created by the relief and vegetation camouflages towers some distance away from the viewer. The arrow indicates approximate position of a tower of the existing Matimba-Witkop No 1 400 kV Transmission line

- *Diretsaneng to Marken:*

  Corridor 1 provides the lowest potential impact of the four proposed corridors. This corridor follows the existing Transmission line through a nek between two ridges (i.e. between Moepel Farms and Masebe Nature Reserve; see Plate 6), which obscures the line for a considerable distance and creates the lower potential impact to the surrounding

area. Here the vegetation is dense, and consists of high trees which obscures the line and provide a natural camouflaging backdrop (Plate 1 and 2, and site 12 on map). Corridors 2, 3 and 4 extend through Ga-matheka, north of Masebe Nature Reserve to Marken. There are numerous settlements and some small game farms which are situated in a high to very high impact zone.

Plate 6 Existing 400 kV Transmission line passes through the nek between Moepel Farms and Masebe Nature Reserve

- *Marken to Overyssel:*

  Setateng and Gamonyeki are not potentially influenced or impacted by corridors 1 and 3. For corridors 2 and 4 the impact on these two settlements are potentially high.

  At Overyssel, the impact associated with corridor 3 is considered to be high a impact. In addition, impact on game farms and tourism operations within this corridor is anticipated to be high. Corridors 2 and 3 are anticipated to have a low impact in this area.

- *Overyssel to Matimba Powerstation (Ellisras):*

  Due to the low relief in this area, impacts are generally in the high impact category. All four corridors show similar results here. The high impact in this area may be reduced by the quality of the view, which is lowered by the presence of existing developments such as the town of Ellisras, Matimba Powerstation (Plate 7) and the numerous powerlines (Plate 8), as well as several mining operations.

Plate 7 Matimba Powerstation , near Ellisras, with numerous overhead powerlines feeding out of the Matimba Substation

Plate 8 Existing towers and overhead lines in the vicinity of Matimba Powerstation

- *Summary:*

  In terms of visibility, the order of preference for the corridors is as follows:

  * Corridor 1 - lowest potential impact on settlements and tourism-related operations
  * Corridor 4 – follows existing linear infrastructure for the majority of its length (i.e. roads and powerlines)
  * Corridor 2 - follows existing linear infrastructure (i.e. roads and powerlines)

* Corridor 3 - highest potential impact in an area which is not currently impacted on by linear infrastructure

3.3. Conclusions

Corridor 1 is clearly the preferred corridor from a visual impact perspective. It follows the existing Transmission line, and it is obscured in critical areas by topography and dense vegetation.

Corridors 2 and 4 are very similar, although corridor 4 does not impact on Setateng and Gamonyeki settlements.

Corridor 3 shows high to very high impact in the critical tourism and game farming areas west of the Marken.

4. REFERENCES

CLARA, J. (2001) Site and corridor selection: identification of alternatives. Report no: TSI/EL/01/167.

HANKINSON, M. (1999) Landscape and Visual Impact assessment. In: Petts, J (ed.), Handbook of Environmental Impact Assessment, Vol. 1., Environmental Impact Assessment: Process, Methods and Potential. Blackwell, Oxford.

ANNEXURE A:
VISUAL IMPACT MAPS