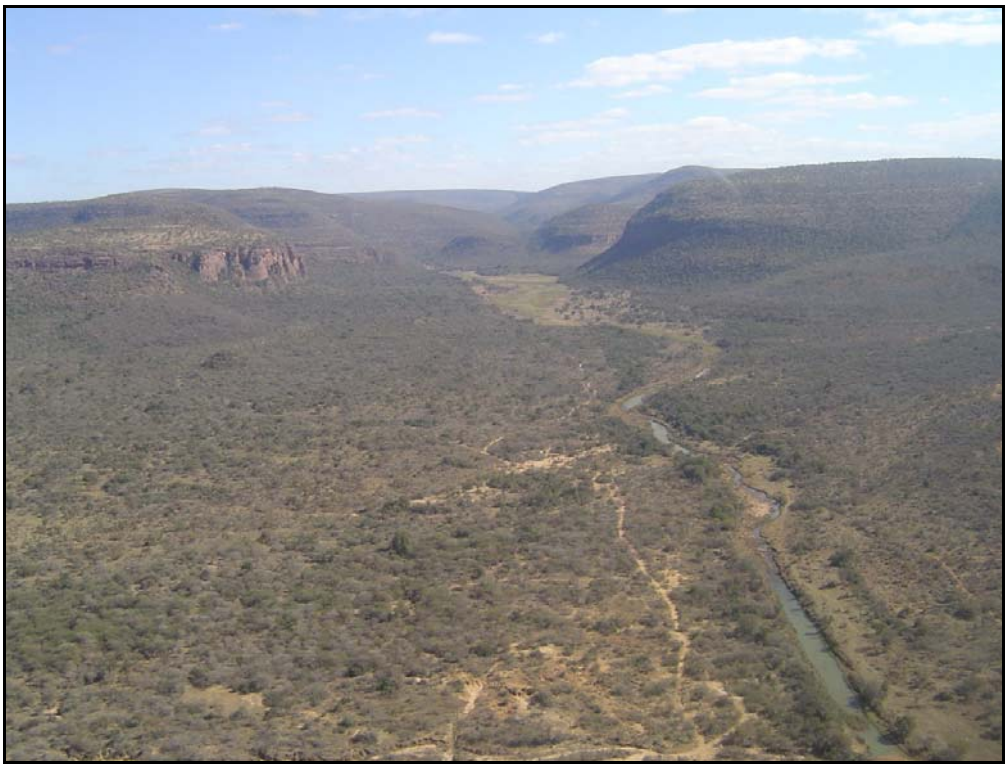
# MOKOPANE INTEGRATION PROJECT

## VISUAL ASSESSMENT - INPUT FOR SCOPING REPORT TRANSMISSION LINE ALTERNATIVE SELECTION AND SUBSTATION ALTERNATIVE SELECTION

**Produced for:**
**Eskom Holdings Limited**

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Lourens du Plessis from MetroGIS (Pty) Ltd undertook the visual scoping assessment in his capacity as a visual assessment and Geographic Information Systems specialist. Lourens has been involved in the application of Geographical Information Systems (GIS) in Environmental Planning and Management since 1990. He has extensive practical knowledge in spatial analysis, environmental modelling and digital mapping, and applies this knowledge in various scientific fields and disciplines. His GIS expertise is often utilised in Environmental Impact Assessments, State of the Environment Reports and Environmental Management Plans.

Savannah Environmental (Pty) Ltd appointed MetroGIS (Pty) Ltd as an independent specialist consultant for the visual assessment. Neither the author, nor MetroGIS will benefit from the outcome of the project decision-making.

## 1. INTRODUCTION AND BACKGROUND

Eskom Holdings Limited intends to construct a new substation in the Mokopane area and to connect the proposed substation with the Delta substation, the Medupi Power Station (near Lephalale) and the Witkop substation (south of Polokwane) by means of the construction of two 765kV transmission power lines.

The study area for the Mokopane Integration Project covers an area of approximately 25 000km$^2$ in the Limpopo Province from Lephalale in the west to Polokwane in the east. The (overlapping) study area for the proposed Mokopane substation covers and area of 700km$^2$ north of Mokopane with four potential site options identified along the existing Matimba-Witkop transmission lines, east of the N11 national road.

The land uses within the study area, in terms of surface area, primarily consist of cattle and game farming to the west and subsistence farming east of the R518 and the N11. The study area includes a number of conservation or protected areas (both provincial and private nature reserves) as well as the Waterberg Biosphere Reserve core, buffer and transitional zones. Some of the reserves in the study area include; D'Nyala, Kwalata, Touchstone, Lapalala, Moepel Farms, Wit Vinger, Percy Fyfe, Kuschke, etc. Industrial and mining land uses occur west of Lephalale in the form of the Groottegeluk coal mine, and the two coal-fired power stations (Matimba and Medupi). Platinum mining activities takes place north-west of Mokopane between the R518 and the N11 national road.

Large tracts of land within the study area are still in a natural state (undisturbed) with some areas in and along the Waterberg escarpment in a virtually pristine condition. This is due mainly to the low population density (less than 10 people per km$^2$) of the Waterberg plateau and escarpment and the relative remoteness and inaccessibility of the terrain. The population density increases eastwards with a great number of settlements occurring along the Mogalakwena River (between the R518 and N11). Here the population density is between 100 to 200 people per km$^2$ and 50 to 100 people per km$^2$ east of the N11.

The land cover types of the study area primarily include Woodland (tall trees higher than 5m) and Thicket and Bushland (trees and bushes 2 to 5m tall). These land cover types are relatively undisturbed for large sections in the west of the study area, but are largely degraded to the east of the R518 due to agricultural activities and settlement patterns.

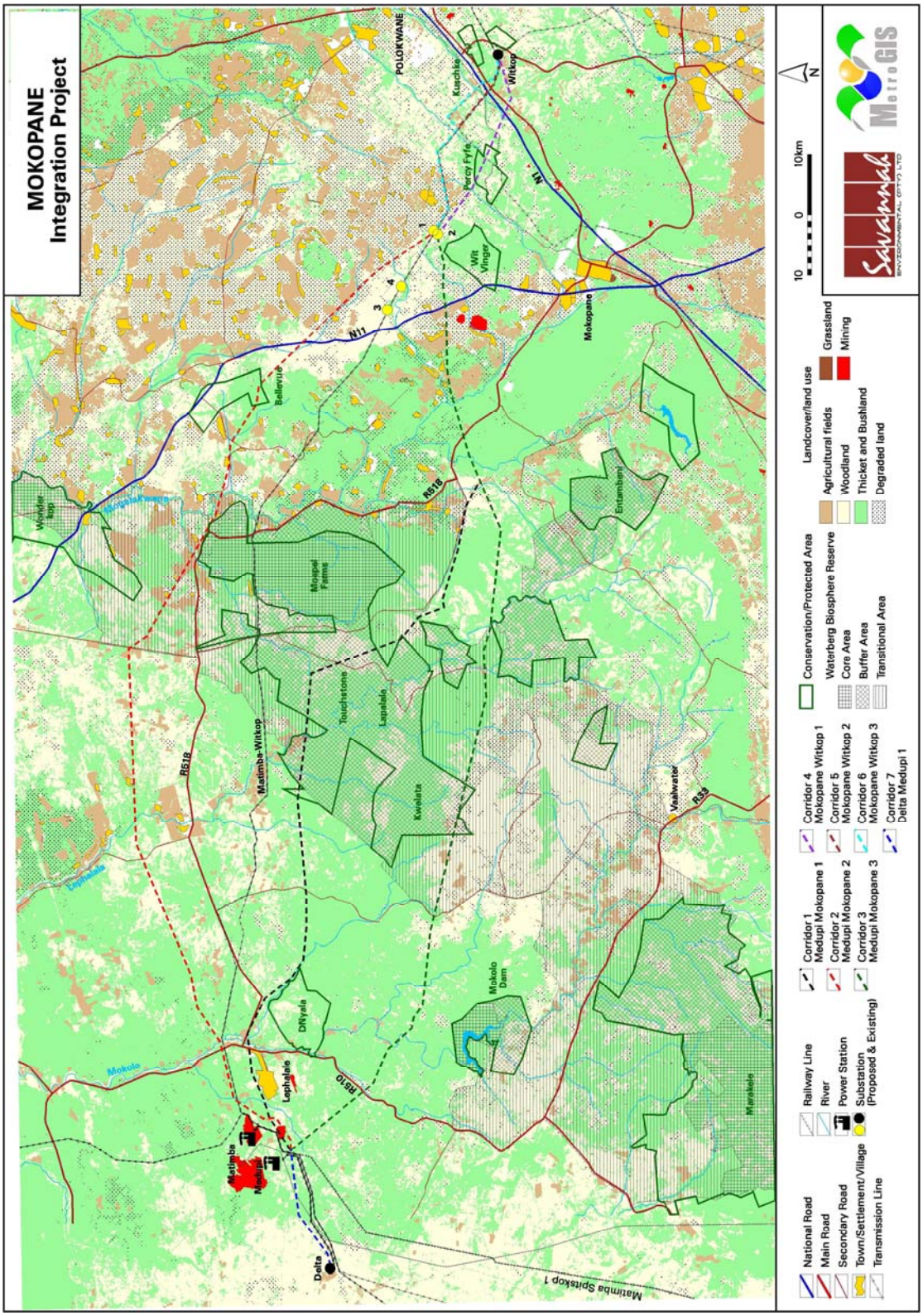


**Figure 1:** Transmission line alternatives - land cover/land use map.

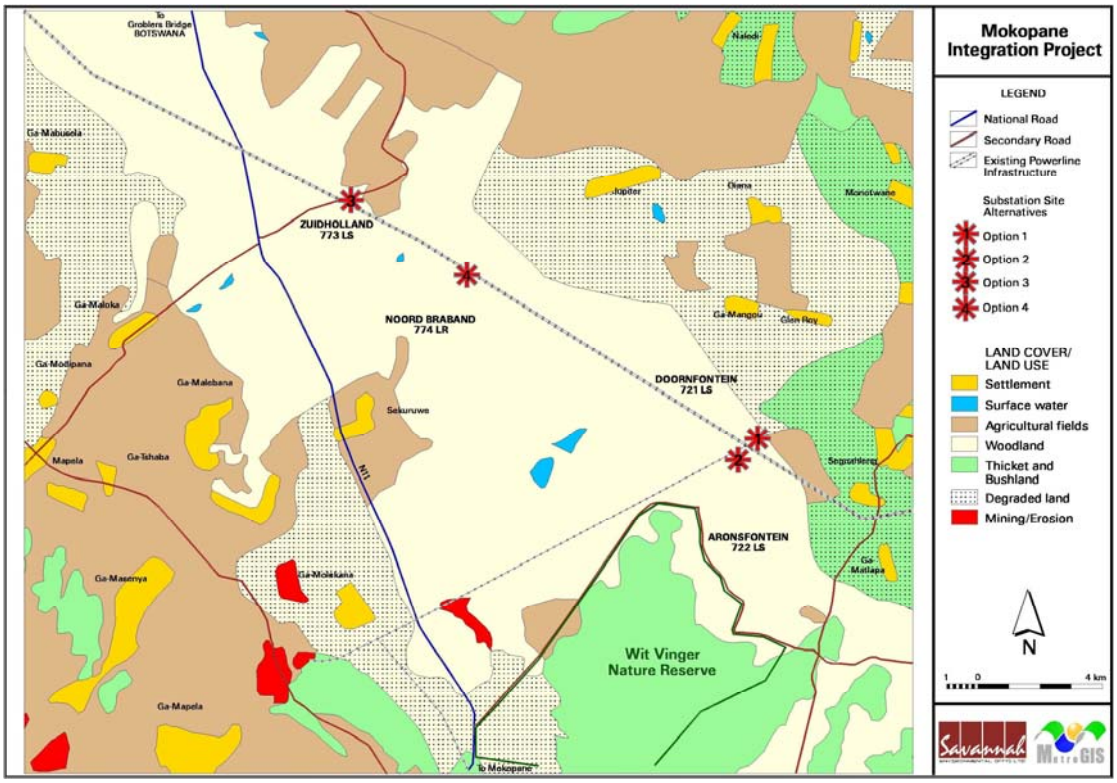


**Figure 2:** Substation alternatives - land cover/land use map.

The Waterberg plateau (table land) and escarpment dominate the topography of the study area that ranges from less than 850m (elevation) above sea level to the north to 1950m above sea level for the mountains east of Mokopane. The terrain north of the Waterberg escarpment is described as plains with even slopes, while the rest of the study area is lowlands with mountains, distinct escarpments and mountains.

Prominent river valleys carving their way through the Waterberg Mountains towards the Limpopo River include the Mokolo and Lephalala rivers. The Mogalakwena River runs east of the Waterberg escarpment.

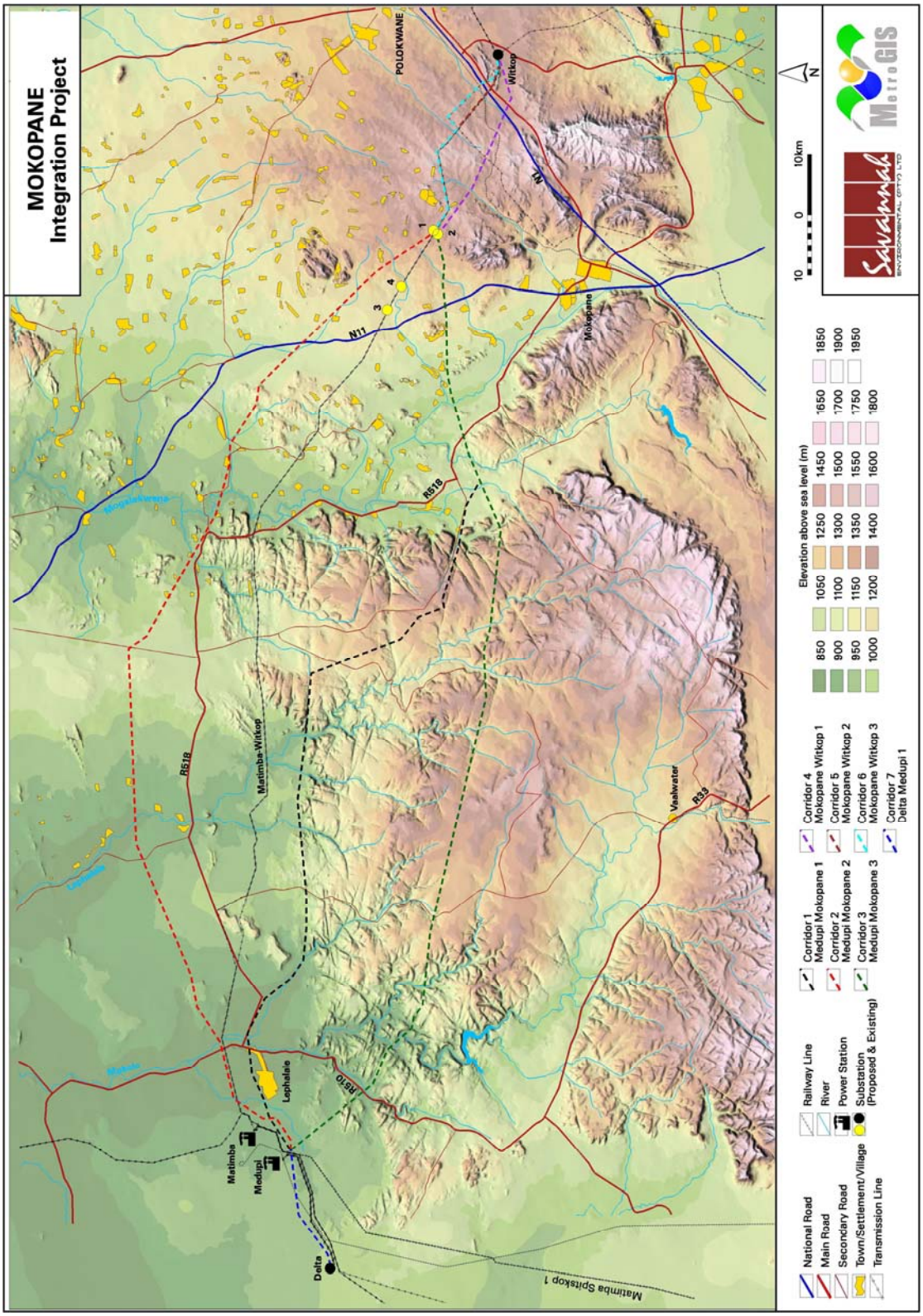


**Figure 3:** Transmission line alternatives - shaded relief map indicating topography and elevation above sea level.

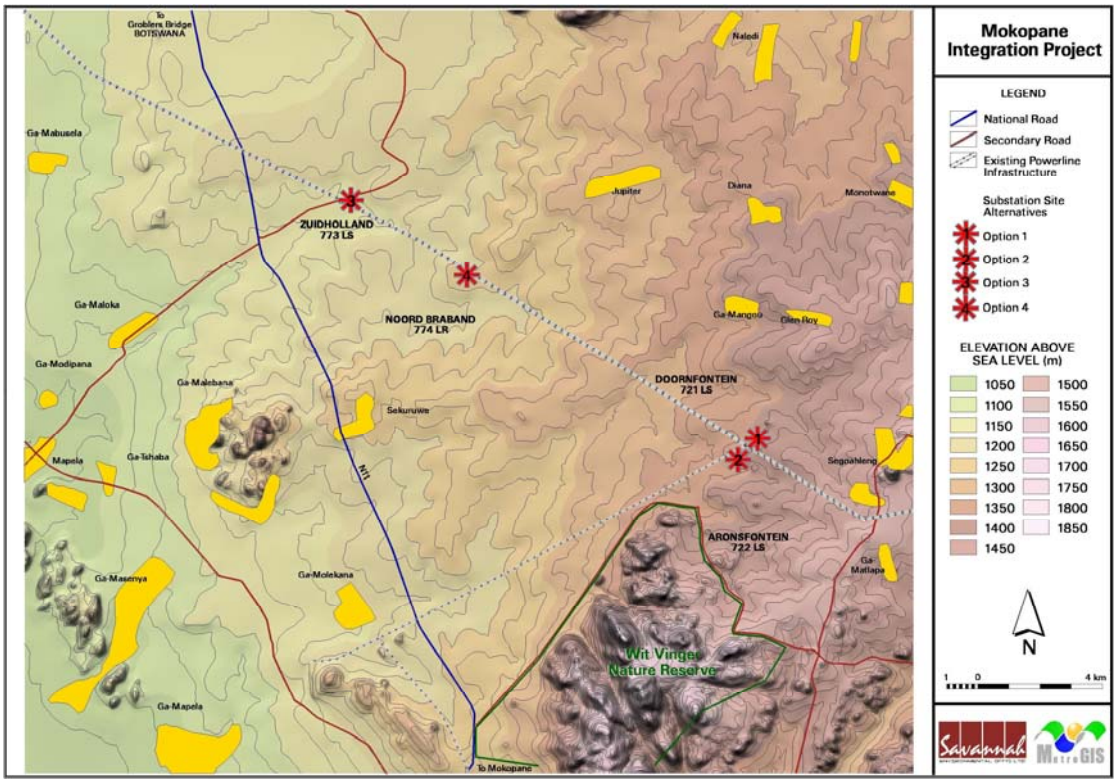


**Figure 4:** Substation alternatives - shaded relief map indicating topography and elevation above sea level.

**Figure 5:** Aerial view of the Waterberg escarpment.

## 2. TRANSMISSION LINE ALTERNATIVES

Seven transmission line development corridors were identified in order to link the Delta substation with the Medupi Power Station and the Witkop substation. Three of these alternatives (Corridors 1, 2 and 3) function as a link between the Medupi Power Station and the proposed Mokopane substation, and three alternatives (Corridors 4, 5 and 6) function as a link between the proposed substation and the Witkop substation. An additional transmission line alternative in the form of the utilisation of the existing Matimba-Witkop transmission line corridor is also considered. Only one transmission line development corridor (Corridor 7) is proposed for the Delta-Medupi section of the Mokopane Integration Project.

The first corridor leaves the Medupi Power station in an easterly direction south of Lephalale before traversing north of the D'Nyala Nature Reserve. It crosses the Waterberg plateau, Waterberg Biosphere Reserve buffer zone (Touchstone Nature Reserve) before spanning across the escarpment and dropping down towards the R518. It continues for an additional 10km before joining the Corridor 3 alternative. The length of the first corridor is 130km (172km total including the joint section with Corridor 3).

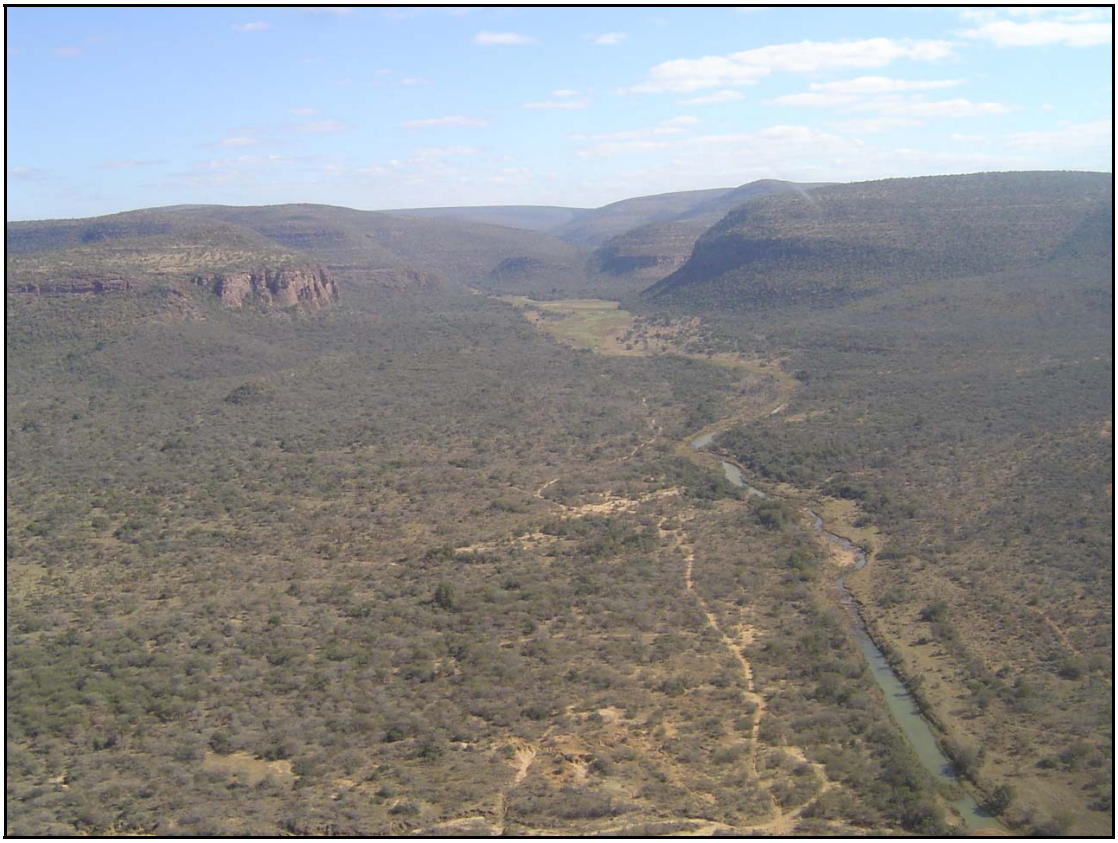

**Figure 6:** The Waterberg Mountains eastern escarpment.

Corridor 2 originates at the Medupi Power Station and proceeds in a north-easterly direction for approximately 30km before veering east for 85km. It traverses the Waterberg Biosphere Reserve's transitional zone before it turns south-east, crossing the southern section of the Bellevue Nature Reserve. It continues for roughly 40km before joining the Matimba-Witkop power lines near the proposed Mokopane substation site. The total length of the transmission line corridor is 180km.

**Figure 7:** Settlements along the eastern section of Corridor 2 (Note the absence of natural woodland and thicket and bushland).

Corridor 3 leaves the Medupi Power Station in a south-easterly direction traversing rough terrain (valleys and ridges near Mokolo River) before continuing over the Waterberg plateau. It crosses into the Waterberg Biosphere Reserve's transitional zone approximately 50km from its origin, traverses the southern section of the Kwalata Nature Reserve (Biosphere Reserve buffer zone) and continues for another 50km before leaving the transitional zone. 16km thereafter it crosses the Waterberg escarpment, drops down to the valley floor and steers east for another 50km before joining the Matimba-Witkop transmission lines. The total length of Corridor 3 is 166km.

**Figure 8:** Aerial view (looking east) of the Waterberg plateau and escarpment.

The existing Matimba-Witkop transmission line corridor originates at the Matimba Power Station and travels east for approximately 29km before reaching the R518. The lines split at this point and the northern section traverses adjacent to this road for almost 9km while the southern section crosses between two hills. The two lines meet up shortly thereafter and continue eastward for 30km before entering the Waterberg Biosphere Reserve's transitional, buffer (Touchstone) and core areas (Moepel Farms). After 32km it crosses the escarpment and continues another 58km to the proposed Mokopane substation site. The Matimba-Witkop transmission line covers a distance of over 182km from Matimba to the proposed substation site. The section from the proposed substation site to the Witkop substation will be discussed as alternative Corridors 5 and 6.

**Figure 9:** Existing Matimba-Witkop 400kV transmission lines (Note: The vegetation cover is removed underneath the power lines).

Corridor 4, from the proposed substation site to the Witkop substation, travels in a south-easterly direction for 11km before traversing the Percy Fyfe Nature Reserve. After 6km it leaves the nature reserve and continues for 16km across predominantly thicket and bushland before entering the Witkop substation. The total length of the fourth corridor is 33km.

**Figure 10:** Aerial view of the Witkop substation.

Corridors 5 and 6 follow the existing Matimba-Witkop 400kV power lines from the proposed substation site to the Witkop substation. Corridor 5 (34.5km total length) follows these power lines for the entire length of its alignment, while Corridor 6 veers off after 19km to follow the Warmbad-Witkop 275kV line for 17km. The total length of Corridor 6 is 37km.

The Delta-Medupi transmission line corridor (Corridor 7) originates at the Delta substation and travels in a north-easterly direction towards the Medupi Power Station. The alignment occurs north of the Matimba-Marang/Pluto/Midas transmission power lines at distances varying between 1.7km at the closest to 3km at the furthest. The total length of the alignment is 20.7km.

**Figure 11:** Existing Matimba-Witkop transmission lines traversing a hill near the Witkop substation.

Initial viewshed analyses from each of the transmission line alternatives are shown in Figure 15. The visibility of the transmission towers where calculated at a maximum offset of 50m above ground level for a radius of 5km (i.e. the expected sphere of visual influence of the transmission line infrastructure) from the centerline. The viewshed analyses do not include the potential visual absorption effect of the natural vegetation or other structures and therefore signify a worst-case scenario in terms of visibility.

It becomes clear that the proposed transmission line infrastructure have the potential to be visually exposed to large areas within their respective 5km buffer zones. This is due mainly to the relatively tall (50m) transmission line towers associated with 750kV power lines. The proposed corridors display a more even potential exposure pattern where they traverse flat terrain and more scattered patterns where they encounter elevated topography. Corridor 2, which does not traverse the Waterberg Mountains and escarpment, is seen as having a larger area of potential visual exposure than Corridors 1 and 3. The existing Matimba-Witkop power lines traverse both flat terrain and the Waterberg escarpment and therefore have a combined pattern of visual exposure.

Corridors 4, 5 and 6 have very similar patterns of potential visual exposure due to their close proximity to each other and the relatively homogenous terrain they traverse.

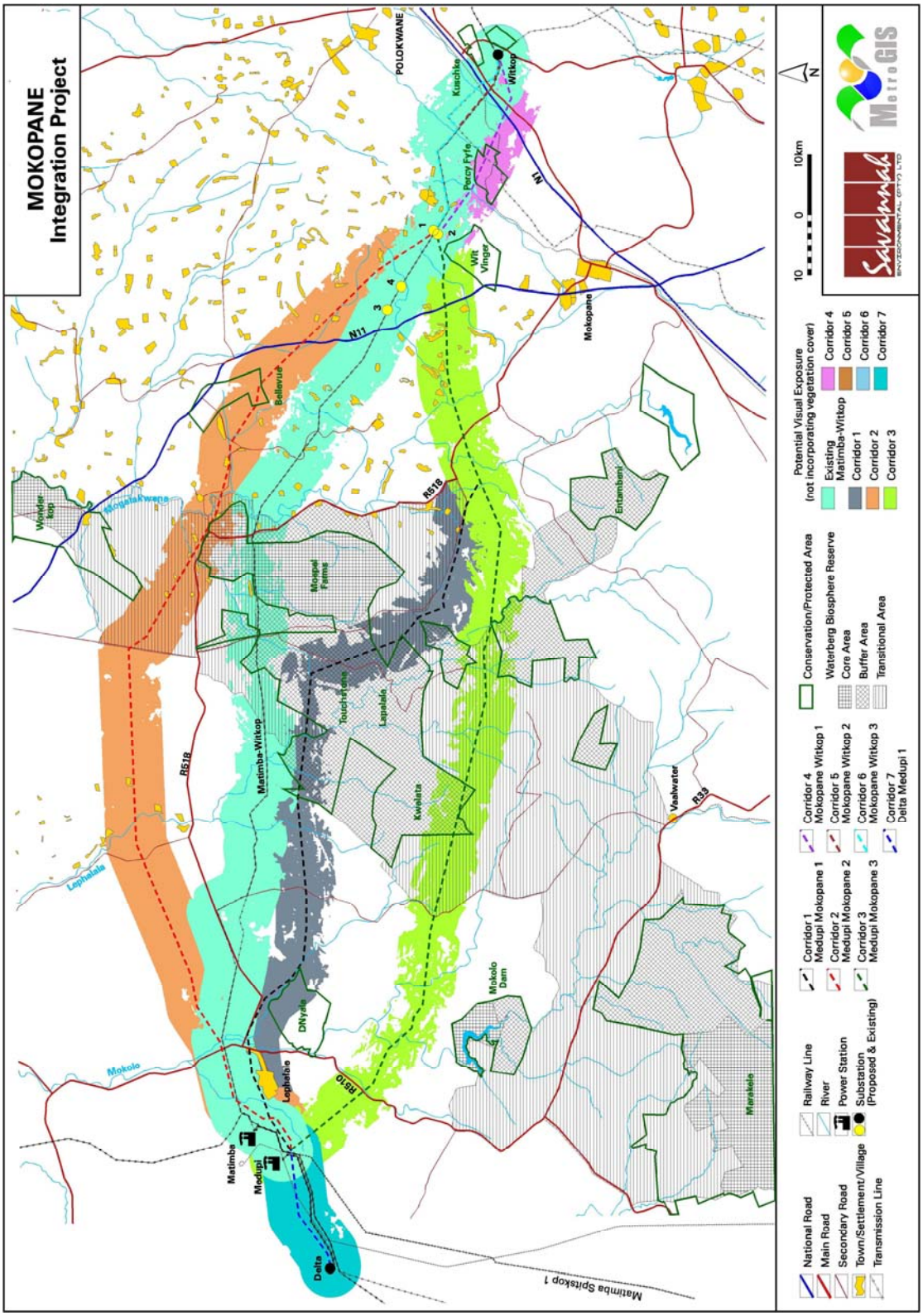


**Figure 12:** Potential visual exposure - proposed transmission line corridors.

It must be borne in mind that the area of potential visual exposure is just one criteria related to the visual impact. Elevated topographical units (i.e. hill, ridges, mountains, etc.) have the potential to expose power line structures over larger distances while flat terrain, combined with the visual absorption capacity of the natural vegetation, may aid in shielding the infrastructure. It is further important to assess the areas that will potentially be exposed to the infrastructure (i.e. the

scenic quality of an area, potential conflicting land uses, the presence of sensitive visual receptors, etc.)

An additional set of criteria was therefore used to allow for an initial comparison between the proposed transmission line corridors in order to nominate a preferred alternative.

The criteria used for the comparison includes:

- The length of the proposed transmission line corridor
- The potential area of visual exposure within the study area
- The proximity and exposure to major roads (based on the number of major road crossing)
- The crossing of the transmission line corridor over elevated topographical units
- The traversing of conservation/protected areas (based on the total crossing distance - additional penalties are incurred where the protected area is a Waterberg Biosphere Reserve core or buffer zone as well)
- The potential consolidation of existing linear infrastructure (based on the distance the transmission line corridor could be placed adjacent to existing power line infrastructure)

A comparative table indicates a summary of the above criteria. Positive values were awarded for opportunities and negatives where constraints were identified.

**Table 1:** Comparative table of Corridors 1, 2, 3 and the Matimba-Witkop transmission lines.

| **Corr.** | **Length (total km)** | **Visible area ($km^2$)** | **Major road crossing** | **Ridge cros-sings** | **Conser-vation area crossing** | **Con-solidation of existing infra-structure** | **Total value** |
|---|---|---|---|---|---|---|---|
| **1** (incl. corr. 3 sect.) | 172 **(-1)** | 1476 **(-1)** | 4 **(-4)** | 3 **(-3)** | 30km (core & buffer) **(-4)** | Low potential **(-1)** | **(-14)** Not pre-ferred |
| **2** | 180 **(-2)** | 1774 **(-2)** | 2 **(-2)** | None **(0)** | 3km **(-1)** | Low potential **(-1)** | **(-8)** Pre-ferred |
| **3** | 166 **(0)** | 1358 **(0)** | 4 **(-4)** | 6 **(-6)** | 8km (buffer) **(-2)** | Low potential **(-1)** | **(-13)** Not pre-ferred |
| **Exist. Tx** | 182 **(-3)** | 1873 **(-3)** | 4 **(-4)** | 2 **(-2)** | 15km (core & buffer) **(-3)** | High potential **(+2)** | **(-13)** Not pre-ferred |

**Table 2:** Comparative table of Corridors 4, 5 and 6.

| **Corr.** | **Length (total km)** | **Visible area ($km^2$)** | **Major road crossing** | **Ridge cros-sings** | **Conser-vation area crossing** | **Con-solidation of existing infra-structure** | **Total value** |
|---|---|---|---|---|---|---|---|
| **4** | 33 **(0)** | 308 **(0)** | 2 **(-2)** | None **(0)** | 6km **(-1)** | Low potential **(-1)** | **(-4)** Not pre-ferred |
| **5** | 35 | 333 | 2 | 1 | None | High | **(-3)** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **(-1)** | **(-1)** | **(-2)** | **(-1)** | **(0)** | potential **(+2)** | Pre-ferred |
| **6** | 37 **(-2)** | 343 **(-2)** | 2 **(-2)** | 1 **(-1)** | None **(0)** | High potential **(+2)** | **(-5)** Not pre-ferred |

The above Table 1 indicates that Corridors 1, 3 and the existing Matimba-Witkop transmission line alignments are not preferred as potential corridors for the Mokopane Integration Project. The fact that these corridors traverse conservation and protected areas as well as high quality scenic terrain (that should ideally not support the construction of transmission line infrastructure) effectively excludes them from being considered as viable alternatives from a visual perspective. The preferred Medupi-Mokopane alternative nominated for further assessment in the EIA phase of this project is Corridor 2. It must be noted however that this corridor also traverses protected areas (to a lesser degree than the above corridors) and that the visual impact assessment will in all likelihood propose site-specific alignment deviations in order to circumvent these areas where possible.

Table 2 highlights Corridor 5 as the preferred alternative for the Mokopane-Witkop section of the Mokopane Integration Project. The utilisation of the existing Matimba-Witkop transmission line corridor emerged as an obvious choice over Corridor 4, which traverses the Percy Fyfe Nature Reserve and Corridor 6, which will increase the length of the transmission line by an additional 2km.

No additional alternatives were offered for the Delta-Medupi transmission line corridor (Corridor 7) and the proposed alignment will be further assessed during the EIA phase of the project.

## 3. ISSUES RELATED TO THE VISUAL IMPACT ASSESSMENT - TRANSMISSION LINE ALTERNATIVES

It becomes apparent that the proposed transmission line alternatives have the potential to be visually exposed to fairly large areas. This is based on the theoretical (worst-case scenario) visibility as indicated by the preliminary viewshed analyses undertaken from each of the corridors. The fact that these areas are exposed does not imply that it constitutes a significant visual impact, at least not for all of the exposed areas. Further investigation is necessary in order to determine the specific visual impact within these exposed areas (i.e. the potential occurrence of sensitive visual receptors).

The visual impact assessment within the EIA will address these and other crucial issues related to the visibility of the proposed Mokopane Integration Project. These issues or criteria will aim to quantify the actual visual impact and to identify areas of perceived visual impact.

Other issues/criteria to be addressed by the visual impact assessment:

- Visual distance/observer proximity to the proposed infrastructure (apply the principle of reduced impact over distance)
- Viewer incidence/viewer perception (identify areas with high viewer incidence and negative viewer perception)
- Landscape character/land use character (identify conflict areas in terms of existing and proposed land use)

- Visually sensitive features (scenic features or attractions)
- General visual quality of the affected area
- Visual absorption capacity of the natural vegetation
- Potential mitigation measures and/or suggested deviations from the proposed alignment

An initial scanning level assessment of the above issues did not reveal any fatal flaws to be associated with the preferred transmission line alternative as suggested in this report. These issues should however still be investigated in greater detail in order to scientifically motivate and/or identify any other mitigating/aggravating circumstances.

## 4. SUBSTATION SITE ALTERNATIVES

Four sites have been identified as potential locations for the construction of the Mokopane transmission substation and turn-in line infrastructure. The four options are situated north of Mokopane and include the farms Doornfontein 721 LS (Option 1), Aronsfontein 722 LS (Option 2), Zuidholland 773 LS (Option 3) and Noord Braband 774 LS (Option 4). The proposed sites are all located in close proximity to the Matimba-Witkop 400kV transmission lines in order to allow for turn-in line infrastructure from these lines to the substation.

Options 1 and 2 are located approximately 1km from each other north of the Wit Vinger Nature Reserve and about 3.3km (line of sight) west of the Segoahleng settlement.

**Figure 13:** General environment near Options 1 and 2 (Note: Wit Vinger Nature Reserve and hills south of the proposed sites).

Option 3 is located along the Matimba-Witkop 400kV transmission lines at a distance of approximately 3km from the N11 national road.

**Figure 14:** General environment near Options 3 (Note: The proposed substation site is located on the right-hand side of the road).

Option 4 is located 4.4km south-east of Option 3. It is 5.7km from the N11 and the closest major settlement, Sekuruwe, is about 5km south-west of the proposed site.

Initial viewshed analyses of the four proposed substation sites, based on a 20m contour interval digital terrain model (DTM) of the study area, indicate the potential visual exposure of each substation site and its associated turn-in line infrastructure. The object offsets for the viewshed analyses were taken at 20m above average ground level (i.e. the approximate height of the substation structures) and the visibility was calculated for a radius of 5km from each site. The viewshed analyses do not include the potential visual absorption effect of the natural vegetation.

Option 1 has a relatively scattered pattern of visual exposure due to the undulating nature of the topography and will potentially be visible from Segoahleng, Ga-Mangou and Glen Roy.

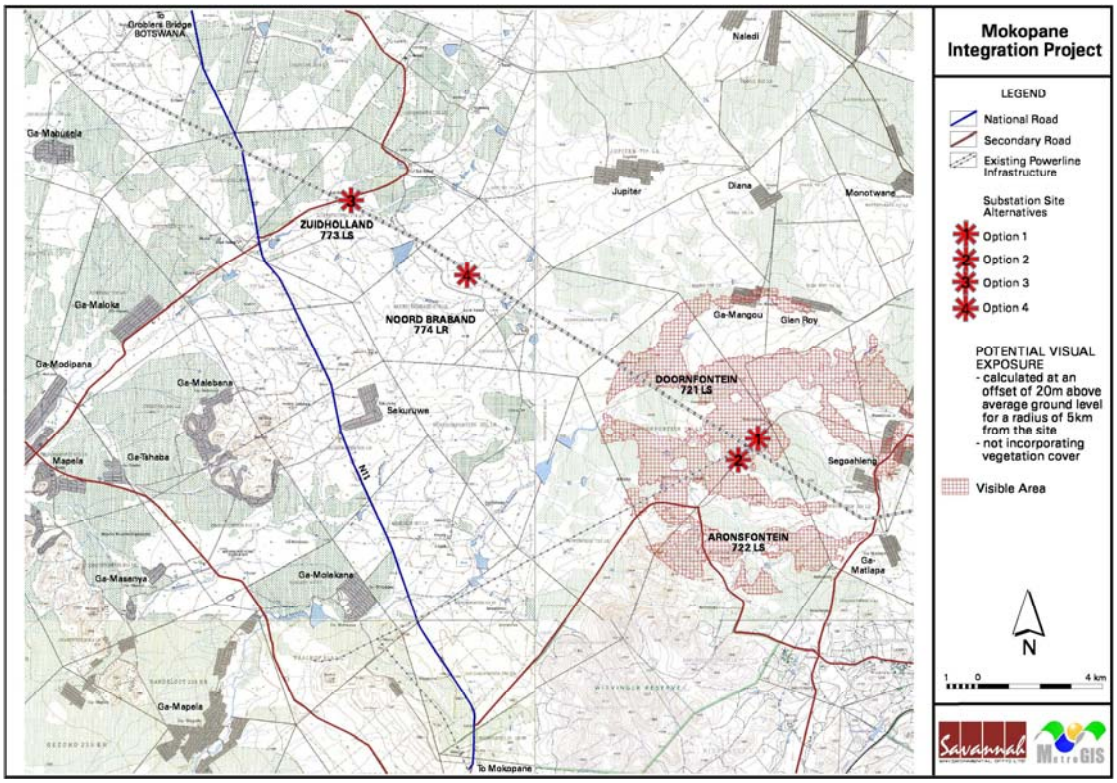


**Figure 15:** Potential visual exposure - substation Option 1.

Option 2 has, due to its relatively close proximity to Option 1, a very similar pattern of visual exposure. Its location slightly lower down the slope makes it slightly less visible from settlements to the north (Ga-Mangou and Glen Roy) but it would still potentially be visible from Segoahleng

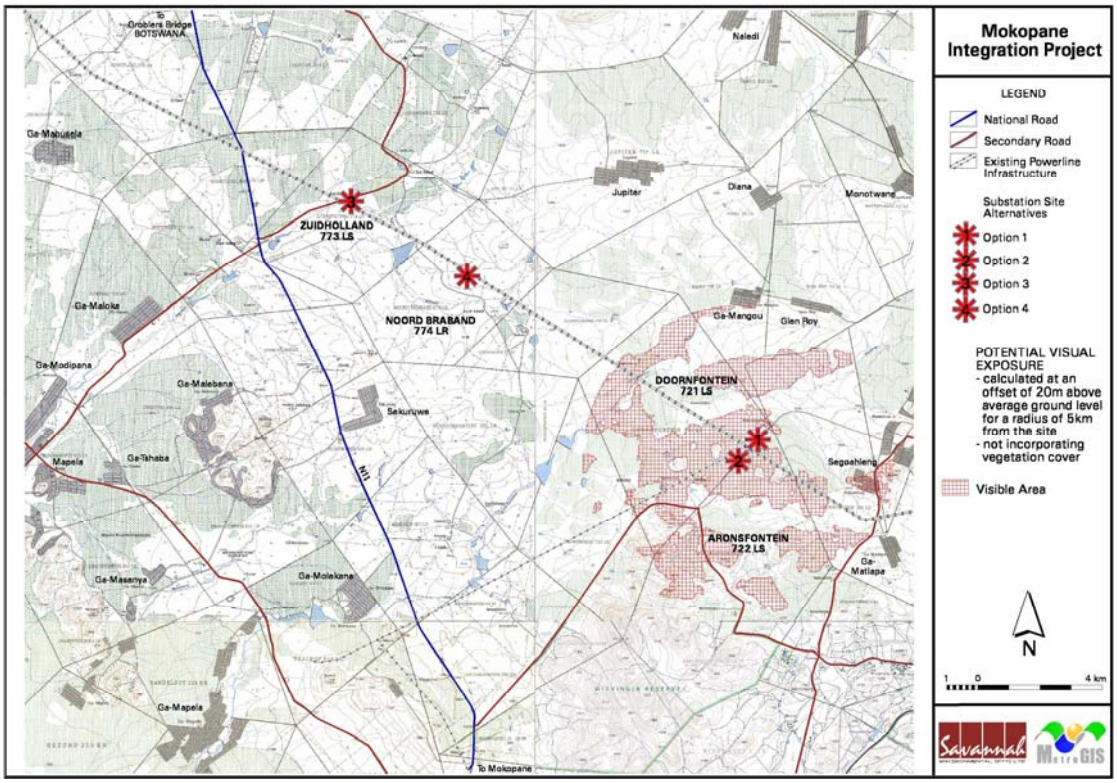


**Figure 16:** Potential visual exposure - substation Option 2.

Site Option 3's core area of visual exposure is indicated on Figure 8. This option is not expected to be visible from any major villages or settlements but it will potentially be visible from the N11 national road at a distance of 3km at the closest.

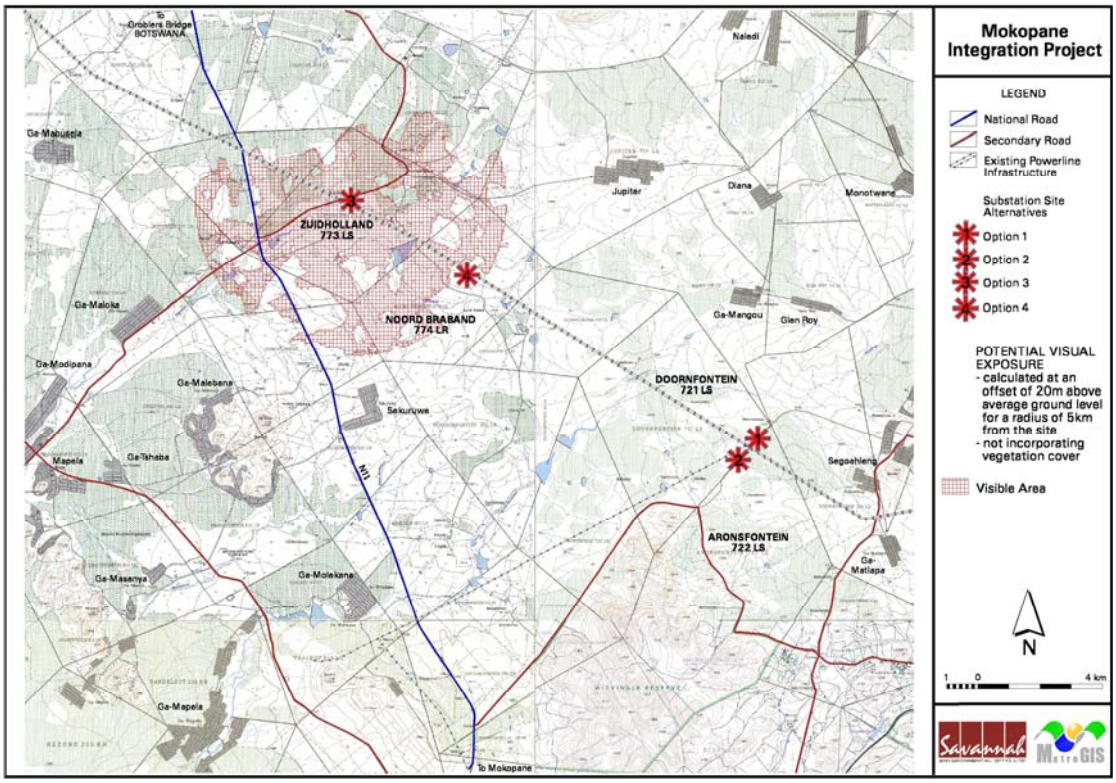


**Figure 17:** Potential visual exposure - substation Option 3.

Option 4 is not expected to be visible, or have a significant visual influence on observers travelling along the N11 (located beyond 5km from the proposed site). It is also not in close proximity to any major settlements within the core area of visual exposure.

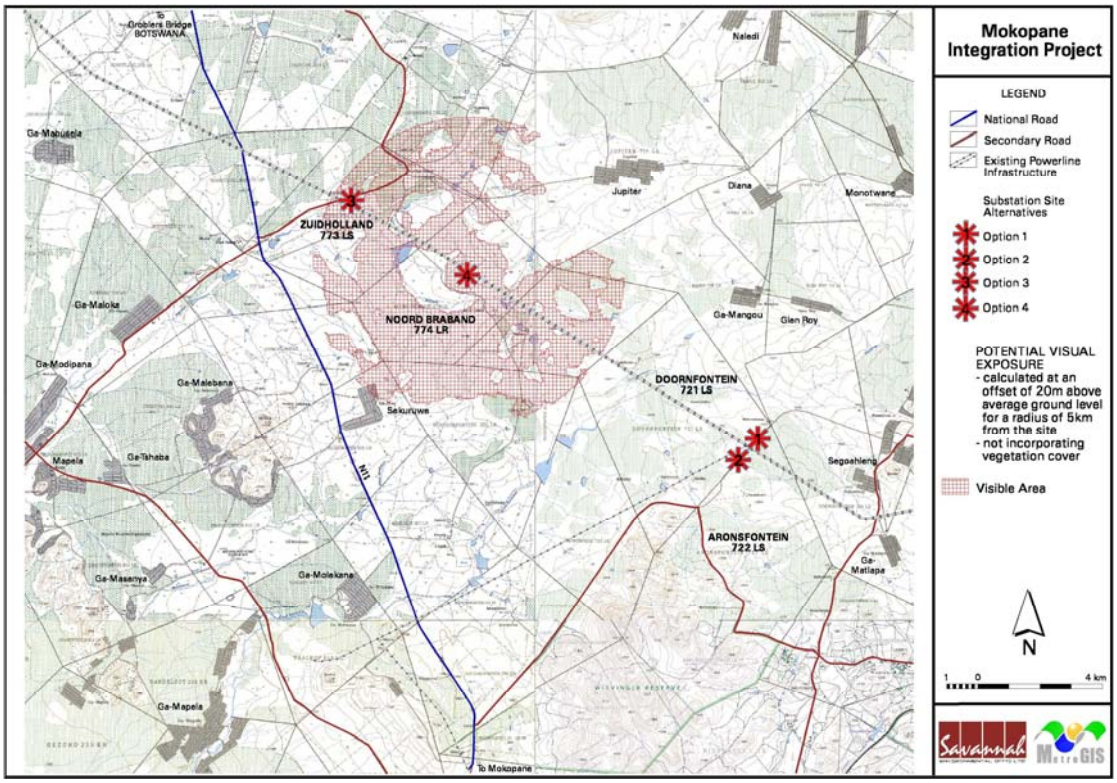


**Figure 18:** Potential visual exposure - substation Option 4.

The proposed Mokopane substation should ideally not be visible from major settlements or major roads where it could potentially have a visual impact on observers residing in the area or travelling along these roads. It should also ideally not be located within the sphere of visual influence of areas with potentially conflicting land uses (i.e. nature reserves). Options 1, 2 and 3 all have the potential to visually impact on either settlements and major roads or the Wit Vinger Nature Reserve. The preferred option for the construction of the Mokopane substation, due to its relatively remote location, is Option 4.

## 5. ISSUES RELATED TO THE VISUAL IMPACT ASSESSMENT - SUBSTATION SITE ALTERNATIVES

It becomes apparent that the proposed substation sites have the potential to be visually exposed to fairly large areas. This is based on the theoretical visibility as indicated by the preliminary viewshed analyses undertaken from each of these sites. The fact that these areas are exposed does not imply that it constitutes a significant visual impact, at least not for all of the exposed areas. Further investigation is necessary in order to determine the specific visual impact within these exposed areas (i.e. the potential occurrence of sensitive visual receptors).

The visual impact assessment within the EIA will address these and other crucial issues related to the visibility of the proposed Mokopane Integration Project. These issues or criteria will aim to quantify the actual visual impact and to identify areas of perceived visual impact.

Other issues/criteria to be addressed by the visual impact assessment:

- Visual distance/observer proximity to the proposed infrastructure (apply the principle of reduced impact over distance)

- Viewer incidence/viewer perception (identify areas with high viewer incidence and negative viewer perception)

- Landscape character/land use character (identify conflict areas in terms of existing and proposed land use)

- Visually sensitive features (scenic features or attractions)

- General visual quality of the affected area

- Visual absorption capacity of the natural vegetation

- Potential visual impact of lighting (after hours operations and security) of the proposed substation

- Potential mitigation measures

An initial scanning level assessment of the above issues did not reveal any fatal flaws to be associated with the preferred substation alternative as suggested in this report. These issues should however still be investigated in greater detail in order to scientifically motivate and/or identify any other mitigating/aggravating circumstances.

## 6. CONCLUSION

It is recommended that the potential visual impact of the proposed Mokopane Integration Project be assessed according to the issues/criteria mentioned earlier in this report. Specific areas of focus for the visual impact assessment of the nominated preferred transmission line alternative and the preferred substation alternative should be on the visual exposure to and potential visual impact on individual residences, lodges (both private and commercial) and communities within close proximity of the proposed infrastructure. The visual impact study must take cognisance of the results and information generated by the social impact assessment study and the public participation process of this project.

## 7. REFERENCES / DATA SOURCES

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