This section of the EIA Report provides a description of the environment that may be affected by the proposed Tshwane Strengthening Project Phase 1 (2X 400kV Apollo-Verwoerdburg turn in and out power lines and Verwoerdburg substation extension). This information is provided in order to assist the reader in understanding the possible effects of the proposed project on the environment. Aspects of the biophysical, heritage, social and economic environment that could be affected by, or could affect, the proposed development have been described. This information has been sourced from both existing information available for the area and proposed development site as well as collected field data, and aims to provide the context within which the environmental assessment has been conducted. A more detailed description of each aspect of the affected environment is included within the specialist assessment reports contained within Appendices I – N.

Alternative power line corridors comparatively assessed within this EIA report include alternative 1, 2 as well as alternative 3 following an existing Apollo-Pluto power line (refer to Figure 4.1). Subsequent to the specialist workshop, an additional alternative 3a was included which is a direct line from the Verwoerdburg substation west of the M57 towards the Apollo-Pluto lines. This line also runs parallel to the existing power lines for about 3 km. This alternative line was also assessed as part of the EIA process.

4.1. Location and Baseline Environment of the Study Area

Most of the land within the study area for the Apollo-Verwoerdberg alignment has been either permanently altered by agriculture or is degraded due to urban encroachment in the region with the exception of the Rietvlei Nature Reserve to the east. Most of the area is covered by agricultural holdings and no major industrial centres occur within the study area, although the Clayville Industrial area is not far to the south. Existing power lines traverse the area substantially due to the proximity and size of the Apollo substation.

The substation and expansion site is largely surrounded by an undeveloped open area. Neighbouring residential areas include Doornkloof (approximately 1.5km to the west extending north-northwest), Irene Extension 10 (approximately 1.3km to the northwest), Irene Glen Private Estate (approximately 600m to the north), and Sunlawns Agricultural Holdings (AH) (approximately 4km to the south). Doornkloof Smallholdings (SH) lies approximately 350m to the east, which is an area that is characterised by mixed land use including private residential and light industrial (refer to Figures 4.2 and 4.3).

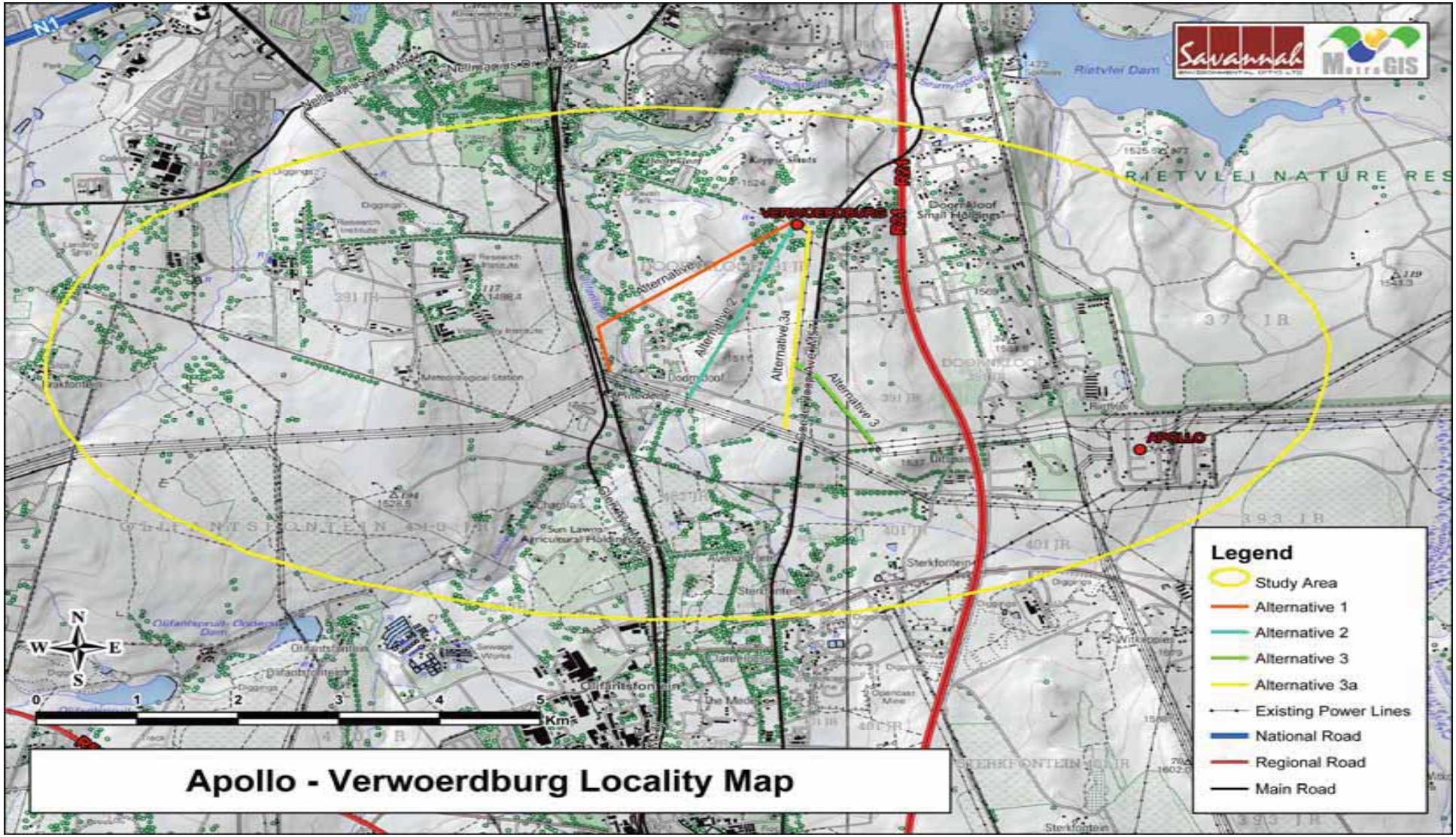

Figure 4.1: Power line Alternative Corridors comparatively assessed during the EIA phase of the process

Figure 4.2: An image showing delineation of the City of Tshwane Metropolitan Municipality and the Kungwini Local Municipality in Gauteng and the location of the identified corridors and substation extension.

Figure 4.3: Location of the proposed extension to Verwoerdburg substation

4.1. Social Characteristics of the Study Area

Apart from the southern-most tip of Alternative 1 (at its bend where it runs parallel to Glen Avenue), which is located within the City of Tshwane (CoT) municipal area, the infrastructure development associated with Tshwane Strengthening Project Phase 1 (Apollo- Verwoerdburg component) is located within the Kungwini Local Municipality (KLM) that forms part of the Metsweding District (MD) of the Gauteng Province.

The proposed turn-in power line development corridors are located and pass through land that is characterised by mixed land uses including agriculture, residential and light industry, respectively (refer to Figure 4.4 and 4.5).

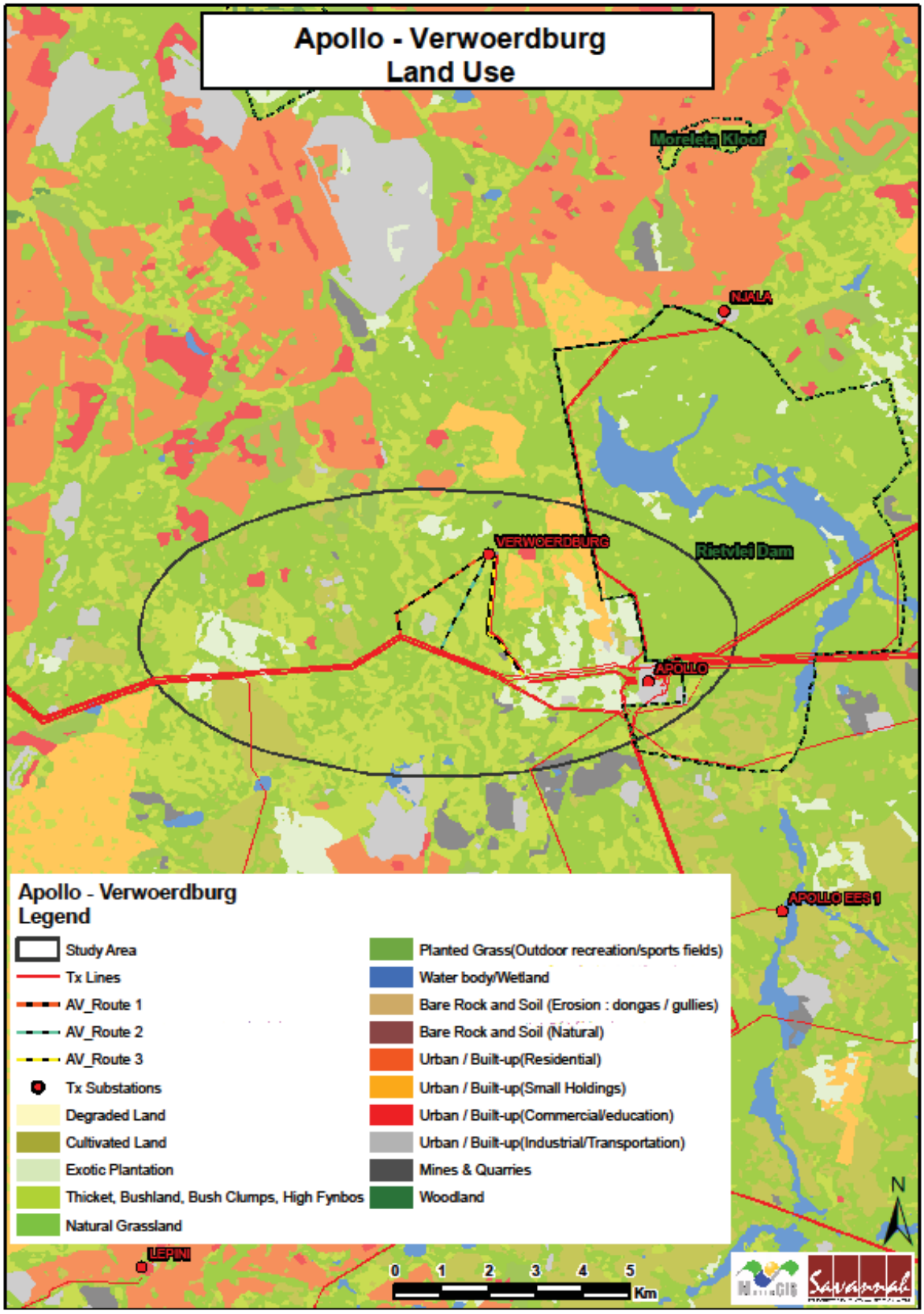

Figure 4.4: Land use map of the study area

4.1.1. Demographic Profile

The KLM covers an area of approximately 2 202km^2 and, according to Community Survey 2007, the area has a total population of 104 150 people. Census 2001 estimated the total population at around 107 543 people. It therefore appears that there is a slight population outflow, even thought a review of the KLM IDP of 2006/07 estimated the population growth rate at +5.5%. According to the IDP's calculations, the population in the KLM would have grown from 2001's 107 543 people to approximately 132 848 people by 2006, escalating to approximately 150 507 people by 2011. It therefore appears that the 5.5% population growth rate was a glaring over-estimation on the part of the KLM, as the population size in fact decreased as suggested by the Community Survey 2007 estimation.

The local municipal area is regarded as an urban area in view of the fact that, by 2006/07, an estimated 77.6% of the population lived in urban areas, with the remaining 22.4% residing in rural areas. Based on Community Survey 2007 population data, the population density in the KLM is approximately 47.3 persons per km^2, but it can be even less in areas that are still developing, such as the immediate area surrounding the proposed development (refer to Figure 4.5).

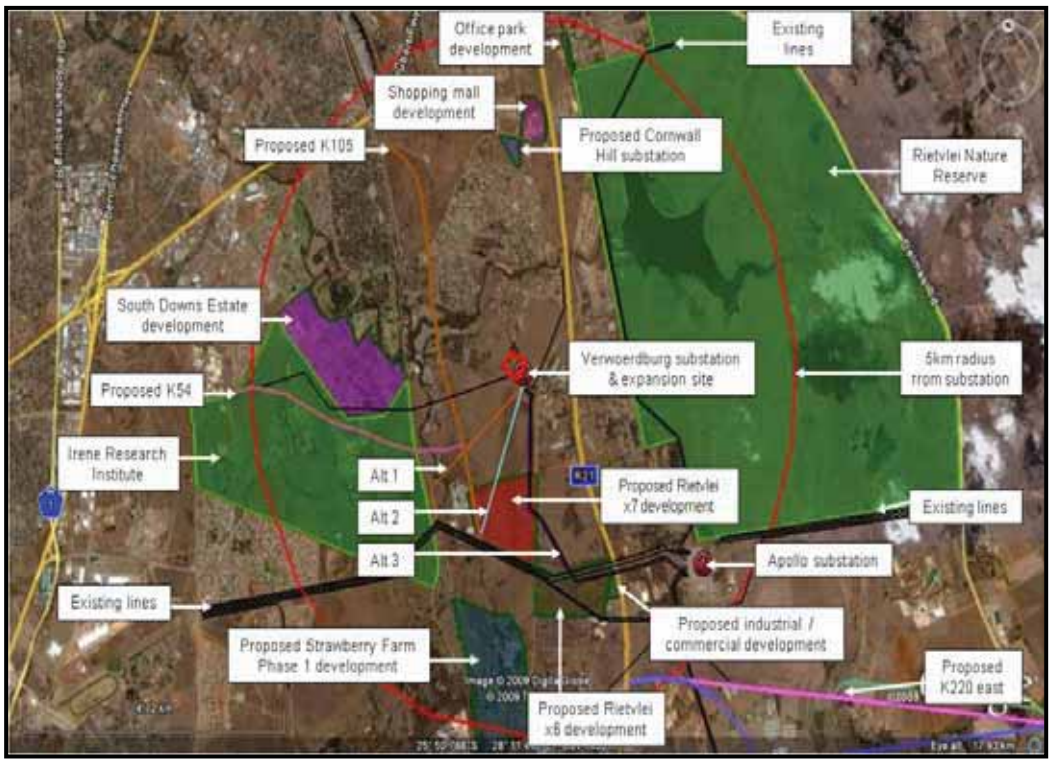

Figure 4.5: Image showing various land uses within the study area

4.1.2. Socio-economic Profile

The study area is characterised by a high employment rate where the majority (79.4%) of the working age population (ages 15-64, but excluding the not economically active population) is formally employed. This is a significant increase from 2001, when less than half (49.2%) of the economically active population were employed. The majority of those employed (36.1%) are engaged in elementary occupations and is therefore regarded as unskilled to semi-skilled. Although the employment rate exceeds the unemployment rate by far, it is still a point of concern that one in every fifth person from the working age population is still unemployed as this gives rise to a whole series of social problems such as poverty, crime and a high dependency ratio.

The education levels of the population within the Eastern Sub-Region of Region A are higher than the national average which is an indication of the higher income levels in the area. Approximately 60% of the residents have completed secondary school with 14% achieving higher education levels. Approximately 18% have only completed primary school. It is therefore clear that a large proportion of the population in the formal residential areas of the study area are living as affluent, well-educated citizens.

4.1.3. Services and Infrastructure

The years between 2001 and 2007 saw a steady increase in the delivery of some municipal services to the households within the KLM. Despite the fact that, according to official statistics from StatsSA, there was a decrease in the number of households in the KLM (from 33 598 in 2001 down to 31 666 in 2007), there are still large segments of households within the municipal area that have to do without proper municipal services.

A comparison between Census 2001 and Community Survey 2007 revealed an improvement to the following service areas (expressed as a percentage of the total number of households serviced): Electricity for cooking (from 56.3% to 71.3%), for heating (from 53.8% to 59.4%), and for lighting (from 70.3% to 82.8%). The only other service that improved was the delivery of purified piped water to households or within a 200m radius of every household (from 77.7% to 86.2%). All other service areas deteriorated in the quality and consistency of these services: Refuse removal once a week dropped from 46.7% to 45.4%, and sanitation dropped from 68.0% to 67.4%.

According to the KLM IDP (2008/09), there are no water backlogs in formal areas within the municipality and the six sewerage plants servicing the municipal area are functioning properly. In contrast, the IDP also admits that new housing

developments placed the existing bulk sanitation services under tremendous strain and that the upgrade of the sewerage plants had become a critical issue. In addition, despite the general improvement in the electricity network, the IDP expresses its concern about the state of electrical infrastructure in the area and felt that the time had come for the infrastructure to be either refurbished or replaced.

4.1.4 Heritage Resources

The Phase I HIA study for the Eskom Project Area revealed the following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999), namely:

- At least two graveyards located near Alternative 01 and Alternative 02 for the 400kV loop-in and loop-out power lines running from the 400kV Apollo-Pluto power line to the Verwoerdburg Substation (refer to Figure 4.6).
- No heritage resources were observed along Alternative 03 and 03a.

These graveyards were geo-referenced and mapped (Table 4.1 and Photograph 4.1).

Table 4.1: Coordinates for two graveyards near Alternatives 01 and 02, two loop-in and loop-out power lines running from the 400kV Apollo-Pluto power line to the Verwoerdburg Substation.

Graveyards	Coordinates
GY01. Approximately 85 graves. Under Eskom's proposed 400kV transmission line.	25º 54.794S' 28º 14.087E'
GY02. Approximately 20 graves in open veld.	25º 54.127S' 28º 13.958E'

Photograph 4.1: Image showing GY01 near Alternative 01 holds approximately 85 graves

Photograph 4.2: Image showing GY02 along alternative 2 which holds approximately 25 graves

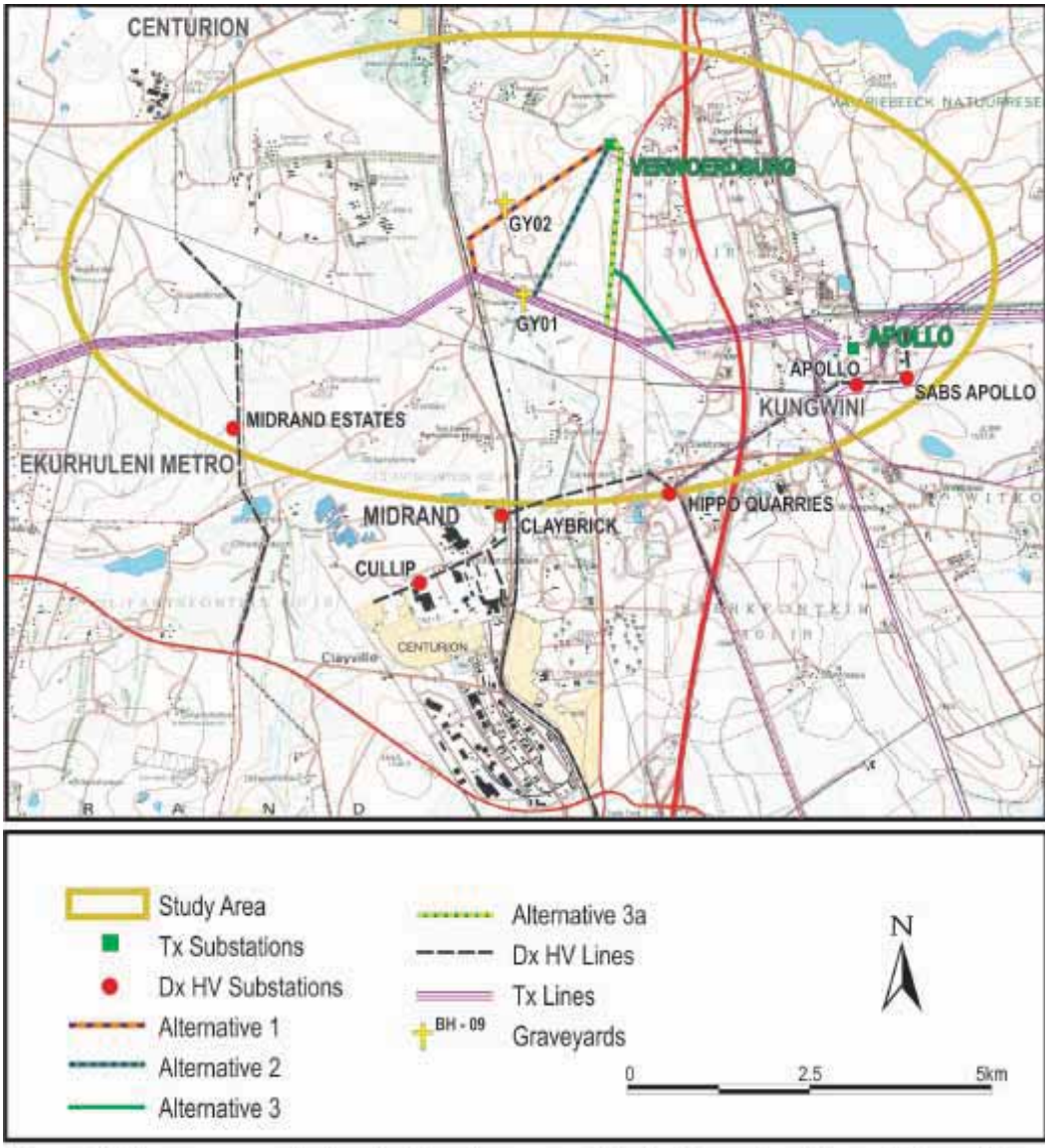

Figure 3- Two graveyards located in close proximity to Alternative 01 and Alternative 02, two loop-in and loop-out power lines running between the 400kV Apollo-Pluto power line and the Verwoerdburg Substation (above).

Figure 4.6: Heritage resources recorded in the study area

4.2. Biophysical Characteristics of the Study Area

4.2.1. Geographical Profile (Topography and Surface Water Hydrology)

The topography of the study area can be described as an undulating plain with an elevation above sea level ranging from 1330 m in the west to 1585 m in the south. Areas of surface water that will potentially be affected by the proposed line variants include a perennial river (Oliphantspruit River) west of the site. According to the GDARD database, Class 3 ridges are present within all of the proposed power line servitudes. The regional vegetation in which the proposed lines are situated is named the Carletonville Dolomite Grassland (Vulnerable status).

The study area is situated in the Sesmyl Spruit drainage system, flowing in an east-west direction from regions south of the Rietvlei Dam where it flows into the Jukskei River west of Centurion. The Kaal Spruit, also known as the Olifantspruit, is a prominent tributary of the system and originates in the Kaalfontein region south of the study area. These streams are perennial and quick flowing drainage courses.

Varied topography is recognised as one of the most powerful influences contributing to the high biodiversity of southern Africa. The interplay between topography and climate over a long period has led to the evolution of a rich biodiversity. Landscapes composed of spatially heterogeneous abiotic conditions provide a greater diversity of potential niches for plants and animals than do homogeneous landscapes. The richness and diversity of flora are found to be significantly higher in sites with high geomorphological heterogeneity and it can reasonably be assumed that associated faunal communities will also be significantly more diverse in spatially heterogeneous environments. The corridor options will potentially affect a Class 3 ridge. Significant ridge areas are present in the middle sections of Alternative Routes 1 and 2.

Ridges are characterised by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and variations thereof), slopes and altitudes, all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. The temperature and humidity regimes of microsites vary on both a seasonal and daily basis. Moist cool aspects are more conducive to leaching of nutrients than warmer drier slopes. Variation in aspect, soil drainage and elevation/altitude has been found to be especially important predictors of biodiversity. Many Red Data/ threatened species of plants and animals inhabit ridges. Due to their threatened status, Red Data species require priority conservation efforts in order to ensure their future survival. It follows that ridges will be characterised by a particularly high

biodiversity; as such their protection will contribute significantly to the conservation of biodiversity in Gauteng.

4.2.2. Climate

The climate of the area can be regarded as typical of the Highveld, with cool to cold, dry winters and warm, moist summers (Koch, 1984). The main climatic indicators are given in Table 4.2.

Table 4.2: Climate Data

Month	Average Rainfall (mm)	Average Min. Temp (^{0}C)	Average Max. Temp (^{0}C)	Average frost dates
Jan	118.8	13.8	27.0	Start date: 13/5 End date: 13/9 Days with frost: ± 115
Feb	93.3	13.1	26.3	
Mar	79.3	11.6	24.9	
Apr	39.6	7.6	23.0	
May	19.7	3.0	20.3	
Jun	6.8	-0.7	17.7	
Jul	8.8	-0.8	17.5	Heat units (hrs > 10^{0}C)
Aug	8.4	1.8	20.6	Summer (Oct-Mar): 1 719 Winter (Apr-Sept): 305
Sep	22.1	6.1	23.6	
Oct	64.1	10.4	26.0	
Nov	109.1	11.9	25.9	
Dec	110.2	13.2	26.8	
Year	680.2 mm	15.4 ^{0}C (Average)		

The long-term average annual rainfall is 680.2 mm, of which 574.9 mm, or 84.5%, falls from October to March. Temperatures vary from an average monthly maximum and minimum of 27.0ºC and 13.8ºC for January to 17.5ºC and -0.8^{o}C for July respectively. The extreme high temperature that has been recorded is 38.9^{o}C and the extreme low –13.3ºC. Frost occurs every year on approximately 115 days on average between May and September.

4.2.2.1. Ecological Profile

The proposed power line corridor options comprise significant areas of importance in terms of C-PLAN. In addition, some of the identified corridors (corridor 1 and 2) crossed areas of high biodiversity. Attributes that will potentially be affected include the following:

- » ridges;
- » perennial rivers;
- » non-perennial rivers;

- primary vegetation;
- RD Mammal;
- RED Invertebrate historic location;
- Red Data plant confirmed location;
- Red Data plant historic location;
- Red Data plant metapopulation;
- Orange Data plant confirmed location;
- Orange Data plant historic location; and
- Orange Data plant metapopulation.

Areas of surface water that will potentially be affected by the corridor options include a perennial river and non-perennial stream. A Class 3 ridge will potentially be affected by some of the corridor options, particularly in the middle sections of Alternative Routes 1 and 2. The current status of the region is relatively transformed, with some areas of remaining natural habitat remaining in the region. Urbanisation, stands of exotic trees and agriculture represents the major land transformation effects within the region. Road infrastructure has caused a relative high degree of habitat fragmentation and isolation. The three corridor options are situated within the Carletonville Dolomite Grassland vegetation type. This vegetation type is regarded as Vulnerable.

The biophysical sensitivity of the corridor options is largely determined by the transformation status of the area. Natural habitat associated with ridges and wetlands are regarded as highly sensitive, and existing information indicates a high biophysical sensitivity within the northern part of the corridor options. Alternative Route 1 and Alternative Route 2 comprise the highest total of Medium-high and High biophysical sensitivities when added together, although Alternative Route 3 comprises the second highest areas of High biophysical sensitivity.

Available data on the SANBI database indicates the presence of approximately 906 species within the ¼-degree grid (2528CC) in which the study area is situated. The prominence of herbs, shrubs, grasses and geophytes indicates a high diversity of habitat types, dominated by a grassland physiognomy. The high floristic diversity provides indication that extensive parts of the study area comprises pristine habitat. Numerous invasive and exotic species are however present throughout the region. A total of 133 plant families are represented in the study area, including Poaceae, Fabaceae, Asteraceae and Cyperaceae.

Habitat Types

An analysis of aerial photographs and results of the field surveys revealed the following floristic habitat types within the corridor options:

- Degraded Grassland Habitat Medium with low Floristic Sensitivity;

- Natural Grassland Habitat with medium-high Floristic Sensitivity;
- Ridge Habitat Type with High Floristic Sensitivity;
- Stands of Exotic Trees with low Floristic Sensitivity;
- Transformed Areas with low Floristic Sensitivity; and
- Wetland Habitat Types with medium-high Floristic Sensitivity.

Naming precedence of faunal habitat types are in accordance with the floristic habitat types identified previous sections, including:

- Grassland Habitat (Natural and Degraded) Medium characterised by high Faunal Sensitivity
- Ridge Habitat Type characterised by high Faunal Sensitivity
- Stands of Exotic Trees characterised by low Faunal Sensitivity
- Transformed Areas characterised by low Faunal Sensitivity
- Wetland Habitat Types characterised by medium-high Faunal Sensitivity

Habitats

The corridor options will potentially affect a Class 3 ridge. Significant ridge areas are present in the middle sections of Alternative corridor 1 and 2.

Varied topography is recognised as one of the most powerful influences contributing to the high biodiversity of southern Africa. The interplay between topography and climate over a long period has led to the evolution of a rich biodiversity. Landscapes composed of spatially heterogeneous abiotic conditions provide a greater diversity of potential niches for plants and animals than do homogeneous landscapes. The richness and diversity of flora are found to be significantly higher in sites with high geomorphological heterogeneity and it can reasonably be assumed that associated faunal communities will also be significantly more diverse in spatially heterogeneous environments.

Ridges are characterised by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and variations thereof), slopes and altitudes, all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. The temperature and humidity regimes of microsites vary on both a seasonal and daily basis. Moist cool aspects are more conducive to leaching of nutrients than warmer drier slopes. Variation in aspect, soil drainage and elevation/altitude has been found to be especially important predictors of biodiversity. Many Red Data/ threatened species of plants and animals inhabit ridges. Due to their threatened status, Red Data species require priority conservation efforts in order to ensure their future survival. It follows that ridges will be characterized by a particularly high biodiversity; as such their protection will contribute significantly to the conservation of biodiversity in Gauteng.

At least three threatened mammal species that occur within Gauteng utilise habitat provided by ridges environment including Juliana's Golden mole (Amblysomus julianae), which is perhaps the most threatened small mammal in Africa. Several bird species occurring in Gauteng that are on the South African or international Red Data lists or are considered to be of conservation concern are dependent on ridges, koppies and hills. Similarly, three rare reptile species that occur in Gauteng utilise rocky habitats such as those provided by ridges. The Northern Pygmy Toad (Bufo fenoulheti) and the Common River Frog (Rana angolensis) are found in kloofs. Many Red Data butterflies (especially those belonging to the lycaenid group) occur on the southern slopes of ridges, e.g. the Heidelberg copper butterfly (Chrysoritis aureus) is restricted to the rocky southern slopes of the Alice Glockner Nature Reserve. Metisella meninx is a vulnerable butterfly species that occurs at altitudes above 1,600m and as such, these butterflies are often present on ridge systems. Invertebrates are reliant on hilltops as thermal refugia from winter cold air drainage.

Alternative Route 3 comprises no high sensitivity areas, rendering this option more suitable for the proposed development than either of the other two options, which comprises relative large areas of high faunal sensitivities. The current status of grassland habitat within existing servitudes (Alternative Route 3) indicates that it is possible to mitigate against expected impacts within a grassland habitat.

- A total of 58 butterfly species are listed for the Q-grid 2528CC, including one Red Data species, namely the Marsh Sylph (*Metisella meninx*).
- A total of 12 frog species are listed for the Q-grid 2528CC, including one Red Data species, namely the Giant Bullfrog (*Pyxicephalus adspersus*).
- A total of 45 reptile species are listed for the Q-grid 2528CC. No Red Data reptile species are regarded likely to occur in the study area.
- A total of 80 mammal species are listed for the region of the study area, including 19 Red Data species.

Alternative Route 1 is regarded the most diverse in terms of available faunal habitat and is expected to exhibit the highest faunal diversity. However, none of the Red Data species listed for the general area are highly likely to be found in the study area. One species of concern is however considered a likely inhabitant, namely *Ichnestoma stobbiai*.

Alternative Route 2 is regarded the second-most diverse in terms of available faunal habitat of the three corridor options. It is likely to host all of the terrestrial species found in the study area of Alternative Route 1, but lack the aquatic and amphibian species limited to the wetland habitat found within Alternative Route 1. It is also considered a likely host of *Ichnestoma stobbiai*.

Alternative Route 3 is the least diverse in terms of faunal habitat. It is likely to host all of the terrestrial grassland species found in the general study, but will lack the aquatic and amphibian species limited to the wetland habitat as well as the ridge specialist species found on the dolomite Ridge Habitat of Alternative Routes 1 and 2.

While alternative Route 3a hosts all of the terrestrial grassland species found in the general study, it lacks the aquatic and amphibian species limited to the wetland habitat as well as the ridge specialist species found on the dolomite Ridge Habitat of Alternative Routes 1 and 2.

Results of the respective floristic and faunal sensitivity analysis are combined to present an overview of the ecological sensitivity of the habitat types identified in the assessment (refer to Figure 4.7). The following ecological sensitivities are ascribed to habitat types:

- Degraded Grassland Habitat — Medium-high Ecological Sensitivity;
- Natural Grassland Habitat — Medium-high Floristic Sensitivity;
- Ridge Habitat Type — High Floristic Sensitivity;
- Stands of Exotic Trees — Low Floristic Sensitivity;
- Transformed Areas — Low Floristic Sensitivity; and
- Wetland Habitat Types — Medium-high Floristic Sensitivity.

The integrated floristic sensitivity map is regarded representative of the biodiversity sensitivity of the area, indicating that Alternative Routes 1 and 2 are not regarded suitable for the proposed development as a result of the presence of various Red/ Orange Data flora species and communities within these two corridor options. Alternative Route 3 and 3a are therefore recommended for the proposed development, although fairly extensive Medium-high ecological sensitivity areas are present within this option. Evidence of existing lines along the Alternative Routes 3 and 3a option bears sufficient evidence to the potential to mitigate expected impacts.

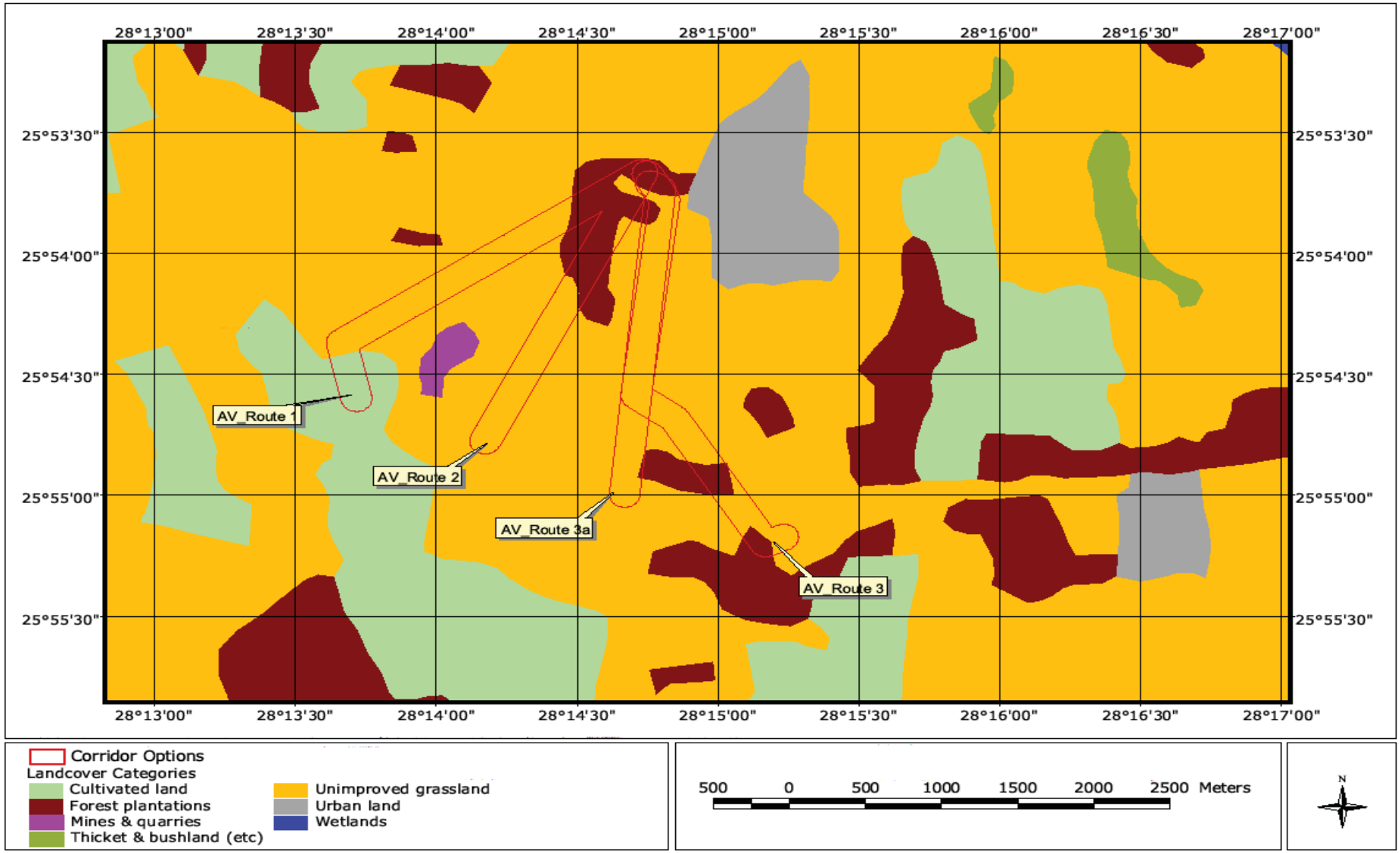

Figure 4.7: Land cover of the study area

Extensive areas within the study area are transformed and some parts of remaining natural habitat is highly fragmented and isolated. However, the largest extent of the study area comprises natural habitat that is characterised by high continuity, i.e., much of the transformation is nodal in nature and while high levels of transformation is present, a high level of continuity is also noted, implying that organisms are able to migrate extensive distances without having to cross any unnatural borders (moderate habitat isolation). The proposed development is not expected to contribute towards local and regional levels of fragmentation and isolation.

The three corridor options are situated within the Carletonville Dolomite Grassland vegetation type. This vegetation type is present on slightly undulating plains dissected by prominent rocky chert ridges. Species-rich grasslands form a complex mosaic pattern dominated by many species. It is regarded as Vulnerable; small extents are conserved in statutory reserves, including Sterkfontein Caves, Oog van Malmanie, Abe Bailey, Boskop Dam Schoonspruit, Krugersdorp, Olifantsvlei and Groenkloof. Almost a quarter is already transformed by cultivation, urban sprawl or by mining activity as well as the building of the Boskop and Klerkskraal Dams. The endemic species *Delosperma davyi* occurs in this vegetation type. Available data on the SANBI database indicates the presence of approximately 906 species within the ¼-degree grid (2528CC) in which the study area is situated. This high floristic diversity is the result of highly diverse biophysical attributes, including soils, geology, micro-climatic conditions, moisture regimes, slopes, aspect, rockiness, soil depth, etc. A dissemination of the growth forms that occur in the region is presented in Table 3. The prominence of herbs (344 species, 38.0%), shrubs (113 species, 12.5%), grasses (128 species, 14.1%) and geophytes (105 species, 11.6%) indicates a high diversity of habitat types. The high diversity of species also provides indication that extensive parts of the study area comprises habitat of a pristine nature in which the natural diversity of the region is reflected. The contribution of weeds and invasive species is also noted and numerous invasive and exotic species are present throughout the region.

A total of 133 plant families are represented in the study area. Prominent families include Poaceae (128 species, 14.1%), Fabaceae (93 species, 10.3%), Asteraceae (89 species, 9.8%) and Cyperaceae (48 species, 5.3%). An analysis of aerial photographs and results of the field surveys revealed the following communities and variations within the proposed corridors (refer to Figure 4.7):

» Degraded Grassland Habitat;
» Natural Grassland Habitat;
» Ridge Habitat Type;
» Stands of Exotic Trees;
» Transformed Areas; and

» Wetland Habitat Types.

The extent of habitat types within the corridor options is presented in Table 4.3

Table 4.3: Extent of habitat types in the study area

Extent of habitat types within corridor sections				
Habitat Type	Corridor 1	Corridor 2	Corridor 3	Corridor 3a
Degraded Grassland Habitat	12.3 ha	2.8 ha	7.0 ha	6.8 ha
Natural Grassland Habitat	17.5 ha	5.8 ha	41.0 ha	42.6 ha
Ridge Habitat Type	12.0 ha	20.2 ha	0.0 ha	0.0 ha
Stands of Exotic Trees	6.4 ha	13.6 ha	9.3 ha	8.2 ha
Transformed Areas	2.5 ha	2.6 ha	4.7 ha	0.9 ha
Wetland Habitat Types	3.2 ha	0.0 ha	0.0 ha	0.0 ha
Total	53.9 ha	45.0 ha	62.0 ha	42.6 ha

Floristic and Faunal Sensitivity Analysis in the study area

The extent of biophysical sensitivities within the respective corridor options are calculated in Table 4.4, indicating that Alternative corridor 1 and Alternative corridor 2 comprises the highest total of High and Medium-high biophysical sensitivities when added together (25.8 ha and 23.2 ha respectively); although Alternative corridor 3 and 3a comprise the second highest extent of High sensitivity areas (7.6 ha).

Floristic sensitivity is based on an analysis of floristic attributes, taking existing impacts and conservation potential into consideration, but also considering the potential significance of impacts resulting from the proposed development.

This assessment indicates the high sensitivity of Alternative 1 and Alternative 2 in terms of biophysical attributes. Certain biophysical attributes within Alternatives 3 and 3a are regarded highly sensitive, but mitigation against significant impacts is regarded possible and either of these routes is regarded suitable in terms of biophysical habitat sensitivities.

Extension of the existing Verwoerdburg Substation is not expected to result in adverse impacts within high biophysical sensitivity areas. The area immediately adjacent to the existing Verwoerdburg Substation is regarded transformed and degraded.

Floristic and Faunal Sensitivity Analysis in the study area

The extent of biophysical sensitivities within the respective corridor options are calculated in Table 4.4, indicating that Alternative corridor 1 and Alternative corridor 2 comprises the highest total of High and Medium-high biophysical

sensitivities when added together (25.8 ha and 23.2 ha respectively); although Alternative corridor 3 and 3a comprise the least highest extent of High sensitivity areas (7.6 ha).

Floristic sensitivity is based on an analysis of floristic attributes, taking existing impacts and conservation potential into consideration, but also considering the potential significance of impacts resulting from the proposed development.

This assessment indicates the high sensitivity of Alternative 1 and Alternative 2 in terms of biophysical attributes. Certain biophysical attributes within Alternatives 3 and 3a are regarded moderately sensitive, but mitigation against significant impacts is regarded possible and either of these routes is regarded suitable in terms of biophysical habitat sensitivities.

Extension of the existing Verwoerdburg Substation is not expected to result in adverse impacts within high biophysical sensitivity areas. The area immediately adjacent to the existing Verwoerdburg Substation is regarded transformed and degraded.

Table 4.4: Floristic sensitivity of habitat types in the proposed corridors

Section	Low / No Sensitivity	Medium Sensitivity	Medium-high Sensitivity	High Sensitivity
Alternative 1	17.8 ha	10.3 ha	10.7 ha	15.1 ha
Alternative 2	16.3 ha	5.4 ha	20.2 ha	3.1 ha
Alternative 3	1.9 ha	40.4 ha	0.0 ha	7.6 ha
Alternative 3a	40.8 ha	34.2 ha	0.1 ha	7.2 ha

Table 4.5: Floristic sensitivity of habitat types within the study area

Criteria	RD species	Landscape sensitivity	Status/Ecological quality	Species composition	Functionality/ fragmentation	TOTAL	SENSITIVITY INDEX	SENSITIVITY CLASS
Community	Criteria Ranking							
Degraded Grassland Habitat	3	3	4	5	2	100	34%	Medium-low
Natural Grassland Habitat	8	8	8	9	7	235	76%	Medium-high
Ridge Habitat Type	10	10	10	9	9	285	92%	High
Stands of Exotic Trees	2	2	2	1	1	53	17%	Low
Transformed Areas	1	1	1	2	3	35	11%	Low
Wetland Habitat Types	6	10	5	6	8	202	65%	Medium-high

Faunal sensitivities are based on the assessment of the following habitat attributes:

- Current biophysical habitat status;
- Ecological linkages to other areas of suitable faunal habitat (migration potential);
- Red Data probabilities.

The calculation of faunal sensitivities are presented in Table 4.6 and visually presented in Figure 4.6. Habitat types that are pristine are regarded as high quality faunal habitat and the likelihood of Red Data species occurring within these areas is generally high.

Table 4.6: Faunal Habitat sensitivity for the study area

Community	Status	Linkage	RD Likelihood	Average	Sensitivity Class
Grassland Habitat	8	6	8	73%	Medium-High
Ridge Habitat Type	9	8	10	90%	High
Stands of Exotic Trees	2	2	1	17%	Low
Transformed Areas	1	1	0	7%	Low
Wetland Habitat Types	4	9	9	73%	Medium-High

These habitat types are often associated with environmental features that are also regarded as sensitive, such as riparian zones, aquatic habitat and rocky outcrops (ridges). The extent of habitat sensitivities within the respective corridor options is indicated in Table 4.7. It is evident that Alternatives 3 and 3a comprise extremely little high sensitivity areas, rendering these options more suitable for the proposed development than either of the other two options, which comprises relative large areas that are regarded high in faunal sensitivities. The status of grassland within existing servitudes indicates that it is regarded possible to mitigate expected impacts within a grassland habitat.

Table 4.7: Extent of faunal habitat sensitivities within corridor options

Corridor Option	Low	Medium-high	High
Alternative 1	8.9 ha	33.0 ha	12.0 ha
Alternative 2	16.2 ha	8.6 ha	20.2 ha
Alternative 3	14.0 ha	48.0 ha	0.0 ha
Alternative 3a	6.1 ha	40.1 ha	0.1 ha

Extension of the existing Verwoerdburg Substation is not expected to affect highly sensitive faunal habitat. The area adjacent to the existing Verwoerdburg substation does not exhibit any faunal attributes of importance.

As can be seen in the Figure 4.7, it is evident that the region is relatively transformed, with only some areas of remaining natural habitat remaining in the region. Urbanisation, stands of exotic trees and agriculture represents the major land transformation effects within the region. Road infrastructure has caused a relative high degree of habitat fragmentation and isolation. The following species are regarded representative of the Carletonville Dolomite Grassland vegetation type. Examples of these birds include the Blue Crane, African Grass Owl, White-bellied Khoraan, Secretarybird, White Stork and Abdims Stork. Avifaunal micro-habitats identified within the study area include (refer to Figure 4.7):

» *Grassland Patches:* The low reporting rate for these species (Harrison *et al* 1997) is evidence of the impact that the surrounding developments are having on the birds that would, under optimum conditions, inhabit these open areas.

» *Ridge Habitat:* These areas are, similarly to the wetland areas, regarded as being extremely sensitive in terms of the conservation targets of GDARD since they provide for high spatial heterogeneities, and are thereby likely to sustain populations of conservation important invertebrate species such as the rock scorpion *Hadogenes* spp and baboon spiders of the genera Harpactira (both genera are currently protected by Schedule B1 of the list of threatened and protected species issued in terms of Section 56(1) of the National Environmental Management: Biodiversity Act, 2004).

From a functional perspective, hills and ridges are important landscape features assisting winged invertebrates in locating potential mating partners.

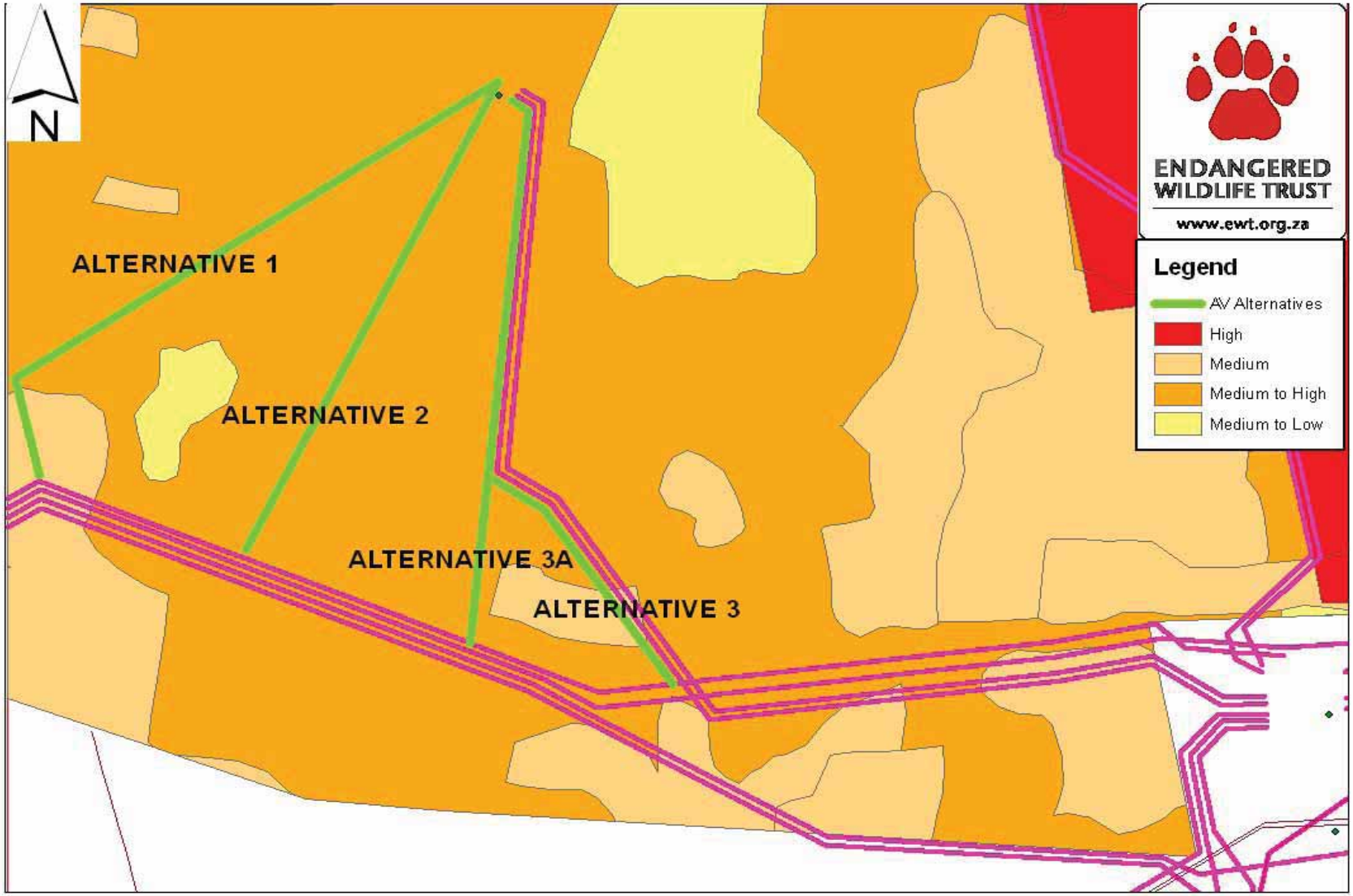

Figure 4.8: Avifauna Sensitive Areas identified for the Pretoria SEA (2008)

On a landscape scale, ridges facilitate animal dispersal to other nearby rocky outcrops and ridges (so-called "stepping stones") and thereby function as important ecological linkages. These micro habitats have been taken into account in identifying the sensitive areas within this study area.

Photograph 4.3: Typical grassland patches in the study area

All the soils around the Verwoerdburg substation are shallow and/or rocky, and have a low potential for arable agriculture. There is thus no limitation to the expansion of the substation as far as soils and agricultural potential is concerned.

In the immediate vicinity of the proposed alternatives, most of the soils are shallow (<400 mm) on rock, with much surface rock outcropping. Alternative 1 crosses a narrow band of deeper soils, close to the Olifantsspruit stream. Further to the south and south-west, deeper, red soils occur, while to the east, zones of moderately deep, red and yellow-brown soils are found. A variety of soil types occur in the study area, which derived from the weathering of dolomite. Rocky outcrops occur on the ridges traversed by the proposed alternative corridor 2. High potential soils were also found on the western part of the site (refer to Table 4.8 and Figure 4.9).

Table 4.8: Agricultural Potential

Agricultural Potential Class	Soil Mapping Units	Effective Depth (mm)
HIGH	Deep to moderately deep Hutton & Avalon soils; no or few physical limitations	600-1200

MODERATE	Moderately deep or variable depth soils; limited depth and occasionally heavy texture	300-1200
LOW	Shallow, gravelly soils, often with some rock; severe depth limitation	<600
ROCKY	Significant rock outcropping (>40%), usually shallow soils with severe depth limitation	<300
WET AREAS	Low-lying areas, soils prone to seasonal waterlogging or flooding	<300
WASTE	Industrial waste areas, such as mine dumps or slimes dams etc	-
URBAN	Housing, industrial, mining, commercial areas etc; not surveyed	-

The soils of the study area are strongly related to the underlying geology and most of the dolomite is overlain by shallow red-brown gravelly soils. The soils are generally less that 500 mm deep (ECO Assessments, 2007). The parent material of the area comprises of dolomite and chert of the Malmani Subgroup, Chuniespoort Group (Geological Survey, 1978).

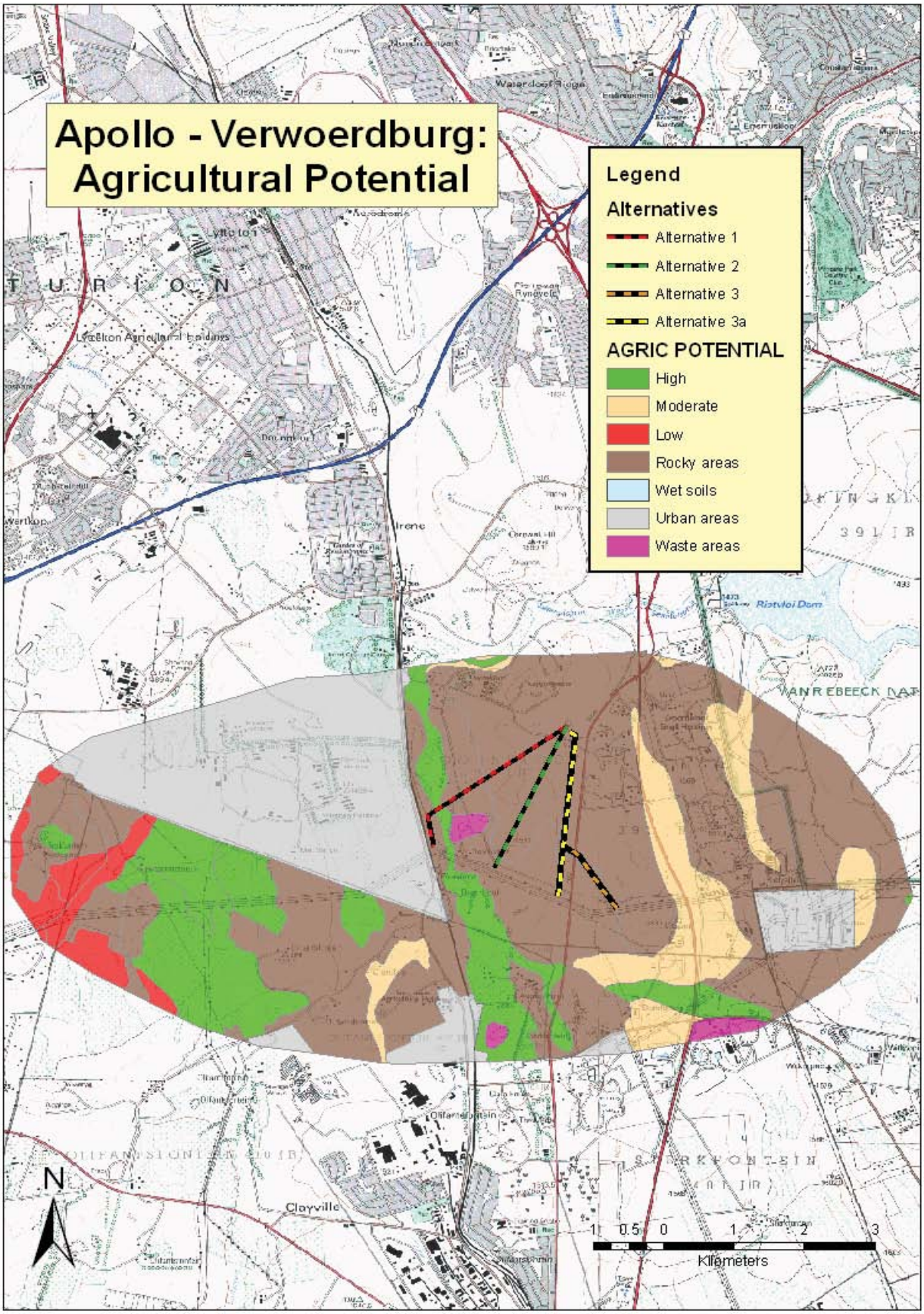

Figure 4.9: Soil Map in the study area

ASSESSMENT OF IMPACTS: VERWOERDBURG SUBSTATION EXTENSION AND LOOP IN AND OUT POWER LINES CHAPTER 5

In order to strengthen the supply of electricity to the Pretoria region, Eskom proposes the construction and operation of a number of new substations and transmission power lines within the Tshwane municipal area with the aim to reinforce the existing electricity supply, primarily to this municipal area. This proposal forms part of the City of Tshwane Electricity Supply Plan Scheme (CTESPS), and includes the extension of the Verwoerdburg substation and 400kV Apollo-Pluto turn-in transmission power lines. Eskom envisages that these developments will meet the metropolitan area's increased demand for electricity, as well the power needs of the Gautrain operation.

One feasible site north-west of the existing Verwoerdburg substation was identified for the expansion of this existing substation. This site is investigated in detail in the EIA Phase of the process. Three alternative corridors were identified and assessed for the turn-in power lines.

This chapter serves to assess the identified potentially significant environmental impacts associated with the proposed site for the extension of the existing Verwoerdburg substation and transmission turn-in lines, and to make recommendations for the management of these impacts for inclusion in the draft Environmental Management Plan (refer to Appendix O).

5.1. Assessment of Potential Impacts on Ecology

Rating of impacts is based on the estimated effect that construction and operation of proposed turn-in power lines and the substation extension will have on terrestrial biodiversity and ecological attributes of the study area. No impacts were identified that could lead to a beneficial impact on the identified habitat type within the study area since the proposed development is largely destructive. Potential impacts include the following, but are not necessarily limited to:

» Direct impacts:
  - o Destruction of threatened flora & fauna species & associated habitat;
  - o Direct impacts on common fauna species;
  - o Destruction of sensitive/ pristine regional habitat types;
» Indirect Impacts:
  - o Impacts on surrounding habitat/ species;
» Cumulative Impacts:
  - o Impacts on local and national conservation obligations & targets;
  - o Increase in local and regional fragmentation/ isolation of habitat; and
  - o Increase in environmental degradation.

Expected impacts are mostly as a result of the physical disturbance of surface areas and clearance of servitudes during the construction period. Impacts within the Ridge Habitat are regarded to be highly significant and expected impacts are regarded as unacceptable, particularly since various Red/ Orange Data plant species are known to occur within this environment (refer to Appendix I). Corridor options that comprise highly sensitive habitat types are therefore regarded unsuitable for the proposed development and the 'No Go' option is therefore recommended for Alternative Routes 1 and 2 from a biodiversity perspective.

Impacts within the remainder of the area, Alternative Route 3 and alternative 3a recommended subsequent to the EIA specialist workshop are regarded to be of moderate nature and the implementation of generic mitigation measures is expected to minimise likely impacts within these environments (refer to biodiversity specialist report contained within Appendix I).

Impacts during the operational phase of the project are mostly restricted to the maintenance procedures within the servitudes as well as latent effects of habitat alteration. Impacts are generally regarded to be of a moderate nature and the implementation of generic mitigation measures are expected to decrease the significance of impacts to an acceptable level within Alternative Route 3.

Impacts on flora and fauna on site are expected to occur mainly in the construction phase of the substation and the turn-in power lines. The assessment of impacts associated with the extension of the substation also takes the construction and operation of proposed power lines into consideration. The potential presence of Red Data in close proximity to the substation site does not influence the site selection process.

In the event of decommissioning of the infrastructure, impacts are expected to be similar to those experienced during the maintenance phase (i.e. as a result of disturbance habitats and ecosystems).

5.1.1. Nature of Potential Impacts of the proposed substation extension and associated 2X400kV loop in/out Apollo-Pluto power lines

5.1.1.1. Destruction of Threatened Flora & Fauna Species & Associated Habitat

The loss of Red Data or Threatened species or areas that are suitable for these species is a significant impact on the biodiversity of a region. Threatened species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers as there are generally few of them, but a high ecological value is placed on the presence of such species in an area as they are

frequently an indication of pristine habitat conditions. Conversely, the presence of pristine habitat conditions can frequently be accepted as an indication of the potential presence of species of conservation importance.

Red Data species are particularly sensitive to changes in their environment, having adapted to a narrow range of specific habitat requirements. Habitat changes, mostly a result of human interferences and activities, are one of the greatest reasons for these species having a threatened status. Surface transformation activities within habitat types that are occupied by flora species of conservation importance will definitely result in significant and permanent impacts on these species and their population dynamics. Effects of this particular impact are usually permanent and recovery or mitigation is generally not perceived as possible.

One of the greatest drawbacks in terms of limiting this particular impact is that extremely little information is generally available in terms of the presence, distribution patterns, population dynamics and habitat requirements of Red Data flora species. However, in this particular instance, a Red/ Orange Data investigation revealed the presence and extent of various important species within some of the corridor options. Eliminating these options as viable corridors for the proposed project, as a result of significant impacts on conservation important species, therefore becomes possible. Furthermore, by applying ecosystem conservation principles to this impact assessment and subsequent planning and development phases, resultant impacts will be limited to a large extent.

Direct threats to threatened fauna species is regarded low in probability, mainly as a result of the ability of fauna species to migrate away from areas where impacts occur. Probably the only exception to this statement will be in the event where extremely localised habitat that are occupied by threatened fauna species are impacted by construction and operational activities to the extent that the habitat no longer satisfy the habitat requirements of the particular species. This impact is highly likely to occur as a result of the known presence of Red/ Orange Data flora species within the corridor options. It is highly likely to result in significant and severe impacts and is therefore likely to result in the recommendation of 'No Go' options for some of the corridor options (refer to Figure 5.1).

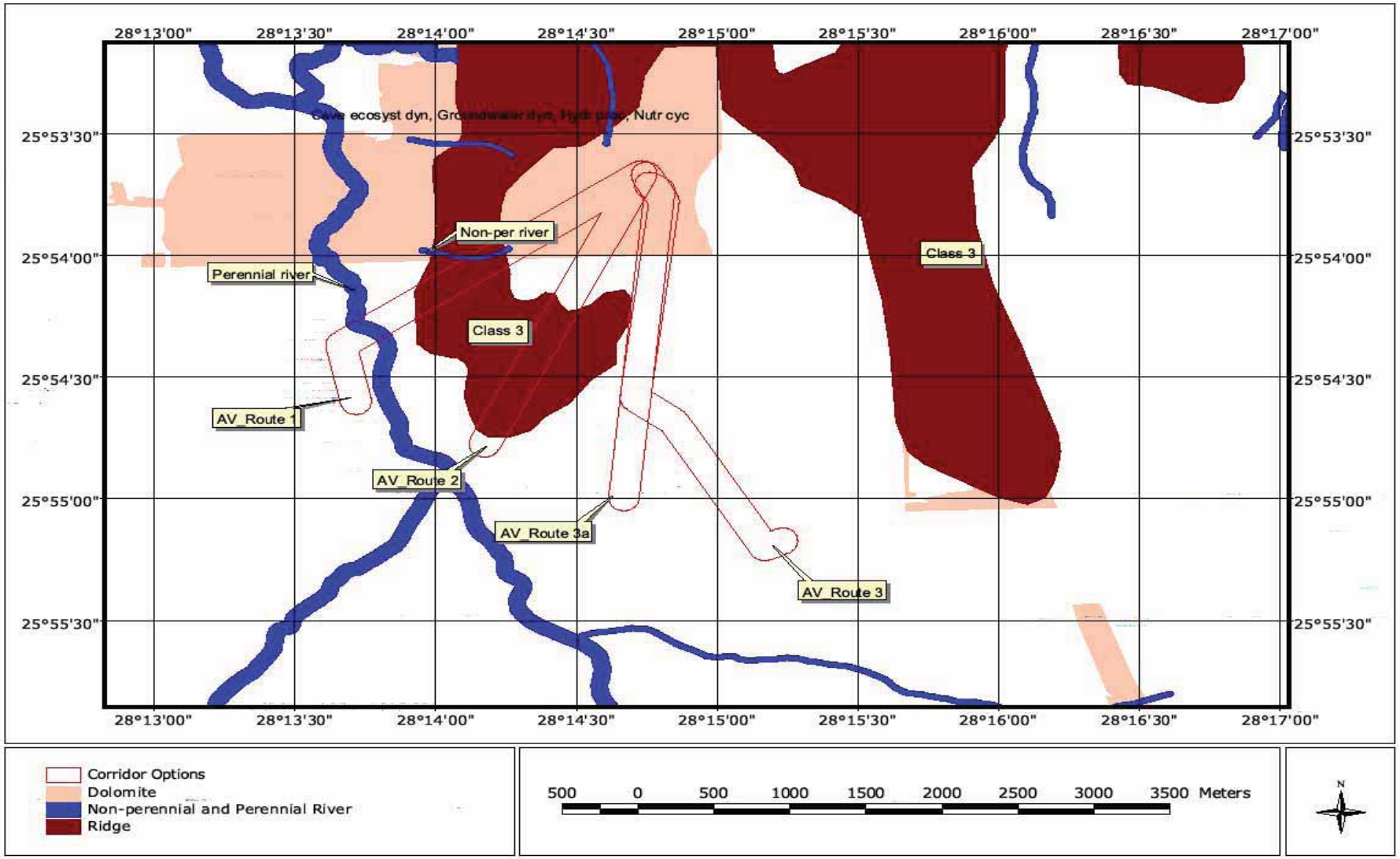

Figure 5.1: C-Plan Sensitivities within the study area

5.1.1.2. Direct Impacts on Common Flora & Fauna Species

The likelihood of direct impact affecting common fauna species is relatively low as a result of the ability of animal species to migrate away from direct impacts. The tolerance levels of common animal species occurring in the study area and impacts resulting from the proposed development is of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from areas of pact during periods of impacts, while affected areas are likely to become repopulated subsequent to high impact periods.

It is likely that common flora species are widespread and occur fairly abundantly in adjacent habitat. The possibility of the proposed power lines and substation affecting common flora species, to the extent that their conservation status might change, is regarded highly unlikely.

This impact, although highly likely to occur, is likely to result in fairly low significance.

5.1.1.3. Destruction of Sensitive/ Pristine Regional Habitat Types

The loss of pristine natural regional habitat types identified within the study area represents loss of habitat and biodiversity on a regional scale. Sensitive habitat types include ridges, koppies, wetlands, rivers, streams and localised habitat types of significant physiognomic variation and unique species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is usually ascribed to floristic communities and faunal assemblages of these areas as they contribute significantly to the biodiversity of a region. Furthermore, these habitat types are generally isolated and are frequently linear in nature, such as rivers and ridges. Any impact that disrupts this continuous linear nature will risk fragmentation and isolation of existing ecological units, affecting the migration potential of some fauna species adversely, pollinator species in particular.

Considering the relative high fragmentation and isolation factors in the general surrounds, the presence of sensitive and pristine habitat types, a high conservation value is ascribed to these areas. The pristine status of natural grassland habitat within the study area is an important factor that is likely to result in strong recommendations pertaining to the suitability of certain corridor options. Impacts within these areas are most likely to result in severe and significant impacts.

5.1.1.4. Impacts on Local and National Conservation Obligations & Targets

This impact is regarded as a cumulative impact since it affects the status of conservation strategies and targets on a local, regional and national level and is viewed in conjunction with other types of local and regional impacts that affect areas of conservation importance. Impacts that could potentially affect the status of protected areas are regarded unacceptable and should be avoided at all costs. Natural habitat in the general surrounds of areas of conservation importance act as a buffer for these areas and also as a potential source of genetic variability, particularly in the case of relatively small conservation areas.

The importance of extensive parts of the study area has been confirmed in the Red/ Orange Data flora assessment as well as in this biodiversity assessment. Potential impacts on these areas of conservation importance is likely to result in severe and significant impacts (refer to Figure 5.1).

5.1.1.5. Increase in Local & Regional Fragmentation/ Isolation of Habitat

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources in the immediate surrounds. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size. The danger in this type of cumulative impact is that effects are not known, or not visible; with immediate effect and normally when these effects become visible they are beyond repair. Linear developments such as roads affect the migratory success of animals in particular.

An important mitigation measure in this regard is to utilise existing corridors of habitat fragmentation. By aligning new servitudes with existing ones or with roads, current levels of habitat fragmentation will not be increased significantly. In contrast, constructing new power lines through areas of unfragmented habitat, the adverse effects of habitat fragmentation and isolation will be maximised. Therefore, where potential servitudes are presented with similar sensitivities, a potential alignment with an existing servitude might result in one being more suitable for the proposed development than an option affecting an area of largely untransformed habitat. Unfortunately this is not always a clear-cut case as it is heavily dependent on the local and regional sensitivity of the existing line, which might be located in areas of high sensitivity, while a line going through

untransformed habitat might represent impacts of lower significance in terms of other types of impacts.

5.1.1.6. Increase in Environmental Degradation

Impacts associated with this particular type of development that will lead to initial, incremental or augmentation of existing types of environmental degradation include impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases are these effects are not bound and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor. Similarly, developments in untransformed and pristine areas are usually not characterised by visibly significant environmental degradation and these impacts are usually most prevalent in areas where continuous and long-term impacts have been experienced.

The following series of tables provides a summary of the potential impacts on ecology associated with the extension/construction and operation of the proposed substation and turn-in power lines. Significance of impacts is rated as high, moderate, or low in accordance with the methodology described in Chapter 3 of this report.

Impact tables summarising the significance of impacts on ecology (with and without mitigation)

Impact Assessment for substation extension

Nature of Impact: Impacts on common flora and fauna

Moderate levels of transformation of natural habitat types are associated with this particular development. Transformation of natural environments inevitably result in the establishment of habitat types that are not considered representative of the region. Surrounding areas are frequently invaded by shrubs, woody and weedy pioneer species, affecting the local biodiversity adversely. Similarly, habitat attributes of isolation and migration corridors are adversely affected.

	Before Mitigation	After Mitigation
Extent	4 (Regional)	4 (Regional)
Duration	5 (Long term)	5 (Long term)
Magnitude	4 (Moderate)	4 (Moderate)
Reversibility	5 (Irreversible)	5 (Irreversible)
Probability	5 (Probable)	5 (Probable)
Significance	90 (High)	90 (High)
Status	Negative	Negative

Irreplaceable loss of resources?	Yes
Can impacts be mitigated	No
Mitigation » Not possible	
Cumulative Impacts » Habitat degradation, loss of conservation areas, increase in conservation status of species	
Residual Impacts » Degradation of pristine habitat, infestation by weeds and alien species, erosion, species loss.	

Impact Assessment for turn-in power line alternatives

Nature of Impact: Destruction of Sensitive Habitats - Impacts of power lines within the corridor alternative 1

Sensitive habitat types identified in the broader study area include ridges, outcrops, riparian habitat and localised floristic variations of significant physiognomic variation and species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds, having adapted to atypical habitat conditions. A high conservation value is attributed to the floristic communities and faunal assemblages that characterise these areas as they contribute significantly to the biodiversity of a region. These habitat types are furthermore frequently isolated and are mostly linear in nature, such as rivers and ridges. Any impact that disrupts this continuous linear nature will result in fragmentation and isolation of existing ecological units, affecting the migration potential of some fauna species adversely, pollinator species in particular.

	Before Mitigation	After Mitigation
Extent	4 (Regional)	4 (Regional)
Duration	5 (Long term)	5 (Long term)
Magnitude	4 (Moderate)	4 (Moderate)
Reversibility	5 (Irreversible)	5 (Irreversible)
Probability	5 (Probable)	5 (Probable)
Significance	90 (High)	90 (High)
Status	Negative	Negative
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated	No	
Mitigation » Not possible		
Cumulative Impacts » Habitat degradation, loss of conservation areas, increase in conservation status of species		
Residual Impacts » Degradation of pristine habitat, infestation by weeds and alien species, erosion, species loss.		

Nature of Impact: Removal of Red Data Species	Impacts of power lines within Corridor Alternative Route 2	
The loss of threatened/ protected species or habitat that is suitable for Red Data species represents a	Without Mitigation	With Mitigation

significant impact on the biodiversity of a region. Threatened species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers as there are generally few of them, but they are extremely important in terms of the biodiversity of an area and high ecological value is placed on the presence of such species in an area. Surface disturbances resulting from the proposed activity represent a significant and important impact on the status and conservation value of pristine regional vegetation types, where present and recovery from these impacts and mitigation of the extent and significance of the impacts are not possible.		
Extent	4 (Regional)	4 (Regional)
Duration	5 (Long term)	5 (Long term)
Magnitude	4 (Moderate)	4 (Moderate)
Reversibility	5 (Irreversible)	5 (Irreversible)
Consequence	18	18
Probability	5 (Probable)	5 (Probable)
Significance	90	90
Status	Negative	Negative
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated	No	
Mitigation	Not possible	
Cumulative Impacts	Habitat degradation, loss of conservation areas, increase in conservation status of species	
Residual Impacts	Degradation of pristine habitat, infestation by weeds and alien species, erosion, species loss.	

Nature of Impacts: Habitat Destruction A possibility exists that due to the transformed nature of the site along this corridor, the site is now devoid of any species of significance. The surrounding areas and species present in surrounding areas have been affected by impacts resulting from the existing infrastructure such as roads and power lines.	Impacts of power lines within Corridor Alternative Route 3	
	Without Mitigation	With Mitigation
Extent	2 (Local)	1 (Local)
Duration	4 (Medium term)	3 (Medium term)
Magnitude	4 (Moderate)	3 (Moderate)
Reversibility	3 (Irreversible, requires human input)	3 (Irreversible, requires human input)

Consequence	13	10
Probability	3 (Probable)	3 (Probable)
Significance	39	30
Status	Negative	Negative
Irreplaceable loss of resources?	No	
Can impacts be mitigated	Yes	
Mitigation	Proper tower placement, limited vegetation maintenance underneath power lines, generic mitigation	
Cumulative Impacts	Infestation by weeds and alien vegetation	
Residual Impacts	Erosion, changes in surface conditions	

Nature of Impacts: Habitat Destruction A possibility exists that due to the transformed nature of the site along this corridor, the site is now devoid of any species of significance. The surrounding areas and species present in surrounding areas have been affected by impacts resulting from the existing infrastructure such as roads and power lines.	Impacts of power lines within Corridor Alternative Route 3a	
	Without Mitigation	With Mitigation
Extent	2 (Local)	1 (Local)
Duration	4 (Medium term)	3 (Medium term)
Magnitude	4 (Moderate)	3 (Moderate)
Reversibility	3 (Irreversible, requires human input)	3 (Irreversible, requires human input)
Consequence	13	10
Probability	3 (Probable)	3 (Probable)
Significance	39	30
Status	Negative	Negative
Irreplaceable loss of resources?	No	
Can impacts be mitigated	Yes	
Mitigation	Proper tower placement, limited vegetation maintenance underneath power lines, generic mitigation	
Cumulative Impacts	Infestation by weeds and alien vegetation	
Residual Impacts	Erosion, changes in surface conditions	

5.1.2. Comparative Assessment of Alternative Turn-in power line corridors

Impacts within the remainder of the area (Alternative Route 3) are regarded to be of moderate nature and the implementation of generic mitigation measures is expected to minimise likely impacts within these environments. Impacts during the operational phase of the project are mostly restricted to the maintenance procedures within the servitudes as well as latent effects of habitat alteration. Impacts are generally regarded to be of a moderate nature and the implementation of generic mitigation measures are expected to decrease the significance of impacts to a benign status within Alternative Route 3.

5.1.3. Conclusions and Recommendations

Based on the observed floristic and faunal sensitivities as well as the tabular assessment of potential impacts as detailed above, it is recommended from a biodiversity perspective that the proposed extension to the Verwoerdburg Substation be implemented. This recommendation is influenced by the fact that the extension of the substation would take place within the footprint of an existing substation.

The presence of extensive High sensitivity areas within Alternative Route corridors 1 and 2 renders these corridor options effectively unsuitable for the proposed development from a biodiversity perspective. The High floristic sensitivity within these options is ascribed on the basis of the presence of Red Data flora species, sensitive ridges and pristine vegetation. While extensive Medium-high sensitivity areas are present within Alternative Route corridors 3 and 3a, mitigation of potential impacts on pristine vegetation is regarded possible. Therefore Alternative corridors 3 and 3a are considered acceptable from a biodiversity perspective.

5.2. Assessment of Potential Impacts on Avifauna

All four alternative corridors and the substation site occur on Carltonville Dolomite Grassland and as such it is expected that the grassland birds would be most well represented in this immediate area. Examples of these birds include the Blue Crane, African Grass Owl, White-bellied Khoraan, Secretarybird, White Stork and Abdims Stork.

Substations and power lines can impact avifauna through electrocutions, collisions, habitat destruction or disturbance.

These potential impacts are discussed and assessed in the tables below.

Electrocutions and collisions are possible within the substation yard during operation and this is caused by live phases that are close together being bridged by a birds extremities. Substations are generally lit and this can attract certain species however most species impacted on by substations are the less sensitive species and therefore of less concern. Electrocutions are not an issue on these larger lines as the wings of the birds cannot span between the conductors.

During the construction phase and maintenance of power lines and substations, some habitat destruction and alteration inevitably takes place. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, through the modification of habitat.

During the construction and maintenance of electrical infrastructure, a certain amount of disturbance to the surrounding area results. For shy, sensitive species this can impact on their usual daily activities, particularly whilst breeding. In general terms, one would expect that any species already existing in the study area must have adapted to relatively high levels of disturbance already present.

Nature: Electrocution of birds in the substation yard Bird species such as Blue Crane, African Grass Owl, White-bellied Khoraan, Secretarybird, White Stork and Abdims Stork may utilise the substation yard to feed or nest. Electrocution in the proposed substation HV yard is possible when certain species enter the HV yard.		
	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	4 (Long term)	4 (Long term)
Magnitude	0	0
Probability	0	0
Significance	0	0
Status	None	None
Reversibility	-	-
Irreplaceable loss of resources	-	-
Can impacts be mitigated	-	-
Mitigation: -		
Cumulative impacts:- None		
Residual impacts: - None		

Nature: Electrocution of birds on the turn-in power lines Electrocutions can have a negative impact on avifauna within the substation yards, however this negative impact will almost certainly be limited to non-sensitive species and thus will be of little concern.		
	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	4 (Long term)	4 (Long term)
Magnitude	0	0
Probability	0	0
Significance	0	0
Status	None	None
Reversibility	-	-
Irreplaceable loss of resources	-	-
Can impacts be mitigated	-	-
Mitigation: -		
Cumulative impacts:- None		
Residual impacts: - None		

Nature: Collisions with the Transmission lines		
	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	4 (Long term)	4 (Long term)
Magnitude	3 (Medium)	2 (Low)
Probability	2 (Improbable)	2 (Improbable)
Significance	26 (Low)	24 (Low)
Status	Negative	Negative
Reversibility	5	5
Irreplaceable loss of resources	Yes	Yes
Can impacts be mitigated	Yes-but not required	
Mitigation: » Not required if alternative 3 and 3a are selected		
Cumulative impacts: » Marginal if placed next to existing lines (Alternative 3)		
Residual impacts: » Medium		

Nature: Habitat Destruction - substation

During the construction and maintenance of the substations, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads and the levelling of substation yards. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the power line servitude associated with the turn-in lines, through the modification of habitat.

	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	2 (Short term)	2 (Short term)
Magnitude	3 (Medium)	2 (Low)
Probability	3 (Probable)	2 (Improbable)
Significance	27 (Low)	16 (Low)
Status	Negative	Negative
Reversibility	3 (Reversible, required human input)	3 (Reversible, requires human input)
Irreplaceable loss of resources	Yes	Yes
Can impacts be mitigated	Yes	

Mitigation:

» Minimal habitat destruction must occur during the clearing of substation yards.

Cumulative impacts:

Marginal because its an extension of an existing substation

Residual impacts:

» There will be medium residual impact as habitat that is removed will not recover fully

Nature: Disturbance of birds

During the construction and maintenance of electrical infrastructure, a certain amount of disturbance results

	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	2 (Short term)	2 (Short term)
Magnitude	2 (Low)	1 (Minor)
Probability	2 (Improbable)	1 (Improbable)
Significance	12 (Low)	5 (Low)
Status	Negative	Negative
Reversibility	1 (Reversible)	1 (Reversible)
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

» Identify active nests during final walk-through survey » Limit construction and unnecessary driving past nests during breeding times. Nest may need to be relocated, if found. » The minimum amount of vehicles and machines must be used on site and specific care should be taken with these vehicles and machines in and around water courses.
Cumulative impacts: » Marginal if placed next to existing lines (Alternative 3)
Residual impacts: » Low Residual impacts

Nature: Faulting-business impact (Impact of birds on quality of supply)

There are a number of mechanisms through which birds are able to cause electrical faults on power lines. In the case of a bird streamer induced fault, the fault is caused by the bird releasing a 'streamer' of faeces which can constitute an air gap intrusion between the conductor and the earthed structure. The fault appears to flash across the air gap (i.e. between the live conductor and the tower steel work which is earthed) and does not follow an insulator creepage path as observed on pollution faults. Bird species capable of producing large or long streamers are more likely to cause streamer faults.

Bird pollution is a form of pre-deposit pollution. A flashover occurs when an insulator string gets coated with a pollutant, which could comprise the insulation properties of the string. When the pollutant is wetted, the coating becomes conductive, insulation breakdown occurs and flashover results. Since this involves a build up of bird faeces or bird pollution and not a once off event such as a streamer, the size of the bird is less important, although still a factor. Obviously the more an insulator string becomes coated with faeces; the more likely it is that the fault will occur. Larger birds and congregation of birds are likely to result in heavy pollution of insulator strings. Bird nests may also cause faults through nest material protruding and constituting an air gap intrusion.

	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	4 (Medium term)	4 (Medium term)
Magnitude	2 (Low)	1 (Minor)
Probability	2 (Improbable)	1 (Improbable)
Significance	20 (Low)	9 (Low)
Status	Negative for business	Negative for business
Reversibility	3	3
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	Yes

Mitigation: » Fit bird guards on self support and guyed V towers only if required.
Cumulative impacts: » Negligible
Residual impacts: » Low

Nature: Electrocution of birds in the substation yard

Bird species such as Blue Crane, African Grass Owl, White-bellied Khoraan, Secretarybird, White Stork and Abdims Stork may utilise the substation yard to feed or nest. Electrocution in the proposed substation HV yard is possible when certain species enter the HV yard.

	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	4 (Long term)	4 (Long term)
Magnitude	0	0
Probability	0	0
Significance	0	0
Status	None	None
Reversibility	-	-
Irreplaceable loss of resources	-	-
Can impacts be mitigated	-	-
Mitigation: -		
Cumulative impacts:- None		
Residual impacts: - None		

Nature: Electrocution of birds on the turn-in power lines

Electrocutions can have a negative impact on avifauna within the substation yards, however this negative impact will almost certainly be limited to non-sensitive species and thus will be of little concern.

	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	4 (Long term)	4 (Long term)
Magnitude	0	0
Probability	0	0
Significance	0	0
Status	None	None
Reversibility	-	-
Irreplaceable loss of resources	-	-

Can impacts be mitigated	-	-
Mitigation: -		
Cumulative impacts:- None		
Residual impacts: - None		

Nature: Collisions with the Transmission lines		
	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	4 (Long term)	4 (Long term)
Magnitude	3 (Medium)	2 (Low)
Probability	2 (Improbable)	2 (Improbable)
Significance	26 (Low)	24 (Low)
Status	Negative	Negative
Reversibility	5	5
Irreplaceable loss of resources	Yes	Yes
Can impacts be mitigated	Yes-but not required	Yes-but not required
Mitigation: Not required if alternative 3 is selected		
Cumulative impacts: Marginal if placed next to existing lines (Alternative 3)		
Residual impacts: Medium		

Nature: Habitat Destruction

During the construction and maintenance of the substations, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads and the levelling of substation yards. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the power line servitude associated with the turn-in lines, through the modification of habitat.

	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	2 (Short term)	2 (Short term)
Magnitude	3 (Medium)	2 (Low)
Probability	3 (Probable)	2 (Improbable)
Significance	27 (Low)	16 (Low)
Status	Negative	Negative
Reversibility	3	3
Irreplaceable loss of resources	Yes	Yes
Can impacts be mitigated	Yes	Yes
Mitigation: Environmental best practice must be followed and enforced: existing roads should be used and minimal habitat destruction must occur in or near any water courses. Minimal habitat destruction must occur during the building of the towers and clearing of the servitudes and substation yards. Where possible servitudes should be		

left uncleared and as natural as possible.
Cumulative impacts: Marginal if placed next to existing lines (Alternative 3)
Residual impacts: There will be medium residual impact as habitat that is removed will not recover fully

Nature: Disturbance of birds

During the construction and maintenance of electrical infrastructure, a certain amount of disturbance results

	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	2 (Short term)	2 (Short term)
Magnitude	2 (Low)	1 (Minor)
Probability	2 (Improbable)	1 (Improbable)
Significance	12 (Low)	5 (Low)
Status	Negative	Negative
Reversibility	1	1
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	Yes

Mitigation:

- » Identify active nests during final walk-through survey
- » Limit construction and unnecessary driving past nests during breeding times. Nest may need to be relocated, if found.
- » The minimum amount of vehicles and machines must be used on site and specific care should be taken with these vehicles and machines in and around water courses.

Cumulative impacts: Marginal if placed next to existing lines (Alternative 3)
Residual impacts: Low Residual impacts

Nature: Faulting-business impact (Impact of birds on quality of supply)

There are a number of mechanisms through which birds are able to cause electrical faults on power lines. In the case of a bird streamer induced fault, the fault is caused by the bird releasing a 'streamer' of faeces which can constitute an air gap intrusion between the conductor and the earthed structure. The fault appears to flash across the air gap (i.e. between the live conductor and the tower steel work which is earthed) and does not follow an insulator creepage path as observed on pollution faults. Bird species capable of producing large or long streamers are more likely to cause streamer faults.

Bird pollution is a form of pre-deposit pollution. A flashover occurs when an insulator string gets coated with a pollutant, which could comprise the insulation properties of

the string. When the pollutant is wetted, the coating becomes conductive, insulation breakdown occurs and flashover results. Since this involves a build up of bird faeces or bird pollution and not a once off event such as a streamer, the size of the bird is less important, although still a factor. Obviously the more an insulator string becomes coated with faeces; the more likely it is that the fault will occur. Larger birds and congregation of birds are likely to result in heavy pollution of insulator strings. Bird nests may also cause faults through nest material protruding and constituting an air gap intrusion.		
	Without mitigation	With mitigation
Extent	1 (Local)	1 (Local)
Duration	4 (Medium term)	4 (Medium term)
Magnitude	2 (Low)	1 (Minor)
Probability	2 (Improbable)	1 (Improbable)
Significance	20 (Low)	9 (Low)
Status	Negative for business	Negative for business
Reversibility	3	3
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	Yes
Mitigation: Fit bird guards on self support and guyed V towers only if required.		
Cumulative impacts: Negligible		
Residual impacts: Low		

6.2.1. Comparative Assessment for turn-in lines alternative corridors

Alternative corridor 1 and 2 cross some open grassland, a ridge and a small stream, which is negative for avifauna as these are habitats that are attractive to certain sensitive bird species. These two alternative corridors are therefore not preferred from an avifauna perspective. In addition, these two alternative route corridors some open grassland and a small koppie, which is negative for avifauna as this is a potentially undisturbed area and as such good habitat for a variety of bird species passes over both medium and medium to high sensitive areas and as such has a higher impact whilst alternative corridor 3 and 3a follows the road for the majority of the route, this is positive for avifauna as the disturbance of the road will mean sensitive bird species are unlikely to occur in this area. For this reason, alternative corridor 3 and 3a are preferred corridors from an avifauna perspective.

6.2.2. Conclusion and Recommendations

Impacts on avifauna as a result of the construction, operation and eventual decommissioning of the substation and turn-in power lines are expected to be of

low significance for all species regardless of the power line corridor alternative selected.

In conclusion, the proposed extension to the Verwoerdburg substation can be initiated with minimal impact to avifauna provided that the recommendations and mitigation measures as recommended by the avifauna specialist are complied with (please refer to Appendix J).

The results of this study show that two preferred route alternatives exist. The first and most preferred alternative is alternative 3. This alternative follows existing lines for the entire length and thus the impact on avifauna in terms of collisions, habitat destruction and disturbance will be significantly lower than the other alternatives considered. The next most preferred alternative is alternative 3a. While this alternative will have slightly higher impacts on avifauna than alternative 3 as a portion of this alternative does not follow an existing line, these are seen as insignificant. Therefore this alternative may also be used with minimal impact on avifauna. These preferred routes follow existing lines and as such all of the impacts associated with power lines will be significantly lower than those associated with alternative 1 and 2. If this route is followed no mitigation is required to minimise the risk of collisions. Even though the area is considered to be disturbed and degraded, care should be taken during construction and maintenance activities to follow environmental best practice and thus reduce the impact of habitat destruction and disturbance.

It is strongly suggested that either Alternative 3 or 3a be used as placing the new lines adjacent to an existing line will, to some extent, mitigate for the impact of collisions.

5.3. Assessment of Potential Visual Impacts

The construction of transmission and substation infrastructure such as the proposed extension of the Verwoerdburg substation in populated areas will always be problematic from a visual impact perspective. The Tshwane Strengthening Project (Apollo-Verwoerdburg component) highlighted this through the number of concerns received from landowners within the study area. The lower density residential areas (agricultural holdings), with a decidedly more rural character, will be more affected by the project infrastructure than the high-density residential areas. This is due to the fact that the higher occurrence of structures and visual clutter within high-density residential areas tend to absorb the visual impact.

5.3.1. Potential Visual Impacts associated with the Construction and Decommissioning Phases of the Verwoerdburg Substation and Turn-in lines

The construction phase of the substation and turn-in lines will see an increase in activities at the substation site. During this time heavy vehicles will frequent the roads, especially the M57 in the area and may cause, at the very least, a visual nuisance to other road users and landowners in close proximity to the construction activities. In the event of decommissioning of the infrastructure, impacts are expected to be similar to those experienced during the construction phase (i.e. as a result of increased activities on site).

Visual impacts associated with the construction phase (and eventual decommissioning phase), albeit temporary, should be managed according to the following principles:

» Reduce the construction/decommissioning period through careful planning and productive implementation of resources.
» Restrict the activities and movement of construction/decommissioning workers and vehicles to the immediate construction/decommissioning site(s).
» Ensure that the general appearance of construction activities, construction camps (if required) and lay-down areas are maintained by means of the timely removal of rubble and disused construction materials.
» Restrict construction activities to daylight hours (if possible) in order to negate or reduce the visual impacts associated with lighting.

6.3.2. Potential Visual Impacts associated with the Operational Phase of the Substation and Turn-in Lines

The construction of transmission infrastructure such as the proposed substation extension and turn-in lines will impose a visual impact on the surrounding area. The lower density residential areas of the study area, with a decidedly agricultural character, will be more affected by the project infrastructure than high-density residential areas. This is due to the fact that the higher occurrence of structures and visual clutter within high-density residential areas tend to absorb the visual impact. Visual impact is generally determined by the visual exposure of the proposed development, viewer incidence/perception, visual distance and the visual absorption capacity of the surrounding area. Impacts are expected where sensitive visual receptors occur. The sensitive visual receptors identified in the study area for the substation and turn-in lines include:

» Residential areas, light industries and agricultural holdings in the vicinity of the study area.

» Users of provincial/regional road (M57), arterial routes and secondary access roads.
» Formal protected areas such as the Rietvlei Nature Reserve within and surrounding the study area.

Viewshed analyses of the proposed infrastructure, based on a 20m contour interval (or 5m if available) digital terrain model of the study area, indicate the potential visual exposure (i.e. areas from where the infrastructure could theoretically be visible). The visibility analyses are undertaken at an offset of 20m above average ground level for the substation and at 35m for the transmission line alternatives in order to simulate a worst-case scenario. The viewshed analyses do not include the visual absorption capacity of natural vegetation in the study area. The visual absorption capacity of the vegetation is, however, addressed as a separate issue within this report and does form part of the visual impact assessment criteria.

The sensitivity analysis comprises an indexed combination of three different data sets. Firstly, the landuse dataset for the study area is either acquired from an external source or captured from aerial photography or satellite imagery. Landuse types are then categorised and subcategorised depending on visual sensitivity and assigned an index value accordingly. A suitable range of proximity buffers from each alternative is also generated and assigned a similar index value since visual impact decreases with increasing distance. The landuse index is combined with the proximity index to give an overall sensitivity value, which then indicates areas where high sensitivity landuses coincide with the areas of high visual impact. Areas where the features are not visible are then clipped out using the viewshed analysis since no visual impact will occur where the features are not visible. This methodology models any potential visual receptor standing anywhere in the study area and provides a broader estimate of the potential visual intrusion rather than picking out each individual visual receptor and estimating sensitivity for each.

Visibility from the M57 and Rietvlei Nature Reserve is possible but it is envisaged that the future construction of light industry and residential estates will absorb this exposure.

The combined results of the visual exposure, viewer incidence/perception and visual distance of the proposed alternative corridors are displayed below in Figure 5.2 - 5.4. Here the weighted impact and the likely areas of impact are indicated as a visual impact index. An area with short distance visual exposure to the proposed substation, a high viewer incidence and a predominantly negative perception would therefore have a higher value (greater impact) on the index. This aids in focussing the attention to the critical areas of potential impact when evaluating the issues related to the visual impact.

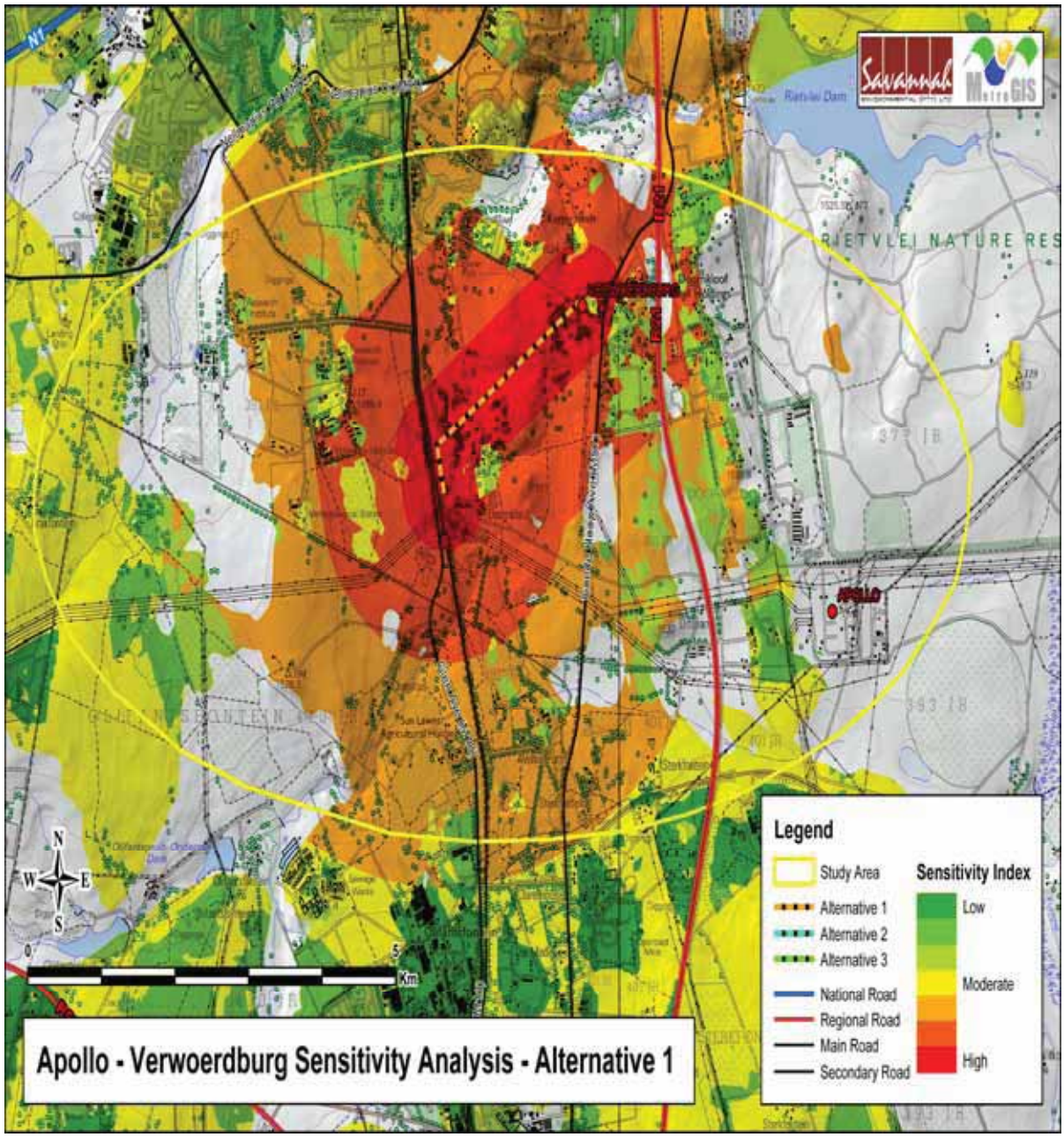

Figure 5.2: Visual Sensitivity Impact Index - Alternative Corridor 1

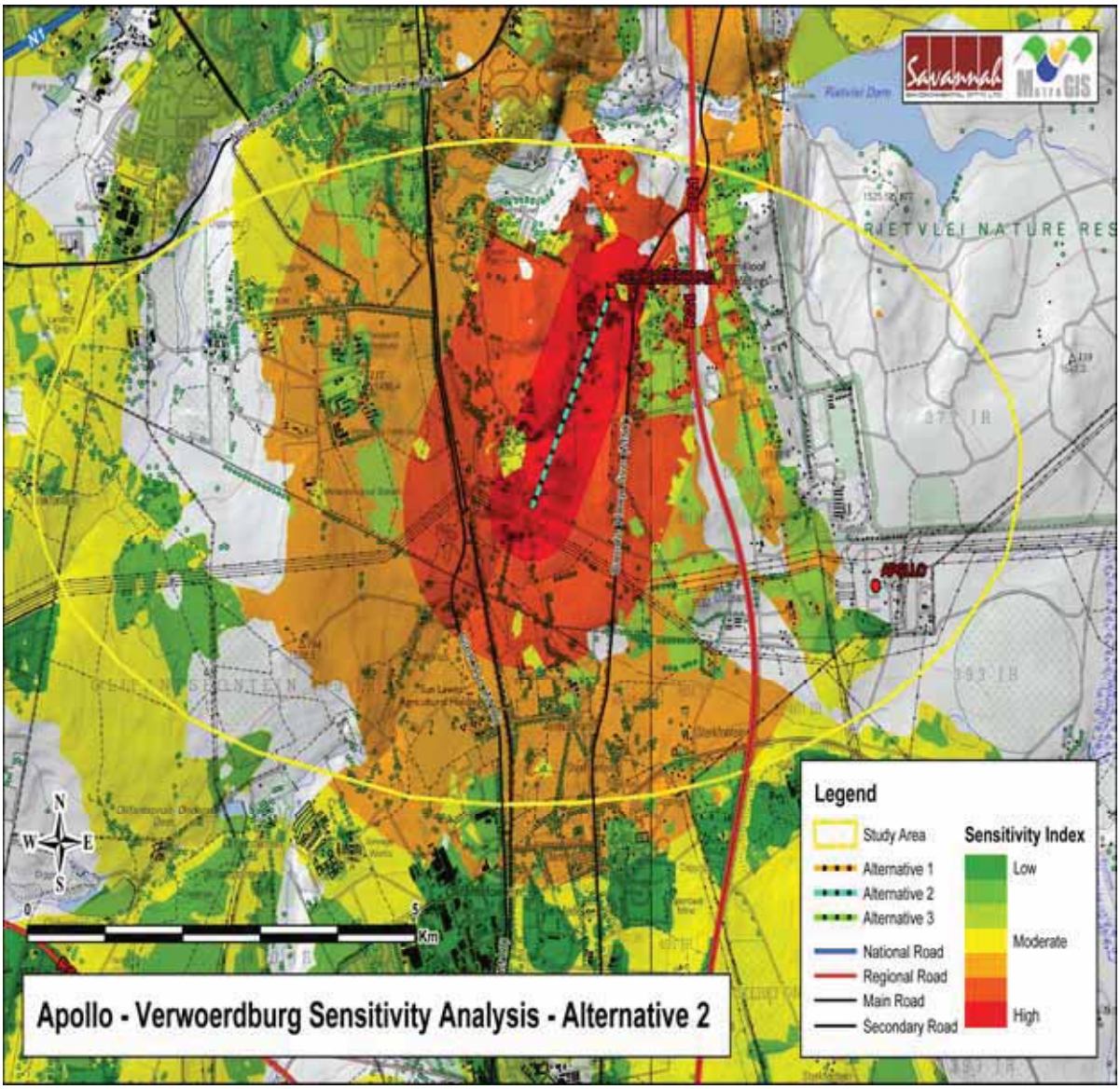

Figure 5.3: Visual Sensitivity Impact Index – Alternative Corridor 2

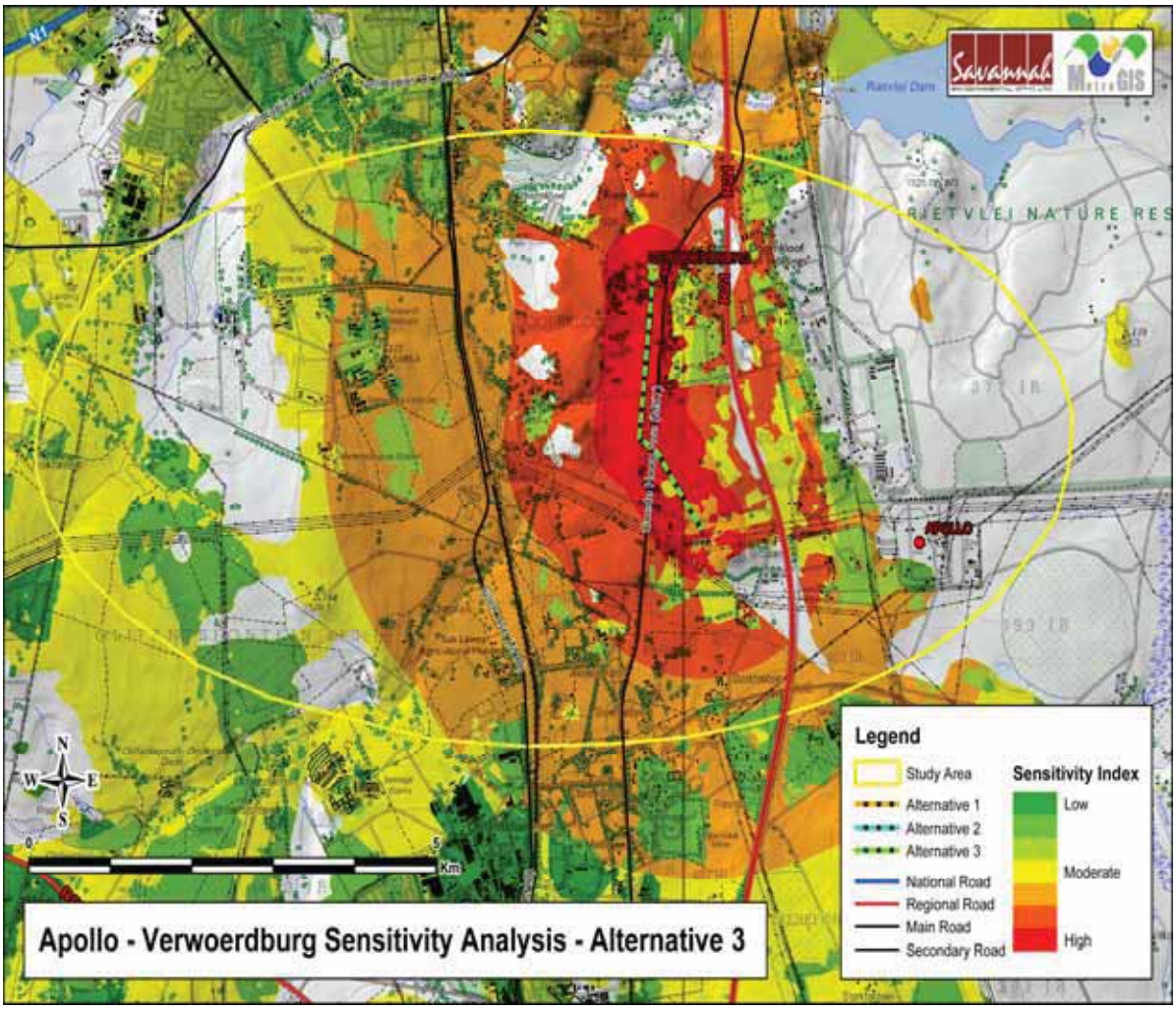

Figure 5.4: Visual sensitivity impact index – Alternative Corridor 3

From the above sensitivity analyses, a clear difference in visual impact of the three alternatives is not obviously apparent. The area calculation (in hectares) below gives a numerical value, and thus a quantifiable value, to compare sensitivities.

Table 5.1 below shows a marginal difference in area covered by each sensitivity category. If the highest and second highest categories are merged to represent where the alignment would have the greatest impact, i.e. in relatively close proximity in areas considered visually sensitive, alternative 3 (1026.84 ha) is preferred on the basis of least overall area of high impact, followed by alternative 2 (1083.19 ha) and alternative 1 (1170.46 ha). Alternative 3 or 3a would also be preferable because they follow a path adjacent to an existing power line, thus reducing the cumulative impact caused by adding to an existing impact. It should be noted, however, that there are no fatal flaws from a visual impact standpoint.

Table 5.1: Comparative Sensitivity Category Area Calculations

Sensitive Index	Alternative 1	Alternative 2	Alternative 3	Alternative 3a
Low	1766.34	1818.91	1609.73	1789.43
	1662.89	1945.98	2580.56	2330.89
	4039.19	4032.64	3987.25	3657.65
Moderate	7068.87	7001.21	7659.15	7444.55
	2011.92	2124.23	2283.96	2266.36
	844.78	796.31	729.07	629.37
High	325.68	286.88	297.77	289.47

There is no comparative study for the substation upgrades since the proposed development is only an extension of an existing substation and no feasible alternatives have been identified. It is expected that the upgrades/extension are largely governed by site-specific technical constraints of the substation layout.

The following series of tables provides a summary of the potential visual impacts associated with the construction and operation of the proposed substation and the power lines. The primary visual impact, namely the appearance and dimensions of the substation infrastructure, is very difficult to mitigate. Therefore, the potential visual impacts are only assessed without mitigation in the tables below.

Please note that due to the declining visual impact over distance, the extent (or spatial scale) rating is reversed (i.e. a localised visual impact has a higher value rating than a national or regional value rating). This implies that the visual impact is highly unlikely to have a national or international extent, but that the local or site-specific impact could be of high significance.[7]

Impact tables summarising the significance of visual impacts associated with the operation of the proposed substation and the turn-in power lines

Nature of Impact: Potential visual impact of the proposed turn-in line alternatives on users of the main and arterial roads				
	Alignment 1	Alignment 2	Alignment 3	Alignment 3a
Extent	Local (4)	Local (4)	Local (4)	Local (4)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Minor (1)	Minor (1)	Minor (1)	Minor (1)
Probability	High (4)	High (4)	High (4)	High (4)
Significance	Moderate (48)	Moderate (48)	Moderate (48)	Moderate (48)

[7] This is only applicable to the visual impact assessment study

Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No	No	No
Can impacts be mitigated during operational phase?	No	No	No	No
Mitigation: Mitigation is not possible.				
Cumulative impacts: The construction of numerous towers will increase the cumulative visual impact of existing power lines that traverse the study area.				
Residual impacts: N.A.				

Nature of Impact: Potential visual impact on receptors within residential areas				
	Alignment 1	Alignment 2	Alignment 3	Alignment 3a
Extent	Local (4)	Local (4)	Local (4)	Local (4)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Low (2)	Low (2)	Low (2)	Low (2)
Probability	High (4)	High (4)	High (4)	High (4)
Significance	Moderate (52)	Moderate (52)	Moderate (52)	Moderate (52)
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Recoverable (3)	Recoverable (3)	Recoverable (3)	Recoverable (3)
Irreplaceable loss of resources?	No	No	No	No
Can impacts be mitigated during operational	No	No	No	No

phase?				
Mitigation: Mitigation is not possible.				
Cumulative impacts: The construction of numerous towers will increase the cumulative visual impact of existing power lines that traverse the study area.				
Residual impacts: N.A.				

Nature of Impact: Potential visual impact on residents in close proximity to the proposed Verwoerdburg substation extension	
Extent	Local (4)
Duration	Long term (4)
Magnitude	Minor (1)
Probability	High probability (4)
Significance	Moderate (48)
Status (positive or negative)	Negative
Reversibility	Recoverable (3)
Irreplaceable loss of resources?	No
Can impacts be mitigated during operational phase?	No
Mitigation: The possible increase of the substation footprint might present new visual impacts. Since the infrastructure is not expected to be taller than a single storey, tree line planting can be effectively used to screen the substation upgrades.	
Cumulative impacts: The possible widening of the substation footprint will increase the cumulative visual impact of existing substation.	
Residual impacts: N.A.	

5.3.3. Comparative Assessment

The visual impact of a 400kV turn-in power lines is definite, long-term, and not given to effective mitigation, but is otherwise entirely limited to the local context. If the highest and second highest categories are merged to represent where the alignment would have the greatest impact, i.e. in relatively close proximity in areas considered visually sensitive, alternative 3 and 3a (1026.84 ha and) are

preferred on the basis of least overall area of high impact, followed by alternative 2 (1083.19 ha) and alternative 1 (1170.46 ha). Either alternative 3 or 3a would also be preferable because they follow a path adjacent to an existing power line for the majority of the route, thus increasing the cumulative impact caused by adding to an existing impact. However, the cumulative impact on the broader scale might be reduced. It should be noted, however, that there are no fatal flaws from a visual impact standpoint.

5.3.4. Conclusion and Recommendations

The visual impact of a 400kV transmission line is definite, long-term, and not given to effective mitigation, but is otherwise entirely limited to the local context. The results of the sensitivity analyses indicate that the most preferred alignment is Alternative 3 based on total area of high visual impact and cumulative impact of existing power lines, although there are no fatal flaws eliminating any alternatives. The second most preferred alternative is 3a although there is not a major difference between these two alternatives in terms of visual impact index.

The upgrade to the Verwoerdburg substation is not likely to cause a major change in the landscape, if at all. However, should there be an increase in the footprint area to an extent that presents a significantly new visual impact, mitigation in the form of visual absorption from planted tree lines is usually an effective and relatively cheap method of offsetting this negative visual impact.

» The primary visual impact, namely the appearance and dimensions of the substation infrastructure, is very difficult to mitigate. The functional design of the structures and the dimensions of the substation are unlikely to be changed in order to reduce visual impacts.
» Mitigation of the visual impact though conventional visual impact mitigation measures (i.e. vegetation screening, landscaping or design) is highly unlikely to succeed due to the inherent functional design of the substation structures.
» The sites proposed for the placement of Verwoerdburg substation extension are both located adjacent to sensitive visual receptors that may experience night time visual impacts in the form of glare or light trespass. Careful planning and sensitive placement of security and operational light fixtures for the substation, designed to contain rather than spread the light, is therefore imperative. The mitigation of secondary visual impacts, such as security and functional lighting, construction activities, decommissioning activities, etc. may be possible and should be implemented and maintained on an on-going basis.

5.4. Assessment of Potential Impacts on soils and Agricultural Potential

In the immediate vicinity of the proposed alternatives, most of the soils are shallow (<400 mm) on rock, with much surface rock outcropping. Alternative 1 crosses a narrow band of deeper soils, close to the Olifantsspruit stream. Further to the south and south-west, deeper, red soils occur, while to the east, zones of moderately deep, red and yellow-brown soils are found.

All the soils around the Verwoerdburg substation are shallow and/or rocky, and have a low potential for arable agriculture. There is thus no limitation to the expansion of the substation as far as soils and agricultural potential is concerned.

Due to the shallow nature of the soils, no impacts on agricultural potential are anticipated as a result of the proposed project. From the soil map in Figure 5.5, it can be seen that the dominant class of broad agricultural potential is low, except for the narrow band of higher potential soils close to the stream, on Alternative 1. For this reason, in comparing the alternatives, it would seem that the most suitable route would be either Alternative 2 or Alternative 3/3a, where all of the soils are shallow and rocky, with a low agricultural potential.

5.4.1. Conclusion and Recommendations

Due to the shallow nature of the soils, no impacts on agricultural potential are anticipated as a result of the proposed project. Due to the presence of a narrow band of higher potential soils close to the stream along Alternative 1, this alternative is not preferred. All other alternatives assessed are considered to be acceptable from an agricultural potential perspective.

From the soil map in Figure 6.5, it can be seen that the dominant class of broad agricultural potential is low, except for the narrow band of higher potential soils close to the stream, on Alternative 1. For this reason, in comparing the alternatives, it would seem that the most suitable route would be either Alternative 2 or Alternative 3/3a, where all of the soils are shallow and rocky, with a low agricultural potential.

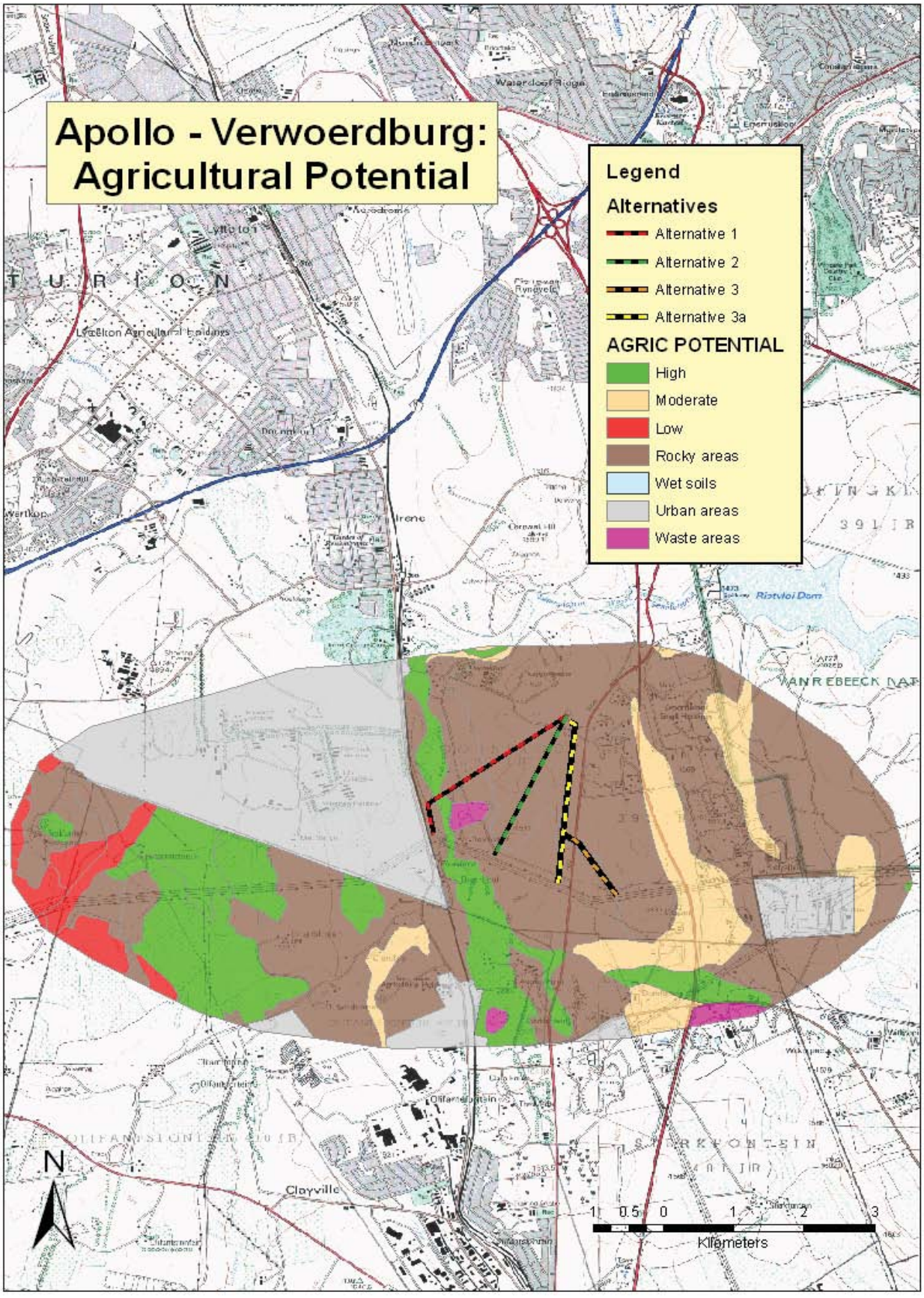

Figure 5.5: Soil Map in the Apollo-Verwoerdburg Area

5.5. Assessment of Potential Impacts on Heritage Resources

The Phase I HIA study for the Eskom Project Area revealed the following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999). The following known heritage resources occur in the study area (Apollo-Verwoerdburg):

» At least two graveyards located near Alternative 01 (~85 graves) and Alternative 02 (~20 graves) for the 400kV loop-in and loop-out power lines running from the 400kV Pluto-Apollo power line to the Verwoerdburg Substation.

All graveyards and graves can be considered to be of high significance and are protected by various laws. Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (No 25 of 1999) whenever graves are older than sixty years. The act also distinguishes various categories of graves and burial grounds.

Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

It is unlikely that either Graveyard 01 or Graveyard 02 will be directly impacted when either Alternative 01 or Alternative 02 is constructed for the proposed loop-in power line between the 400kV and the Verwoerdburg Substation due to the following reasons:

» Graveyard 01 is located at a safe distance to the north of Alternative 01 and can thus be avoided by the power line.
» Graveyard 02 is located at a safe distance to the west of Alternative 02 and can thus be avoided by the power line
» No heritage resources were observed along Alternative 03 and 03a.

5.5.1. Conclusions and Recommendations

All graveyards and graves can be considered to be of high significance and are protected by various laws. Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (No 25 of 1999) whenever graves are older than sixty years. The act also distinguishes various categories of graves and burial grounds. Against this background, alternative 3 and 3a will have no impact to the heritage resources on site.

5.6. Assessment of Potential Social Impacts

Impacts on the social environment as a result of the proposed expanded substation and turn-in lines are expected to occur during both the construction and operation phases (as well as during the eventual decommissioning of the infrastructure). The construction phase associated with the proposed substation and turn-in lines is expected to last for approximately 12 months.

The Social Impact Assessment considers the following:

» Demographic processes (Change in population size, density and/or demographic profile). Table 3 from the Specialist Social Impact Assessment report in Appendix M provides the number of construction workers anticipated on site during construction.
» Economic processes (the way in which people make a living and the economic activities in the society)
» Geographic processes (land use patterns)
» Empowerment, institutional and legal processes (the ability of people to be involved and influence decision making process and role and efficiency and operation of governments and other organisations),
» Socio-cultural process (the way in which humans behave, interact and relate to each other and their environment and the belief and value systems which guide these interactions)

Considering all these processes, potential social health impacts will also be assessed. A distinction was made between the change process and impacts. A change process is defined as a change that takes place within the receiving environment as a result of a certain intervention. A potential social impact follows as a result of the impact once it is experienced as such by an individual/household/community/organisation on a physical and cognitive level.

Potential impacts (with and without mitigation) specific to the substation site and turn-in lines are summarised in the tables below. In order to assess the corridor alternatives in respect of their anticipated social impacts, a distinction is made between the following impacts:

» Category 1: Impacts that are not expected to differ between the proposed corridor alternatives, e.g. the number of construction workers that will be needed for the proposed project remains the same, irrespective of the chosen alternative.
» Category 2: Impacts that are expected to differ between the proposed alternative Corridors, e.g. the number of households to be resettled increases if the development traversed densely populated areas as opposed to skirting populated areas.

5.6.1. Geographic Change Processes

The following geographic change processes are likely to occur:

» Change in access to resources that sustain livelihoods; and
» Land acquisition and disposal, including availability of land.

A change in the surrounding land use of an area associated with a linear development, such as a transmission power line, is often a gradual process that in the end could set an unintentional precedent for further land use changes. Often these additional land use changes are of a similar nature than the original development, e.g. the placement of a new transmission power line next to an existing transmission power line, as is the case with Alternative 3 and 3a. Usually, depending on the results of the various specialist studies, the placement of new infrastructure within an existing 'disturbed corridor' is preferred as it reduces the impact on sense of place by avoiding green field areas.

GEOGRAPHIC CHANGE PROCESS	
Summary of change process: The proposed 400kV turn-in/out transmission lines will be operated within a servitude of 110m in width. Although most land uses are still permitted within the servitude (except permanent structures and human occupation), the landowner has to comply with the requirements set forth by Eskom to ensure the safe operation of the lines. The landowner therefore has to factor transmission line towers and the servitude into future land use, which changes the way in which the landowner used to use the land, e.g. a row of houses that has to be removed from a development to make way for the servitude. As Eskom already owns the site for the substation extension, the impact of land use changes on this particular property will be limited.	
Nature of impact: A loss of land impacts financially on a private landowner who is limited in terms of the land uses within the servitude area.	
Site characteristics: At present there are no land use activities taking place in the area surrounding the substation. Future planning includes a number of mixed land use developments, e.g. residential developments, office and retail developments, road developments, etc. The turn-in transmission line route alternatives 1 and 2 mostly traverse 'green field' areas (i.e. areas where no similar infrastructure is present; also earmarked for future development), whereas alternative 3 and 3a – although it also traverses a development area - is located next to two existing transmission lines, which was factored into the development plans for the affected property.	
Mitigation measures: • The use of alternative 3 and 3a will minimise the extent of the expected impacts as it is located next to existing infrastructure of a similar nature, and preferred by the affected landowner who has factored the existing transmission lines into his development plans. • The affected landowner has prepared all the required documentation for township establishment and at the time of the study, was in the process of lodging a formal application with the local municipality for township establishment (Rietvlei extensions 6 and 7). It is therefore vital to consult with the landowner on a continuous basis and to communicate any route deviations to the landowner to ensure that the infrastructure does not cause extensive alterations to the development's site layout plan. • Land rehabilitation should take place upon completion of the	Enhancement measures: • N.A.

construction process to ensure that the land is returned to the landowner in the same condition as prior to construction, unless otherwise agreed with the landowner in question.								
Rating Scale	Substation		Alternative 1		Alternative 2		Alternative 3 and 3a	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Extent	Local [2]	Site [1]	Local [2]	Site [1]	Local [2]	Site [1]	Local [2]	Site [1]
Duration	Short [2]	Short [2]	Very short [1]	Very short [1]	Very short [1]	Very short [1]	Very short [1]	Very short [1]
Magnitude	Low [4]	Low [4]	Very high [10]	Moderate [6]	Very high [10]	Moderate [6]	Moderate [6]	Low [4]
Reversibility	Reversible [1]	n/a	Recoverable [3]	n/a	Recoverable [3]	n/a	Recoverable [3]	n/a
Probability	Improbable [2]	Improbable [2]	Highly probable [4]	Probable [3]	Highly probable [4]	Probable [3]	Highly probable [4]	Improbable [2]
Significance	Low [18]	Low [18]	High [64]	Low [24]	High [64]	Low [24]	Medium [48]	Low [12]
Status	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Cumulative impacts: • Based on the number of development projects in the area, land use change seems inevitable. The loss of land due to the current project is minimal when compared to the other development projects in the area.								
Residual impacts: • A precedent for land use change has been set.								
Links: • Impacts due to land use (geographic) change processes links to economic change processes (compensation for servitude), emancipation and empowerment processes (negotiations), and socio-cultural processes (change in sense of place).								

5.6.2. Demographic Change Processes

It is expected that the expansion of the substation together with the construction of the turn-in/out transmission lines will lead to a temporary change in the population size of the affected area and also, possibly, to the composition of the local population. In this regard, the following demographic change processes are likely to occur:

» An influx of construction workers;
» An influx of unemployed job seekers; and
» In one instance, the possible relocation of an individual household (should Alternative 1 be adopted).

The construction of a substation as well as that of a transmission lines requires skilled workers. In all probability, these skills will not be present in the area, resulting in the fact that a contractor will bring in his own workforce – people who do have the required skills, but who are normally also not from the local area. However, a construction team consists of a certain number of people (the size of the team depends largely on the type of construction required) and they enter the area with a very specific purpose. The time they spend in the area is clearly defined and often controlled as such (e.g. construction workers arrive on site in the morning and depart from the area in the evening), and due the nature of their work, their contact with the local community is limited.

Once the project has been completed, construction workers who form part of a contractor's permanent workforce will move on to a next project and will seldom stay in the area. At the peak of construction the number of construction workers on site is estimated to be around 145 people (of which about 60 will be at the substation site and the other 85 will be spread out across the length of the turn-in lines). Because the construction workers will commute to site, it is expected that the influx of construction workers will have a negligible effect on the highly urbanised host community.

Unlike the regulated circumstances surrounding a construction team, the influx of job seekers is unregulated and often very difficult to control. It is also very difficult to predict how many job seekers could be expected and the extent to which they can change the size and composition of the local population, as the intensity of the effect will be influenced by the actual number of job seekers.

Given the skills required for the respective construction processes, it is highly unlikely that a job seeker will find formal employment by loitering at the construction camp or site. The unemployed job seekers then become a burden to the host community, as they do not have the means to sustain themselves, and then become dependent on others (usually people who themselves only have

limited resources). The presence of job seekers can also lead to the expansion of the informal settlement located approximately 3.5km south of the Verwoerdburg substation. This settlement also appears to encroach upon an existing transmission line servitude, which creates a health and safety risk for people living on the outer edges of the settlement.

DEMOGRAPHIC CHANGE PROCESS								
Summary of change process: Construction workers enter the area on a temporary basis and will not have an effect on the population size. Job seekers might also enter the area, but usually the number is restricted to individuals.								
Nature of impact: Generally speaking, accelerated population growth creates unexpected demands on local resources. However, this will not be the case with the current project, as the size of the construction team is too small and their time spent in the area too limited to have any real effect on the local population size. Individual job seekers will also not contribute to accelerated population growth.								
Site characteristics: The local population consists of mostly medium to high income groups. The area itself is currently undergoing a transformation due to the large number of developments, but this is due to people moving into the area on a permanent basis (e.g. residents in new developments).								
Mitigation measures: • Do not create false expectations – inform local job seekers upfront about the skilled nature of the construction and the low likelihood of employing an unskilled and/or inexperienced workforce. • Also inform local communities that contractors have a permanent workforce and that they will mostly likely make use of this workforce, which will further reduce the possibility of local employment. • Discourage job seekers to travel to the area by advertising in the local and/or regional press before construction commences to show that all positions have been filled and that there are no further job opportunities available.				Enhancement measures: • None.				
Rating Scale	Substation		Alternative 1		Alternative 2		Alternative 3 and 3a	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Extent	Local [2]	Site [2]	Local [2]	Site [1]	Local [2]	Site [1]	Local [2]	Site [1]
Duration	Short [2]	Very short [1]	Short [2]	Very short [1]	Short [2]	Very short [1]	Short [2]	Very short [1]
Magnitude	Moderate [6]	Low [4]	Moderate [6]	Low [4]	Moderate [6]	Low [4]	Moderate [6]	Low [4]
Reversibility	Recoverable [3]	n/a	Recoverable [3]	n/a	Recoverable [3]	n/a	Recoverable [3]	n/a

Probability	Improbable [2]	Very improbable [1]	Improbable [2]	Very improbable [1]	Improbable [2]	Very improbable [1]	Improbable [2]	Very improbable [1]
Significance	Low [26]	Low [7]	Low [26]	Low [7]	Low [26]	Low [7]	Low [26]	Low [7]
Status	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Cumulative impacts: • The influx of job seekers to other development projects in the area – job seekers might go around looking for work on all these projects.								
Residual impacts: • Job seekers who remain in the area despite being unable to secure any employment, increasing the dependency ratio on the local authority.								
Links: • Impacts due to demographic change processes in turn links to institutional and legal change processes (change in housing needs/demands, change in community infrastructure), and socio-cultural processes (dissimilarity in social practices, conflict, and safety and crime impacts).								

5.6.3. Economic change processes

The EIA study identified the following economic change processes as likely to occur:

» Enhanced / reinforced economic opportunities;
» Change in the employment equity of vulnerable groups; and
» Change in occupational opportunities.

In addition to the identified change processes mentioned above, the SIA study also considered enhanced electricity supply and economic growth as an additional change processes on a more macro-scale. These change processes will be discussed separately together with a detailed assessment of the expected impact as a result of the change process taking place.

The construction phase of the project for both the substation and the turn-in/out lines will create an estimated 425 job opportunities over the length of the contract period. Most of these jobs will have an average contract period of 2-3 months. Due to the skilled nature of the construction processes, only experienced/skilled workers are used, usually in the form of the contractor's own permanent workforce. According to an Eskom official, contractors seldom employ causal workers from the local community, mainly because of the skills levels required, and the sensitive nature of the material used in these installations (i.e. the copper wiring often gets stolen).

In addition to direct employment opportunities, construction activities usually also lead to indirect employment opportunities, which can be either formal or informal. Indirect formal employment refers to direct employment by the contractor but not as part of the actual construction team, e.g. support staff such as messengers and personal assistants. Indirect informal employment relate to entrepreneurial services that are not directly employed by the contractor or linked with the construction activities, e.g. domestic services, food stalls, etc. at either the construction camp or the construction site.

A drawback is that most of the employment opportunities created by the construction of the proposed substation and turn-in/out lines will be temporary in nature and will only last for the duration of the construction period. However, on a more positive note, it means that a group of people have not only acquired a new skill, but have also gained some work experience, which will make them more 'marketable' in future.

Most, if not all, economic activities are dependent on a reliable electricity supply. This and other resources such as water and fuel enable normal economic growth. Normal economic activities, e.g. industry and businesses, are affected when

electricity is not available. The economic impact on such services increases the longer services such as electricity are unavailable. Services become unreliable or unavailable when the demand for such services exceeds the supply, resulting in load shedding, as was the case in South Africa in the beginning of 2008.

The proposed extensions to the substation and the associated turn-in/out transmission lines will enhance the electricity supply to the City of Tshwane, which in turn will indirectly stimulate economic growth as the supply can meet the demand, allowing businesses and industries to expand. Growing businesses and industries create additional employment opportunities, which enhance economic growth, permitting a positive economic impact to filter down to a more grassroots level.

<table>
<tr><th colspan="2">ECONOMIC CHANGE PROCESS</th></tr>
<tr><td colspan="2">Summary of change process: The construction and maintenance of the proposed substation extensions and turn-in/out transmission lines will create an estimated 425job opportunities. Employment enhances economic equities, even if it is over the short-term. Members of vulnerable groups will have equal opportunity to apply for local positions, but such persons often do not apply as they are ‘trapped’ within their traditional role of housekeeper, caregiver, etc. A change in occupational opportunities is an indirect result of the project as auxiliary services are required during the construction phase, such as shelter, food, etc. A reliable electricity supply stimulates economic growth.</td></tr>
<tr><td colspan="2">Nature of impact: Employment first and foremost has an economic impact on the individual and his/her nuclear family. In addition to securing an income, employment (direct formal or indirect informal) also creates a sense of self-worth and offers the individual the opportunity to extend his/her skills base and to gain some experience – this makes people more ‘marketable’ for future jobs. On a macro scale, the availability of electricity enhances economic growth, which creates more job opportunities with a positive economic impact. On the whole, negative economic impacts will be confined to single landowners.</td></tr>
<tr><td colspan="2">Site characteristics: The local population consists of mostly medium to high income groups. According to the latest census results (2001), the surrounding areas are characterised by high employment rates, e.g. 86.2% for Doornkloof and 96.4% for Irene. It can be expected that the employment rate in the informal settlement will be significantly lower.</td></tr>
<tr><td>Mitigation measures:
Regarding the informal trade: Make use of a permit system and only allow vendors with a valid permit to supply goods and services. Such a system can also assist in controlling access to and from the construction sites and camp by knowing who the vendors are and who the loiterers are, and it can aid in preventing conflict amongst vendors due to an over-supply of the same product.
Payment should comply with applicable Labour Law legislation in terms of minimum wages.
Where required, workers must be registered with any and all official bodies as required by law, e.g. Income Revenue Services, Unemployment Insurance Fund, etc. This will enable the worker to claim from the UIF as a means of continuous financial support when</td><td>Enhancement measures:
Contractors must be contractually obliged to appoint local labour wherever possible.
Give preferential treatment to local entrepreneurs and/or subcontractors to supply goods and services.
Females should be encouraged to apply for positions.
Individuals with the potential to develop their skills further should be afforded training opportunities, where possible.</td></tr>
</table>

his/her position on the construction team either becomes redundant or once the construction phase comes to an end.								
Rating Scale	Substation		Alternative 1		Alternative 2		Alternative 3 and 3a	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Extent	Local [2]	National [4]	Local [2]	National [4]	Local [2]	National [4]	Local [2]	National [4]
Duration	Very short [1]	Long term [4]	Very short [1]	Long term [4]	Very short [1]	Long term [4]	Very short [1]	Long term [4]
Magnitude	Low [4]	Moderate [6]	Low [4]	Moderate [6]	Low [4]	Moderate [6]	Low [4]	Moderate [6]
Reversibility	Recoverable [3]	n/a	Recoverable [3]	n/a	Recoverable [3]	n/a	Recoverable [3]	n/a
Probability	Improbable [2]	Probable [3]	Improbable [2]	Probable [3]	Improbable [2]	Probable [3]	Improbable [2]	Probable [3]
Significance	Low [20]	Medium [42]	Low [20]	Medium [42]	Low [20]	Medium [42]	Low [20]	Medium [42]
Status	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Cumulative impacts: • None								
Residual impacts: • Increased capacity resulting in a stable network that can facilitate economic growth.								
Links: • Economic change processes link to geographic change processes (change in access to resources that sustain livelihoods), and demographic processes (influx of job seekers to an area with a growing economy).								

5.6.4. Socio-cultural Change Processes

As indicated in Chapter 4, a high income residential estate (Irene Glen Private Estate) lies to the north of the Verwoerdburg substation adjacent to Hennops River. The estate has strict security measures with only one access road off the R21 with access control measures that limit access to mostly residents and their visitors. The estate has board of directors and a homeowners association who regulate the functioning of the estate through enacted rules and regulations, including aspects such as rules of conduct, security measures, rules pertaining to tenants, visitors, contractors and employees, rules pertaining to the letting and reselling of a property, building guidelines, etc. Residents voluntarily abide by these rules, which in turn enhance a sense of community through the practise of 'good neighbourliness' where residents do not live in isolation or detract from the estate's shared wellbeing, but rather contribute to each other's quality of life. The sense of community is further fostered through a monthly newsletter, a local newspaper called "The Glen," and a homeowner's association website.

To the west of the substation site lays the residential area of Doornkloof. This is an 'open' high-income residential area (as opposed to the access-controlled setting of an estate). The area also has a homeowners association and, based on the activity on their website, appears to be a very active community 'watchdog' that is constantly participating in EIA processes and informing residents on new developments in the area and the progress made on local projects. Apart from local development projects, the website also contains other notices and updates of importance to residents and at the time of the study, contained over 100 such notices, dating back as far as 2004.

Doornkloof Smallholdings to the east of the substation site is characterised by mixed land use including residential, light industrial and commercial uses, religious areas and other uses such as a youth/church camping ground. This implies that the area has a constant through-flow of people such as groups making use of the camping ground for a weekend, or employees arriving or departing from their place of work, or people attending church or church activities once or twice a week. As such the area does not really have a dominant resident local community, but this does not in any way exclude the possibility that other land-users in the area could still have a sense of 'business community' (although the high walls and locked gates would suggest a certain degree of isolation between the various types of land uses and ultimately the people occupying the properties during certain times of the day/week).

Large portions of the open land surrounding the substation and the proposed turn-in/out route alignments have been earmarked for future mixed land-use developments. As the study area forms part of a bigger geographical area that is currently experiencing huge development pressure, the landowner(s)/

developer(s) are in an ideal position to benefit substantially from mixed land-use developments on their properties. It is therefore not likely that these property owners will have a strong sense of place attachment, as their main aim is not to reside in the area themselves, but rather to develop and sell off the land, after which they will in all probability withdraw from the area.

As per the results of the EIA study, the following socio-cultural change processes are likely to occur:

» Dissimilarity in social practices;
» Alteration in family structure;
» Conflict;
» Safety and crime impacts; and
» Change in sense of place.

These change processes will be discussed separately together with a detailed assessment of the expected impact as a result of the change processes occurring.

Dissimilarity in social practices occurs when there are different values, social standards, religious believes, etc. between a large group of newcomers to an area and that of the area's local residents. In theory the existence of two groups with different social practices living alongside each other should not in itself be the cause of problems – it is when the one group attempts to exert power over the other group or where different cultural values are not respected, that conflict situations arise. Such conflict situations can turn violent and often require third party intervention.

The potential impact on socio-cultural behaviour and the related perception of environmental changes can have either a positive or a negative impact on sense of place (e.g. peace of mind vs. frustration/anger). The introduction of a new project to the area can be viewed as a positive impact if people perceive the project as infrastructural and/or economic development that is not intrusive on their lives and do not cause them immediate danger. Potential negative impacts include the visual impact and the resultant intrusion on sense of place.

<table>
<tr><th colspan="2">SOCIO-CULTURAL CHANGE PROCESSES</th></tr>
<tr><td colspan="2">Summary of change process: The arrival of people who are not from the area can lead to conflict if there is dissimilarity in social practices and if such differences are not respected. Family structures can be altered where the breadwinner is absent for prolonged periods of time and in cases of HIV transmission, the family structure can further be altered. Due to the fact that existing infrastructure of a similar nature is already present in the area, it is unlikely that the project will alter the way in which people relate to each other and their environment, and therefore unlikely to affect their sense of place.</td></tr>
<tr><td colspan="2">Nature of impact: Conflict affects a community's group cohesion and way of life. Apart from the obvious health impacts associated with illnesses such as HIV, it also bears an economic impact when people become too ill to work – on the macro economy as well as the micro economy of the family who loses their source of income, which affects their livelihood. People lose their sense of belonging and place attachment, resulting in a loss of sense of place.</td></tr>
<tr><td colspan="2">Site characteristics: The area is characterised by medium to high-income groups, which functions within the traditional family unit. Residents seem to have a strong sense of place attachment due to the unique characteristics of the area with amenities like the Rietvlei Nature Reserve close by. However, it should be noted that the area is undergoing immense development – it therefore appears that the transformation of the area is unavoidable.</td></tr>
<tr><td>Mitigation measures:
The use of Alternative 3 and 3a will reduce the potential impact on sense of place, as it is located next to existing infrastructure of a similar nature (i.e. sense of place on his alternative has already been altered).
Launch a STI and HIV/AIDS awareness campaign to educate construction team members and the local community on this issue. Identify and train peer educators and provide the necessary resources (posters, information booklets, referral sources for VCT, etc.) to ensure an effective campaign.
Avoid potential conflict situations that can arise from limited employment opportunities by using a fair and transparent recruitment process. Consider implementing the use of a rotary employment scheme, if and where feasible, to extend employment opportunities to more individuals.</td><td>Enhancement measures:
None</td></tr>
</table>

- Do not allow idle loitering of job seekers, or other individuals who are not involved with the project, at either the construction site or the construction camp. This is to prevent a potential increase in opportunistic crimes.
- Implement a project information centre at the site offices where local residents can obtain information on the progress of the construction process and on what to expect in future (for example the types of activities that will take place and when and how these will be executed). Also, display and/or inform local residents of current changes and future possibilities associated with the project. The information centre can also serve as a central point where residents can complain or bring problem areas associated with the construction process under the project manager's attention. The information centre must be easily accessible to the public and can operate on a part-time basis, but the centre's hours of operation must be clearly displayed and/or communicated to the local community.

Rating Scale	Substation		Alternative 1		Alternative 2		Alternative 3 and 3a	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Extent	Local [2]	Site [1]	Local [2]	Site [1]	Local [2]	Site [1]	Local [2]	Site [1]
Duration	Short [2]	Very short [1]	Short [2]	Very short [1]	Short [2]	Very short [1]	Short [2]	Very short [1]
Magnitude	Moderate [6]	Low [4]	High [8]	Moderate [6]	High [8]	Moderate [6]	Moderate [6]	Low [4]
Reversibility	Recoverable [3]	n/a	Recoverable [3]	n/a	Recoverable [3]	n/a	Recoverable [3]	n/a
Probability	Improbable [2]	Very improbable [1]	Probable [3]	Improbable [2]	Probable [3]	Improbable [2]	Improbable [2]	Very improbable [1]
Significance	Low [26]	Low [6]	Medium [45]	Low [16]	Medium [45]	Low [16]	Low [26]	Low [6]

Status	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Cumulative impacts: • A wide range of development projects is taking place in the area that all contribute to the transformation of the area.								
Residual impacts: • An increase in the HIV infection rate. • Vulnerable families. • A loss of place attachment and sense of place.								
Links: • Socio-cultural change processes links to demographic change processes (population growth and decline), economic change processes, and empowerment and emancipation processes (people are disempowered when they are forced to remain in a destructive cycle).								

5.6.5. Conclusions in terms of Impacts on the Social Environment

As could be expected, the construction phase is characterised by a number of negative social impacts, which is mainly due to the nature of the activities that take place during this phase. Although the expected social impacts associated with the construction phase are mostly negative across all the change processes, these impacts are for the most part only temporary in nature and as such and expected to only last over the construction period.

Even though all of the identified social impacts can be mitigated or enhanced successfully, it can only be done if Eskom, or its appointed contractor(s), commit to the responsibility of ensuring that the level of disturbance brought about to the social environment by the more negative aspects of the project, is minimised as far as possible.

Overall, based on the conclusions and findings of this report, the upgrade of the Verwoerdburg substation and the construction and operation of the proposed turn-in/out lines do not pose any social impacts that are deemed irreversible, fatally flawed, or severely detrimental to the social environment. However, this finding is subject to the implementation of, and adherence to, the identified mitigation measures contained in this report, and as recommended for inclusion in the EMP. In addition, the social specialist strongly recommends the following:

» Ensure that social issues identified during the EIA phase are addressed during construction. This could be done by engaging social specialists where necessary or by ensuring that the ECO used during construction have the necessary knowledge and skills to identify social problems and address these when necessary. Guidelines on managing possible social changes and impacts could be developed for this purpose.

» Always inform landowners on any construction activity to start on their property. Prepare them on the number of people that will be on the property and on the activities they will engage in.

» Ensure that Eskom employees are aware of their responsibility in terms of Eskom's relationship with landowners and communities surrounding power lines. Implement an awareness drive to relevant sections to focus on respect, adequate communication and the 'good neighbour principle.'

» Incorporate all mitigation measures in the SIA that are relevant to the construction phase in the EMP to ensure these are adhered to by Eskom and the contractor.

Based on the results of the SIA, the use of Alternative 3 and 3a are preferred. This alternative is located adjacent to two existing transmission lines and a metropolitan road (M57), which places alternative 3 within a disturbed corridor. The use of a disturbed corridor implies that people living in the area are used to presence of the lines and therefore an additional line is less likely to change their perception of their area as when the line is placed across a previously undisturbed area (as is the case for most of alternatives 1 and 2). The relocation of structures will not be required with the use of alternative 3 and 3a, whereas there is a distinct possibility that a household would have to be relocated if alternative 1 was implemented. In addition, the affected landowner indicated that alternative 3 will have the least effect on his development plans, as the existing lines have already been factored into the development's site layout plan.

CONCLUSIONS AND RECOMMENDATIONS CHAPTER 6

The conclusions and recommendations of this EIA are a result of the assessment of the impacts identified by the specialists, and the parallel process of public participation. The public consultation process has been extensive and every effort has been made to include representatives of all stakeholders in the study area.

6.1. Overview of the Proposed Project

In order to reinforce the existing Transmission network in the Tshwane Region, Eskom Transmission is currently proposing the construction of a 400kV transmission power line between the existing Apollo and Pluto substations. In addition, increased demand for a reliable electricity supply in the Central Grid has necessitated that Eskom Transmission improves the reliability and capacity of the transmission network in the area. Further, upgrade of the 400/132kV Verwoerdburg substation and establishment of a new Phoebus substation is also being proposed in the area in order to improve the reliability and quality of supply problems in the Tshwane area. Various transmission options were investigated by Eskom Distribution network planning, the investment and a new Transmission network was preferred as the most suitable long-term solution. Eskom Transmission is therefore proposing the construction of the Tshwane Strengthening Project Phase 1.

In total, approximately 36 km of new power line is proposed as part of the entire Tshwane Strengthening project Phase 1. The purpose of this project is to:

» Improve the reliability of the existing Central Transmission network.
» Improve the voltage regulation on the Central Grid Distribution and City of Tshwane Metropolitan Municipality network.
» Create additional Transmission network capacity which will supply the increasing electricity demand in the Central Grid.

As part of its assessment of supply requirements, and as a result of the projected load growth of the Gauteng region, Eskom have determined that additional transmission capacity will be required in the Tshwane Region area by the year 2013. For this reason, Eskom Transmission is proposing the Tshwane Strengthening Project. Figure 6.1 and 6.2 provide an indication of the study area considered within the EIA process for this proposed project. This report focuses on the following components:

» The extension and upgrade of the existing Verwoerdburg Substation.

» Construction of 2x 400kV loop in and out lines from the existing Apollo–Pluto transmission line which will feed into the Verwoerdburg Substation, a distance of approximately ~4 km.

The Environmental Impact Assessment (EIA) for the proposed Tshwane Strengthening Project Phase 1 has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006, in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998).

The EIA Phase aimed to achieve the following:

» Provide an overall assessment of the social and biophysical environments affected by the proposed alternatives put forward as part of the project.
» Assess potentially significant impacts (direct, indirect and cumulative, where required) associated with the proposed project.
» Comparatively assess identified feasible alternatives put forward as part of the project.
» Nominate a preferred power line alternative corridor for consideration by the decision-making authorities (i.e. DEA and GDARD).
» Identify and recommend appropriate mitigation measures for potentially significant environmental impacts.
» Undertake a fully inclusive public involvement process to ensure that I&APs are afforded the opportunity to participate, and that their issues and concerns are recorded.

The following site location for the proposed substation expansion and power line alternative corridors have been considered within this EIA process (refer to Figure 6.1 and 6.2):

» A potential site for the proposed extension to Verwoerdburg substation. This site is located north-west of the existing Verwoerdburg substation, and it is owned by the applicant, Eskom Holdings. Subsequent to a authority meeting and site visit with the CoT Electrictity Department, the site south of the existing substation was recommended as a preferred option for extension due to the planned expansion by the CoT on the north-western side and already existing power line towers.
» Three turn-in transmission line development corridors in order to link the Apollo-Pluto power lines with the Verwoerburg substation.

The conclusions and recommendations of this EIA are the result of the assessment of identified impacts by specialists, and the parallel process of public

participation. The public consultation process has been extensive and every effort has been made to include representatives of all stakeholders in the study area.

Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within Appendices I-N provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of the proposed project. This chapter concludes the EIA process by providing a summary of the conclusions of the assessment of the proposed substation site and alternative transmission line alternatives identified for the 400kV transmission power lines. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental consultants during the course of the EIA and presents an informed opinion of the environmental impacts associated with the proposed project.

Figure 6.1: Image showing the location of the proposed extension of Verwoerdburg substation

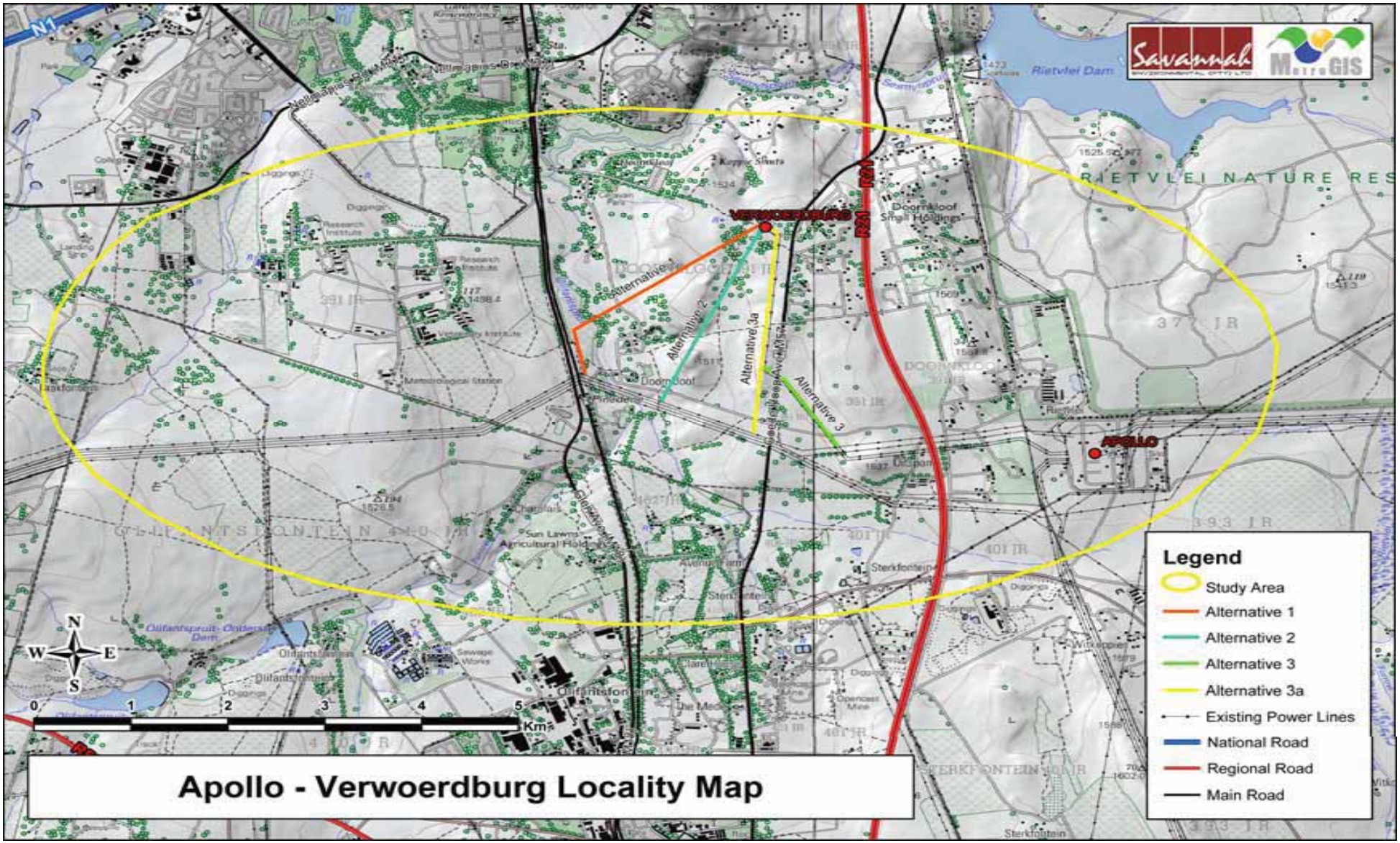

Figure 6.2: Map showing nominated alternatives considered in the EIA Study

6.1.1. Conclusions and Recommendations drawn from the Assessment of the proposed extension of the Verwoerdburg Substation

The majority of potential impacts identified to be associated with the construction and operation of the proposed substation are anticipated to be localised and restricted to the existing substation site footprint. No environmental fatal flaws were identified to be associated with the site. This is largely due to the fact that the extension of the substation at this site is within the existing substation site footprint, which is already transformed as well as the fact that it would be associated with minimum disturbance to environment. For this reason, the majority of the specialists recommended that the proposed extension be implemented within this proposed development footprint.

Some areas requiring mitigation have been highlighted. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Plan (EMP) included within Appendix O.

The majority of potential impacts identified to be associated with the construction and operation of the proposed substation are anticipated to be localised and restricted to the existing substation site footprint. No environmental fatal flaws were identified to be associated with the site. However some areas requiring mitigation have been highlighted. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Plan (EMP) included within Appendix O.

6.1.2. Conclusions and Recommendations drawn from the assessment and comparison of the loop in and out transmission power line alternatives

From the conclusions of the specialist studies undertaken, the following has been recommended regarding the power line corridors investigated:

- In terms of impacts on biodiversity, alternatives 1 and 2 are considered to be “very least preferred” because of the ecological attributes and sensitivities along these corridors. For this reason, alternative corridor 3 and 3a are preferred with moderate to low ecological sensitivity.

- In terms of avifauna, the first and most preferred alternative is alternative 3. This alternative follows existing power lines for the entire length and thus the impact on avifauna in terms of collisions, habitat destruction and disturbance will be significantly less. The next most preferred alternative is alternative 3a. While this alternative will have slightly higher impacts than alternative 3 these impacts are seen as insignificant and thus this alternative may also be used with minimal

impact on avifauna. Alternatives 1 and 2 are not preferred due to the sensitive habitats which are crossed by these corridors.

» From a visual sensitivity analysis undertaken, the preferred alignment is Alternative 3 based on total area of high visual impact and cumulative impact of existing power lines, although there are no fatal flaws eliminating the three (alternative 1, 2 and 3a) alternatives.

» In terms of Agricultural Potential, in comparing the alternatives, the most suitable route would be either Alternative 2 or Alternative 3/3a, where all of the soils are shallow and rocky, with a low agricultural potential. Alternative 1 is not preferred due to an area of higher potential in the vicinity of the river.

» From a Heritage Impact assessment, no heritage resources were identified along alternative corridor 3 and 3a. Graveyards were identified to be located in the vicinity of Alternatives 1 and 2. Against this background, the preferred alternative corridors are 3 and 3a.

From the conclusions of the specialist workshop undertaken, it was concluded that Alternative corridor 1 and 2 are not recommended for development due to the unacceptably high impacts on the biophysical environment as well as the impacts on the social environment. Therefore, development within these two corridors should be avoided. Alternative corridor 3 was nominated as the preferred alternative by the majority of the specialists. Impacts associated with Alternative 3a are not expected to differ significantly from those associated with Alternative 3. Therefore, this alternative is considered acceptable from an environmental perspective.

As Alternative 3a is shorter than Alternative 3 and would eliminate the need for a bend (and an associated self-supporting tower), this alternative is preferred from an economic and technical perspective. Therefore, from a holistic perspective (i.e. considering technical, ecological, social and economic criteria), Alternative 3a is nominated as the preferred alternative (refer to Figure 6.3).

It is considered vital that construction of the two turn-in power lines within this corridor take the recommended conditions identified by the specialist studies in to consideration. Should the project be authorised by DEA, the final routing of the turn-in power lines within the nominated preferred corridor should be undertaken in consultation with the affected landowners and the following specialists.

» Biodiversity specialist
» Avifauna specialist
» Heritage specialist

In addition, once the final turn-in transmission power line alignment has been negotiated and the tower positions surveyed and pegged, a walk-through survey must be undertaken by the specialists in order to minimise potential environmental impacts associated with the proposed project.

6.2. Overall Conclusion (Impact Statement)

The findings of the specialist studies undertaken within this EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that:

» Although some impacts of potential high significance are associated with the transmission lines and substation, there are no environmental fatal flaws that should prevent the proposed turn in and out power lines and substation from being constructed on the proposed alignment and the proposed substation extension site respectively, provided that the recommended mitigation measures are implemented.
» No issues of significance were identified to be associated with the proposed extension of the Verwoerdburg substation.
» Alternative corridor 1 and 2 are not preferred from the conclusions of the majority of the specialists. This alternative corridor was only preferred from an agricultural potential perspective.
» The majority of the specialists recommended that alternative 3 be nominated as the preferred alternative followed by alternative corridor 3a.
» From a holistic perspective, Alternative Corridor 3a is nominated as the preferred corridor for the construction of the proposed turn-in transmission power lines.
» The significance levels of the majority of identified negative impacts can be mitigated and minimised by implementing the recommended mitigation measures

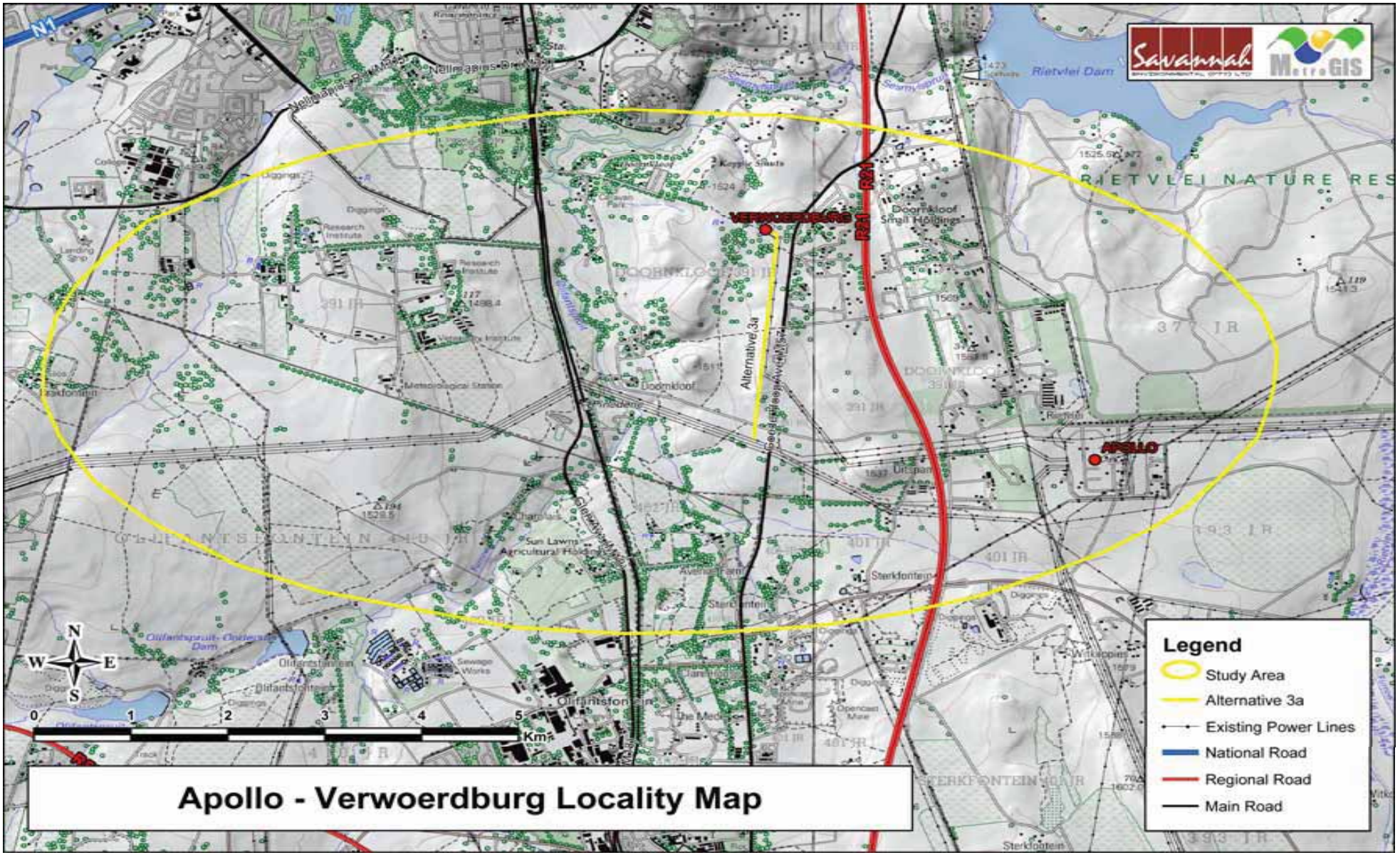

Figure 6.3: Nominated preferred alternatives for the Apollo-Verwoerdburg power line

6.3. Overall Recommendation

Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the proposed substation extension, construction and operation of the loop in and out transmission power lines, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the application for the proposed Tshwane Strengthening Project Phase 1, Apollo-Verwoerdburg component (EIA Ref 12/12/20/1470) be authorised by DEA to include the following:

» Extension/upgrade of the Verwoerdburg substation at proposed site adjacent to the existing substation.
» Construction of 2X 400 kV transmission power lines looping in and out of the Apollo-Pluto transmission lines within Alternative Corridor 3a. Eskom must negotiate the most appropriate route within this corridor with the affected landowners.

The following conditions of this recommendation must be included within the authorisation issued:

» All mitigation measures detailed within this report and the specialist report contained within Appendices F to K must be implemented.
» The draft Environmental Management Plan (EMP) as contained within Appendix O of this report should form part of the contract with the Contractors appointed to construct and maintain the proposed Tshwane Strengthening Project Phase 1 (Apollo-Verwoerdburg component), and will be used to ensure compliance with environmental specifications and management measures. The implementation of this EMP for all life cycle phases (for Construction and Operation) of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.
» Applications for all other relevant and required permits required to be obtained by Eskom must be submitted to the relevant regulating authorities. This includes permits for the transporting of all components (abnormal loads) to site and disturbance of protected vegetation.
» During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum.
» The EMP for construction must be updated to include site specific information and specifications resulting from the final walk-through surveys. This EMP must be submitted to DEA for approval prior to the commencement of construction on site.

- Utilisation of cross-rope suspension tower structures is recommended where possible rather than the conventional self-supporting strain towers that are more obstructive
- Mitigation of the visual impact though conventional visual impact mitigation measures (i.e. vegetation screening, landscaping or design) is highly unlikely to succeed due to the inherent functional design of the substation structures and transmission line infrastructure. The mitigation of secondary visual impacts, such as security and functional lighting, construction activities, etc. may be possible and should be implemented and maintained on an on-going basis.
- The process of communication and consultation with the community representatives must be maintained after the closure of this EIA process, and, in particular, during the construction phase associated with the proposed project.
- Finally to ensure that social impacts are mitigated during construction and operation, it is recommended that the following be implemented and monitored by an ECO;
  - A social management Plan during construction and operation
  - A decommissioning and Closure Plan
  - A stakeholder Engagement Plan
  - A grievance mechanism for the construction and operation phases

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