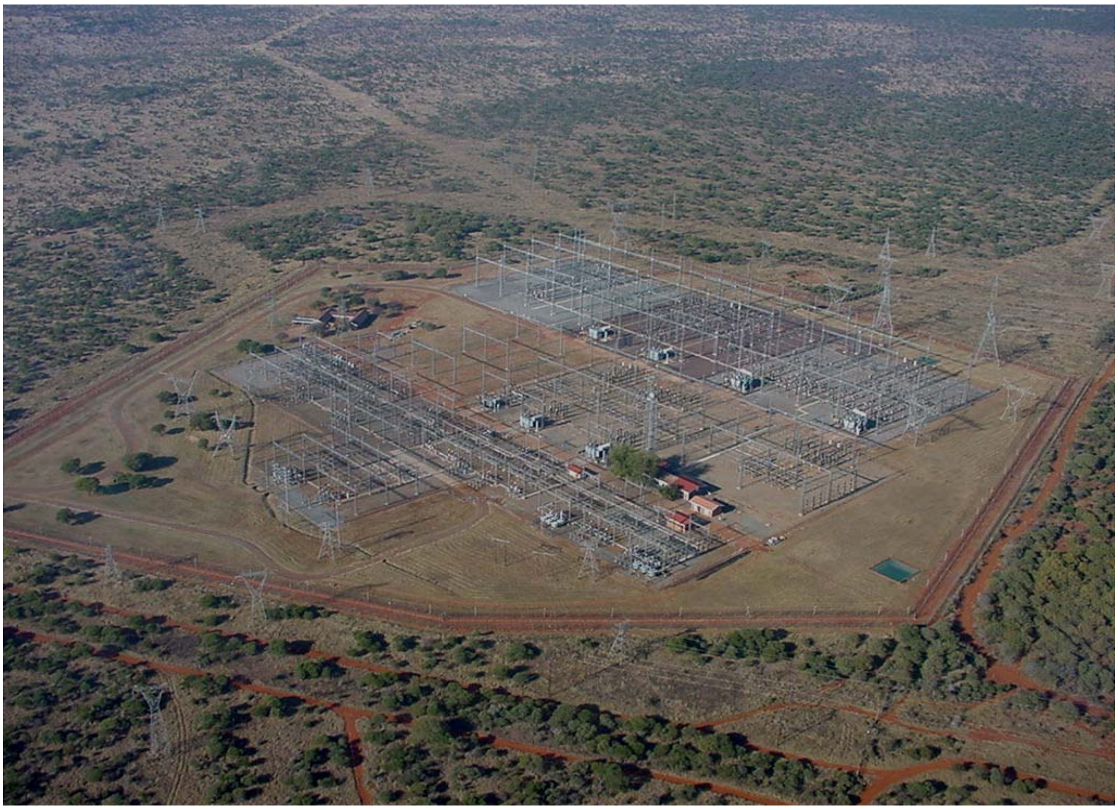


Figure 9: An Example of a Main Transmission Substation: Spitskop MTS

(Courtesy of Eskom)

4.4.2. 765kV Transmission Turn – ins

The technical details regarding the 765kV power lines are as follows:

- Servitude size for 1x 765kV power line = 80m
- Height of 1x 765kV power line = up to 55m
- Minimum conductor clearance = 10.4m
- Span length between towers = between 300 - 500m
- Servitude size for 3x 765kV power lines = minimum 240m

4.4.3. 400kV Transmission Turn-ins

The technical details regarding the 400kV line-in-line-out power lines are as follows:

- Single line servitude size is 55m;
- Towers are up to 38m in height.
- Distance between towers is between 350 and 500m, depending on terrain and route angles.
- Minimum conductor clearance is 8.1m, above ground.

Tower design for the 400kV and 765kV lines are most probably going to be the Guyed-V design or Cross-Rope suspension designs are shown in Figures 10,11,12, and 13 below. Strain towers will likely be utilised where difficult terrain is encountered or line deviations of more than 30° is unavoidable.

Figure 10: Guyed V 400kV Tower Design

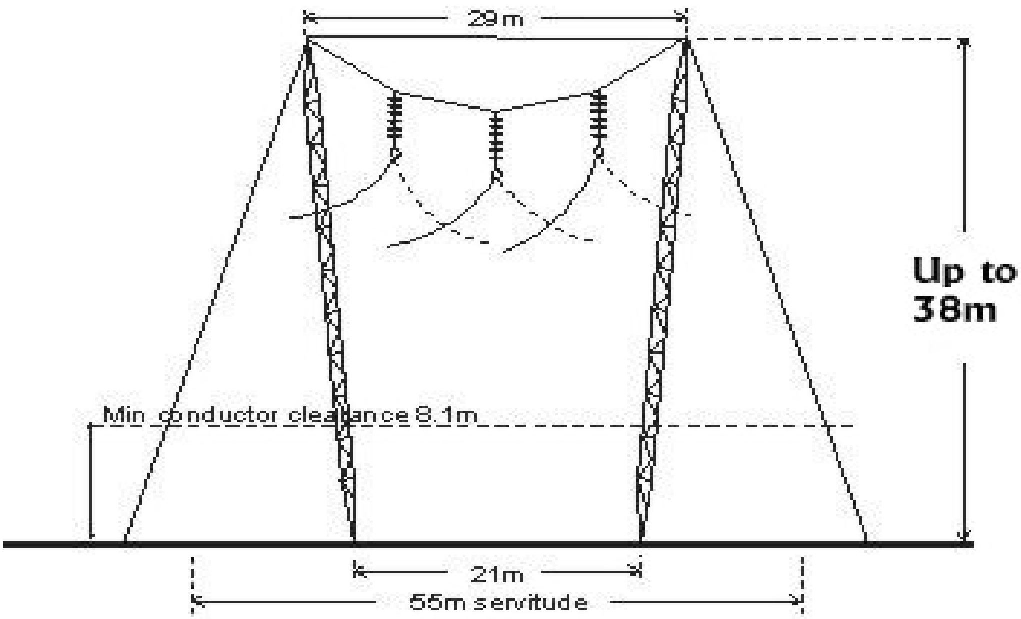


Figure 11: Cross-Rope Suspension 400kV Tower Design

(Courtesy of Eskom)

Figure 12: Cross-Rope Suspension Tower Design

Figure 13: Strain Tower

4.4.4. Land Use Restrictions in Power Line Servitudes

In terms of Eskom's policies the company has the right to impose some restrictions and/or allowances on certain activities within their servitudes. These for example include:

Restrictions:

- No building of houses, sheds or similar constructions that could affect or be affected by the power line and pylons.
- No blocking of access to the servitude area that would deny Eskom maintenance operators access to and/or servicing the servitude area.
- The planting of trees and crops that could pose a threat to the functioning of the power lines (e.g. forestry plantations, sugar cane which could pose a fire risk).
- No blasting or excavating within the servitude area without prior approval from Eskom.

Allowances:

- Grazing and dry land cultivation activities within the servitude area.
- Vegetation clearing and animal movement within the servitude area.
- Placing of topsoil berms not exceeding certain dimensions under the power lines or within the servitude area.

4.5. PROJECT ALTERNATIVES

4.5.1. "No – Go" Option

Eskom is mandated by the Government of the Republic of South Africa to supply sufficient and reliable electricity required for sustainable developments and future growth of the country's economy. The 'Do Nothing' alternative for the proposed project will compromise the security of power supply for the greater Rustenburg area including areas between Spitskop and Brits. This would have an impact on both the local and national network. The 'no-go' option implies that the status quo will persists and from an environment and social perspective this implies that all the associated impacts will not be realised. Over time, Eskom's ability to provide efficient and reliable service to its customers and its' capability to support future developments in the area will be hampered. The future demand for additional household and commercial connections will not be met and as such the wellbeing of local residents would not be improved, any expansion plans of the numerous mining operations within the general study area would be hampered and potential job creations will not be generated.

Impacts to the national economy would be due to reduced outputs, which would invariably result in declining contributions to the national economy. Rustenburg is one of the primary mining hubs in the country, in which extensive platinum mining takes place. Based on these reasons, the 'no-go' option is not supported and will not be discussed any further.

4.5.2. Substation Site Options

For Scoping Phase, a total of 13 sites were identified. Sites A, B and C on the farms Frischgewaagd 96JQ, Styldrift 90JQ and Goedgedacht 110JQ respectively were identified and recommended to the study by Eskom. The selection was based on preliminary geotechnical investigations. The report can be found as Appendix 11 A of this report. Site A & Site B were subsequently dropped in the initial stages of the Scoping Phase, following the preliminary screening exercise and specialist investigations.

Sites D, E, F, G, H, I, J, K, L and M were identified thereafter due to the need for the study to have feasible alternatives. These too were subjected to the preliminary screening exercise, and were also dropped from the study except sites D, E, L and M. Therefore, a total of five sites were assessed further in the technical EIA Phase and are presented in Table 4 and depicted in Figure 15 below. All five sites fall within the Rustenburg Local Municipality. The associated Geotechnical reports are attached as Appendix 11B, 11C and 11D.

Site C

Site C is located on farm Goedgedacht 110 JQ (portion 0) and is owned by Royal Bafokeng Nation (RBN). It lies north-east of Chaneng and close to existing Paul Traction Substation. The site is being leased by Anglo Platinum and mining is the main landuse. The vegetation of this site comprises relative pristine open Acacia savanna on open plains. A relative high grazing factor is noted.

Site D and E

Sites D and E are within Frischgewaagd 96 JQ and are operated by Platinum Group Metals (PTM SA). The two sites lie north-west of Chaneng and are located east of R565. Matimba – Marang transmission powerlines run next to these sites. From the northern side runs the Elands River. Surrounding areas are relative pristine, comprising open *Acacia* savanna. A relative high grazing factor is noted.

Site L

This site is situated on farm Elandsfontein 102 JQ (Portion 12) and is operated by PTM SA. R565 runs east of this site. It is characterised by natural/ pristine woodland with a relative high diversity. A moderate level of habitat variation is also noted. Woody species frequently encountered include *Olea europaea, Searsia* species, *Sclerocarya birrea, Boscia albitrunca* and *Acacia* species.

Site M

This site is situated on Boschhoek 103JQ (Portion 89). Agriculture is the dominant landuse. It contains woodland plains comprising degraded *Acacia* veld with *Dichrostachys cinerea* infestation in parts. The site is characterised by red soils. The vegetation is dominated by *Acacia* species, but some *Sclerocarya birrea* individuals are present in the surrounds. While no sensitive habitat is noted on the site, rocky outcrops and hills are noted towards the north-west.

Details of the proposed corridors are reflected in Table 9 and Figure 14 below.

Table 9: **Substation Sites Assessed**

Site Option	Farm Name	Status	Coordinates	Owner	Landuse
C	Goedgedacht 110 JQ (portion 0)	EIA phase assessment	E27°9'49.3 S25°24'17.2	Royal Bafokeng Nation (RBN)	Mining
D	Frischgewaagd 96 JQ (portion 10)	EIA phase assessment	E27°5'9.43 S25°23'45.18	PTM SA	Agriculture
E	Frischgewaagd 96 JQ (portion 10	EIA phase assessment	E27°4'3.64 S25°26'48.15	PTM SA	Agriculture
L	Elandsfontein 102 JQ (Portion 12)	EIA phase assessment	E27°4’0.22 S25°26’55.16	PTM SA	Agriculture

Site Option	Farm Name	Status	Coordinates	Owner	Landuse
M	Boschhoek 103JQ (Portion 89)	EIA phase assessment	E27°4'42.48 S25°28'12.29	Mr. M. Scheepers	Agriculture

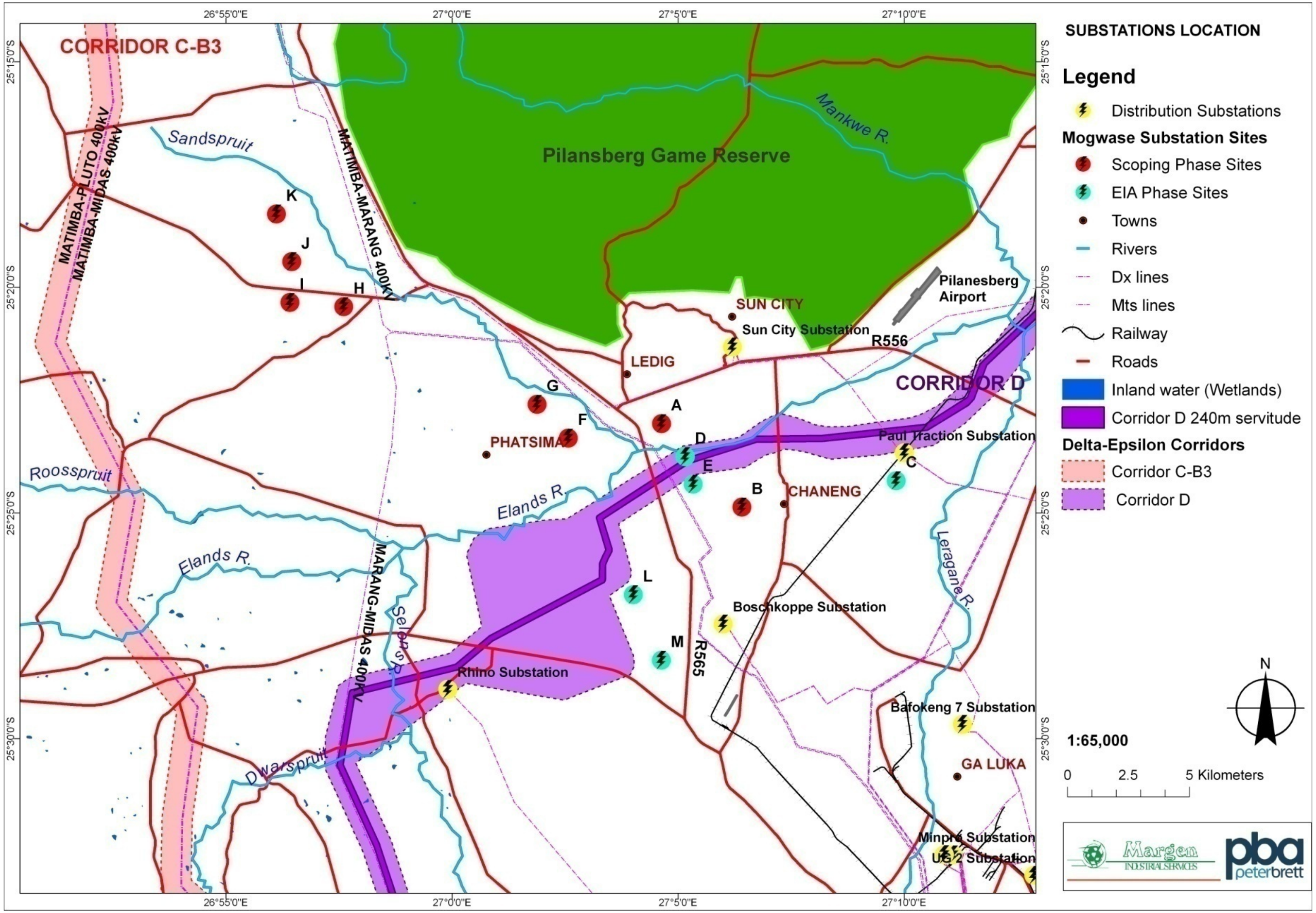


Figure 14: Proposed Sites for Ngwedi Substation

4.5.3. Alternative Corridor Options

Figure 15 presents the 5 corridors with two deviations that were identified during the Scoping Phase. All these corridors and turn-ins were further assessed in the technical EIA Phase. The assessment determined possible alignments that would link the various sites to the main transmission lines of Matimba – Midas 440kV, Matimba – Marang 400kV and 765kV Delta (Masa) – Epsilon (Selomo) power lines through the proposed turn-ins (Table 10). The details of the proposed corridors are as follows:

Corridor 1

The proposed corridor is the north most of the four corridors running from the east of the study area from Matimba – Midas 400kV line to the west. To the furthest site on the eastern side (Site C), the corridor crosses over 58 farm portions which are within the main farms of Bultfontein204JP, Kleingenoeg 174JP, Vlakfontein 207JP, Palmietfontein 208JP, Mahobieskraal 211JP, Zandrivierspoort 210-JP, Koedoesfontein 94JQ, Frischgewaagd 96JQ, Styldrift 90JQ, Rhenosterspruit908JQ and Goedgedacht 110JQ. It passes through two small settlements situated on Farms Vlakfontein 207 JP and Mahobieskraal 211JP, before it aligns along the eastern boundary of Ledig Township. It also lies just south of the Pilanesburg Nature Reserve and north of the Swartkop Mountains.

Corridor 2

Corridor 2 lies south of corridor 1 and it is located just south of the Swartkop Mountain. It traverses through approximately 58 farm portions from Matimba – Midas 400kV power line connection to Site C. The main farms are Vlakfontein 207JP,Vlaklaagte 215JP,Zwartdoorns213JP, Mahobieskraal 211JP, Zwartkoppies 212 JP, Mimosa 81JQ, Koedoesfontein 94 JQ, Frischgewaagd 96JQ, Styldrift 90JQ, Rhenosterspruit 908JQ and Goedgedacht 110JQ. It also passes in close proximity of Phatsima Township.

Corridor 3

Corridor 3 lies south of Corridor 1 and Corridor 2. It traverses through approximately 46 farm portions to the proposed substation Site C from Matimba – Midas power line. The main farms are namely; Vlaklaagte 215JP, Hoogeboomen 232JP, Grootwagendrift 233JP, Onderstepoort 98JQ, Frischgewaagd 96JQ, Styldrift 90JQ, Rhenosterspruit908JQ and Goedgedacht 110JQ. The corridor encloses Elands River for the majority of its length.

Corridor 4

Runs in a southerly direction along the Matimba- Marang transmission power lines, west of Chaneng township, and turns into a westerly direction along the border of farms Frischgewaagd 96 JQ and Elandsfontein 102 JQ, towards site L and turns in a southerly direction between portion 12 and portion 1 of farm Elandsfontein 102 JQ to the proposed site M.

Corridor 5

Originates from Delta (Masa) – Epsilon (Selomo) Corridor D at the west of farm Elandsfontein 102JQ portion 12 and runs in a south – east direction where in merges into Corridor 5.

Table 10: Details of Corridor Options

Name	Width of Study Corridor	Length (km): Matimba – Midas 400kV Power Line to Farthest Substation Site	Affected Farms
Corridor 1	2km	35.92 to site C.	See Appendix 12 A
Corridor 2	2km	33.93 to site C.	See Appendix 12 B
Corridor 3	2km	32.36 to Site C.	See Appendix 12 C
Corridor 4	450m	6 to Site L 8.8 to Site M	See Appendix 12 D
Corridor 5	270m	1.5 to Site L 4.5 to Site M	See Appendix 12 E

4.5.4. Scenarios: Connection of the Proposed Delta (Masa) – Epsilon (Selomo) 765kV power line corridors (Corridor D and Corridor CB_3) to the Proposed Ngwedi Substation.

Presented below are the potential scenarios for linking the proposed corridors to the main Delta – Epsilon (Masa – Selomo) corridors. As indicated earlier, the 765kV lines to Ngwedi substation can come from either Delta – Epsilon (Masa – Selomo) Corridor CB_3 or Delta – Epsilon (Masa – Selomo) Corridor D. The scenarios are as follows:

Scenario 1: 3 x 765kV Delta – Epsilon (Masa - Selomo) transmission power lines originate from Corridor CB_3.

Corridors 1 to 3 originate from the west of the study area along the Matimba- Midas 400kV power line towards the east of the study area. The corridors are 2km wide each, of which will accommodate the five transmission power lines of:

- 2 X 400kV lines from Matimba – Midas with servitude of 110m.
- 2 X 400kV lines from Matimba – Marang with servitude of 110m.
- 3 X 765kV from Delta (Masa) – Epsilon (Selomo) CB_3 of which will have servitude of 240m.

The remaining area is a buffer required for deviating to avoid certain obstacles along the corridors. These corridors can link to the proposed sites that are located within the load centre and to site C. Should Site L or Site M be selected as the preferred sites, then Corridor 5 will have to be utilised to link the turn-ins.

Scenario 2: 3 X 765kV Delta – Epsilon (Masa - Selomo) transmission power lines originate from Corridor D.

Corridor 1 to 3 will serve to link the turn-ins from Matimba – Midas and Matimba – Marang transmission power lines connecting them to either of the proposed substation sites located in the load centre. The 765kV Delta - Epsilon (Masa - Selomo) transmission lines to the proposed substation will be connect directly to these sites from Corridor D.

Corridor 5 will be utilised only if Site L or Site M is selected as the preferred option for the proposed substation. In this case the 765kV Delta – Epsilon (Masa - Selomo) lines will come through Corridor 5 and the remaining turn-ins will utilise Corridor 4.

It is important that the study highlights that according to the EIA Study for the Delta – Epsilon 6 X 765kV power lines project that the alignment of Corridor D took into consideration the location of the Ngwedi load centre and was thus placed in close proximity of this load centre. The study therefore recommends the use of Corridor D as opposed to Corridor CB_3.

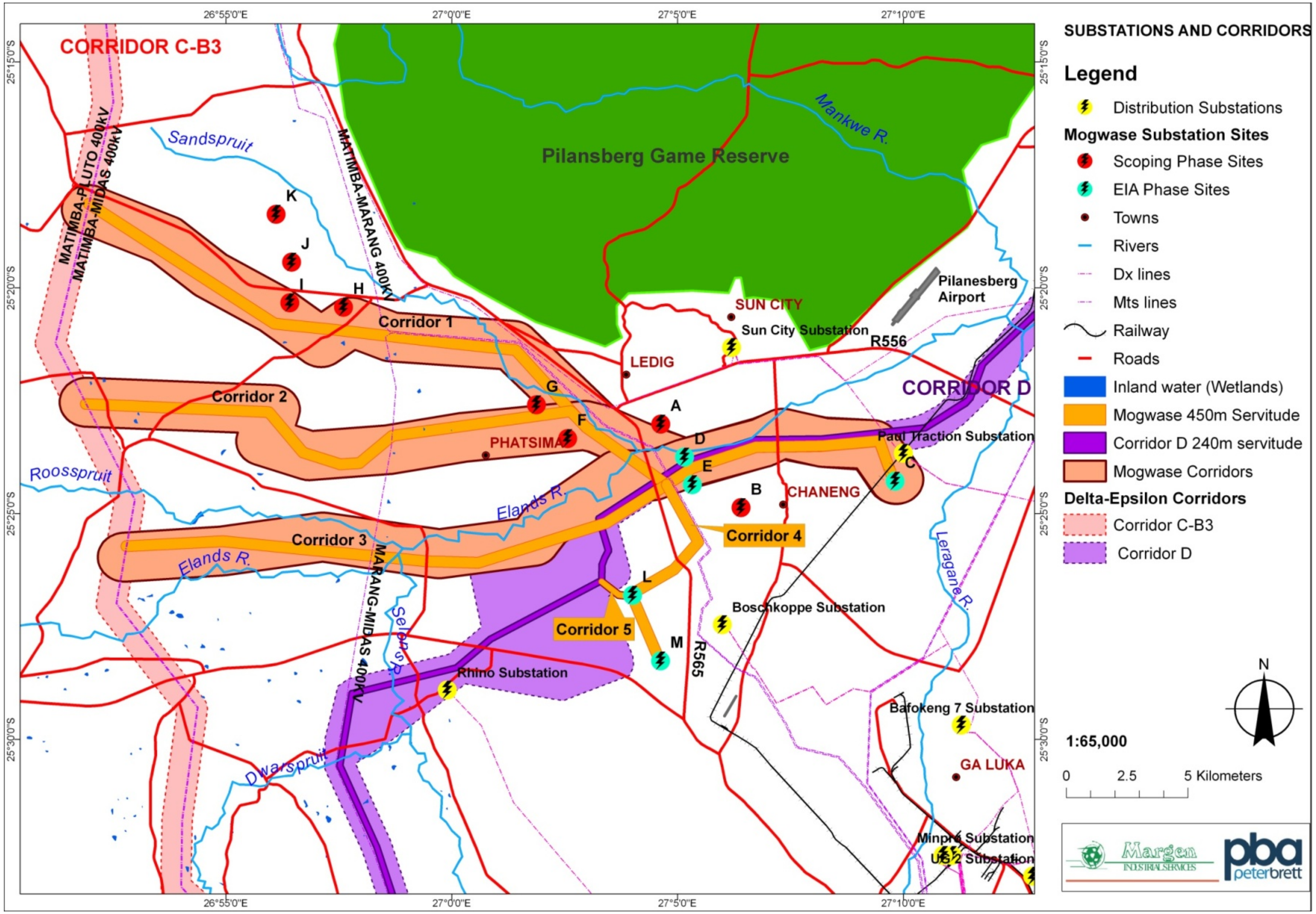


Figure 15: Proposed Corridor Options

4.5.5. Tower Design Alternatives

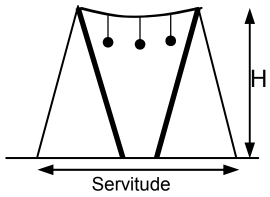
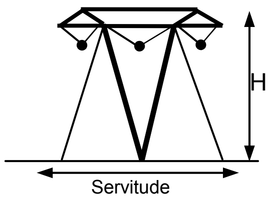
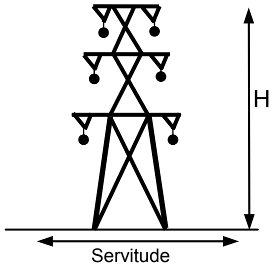
A total of five possible tower designs are under consideration for the proposed 765kV and 400KV transmission lines (Table 11). Some of these structures were presented in section 4.4 above. The towers for the 400kV power lines will use less steel, have a smaller footprint and will be comparatively shorter than the 765kV towers.

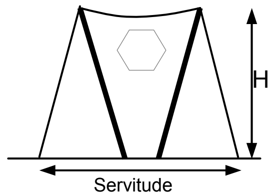
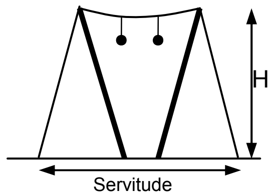
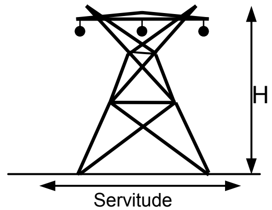
The tower structures under consideration are namely:

- Cross rope suspension.
- Guyed V.
- Strain Towers.
- Hexagonal Cross rope double circuit tower.
- Cross rope double circuit tower.

The latter two alternatives are double circuit structures. These structures allows for two conductors as opposed to one conductor to be placed in one tower structure and therefore result in the utilisation of a fewer number of power lines, less vegetation and habitat destruction and visual impacts. However, they are comparatively more expensive structures to the single circuit structures. In addition, in the case of South Africa they are yet to be designed and tested to determine applicability for use and can therefore have technical and maintenance problems that would place the electricity network at high risk. The possibility of utilising these structures is low.

Table 11: Tower Design Alternatives

Transmission Structures	Height (H)	Servitude (single line per corridor)	Advantages	Disadvantages	Illustration
765 kV Cross Rope (single circuit)	55m	80m	Less visual impact as less steel used; no place for birds to perch above conductors hence issues such as flashovers and shorting caused by birds are avoided. A cheaper structure.	Live-line maintenance and construction problems still to be resolved. Anchor cables are more difficult in cultivated areas.	
765 kV Guyed-V (single circuit)	55m	80m	Extensively used in the study area. More visual uniformity when following existing lines. The 765kV tower design is tried and tested.	More visible due more steel used for tower. Bird guards required to avoid flashovers. Anchor cables are more difficult in cultivated areas.	
765 kV Double Circuit (Self supporting)	60 to 80m	80m	Two power lines on one tower, hence overall footprint and servitude requirements are less. Is a proven technical solution.	Height of structure (80m) is substantially higher than single circuit hence visual impact will be very high. Expensive structure.	

Transmission Structures	Height (H)	Servitude (single line per corridor)	Advantages	Disadvantages	Illustration
765kV Hexagonal Double Circuit (Cross-rope)	55 to 70m	80m	Two power lines on one tower, Substantially lower visual impact. As above, only one instead of two power lines required hence servitude requirement is less	Potentially high structure (Up to 70m), therefore still a visual impact concern. Technical and maintenance aspects still to be resolved	
HVDC (Cross-rope)	50m	80m	Has the capacity to carry the amount of power generated in the Waterberg area southwards without the need for additional power lines. Visually similar to 765kV AC Cross-Rope design.	Construction and cost issues to be resolved. Operational aspects to be investigated. Possible unsafe field effects have not been resolved;	
765 kV Self Supporting (at turns and termination points)	45-50m	80 - 100m	No anchor cables, and therefore better in cultivated areas. Tried and tested design.	Visually more intrusive due to substantial amount of steel used.	

4.5.6. Underground Power Lines

The alternative to overhead power lines is subterranean lines that are submerged under the ground. Underground power lines result in less severe visual or aesthetic impacts and the consequential social and economic effects that are associated with the visual impacts would also be reduced. In this respect, stakeholders such as game farm owners or tourism related business owners would prefer this alternative as the visual scenery will not be altered significantly and the consequential economic benefits gained through these activities would not be affected.

Conversely, preference for overhead lines is based mainly on the grounds of costs but also on the design and operation of underground lines of this magnitude. Efficient operation of underground lines requires that they operate within a certain range of temperature of which can only be achieved by the use of large amount of insulation, which incur costs. In additional, the operational lifespan of the underground cabling are comparatively shorter and therefore require frequent replacement. The result is that, the utilisation of underground power lines is a more expensive option. The general guideline internationally is that underground cables may be as much as 20 time or more of the equivalent overhead lines.

Restrictions on the type of land use activities above underground lines and under overhead lines are exercised in both cases. Any form of development, ploughing or even the growth of vegetation with extensive root systems above underground cables is severely restricted. The construction of underground lines still causes environmental damage due to the extensive excavations that have to be conducted for the entire length of the proposed line. On the other hand excavations for the overhead power lines are restricted to the footprint of each pylon. Activities such as dry land cultivation and grazing can still occur under overhead power lines. Refer to Appendix 14C for the technical notes on underground power lines for more details.

Eskom is not considering the use of underground lines for any of the associated transmission power lines based on the above mentioned reasons and as a result this alternative will not be discussed further in this EIA study.

4.6. ASSOCIATED DISTRIBUTION POWER LINES

It is proposed that apart from the 765kV Masa-Epsilon (Selomo) power line that will terminate at Ngwedi and the 765kV and 400kV power lines into and out of the substation, between four and six distribution power lines will connect Ngwedi substation to several distribution substations in the vicinity.

At the time of writing this report, four 132kV distribution power were proposed:

- 1 line to the Sun City substation.
- 1 line to SA Chrome substation south of the project area.
- 1 line to Turnberry substation.
- 1 line to Styldrift substation

A schematic of the proposed integration of Ngwedi substation with the surrounding Distribution network of substations is attached below (Figure 16). It should be noted that the green lines indicate distribution lines and turquoise lines represent the proposed distribution lines.

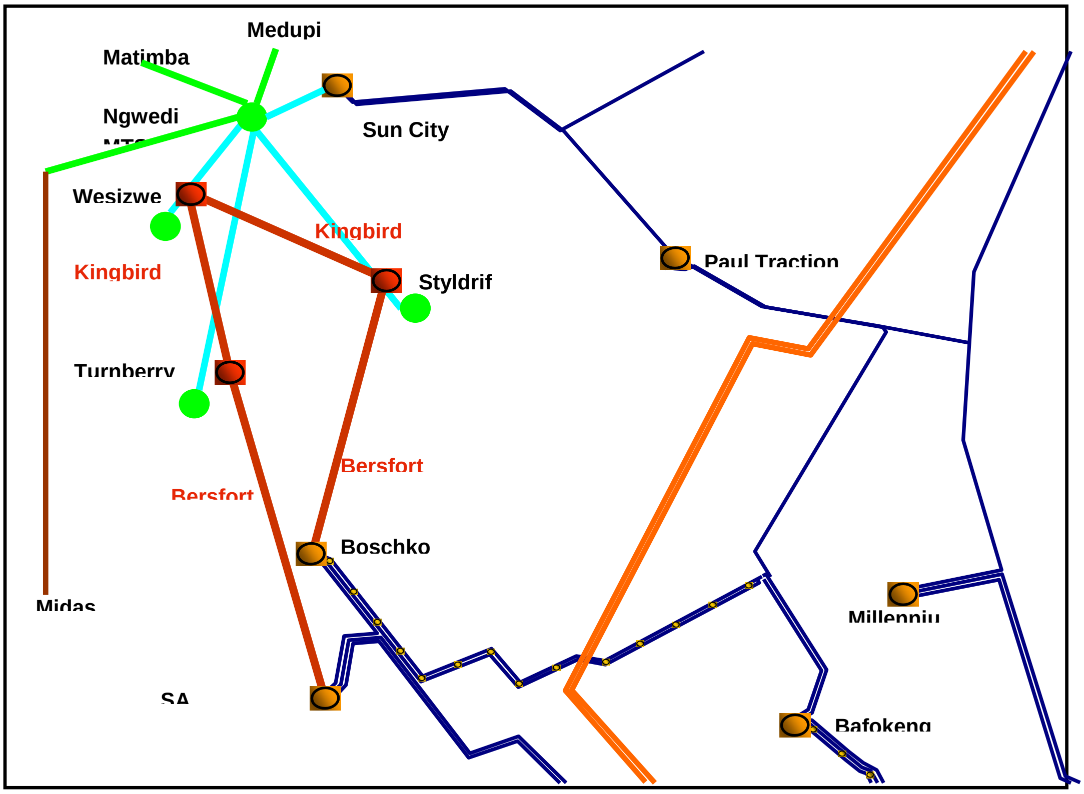


Figure 16: Schematic of Ngwedi Substation and Distribution Network Integration

(Source Eskom Planning Division)

4.7. PROJECT IMPLEMENTATION PROCESS

The process outlined below is detailed in Eskom's fact sheet on power line construction. [30]

4.7.1. Route Identification and Environmental Impact Assessment

The EIA study plays a vital role in defining the planning of the project, specifically in terms of determining the best route for the proposed power line and site for the substation from an environmental perspective. Should the DEA approve the EIA report and issue Eskom with a positive Record of Authorisation (RoA) to proceed with this project, the subsequent activities will be set in motion. The process outlined below is detailed in Eskom's fact sheet on power line construction.

4.7.2. Land and Rights Acquisition

In order to facilitate the construction and maintenance process, Eskom has to secure land for the substation and a right of way for the strip of land for the authorised route. The process entails the identification of properties, boundaries and property owners, thereafter the market value of each of the affected properties are determined by an independent evaluator prior to the commencement of negotiations between Eskom and the property owners. Once acquired, the acquired land and the right of way are registered at the Deeds office.

4.7.3. Survey and Line Design

The design engineers use the topographical profile and site plans prepared by the surveyors who would have surveyed the authorised power line route and substation site to determine the design requirements and technical specifications for the materials and equipment to be used. Basically, this information will determine, for example, the type of tower structures and foundations to be installed.

[30] Eskom Construction of Power Line Fact Sheet. www.eskom.co.za/content/TD%200099Build Powerline.doc

4.7.4. Construction

The actual construction procedures will be suited based on the conditions on the ground, however typical procedures will consist of the removal of vegetation cover in the appropriate areas, construction of the power line and substation which will include excavation, establishing foundations, putting in place the required infrastructural components and connecting to the grid system. A detailed breakdown of the construction process for power lines, refer to Appendix 14A.

4.7.5. Site Restoration and Clearance

It is important that after the project has been completed that all the excess material and equipment are removed from the project area and any disturbed environment outside the new structures should be returned to a condition close to its original state. Eskom policy requires that affected landowners sign off release forms confirming that the land was rehabilitated to an acceptable standard.

4.7.6. Operations and Maintenance

Ongoing maintenance shall be carried out on a periodic basis throughout the operational lifespan of the power lines and the proposed substation. Depending on the agreements reached between Eskom and the landowners the maintenance of the servitude can be carried out by either party. Typically, Eskom conducts site visits to inspect for example, the condition of the pylons, power lines, the substation and of the servitude.

4.7.7. Decommissioning

This exercise will take place at the end of the operational lifespan of the associate power lines or of the substation. The line span of these facilities is generally between 60 to 80 years and there have been no examples of MTS decommissioning in South Africa. However, it is generally assumed that the decommissioning process is the reserve of the construction process whereby the various structures and components will be put out of operation and removed.