# SCOPING REPORT:

# Ecological study of the proposed Steelpoort Integration Project for ESKOM in Limpopo Province

Prepared by

David Hoare
(M.Sc., Pr.Sci.Nat.)

David Hoare Consulting cc
41 Soetdoring Ave
Lynnwood Manor,
Pretoria

for

Savannah Environmental (Pty) Ltd
216 Weltevreden Road.
PO Box 148,
Sunninghill,
2197

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## EXECUTIVE SUMMARY

The objectives of this study were to provide an assessment of potential impacts on flora, fauna and ecology by the proposed powerline infrastructure. This report comprises the ecological assessment of the study area for the Scoping study and serves to assist in assessing potential impacts of the proposed routes and thus assist in selecting a preferred route for the 50 km 400kV powerline.

The proposed project contains a number of route alternatives. These include two main route alternatives, the Western alternative and Eastern alternative, as well as some localised alternative routes, the Southern sub-alternative, the R555 sub-alternative and the Northern sub-alternative. There is also the Turn-in line in the south of the study area and the substation.

A literature survey was undertaken to describe broad vegetation patterns and compile a preliminary plant community map of the study area. This preliminary map was ground-truthed during a brief field visit from 25-27 June 2007. The published studies also provided an indication of species composition, diversity and the presence of plant species of special concern within different plant communities. The general status of the vegetation was derived by updating the National Landcover data layer for the study area. A list of Red Data flora species which could potentially occur within the study area was compiled on the basis of existing data (from SANBI) as well as from literature sources.

To assess the possible presence/absence of Red Data fauna species an assessment of the presence, status and linkage of available habitat in the study area was undertaken. The three parameters used to assess the probability of occurrence for each species were Habitat requirements, Habitat status and Habitat linkage.

Sensitivity of habitats and sites within the study area was assessed using a combination of criteria, including the following:

1. Conservation status of untransformed habitats occurring in the study area
2. Presence and number of Red Data Species and other Species of Special Concern
3. Within-habitat species richness of flora and the between-habitat (beta) diversity of the site
4. The type or nature of topography of the site, i.e. presence of ridges, koppies, etc.
5. The type and nature of important ecological processes on site, especially hydrological processes, i.e. wetlands, drainage lines etc.

Potential impacts are evaluated for each route alternative according to *magnitude*, *extent*, *duration* and *probability* and, based on the above, the rated significance of the impacts is given (rated "Low", "Medium" or "High").

The study area falls entirely within the area of the Sekhukhuneland Centre of Plant Endemism (SCPE). Three main subcentres have been identified for the SCPE, i.e. the Roossenekal Subcentre, the Leolo Mountain Subcentre and the Steelpoort Subcentre, within which the study area is located. The SCPE is poorly conserved, has been

transformed to some degree (approximately 29%) and is under pressure from new mining applications.

Within the study area there are five main vegetation types, namely Rand Highveld Grassland, Sekhukhune Mountain Bushveld, Sekhukhune Plains Bushveld, Sekhukhune Montane Grassland and Central Sandy Bushveld. On the basis of the brief site visit and published information, there are three broad plant communities that have been identified as occurring in the study area and potentially affected by the proposed infrastructure, namely *Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld, *Kirkia wilmsii-Acacia caffra* Mountain Bushveld and *Combretum eryhtrophyllum-Celtis africanus* Riparian Woodland.

Many highly localised species are threatened with extinction in Sekhukhuneland. There are 58 endemic and approximately another 70 near-endemic plant taxa in Sekhukhuneland as well as 46 taxa that provisionally meet the criteria for a category of threat. Twenty nine of these species could occur in habitats within the study area, 23 of which are most likely to occur in the *Kirkia wilmsii-Acacia caffra* Mountain Bushveld vegetation type. There are 13 Red List mammal species that have a HIGH chance of occurring in the study area as well as three Red List reptile species, one Red List amphibian and one Red List freshwater fish species. These are distributed amongst the different habitats, but the *Kirkia wilmsii-Acacia caffra* Mountain Bushveld vegetation type provides habitat for a greater proportion of these species than any other vegetation type.

A map of the sensitivity and conservation value of the different parts of the study area was produced showing the distribution of areas in different sensitivity classes (very low, low, medium, high, very high) relative to the proposed infrastructure. It is possible from this map to identify areas where there are possible conflicts between the alignment of the proposed infrastructure and areas of high sensitivity or conservation value.

The western alternative includes approximately 27km of natural area classified as being of High or Very High sensitivity. This includes approximately 4 km of Very High sensitivity area in the extreme northern end of the study area. The eastern alternative includes approximately 42km of natural area classified as being of High or Very High sensitivity. This includes approximately 26 km of Very High sensitivity area along the southern half of the alignment in the rocky hills. The southern and R555 sub-alternatives each includes approximately 1 km of natural area classified as being of High or Very High sensitivity. None of the northern sub-alternative includes any areas of natural area classified as being of High or Very High sensitivity. The turn-in line includes approximately 18 km of natural area classified as being of High or Very High sensitivity.

A number of potential impacts were identified and assessed, as follows (with significance in brackets):

1. Destruction or disturbance to sensitive ecosystems leading to reduction in the overall extent of a particular habitat (High-)
2. Destruction of vegetation in the footprint of tower structures leading to reduction in the overall extent of a particular habitat (Medium-)

3. Fragmentation of sensitive habitats (High-)
4. Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species (High/Medium)
5. Disturbance of natural vegetation through trampling, compaction by motor vehicles etc. leading to degradation or destruction of vegetation or habitat or loss of individuals of rare, endangered, endemic and/or protected species (Medium-)
6. Impairment of the movement and/or migration of animal species resulting in genetic and/or ecological impacts (High-)
7. Increased soil erosion, increase in silt loads and sedimentation (Medium-)
8. Establishment and spread of declared weeds and alien invader plants (Medium-)
9. Damage to wetland and riparian areas (High-)
10. Increased dust during construction leading to potential damage of habitat or displacement of animals (Low-)
11. Increased noise pollution during construction leading to potential displacement of individuals (Low-)
12. Increased risk of veld fires leading to damage to habitats or loss of individuals of species of concern or loss of vegetation production (Low-)

Recommendations for mitigation of impacts were to reduce the possibility of soil erosion, minimise invasion by alien plants, control dust on construction sites and avoid damage to sensitive habitats.

Some of the proposed alignments may have significant impacts on sensitive habitats, whereas other alignments are less likely to do so. For example, the eastern alternative crosses a much greater area of habitat classified as having Very High sensitivity than any other alignment. Ideally, all areas of Very High sensitivity should be avoided.

The eastern alternative is considered to be a very poor option from an ecological point of view. Selection of this alternative introduces four of the five impacts of high significance. In addition, the northern sub-alternative is preferred to the western alignment. The southern and R555 sub-alternatives are both acceptable, although there may be localised impacts on sensitive habitats. The western alternative is therefore preferred with the northern sub-alternative rather than the western alignment.

The substation site occurs in an area classified as having high sensitivity and is therefore less likely to have significant impacts than if it were placed within habitats classified as having Very High sensitivity. The site is acceptable for the proposed infrastructure when considered in the context of the overall sensitivity of the SCPE.

Recommendations for the EIA are to undertake the walk-through of habitats should be undertaken during the summer in order to be able to assess habitat properly as well as to have a higher probability of detecting species of special concern.

## REGULATIONS GOVERNING THIS REPORT

This report has been prepared in terms the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 - Specialist reports and reports on specialised processes under the Act. Relevant clauses of the above regulation are quoted below and reflect the required information in the "Control sheet for specialist report" given above.

*Regulation 33. (1):* An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.

*Regulation 33. (2):* A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

(a) details of (i) the person who prepared the report, and
(ii) the expertise of that person to carry out the specialist study or specialised process;
(b) a declaration that the person is independent in a form as may be specified by the competent authority;
(c) an indication of the scope of, and the purpose for which, the report was prepared;
(d) a description of the methodology adopted in preparing the report or carrying out the specialised process;
(e) a description of any assumptions made and any uncertainties or gaps in knowledge;
(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
(h) a description of any consultation process that was undertaken during the course of carrying out the study;
(i) a summary and copies of any comments that were received during any consultation process;
(j) any other information requested by the competent authority.

### Appointment of specialist

David Hoare of David Hoare Consulting CC was commissioned by Savannah Environmental (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment and Environmental Management Plan for the proposed Steelpoort Integration Project in the Limpopo Province. The consulting services comprise an assessment of potential impacts on the flora, fauna and ecology in the study area as a result of the proposed project.

**Details of specialist**

David Hoare
David Hoare Consulting CC
Postnet Suite no. 270
Private Bag X844
Silverton
0127

Telephone: (012) 804 2281
Fax: (012) 804 2281
Email: dhoare@lantic.net

**Summary of expertise**

David Hoare:

- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting CC, an independent consultancy, in 2001.
- Ecological consultant since 1995.
- Conducted, or co-conducted, over 120 specialist ecological surveys as an ecological consultant.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science at 2 universities and referee for 2 international journals.

**Independence:**

David Hoare Consulting CC and its Directors have no connection with ESKOM. David Hoare Consulting CC is not a subsidiary, legally or financially, of the proponent, remuneration for services by the proponent in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. The percentage work received directly or indirectly from the proponent in the last twelve months is approximately 6% of turnover.

**Scope and purpose of report**

The scope and purpose of the report are reflected in the "Terms of reference" section of this report

## TERMS OF REFERENCE

The contractually-defined objectives of this study were to provide an assessment of potential impacts on flora, fauna and ecology by the proposed infrastructure. The ecological assessment was to aim to determine a most preferred location for the proposed substation and transmission lines within the study area. It was therefore most important to identify any areas or locations that cannot be impacted by the substation site and/or crossed by these transmission lines. In order to provide pertinent recommendations, the following methodology was proposed:

1. Floristic diversity and variations:

Detailed investigation into the status of the vegetation, including:

- General floristic diversity;
- General status of vegetation;
- Status of primary vegetation;
- Habitat suitability for Red Data flora species;
- Potential presence of Red Data flora species;
- Perceived impacts that might result from the proposed development.

A list of Red Data flora species which could potentially occur within the study area was to be compiled on the basis of existing data (from SANBI, environmental and conservation authorities, etc.)

Expected outcomes of this part of the investigation will include descriptions of the floristic environment that will be influenced by the proposed development, the status and importance of the vegetation, sensitive areas will be identified and highlighted, and the likelihood of Red Data flora species occurring in the study area will be indicated. Potential impacts on vegetation will be included within the impact assessment.

2. Faunal habitat assessment and RD probabilities:

In order to present an ecological overview of the proposed substation sites and transmission line routes, and assess the potential impacts on the ecological environment it is imperative that the suitability of the proposed substation sites and transmission line routes for general faunal diversity and suitability for the potential presence of Red Data fauna species be investigated.

The most reliable manner, in which the presence/absence of Red Data fauna species can be assessed, without the aid of exhaustive trapping surveys, is by means of subjective assessments of the presence, status and linkage of available habitat in the study area. These attributes are rated for each species using the available literature and personal field experience.

Three parameters should be used to assess the probability of occurrence for each species:

*Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area are assessed;
*Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition is assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
*Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

The results from this assessment are to be integrated into the ecological impact evaluation.

Expected outcomes of this investigation will include an indication of the likelihood of Red Data fauna species occurring within specific areas, highlighting areas of any particular importance. These results will be incorporated into the Sensitivity Analysis and Ecological Impact Evaluation.

3. Exclusions

This study specifically excludes the following:

1. The avifauna impact assessment, which will be undertaken by a separate specialist.

## INTRODUCTION

Eskom Transmission appointed Savannah Environmental (Pty) Ltd to undertake an EIA and compile an EMP for the proposed Steelpoort Integration project. This project involves the following:

- Construction of a 400 kV substation at Steelpoort (in the vicinity of the proposed Steelpoort pumped storage scheme being proposed by Eskom Generation)
- Construction of 2x40 km 400 kV loop in and out the Duvha-Leseding 400kV line into the Steelpoort substation
- Construction of 50 km 400kV powerline between the proposed Steelpoort and existing Merensky substations
- Associated works to integrate the station into the Transmission grid (including the establishment of a communication tower, etc)

Currently, there is only one technically feasible site which has been identified for the substation, which is near to the lower dam of the pumped storage scheme. There are currently two proposed routes for the construction of the 50 km 400 kV powerline, both within 4 km of the existing R555 road between Roossenekal and Steelpoort (Figure 1). The first alternative runs along the north-western side of the road (the western alternative) and the second alternative runs along the south-eastern side of the road (the eastern alternative). The western and eastern alternative routes join approximately 11 km from the northern endpoint. There is a short northern alternative route along a portion of this section.

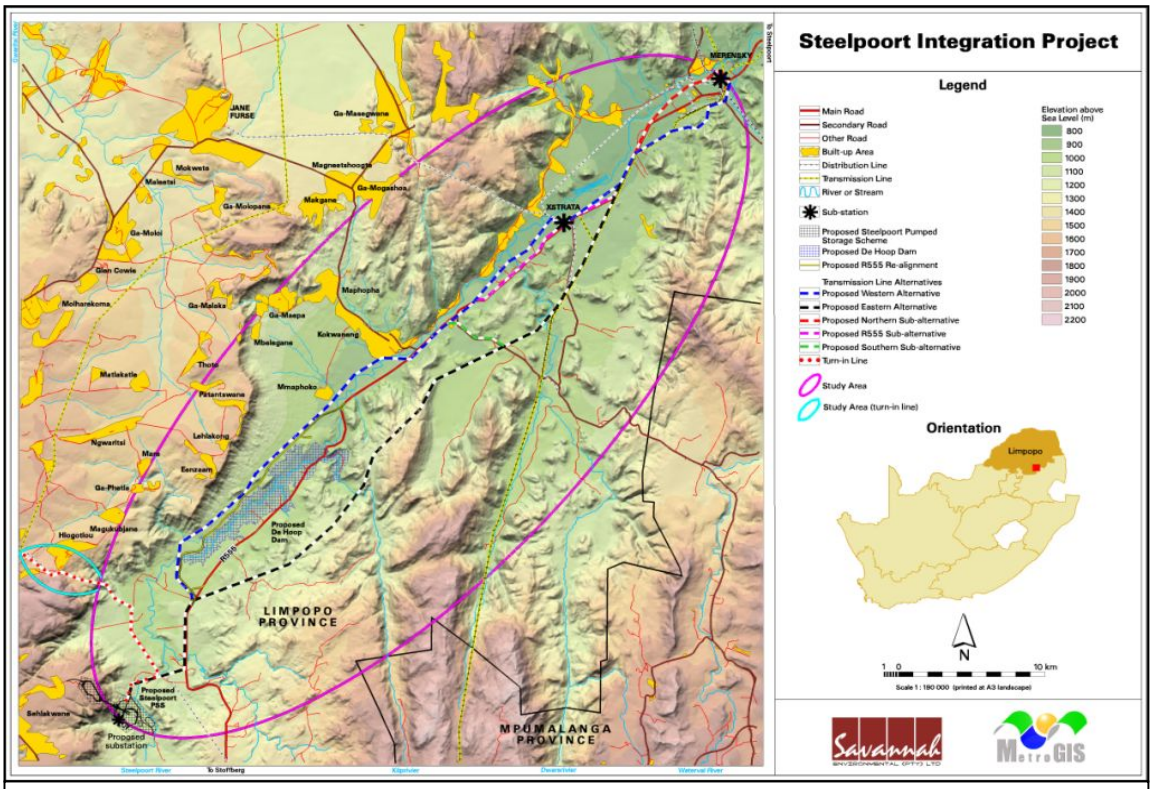


**Figure 1: General view of study area showing study area and alternative alignments.**

A full EIA process for the project is required, including a scoping study, an EIA and EMP. The study was to be on a regional level, with the detailed studies of the surveyed tower footprints to be undertaken during the detailed EMP phase (after Eskom have surveyed and pegged the approved route). David Hoare Consulting cc was appointed on 30 March 2007 by Savannah Environmental (Pty) Ltd to provide specialist ecological consulting services for the Environmental Impact Assessment and Environmental Management Plan for the proposed Steelpoort Integration Project in the Limpopo Province. The consulting services comprise an assessment of potential impacts on the flora, fauna and ecology in the study area by the proposed project

This report comprises the ecological assessment of the project study area for the Scoping study and serves to assist in assessing potential impacts of the proposed routes and thus assist in selecting a preferred route for the 50 km 400kV powerline. The report also assesses the proposed substation site in order to asssess whether the site is acceptable from an ecological perspective.

## METHODOLOGY

### Flora

A literature survey was undertaken to locate studies done in the area. From this, broad vegetation patterns and more detailed plant community descriptions were obtained. These descriptions were detailed enough to compile a preliminary plant community map of the study area (see Figure 4). This was done by mapping from aerial photographs of the study area using other environmental layers and maps for additional information, e.g. topography, land-types, etc. This preliminary map was ground-truthed during a brief field visit from 25-27 June 2007. The published studies were also sufficiently detailed to provide an indication of species composition, diversity and the presence of plant species of special concern within different plant communities.

From this process it was possible to describe the following attributes of the vegetation:

- Descriptions of the floristic environment that will be influenced by the proposed development;
- General floristic diversity;
- Habitat suitability for Red Data flora species;
- Potential presence of Red Data flora species;
- Importance of the vegetation and identification of sensitive areas.

The general status of the vegetation was derived by updating the National Landcover data layer for the study area (Fairbanks et al. 2000) using available aerial photography. From this it could be determined which areas were transformed and no longer had primary vegetation. From this process it was possible to describe the following attributes of the vegetation:

- General status of vegetation;
- Status of primary vegetation;

The general status of the vegetation was derived by updating the National Landcover data layer for the study area. A list of Red Data flora species which could potentially occur within the study area was compiled on the basis of existing data (from SANBI, environmental and conservation authorities, etc.) as well as from literature sources.

A list of Red Data flora species which could potentially occur within the study area was compiled on the basis of existing data (from SANBI, environmental and conservation authorities, etc.) as well as from literature sources. A preliminary list was compiled and staff from the Threatened Species Programme of SANBI was consulted to obtain the most recent IUCN statuses of these species. The updated list was then evaluated to determine which species were likely to occur in the available habitats in the study area.

Potential impacts on vegetation were included within the impact assessment (see below).

### Fauna

No exhaustive field surveys to determine the composition of the fauna was undertaken at this stage. To reliably assess the possible presence/absence of Red

Data fauna species an assessment of the presence, status and linkage of available habitat in the study area was undertaken. These attributes were rated for each species using the available literature and personal field experience in studying habitat patterns. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

**Sensitivity Analysis**

Sensitivity of habitats and sites within the study area was assessed using a combination of criteria, as follows:

| | **Criterion** | **Definition** |
|---|---|---|
| 1 | Conservation status of untransformed habitats occurring in the study area | The extent of each broad vegetation type occurring within the study area that is conserved and/or transformed relative to a targeted amount required for conservation |
| 2 | Presence and number of Red Data Species and other Species of Special Concern | Presence or potential presence of Red Data Species within habitats |
| 3 | Within-habitat species richness of flora and the between-habitat (beta) diversity of the site | Estimated per habitat type in the study area on the basis of existing knowledge/field data |
| 4 | The type or nature of topography of the site, i.e. presence of ridges, koppies, etc. | Steepness and/or nature of topography in the study area. |
| 5 | The type and nature of important ecological processes on site, especially hydrological processes, i.e. wetlands, drainage lines etc. | Habitats and/or terrain features that represent ecological processes, such as water-flow, migration routes, etc. |

The first two of these criteria are the most commonly used criteria for assessing the conservation value of a site and also constitute the criterion most commonly employed to justify the conservation of a site.

***Conservation status of vegetation***

On the basis of a recently established approach used at national level by SANBI (Driver et al. 2005), vegetation types can be categorised according to their

conservation status which is, in turn, assessed according to degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 1, as determined by best available scientific approaches (Driver et al. 2005).

**Table 1: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (minimum conservation requirement).**

| Habitat remaining (%) | | |
|---|---|---|
| 80–100 | least threatened | LT |
| 60–80 | vulnerable | VU |
| *BT–60 | endangered | EN |
| 0–*BT | critically endangered | CR |

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

The national status is based on 1996 National Landcover data (Fairbanks et al. 2000) and is, therefore, out of date. Additional transformation has taken place since 1996 and satellite data is also not able to distinguish secondary vegetation from untransformed vegetation (Hoare et al. in prep.). For this reason updated transformation information is often required to improve the conservation assessment. Landcover data supplemented with topocadastral data (1:50 000 series from the Surveyor General), aerial photographs, satellite data (Landsat TM) and field verification can be used to produce improved landcover maps to indicate areas that are considered to be transformed.

**Impact assessment**

Potential impacts are evaluated for each route alternative and the proposed sub-station site according to *nature* and *extent* These criteria are defined as follows:

1. Nature
   The nature of the impact is what the impact is / what it entails and whether it is a negative (destructive) or positive (beneficial) impact.

2. Extent of the impact
   A description of whether the impact will be: (1) local extending only as far as the development site area; or (2) limited to the site and its immediate surroundings (up to 10 km); or (3) will have an impact on the region, or (4) will have an impact on a national scale or (5) across international borders. The criterion is scored according to the number in brackets.

**Assumptions, uncertainties and gaps in knowledge**

1. Assume databases and literature sources are adequate for determining the possible presence of threatened species. These often depend on good geographical coverage of species observations, which is seldom the case.

2. Assume species threatened status has been correctly determined and that no other species should be on the Red Lists.

**Limitations**

Descriptions of vegetation are based primarily on literature review in combination with a single site visit in winter (June). The vegetation description and sensitivity map are based on relatively coarse data since no aerial photography was available to map plant communities accurately. There may therefore be relatively large inaccuracies in the location of boundaries between vegetation units and thus sensitivity classes. This is, however, acceptable in the context of establishing overall ecological sensitivity for comparative purposes.

## RESULTS: DESCRIPTION OF ECOLOGICAL PATTERNS WITHIN THE STUDY AREA

The following section provides a description of the environment that may be affected by the activity. This description includes patterns of flora and fauna within the study area.

### Vegetation biogeography

The study area falls entirely within the centre of the Sekhukhuneland Centre of Plant Endemism (van Wyk & Smith 2001) (Figure 2). The Sekhukhuneland Centre of Plant Endemism (SCPE) is defined on the basis of geology and corresponds to the surface outcrops of the Rustenburg Layered Suite of the eastern Bushveld Complex (SACS 1980; van Wyk & Smith 2001). The Sekhukhuneland Centre of Plant Endemism was described in detail by Van Wyk & Smith (2001), with the exact area being defined as bordered by the Highveld Escarpment to the south, Strydpoort Mountains to the north, the Steenkampsberg and Drakensberg to the east, and the Springbok Flats to the west. From the Steelpoort River valley which lies at about 900m, the Leolo Mountains rise to 1932 m, the highest point of the area. In the SCPE there are numerous eroded areas underlain by toxic soils that are considered to be natural features (Siebert 1998 in van Wyk & Smith 2001).

The SCPE falls within the rainfall shadow of the Drakensberg Escarpment, and it is relatively more arid than the areas to the east. The endemic plants of the SCPE are primarily edaphic specialists that are derived from the unique geology. The

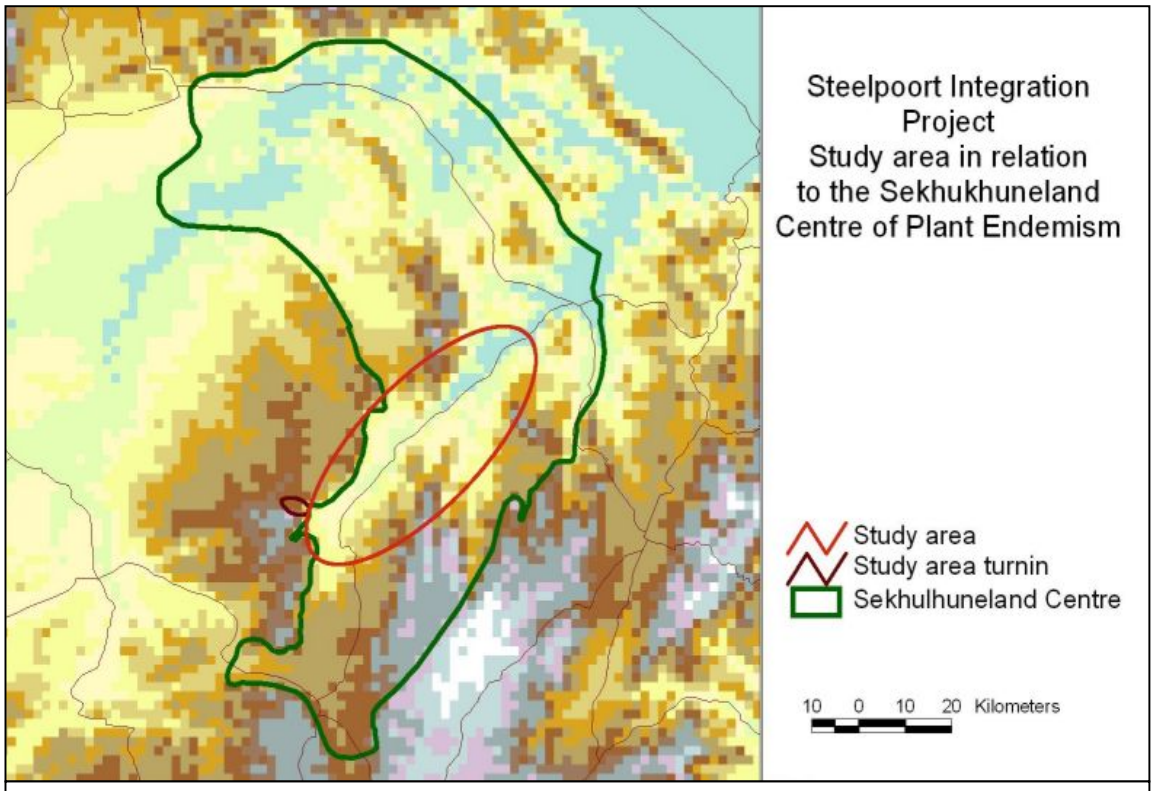


**Figure 2: Relationship of the Sekhukhuneland Centre of Plant Endemism (SCPE) to the study area.**

ultramafic substrates, norite, anorthosite and pyroxenite, show a significant positive correlation with percentage endemism (Siebert 1998 in van Wyk & Smith 2001). Heavy-metal soils are derived from these formations. Endemics are both herbaceous and woody with endemism high in the Anacardiaceae, Euphorbiaceae, Liliaceae (incorporating Asphodelaceae) and Lamiaceae (VanWyk & Smith 2001).

Three main subcentres have been identified for the SCPE (Siebert et al. 2002), based on the distribution of endemic/near-endemic and threatened plant taxa recorded for each of these areas (Siebert 1998):

a) Roossenekal Subcentre (Roossenekal-Dwars River area). This is the most southern plant diversity 'hotspot' and is characterised by undulating norite hills. This 1 000 $km^2$ area is a unique ecotone between the Highveld and Lowveld of South Africa. A total of 62 (30/33) SCPE endemics/near-endemics and nine newly assessed Red List taxa occur in this subcentre. Six taxa are exclusively endemic to this subcentre.

b) Leolo Mountain Subcentre. The subcentre is merely a geological extension of the former, but is isolated by broad, dry valleys. The Leolo Mountains harbour relict patches of Afromontane Forest and there are rare wetland systems on the summit. There are 29 (19/10) SCPE endemics/near-endemics and eight newly assessed Red List taxa in this 400 $km^2$ subcentre. Five taxa are endemic to this subcentre only.

c) Steelpoort Subcentre (Steelpoort-Burgersfort area). It is located in the larger Steelpoort River valley, where it comprises undulating norite, pyroxenite and magnetite outcrops and hills, and dongas (areas of weak structured soils). This 2 600 $km^2$ is the core region of the SCPE and it is a unique *Kirkia wilmsii*-dominated mountain bushveld. There are 86 (44/42) SCPE endemics/near-endemics and 16 newly assessed Red Data List taxa in this subcentre. Twenty taxa are endemic to this centre and occur nowhere else.

***Conservation within the SCPE***

The Sekhukhuneland Centre is in urgent need of legal protection. There are no proclaimed nature reserves within the Mpumalanga portion of the SCPE and there is only one small reserve offering the SCPE some form of legal protection in Limpopo Province; that is the 2 800 ha Potlake Nature Reserve. It is estimated that approximately 29% of the SCPE has already been transformed

The SCPE forms part of the Bushveld (Igneous) Complex, which has ultramafic layers, the largest reserves of chrome and platinum-group metals in the world (VanWyk & Smith 2001). Surface outcrops of iron-rich chromite and vanadium are being removed at a rapid rate by strip or opencast mining, usually without any detailed knowledge of the flora on these sites (Siebert 2001). This mineral wealth has resulted in the operation of numerous mines in the Sekhukhuneland area causing the large-scale loss of valuable habitat.

**Vegetation**

Vegetation may be described at various hierarchical levels from Biome, to broad Vegetation Type and down to Plant Community level associated with local habitat conditions. The following section describes patterns within the study area at these three levels.

The vegetation in this region has been studied in some detail (Abbott & Arkell 1998; Siebert 1998, 2001; Siebert et al. 2001, 2002a, b, c, d), although it is difficult to ascertain whether any particular point of interest within the study area has been studied. There has also been some local scale, unpublished studies undertaken as specialist studies for EIAs in the study area. There is therefore adequately published information that can be used to place the current study area in context (see Mucina et al. 2000), as well as the broad descriptions of Acocks (1953, 1988), Low and Rebelo (1998) and Mucina et al. (2006).

The study area falls within parts of both the Savanna and Grassland Biomes (Rutherford & Westfall 1986). The most recent and detailed description of the vegetation of this region is part of a national map recently completed (Mucina, Rutherford & Powrie, 2005; Mucina et al. 2006). This map shows a number of vegetation types occurring in the study area and immediate surroundings (Figure 3). The map indicates that most of the study area within which the proposed route alternatives occur falls within Sekhukhune Mountain Bushveld. Other vegetation types that occur along the proposed route and that may be affected are Sekhukhune Plains Bushveld, Sekhukhune Montane Grassland and Rand Highveld Grassland.

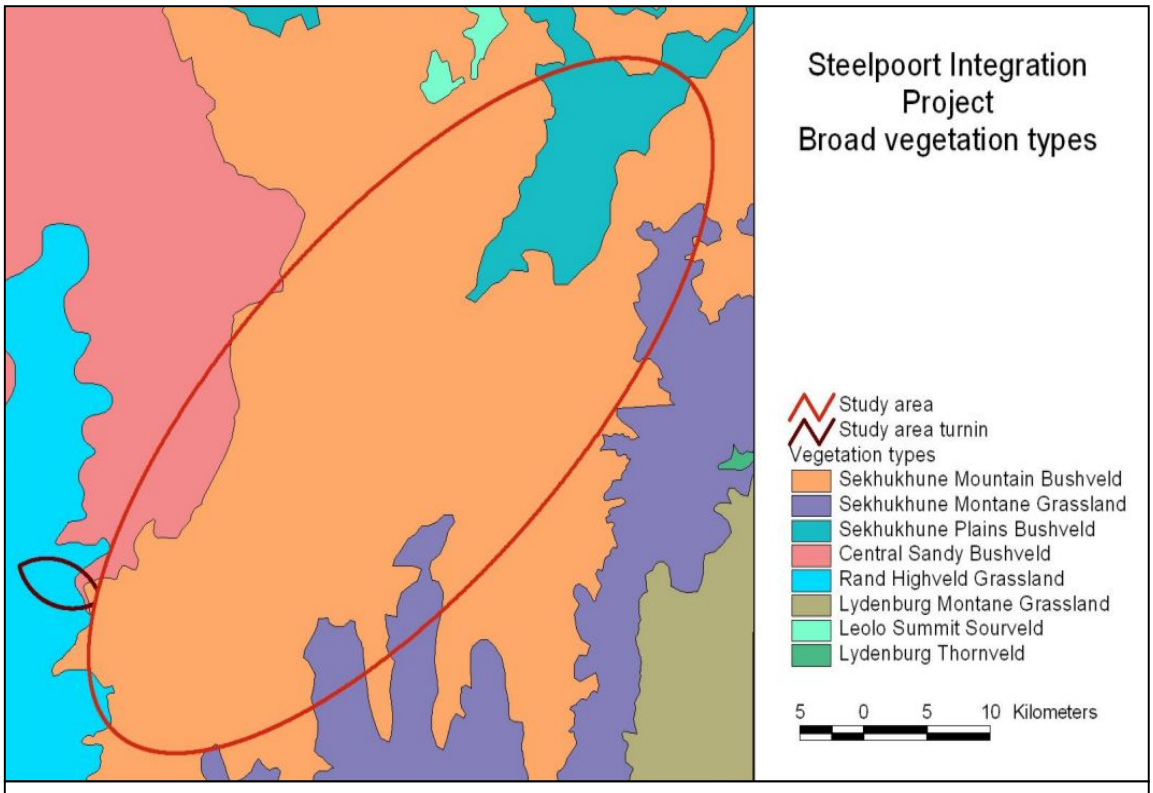


**Figure 3: Vegetation types of the study area and immediate surroundings showing study area and proposed alternative alignments.**

These vegetation types are described in more detail below. Central Sandy Bushveld also occurs in the study area, but this will not be affected by the proposed infrastructure, except for a small piece that may be affected by the turn-in line..

***Sekhukhune Mountain Bushveld***
This is a dry, open to closed microphyllous and broad-leaved savanna on hills and mountain slopes that form concentric belts parallel to the north-eastern escarpment. The open bushveld is often associated with ultramafic soils on southern aspects and contain a high diversity of edaphic specialists. The bushveld of mountain slopes is generally taller than in the valleys. The bushveld of valleys and dry northern aspects is usually dense, like thicket. This vegetation unit is approximately equivalent to the major vegetation type described by Siebert et al. (2002) as a mixture of *Kirkia wilmsii-Terminalia prunellioides* Closed Mountain Bushveld and *Combretum hereorense-Grewia vernicosa* Open Mountain Bushveld. Siebert et al. (2002) indicate that these two communities are floristically very similar and occur in the same geographic region.

This vegetation type is considered to be Least Threatened (refer to table 2). Although none is conserved, approximately 15% is transformed, mainly by cultivation and urbanisation. An increasing area is under threat from mining activities. This vegetation type forms part of the Steelpoort Subcentre of the SCPE. It is the most widespread vegetation type in the study area, but incorporates the greatest diversity of plant communities.

***Sekhukhune Plains Bushveld***
This is a short, open to closed thornveld occurring on the mainly semi-arid plains and open valleys between the chains of hills and small mountains running parallel to the escarpment. Encroachment by indigenous microphyllous trees and invasion by alien species is common. This is approximately equivalent to the major vegetation type described by Siebert et al. (2002) as *Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld.

This vegetation type is considered to be Vulnerable (refer to Table 2) with 2% conserved of a target of 19% and approximately 25% transformed, mainly by dry-land subsistence cultivation. The vegetation is heavily degraded in places and over-exploited for cultivation, mining and urbanisation. There is a small amount of pressure from chrome and platinum mining and associated infrastructure

***Sekhukhune Montane Grassland***
This is a dense, short, sour grassland that occurs in the major chain of hills that transect the area and have a north-south orientation, creating moderately steep slopes with predominantly eastern and western aspects. This vegetation type comprises the Roossenekal Subcentre of the SCPE. It contains heterogenous rocky habitats and there may be scattered shrubs and trees in sheltered habitats. This is approximately equivalent to the major vegetation type described by Siebert et al. (2002) as *Themeda triandra-Senecio microglossus* Cool Moist Grassland.

This vegetation type is considered to be Vulnerable (Table 2) with none conserved of a target of 24%, and approximately 30% transformed, mainly by commercial and

subsistence cultivation. Vast areas are mined for vanadium using strip mining and in recent years mining of gabbro has increased substantially.

***Rand Highveld Grassland***
This is a species rich wiry grassland alternating with low shrubland on rocky outcrops and steeper slopes. It is a widely distributed vegetation type that probably encompasses a lot of floristic variation. On the highveld it occurs on the plains between the ridges, but towards Sekhukhuneland it extends onto the ridges and is replaced on the plains by other vegetation types.

This vegetation type is considered to be Endangered (refer to Table 2) with 1% conserved of a target of 24%, and approximately 49% transformed, mainly by cultivation, plantations, urbanisation and dam-building. The rates of transformation are probably higher than reported and many of the untransformed areas have been degraded by poor management practices.

***Central Sandy Bushveld***
This is a vegetation type consisting of tall deciduous *Terminalia sericea* and *Burkea africana* woodland on deep sandy soils and low broad-leaved *Combretum* woodland on shallow, rocky or gravelly soils. It occurs on undulating terrain from Pilanesberg to near Doorndraai Dam. In the study area it more-or-less marks the western boundary of the SCPE.

This vegetation type is considered to be Vulnerable (refer to Table 2) with <3% conserved of a target of 19%, and approximately 24% transformed, mainly by cultivation and urbanisation.

**Conservation status of broad vegetation types**
Of the four vegetation types occurring in the study area (Table 2), Rand Highveld Grassland is considered to be Endangered, Sekhukhune Mountain Bushveld is considered to be Least Threatened, Sekhukhune Plains Bushveld is considered to be Vulnerable and Sekhukhune Montane Grassland is considered to be Vulnerable (Driver et al. 2005; Mucina et al., 2006).

**Table 2: Conservation status of different vegetation types occurring in the study area, according to Driver et al. 2005 and Mucina et al. 2005.**

| Vegetation Type | Target (%) | Conserved (%) | Transformed (%) | Conservation status |
|---|---|---|---|---|
| Rand Highveld Grassland | 24 | 1 | 49 | Endangered |
| Sekhukhune Mountain Bushveld | 24 | 0.4 | 15 | Least Threatened |
| Sekhukhune Plains Bushveld | 19 | 2 | 25 | Vulnerable |
| Sekhukhune Montane Grassland | 24 | 0 | 30 | Vulnerable |
| Central Sandy Bushveld | 19 | <3 | 24 | Vulnerable |

**Plant communities**

The plant communities of the Sekhukhune region have been studied and described in detail by Stefan Siebert (Siebert 2001, Siebert et al. 2001, 2002, 2003). The objectives of his studies were to identify, classify and describe the various plant communities in Sekhukhuneland in order to obtain a better knowledge of the plant diversity of the region (Siebert et al. 2003). The vegetation of the SCPE can be broadly described as mountain bushveld that forms a mosaic with moist grassland in the south and semi-arid bushveld in the north. A characteristic feature of the entire region is the scattered rocky outcrops within this region of undulating hills and mountains. Siebert et al. (2002) describe six major vegetation formations in the SCPE. as follows:

1. *Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld
2. *Kirkia wilmsii-Terminalia prunelliodes* Closed Mountain Bushveld
3. *Combretum hereorense-Grewia vernicosa* Open Mountain Bushveld
4. *Hippobromus pauciflorus-Rhoicissus tridentata* Rock Outcrop Vegetation
5. *Themeda triandra-Senecio microglossus* Cool Moist Grasslands
6. *Fuirena pubescens-Schoenoplectus corymbosus* Wetland Vegetation.

The Rock Outcrop and Wetland Vegetation are azonal and cross major vegetation type boundaries, whereas the other four are zonal and restricted to specific geographic regions. Siebert et al. (2002) list dominant, diagnostic and characteristic species for these vegetation types as well as endemic, sub-endemic and threatened plant species found in each vegetation type. For each major vegetation type they also describe a hierarchy of plant communities associated with specific habitats. For example, the *Kirkia wilmsii-Terminalia prunelliodes* Closed Mountain Bushveld is described as having 20 plant communities (Siebert et al. 2002b). There is, therefore, detailed information to assess any habitat within the study area in terms of broad plant species composition as well as the potential presence of threatened and endemic/near endemic plant species. The challenge is to link the published description with a mapped region on the ground.

On the basis of the brief site visit and published information, there are three broad plant communities which have been identified as occurring in the study area and potentially affected by the proposed infrastructure as well as two others that occur in the defined study area (Figure 4). The three potentially affected plant communities are described below:

**1. *Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld**

(Sekhukhune Plains Bushveld)

This vegetation occurs in the moderately arid and warmer bottomlands of the Steelpoort River valley and other dry valleys between the mountains. It is a sparse to dense thornveld reaching a height of 3m. The most abundant and characteristic species are the small trees, *Acacia tortilis*, *Boscia foetida* and *Dichrostachys cinereus*, the forbs, *Becium filamentosum*, *Felicia clavipilosa*, *Gisekia africana*, *Hermannia odorata* and *Melhania rehmannii*, and the grasses, *Aristida congesta*, *Enneapogon cenchroides*, *Enneapogon scoparius* and *Urochloa mossambicensis*.

**2. *Kirkia wilmsii-Acacia caffra* Mountain Bushveld**

(Sekhukhune Mountain Bushveld)
On the basis of close floristic similarities, this vegetation type includes three vegetation types described by Siebert et al. (2002) combined into a single alliance, namely *Kirkia wilmsii-Terminalia prunelliodes* Closed Mountain Bushveld (the most common floristic unit), *Combretum hereorense-Grewia vernicosa* Open Mountain Bushveld and *Hippobromus pauciflorus-Rhoicissus tridentata* Rock Outcrop Vegetation. The vegetation type occurs on mountain slopes underlain by norite and pyroxenite, as well as on anomolous soils with high concentrations of heavy metals as well as sheltered habitats of rock outcrops, ridges, flats and boulders. Common species include the trees and shrubs, *Acacia nigrescens*, *Commiphora mollis*, *Acacia senegal* var *leiorachis*, *Combretum apiculatum*, *Combretum hereroense*, *Grewia vernicosa*, *Tinnea rhodesiana*, *Vitex obovata* subsp *wilmsii*, *Kirkia wilmsii* and *Terminalia prunellioides*. Diagnostic species occurring in this vegetation order include *Aloe burgersfortensis*, *Asparagus sekhukhuniensis*, *Catha transvaalensis*, *Elephantorrhiza praetermissa*, *Euphorbia sekukuniensis*, *Hibiscus barnardii*, *Jamesbrittenia macrantha*, *Plectranthus venterii*, *Rhoicissus sekhukhuniensis*, *Vitex obovata* subsp *wilmsii* and *Zantedischia pentlandii*.

**3. *Combretum eryhtrophyllum-Celtis africanus* Riparian Woodland**
This woodland occurs on the riverbanks of the Steelpoort River on level to moderate slopes and deep alluvium. The vegetation is a gallery forest that is characterised by the presence of woody species such as *Celtis africana*, *Combretum erythrophyllum*, *Ficus sur*, *Acacia karroo*, *Kirkia wilmsii*, *Peltophorum africanum*, *Schotia brachypetala*, *Ziziphus mucronata*, *Melia azeradach* and *Olea europea*.

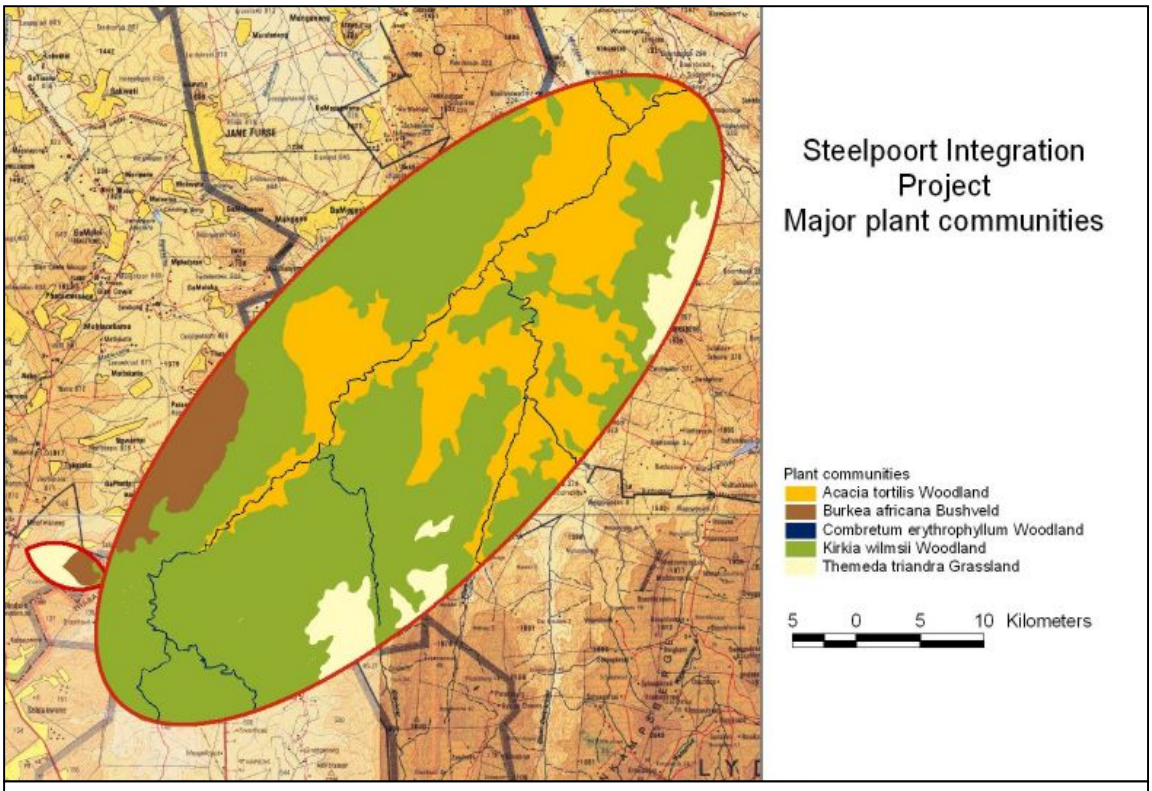


**Figure 4: Major plant communities of the study area and immediate surroundings showing study area and proposed alternative alignments.**

**4. *Themeda triandra-Senecio microglossus* Cool Moist Grasslands**
(Sekhukhune Montane Grassland)
These grasslands occur on the higher altitude regions and plateau of the mountains. Soils are generally very shallow and the vegetation is very dense short grassland with scattered woody species. Cool climate, winter frosts, seasonal fires and shallow soils are the defining ecological conditions under which these grasslands occur. Dominant species include *Brachiaria serrata*, *Diheteropogon amplectens*, *Elionurus muticus*, *Setaria sphacelata*, *Themeda triandra* and *Tristachya leucothrix*. According to the proposed routes provided, this vegetation type will not be affected by the proposed infrastructure.

**5. *Burkea africana-Combretum apiculatum* Open Mountain Bushveld**
(Central Sandy Bushveld)
This occurs on the highland plateau in the south-west of the study area. The description is as for Central Sandy Bushveld. According to the proposed routes provided (Figure 1), this vegetation type will be affected by the proposed turn-in line.

**Plant species of special concern**
The objective of this section was to compile a list of plant species for which there is conservation concern. This includes threatened, rare, declining, protected and endemic or near endemic plant species.

Lists of threatened plant species previously recorded in the study area in which the proposed infrastructure is situated were obtained from the South African National Biodiversity Institute (SANBI) and literature sources for the entire SCPE. These are listed in Appendix 2. The species on this list were checked for recent IUCN assessments or, where recent assessments were not available, the published assessment according to a recent publication of threatened plant species in the area (Siebert et al (2002d) was accepted as correct. The list contained 36 species for the SCPE assessed according to IUCN Ver. 3.1 (IUCN, 2001) criteria. Three of these are listed as Critically Endangered, three as Endangered, twelve as Vulnerable, six as Near Threatened and five as Data Deficient. There were also seven species listed as Least Concern, but either Rare or Declining (Appendix 2). Some of these species are also endemic to the SCPE. There are an additional ten species that are not considered to be threatened, but are endemic to the SCPE.

Many highly localised species are threatened with extinction in Sekhukhuneland. This situation arises because the region is rich in ultramafic-induced endemic plant species (Siebert 1998), and the substrate to which they are endemic is being utilised for mining purposes. There are 58 endemic and approximately another 70 near-endemic plant taxa in Sekhukhuneland. Appendix 1 provides details of 46 taxa that provisionally met the criteria for a category of threat, i.e. Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) or a near threatened category. Appendix 1 also provides details of 31 taxa that were previously listed by Hilton-Taylor (1996) but are no longer considered threatened, as well as those with uncertain status.

The species listed were allocated to one of three sub-centres within the SCPE. This division was useful since the proposed infrastructure affects two of the sub-centres (one only partially) and species found only within vegetation of the third sub-centre could be discarded from further consideration.

On the basis of habitat preferences the species could be allocated to habitats within the study area where they are most likely to be found (Table 3).

**Table 3: The number of plant species of special concern that are likely to occur in the different plant communities found in the study area.**

| Plant community | Number of threatened plant species |
|---|---|
| *Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld | 4 species (1 EN) |
| *Kirkia wilmsii-Acacia caffra* Mountain Bushveld | 23 species (2 CR, 2 EN, 6 VU) |
| *Themeda triandra-Senecio microglossus* Cool Moist Grasslands | 12 species (1 CR, 2 VU) |
| *Burkea africana-Combretum apiculatum* Open Mountain Bushveld | 6 species |
| *Combretum eryhtrophyllum-Celtis africanus* Riparian Woodland | 2 species (1 VU) |

**Animal species of special concern**

The objective of this section was to compile a list of animal species for which there is conservation concern. Species discussed are those that have been previously recorded from either Mpumalanga or Limpopo Provinces, since the Sekhukhuneland area occurs on the boundary between these two provinces. These species are listed in Appendix 2. Those species with a geographical distribution that includes the study area are discussed further.

***Mammals***

There are thirteen Red List mammal species that have a HIGH chance of occurring in the study area, many of which have been previously recorded in grids within the study area. Three of these species, the Spotted necked otter, Swamp musk shrew and Water rat, occur in aquatic, semi-aquatic or marshy habitats. Two species, the Greater dwarf shrew and Pangolin, are dependant on the presence of ants and/or termites or termite mounds. One species, the Rock dormouse, occurs entirely in rocky terrain and, in the study area, the Lesser grey-brown musk shrew occurs in rocky areas. A single species of bat, Welwitsch's hairy bat, roosts in shrubs and trees. The remaining five species, the African weasel, Brown hyena, Honey badger, Single-striped mouse and Southern African hedgehog, have wide habitat tolerances or more catholic requirements and it is difficult to establish a link with a single vegetation type or habitat and these species.

***Reptiles***

There are three Red List reptile species that could occur in the study area, i.e. the African rock python, the Swazi rock snake and the Variegated wolf snake. All three of these species have a HIGH chance of occurring in the study area and, on the basis of

habitat requirements, are most likely to occur in rocky habitats, either on rocky outcrops or in rocky, well-wooded valleys.

***Amphibians***

There is one Red List amphibian that could occur in the study area, the Giant bullfrog. This species occurs in seasonal, shallow grassy pans in flat open areas, but also utilises non-permanent vleis and shallow water on the margins of waterholes and dams. It has not previously been recorded in the study area and, on the basis of habitat requirements, has a MEDIUM chance of occurring in the study area.

***Fish***

There is one Red List freshwater fish species that occurs in the study area, the Marico barb (*Barbus motebensis*). This species, classified as Vulnerable, occurs in the headwater tributaries of the Marico, Crocodile and Steelpoort branches of the Limpopo River system. It is known to occur in palustrine wetlands (marshes, swamps, floodplains) associated with riverine wetlands and man-made dams.
Most likely potential impacts: river siltation due to construction impacts

**Table 4: The number of animal species of special concern that are likely to occur in the different plant communities found in the study area.**

| Plant community | Number of threatened plant species |
|---|---|
| *Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld | 8 species (8 mammals) |
| *Kirkia wilmsii-Acacia caffra* Mountain Bushveld | 12 species (9 mammals, 3 reptiles) |
| *Themeda triandra-Senecio microglossus* Cool Moist Grasslands | 6 species (6 mammals) |
| *Burkea africana-Combretum apiculatum* Open Mountain Bushveld | 7 species (7 mammals) |
| *Combretum eryhtrophyllum-Celtis africanus* Riparian Woodland | 8 species (6 mammals, 1 amphibian, 1 fish) |

## SENSITIVITY ASSESSMENT

### Sensitivity of different parts of study area

The classification of the study area into different sensitivity classes is based on information collected at various levels. This includes the national conservation status of the vegetation, the presence of species of special concern and the condition of the vegetation.

The study identified a number of vegetation types occurring in the study area. These vegetation types have been identified at a national level as having different conservation values depending on the amounts conserved and transformed. A summary of these is given in Table 2. Vegetation types with a higher conservation value are assigned a higher sensitivity score relative to the most transformed vegetation type, according to the following formula:

((log ((transformed % / (100 - target %)) x 100)) / 2) x 100

| | |
|---|---|
| *Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld | 74% |
| *Kirkia wilmsii-Acacia caffra* Mountain Bushveld | 65% |
| *Themeda triandra-Senecio microglossus* Cool Moist Grasslands | 80% |
| *Burkea africana-Combretum apiculatum* Open Mountain Bushveld | 74% |
| *Combretum eryhtrophyllum-Celtis africanus* Riparian Woodland | 90% |

A number of threatened plants and animals may occur in the study area. These are

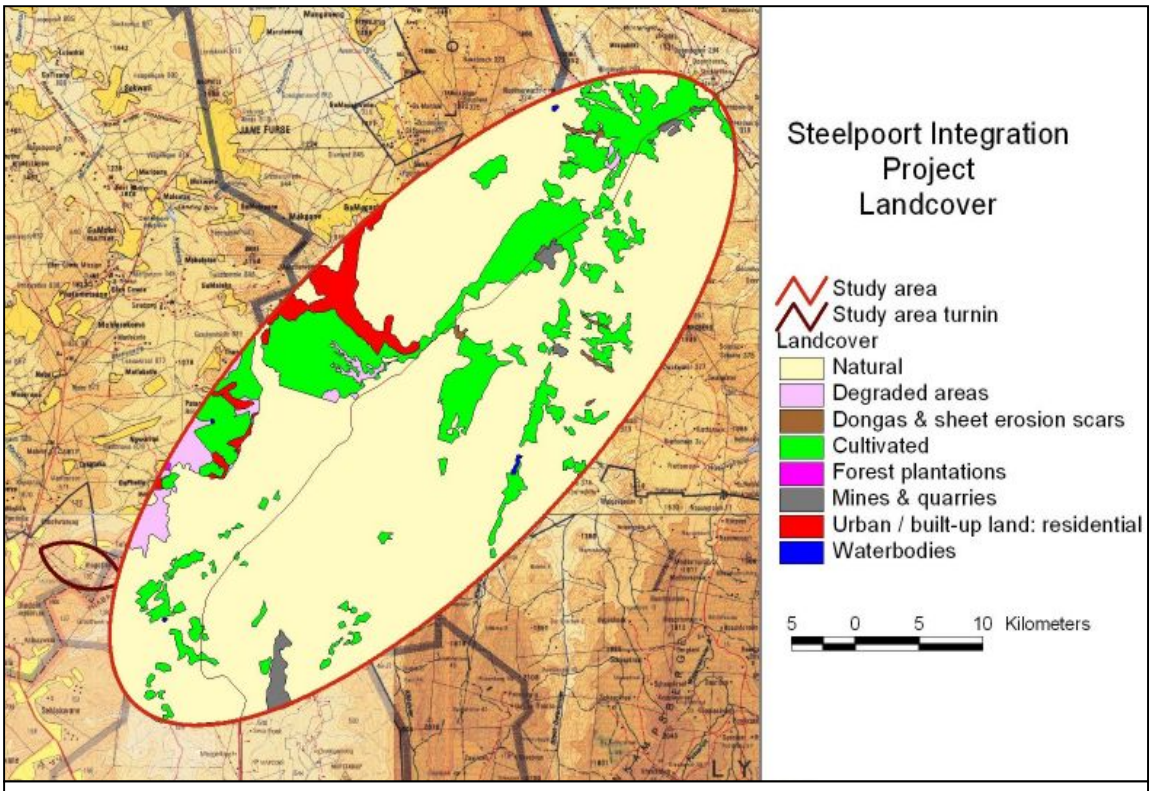


**Figure 5: Landcover of the study area showing natural and transformed areas.**

restricted to particular habitat types and, on the basis of habitat preference, can be assigned as being likely to occur in particular vegetation types. The likelihood of threatened plants or animals occurring in different vegetation communities is given in Table 3 and 4. Some species may be found across a number of vegetation types and have therefore been given a lower score in terms of specific habitat requirements. A summary of the most threatened species that are dependant on a particular habitat is given in Table 5. Vegetation communities with a higher chance of harbouring species of special concern are assigned a higher sensitivity score. This is done by assigning the plant community with the highest numbers of dependant species a 100% score and the others a proportionate score relative to the number of dependant species that they harbour (log scale).

**Table 5: The number of threatened species that are highly dependant on particular plant communities found in the study area.**

| | **Plant community** | **Number of dependant species** | **Sensitivity score (%)** |
|---|---|---|---|
| *1* | *Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld | 1 species | 44 |
| *2* | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld | 13 species | 100 |
| *3* | *Themeda triandra-Senecio microglossus* Cool Moist Grasslands | 3 species | 68 |
| *4* | *Burkea africana-Combretum apiculatum* Open Mountain Bushveld | 0 species | 0 |
| *5* | *Combretum eryhtrophyllum-Celtis africanus* Riparian Woodland | 3 species | 68 |

The study area has some areas that have been transformed by various factors, including cultivation, mining and urban areas (Figure 5). There are also some degraded areas close to large urban settlements and some severe donga erosion. The degraded and transformed areas have been assigned a sensitivity score of very low since they have little capacity to harbour biodiversity or threatened species and do not contribute to the conservation of vegetation patterns. This does not imply that they have no natural value, but that they have reduced conservation value in terms of preserving patterns of species distribution and species composition.

The above factors have all been taken into account to define areas with different sensitivity and conservation value. This was done by adding sensitivity scores for the different components and obtaining a percentage sensitivity value for each vegetation community. The scores and summary is given in Table 6. A map of the sensitivity and conservation value of the different parts of the study area is shown in Figure 6, which shows the distribution of areas in different sensitivity classes (very low, low, medium, high, very high) relative to the proposed infrastructure. It is possible from this map to identify areas where there are possible conflicts between the alignment of the proposed infrastructure and areas of high sensitivity or conservation value.

**Table 6: The sensitivity scores for the plant communities found in the study area. Plant communities are according to the numbers in Table 5.**

| Criterion | 1 | 2 | 3 | 4 | 5 | Trans-formed areas |
|---|---|---|---|---|---|---|
| Conservation status of untransformed habitats | 74 | 65 | 80 | 74 | 90 | 0 |
| Presence and number of Red Data Species | 44 | 100 | 68 | 0 | 68 | 0 |
| Within-habitat species richness and between-habitat (beta) diversity of the site | 50 | 90 | 75 | 90 | 50 | 0 |
| The type or nature of topography of the site | 40 | 90 | 70 | 80 | 40 | 30 |
| The type and nature of important ecological processes on site, especially hydrological processes | 30 | 60 | 40 | 60 | 100 | 20 |
| **TOTAL (%)** | **48** | **81** | **67** | **61** | **70** | **10** |

*Sensitivity: <20 = very low, 20–40 = low, 40–60 = medium, 60–80 = high, >80 = very high.

The proportions of different parts of the study area in different sensitivity classes is as follows: very low (16.0%), low (14.9%), medium (0.8%), high (45.9%), very high (22.4%).

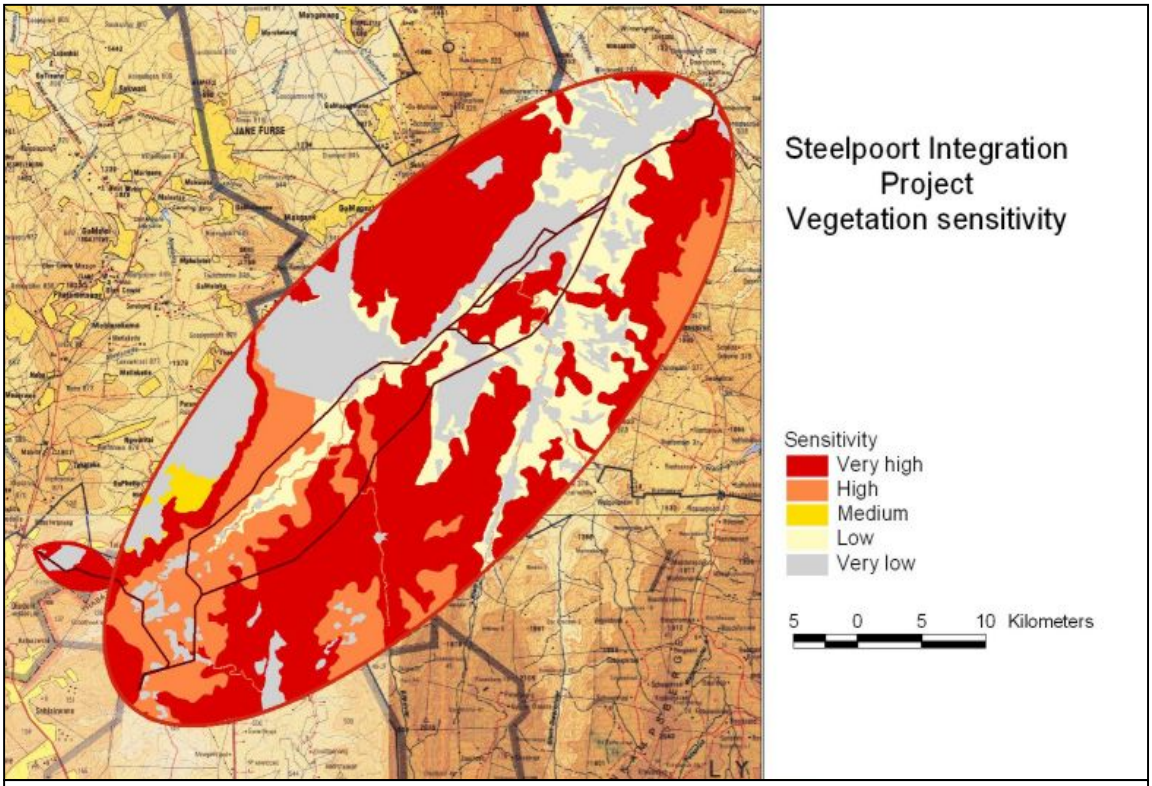


**Figure 6: Habitat sensitivity / conservation value of the study area.**

**Sensitivity of different route alternatives**

The proposed project contains a number of route alternatives and the proposed substation. These route alternatives include two main route alternatives, the Western alternative and Eastern alternative, as well as some localised alternative routes, the Southern sub-alternative, the R555 sub-alternative and the Northern sub-alternative. There is also the Turn-in line in the south of the study area. These different routes were analysed to determine the proportions and distances that each passes through different land sensitivity classes, as shown in Figure 6. A summary of the estimated different proportions is given in Table 7

**Table 7: Estimated proportions of each route alternative in different sensitivity classes (distances and proportions are estimated using a relatively course analysis technique).**

| Route | Approximate distance | Proportion in different sensitivity classes (%) | | | | |
|---|---|---|---|---|---|---|
| | | Very low | Low | Medium | High | Very high |
| Western alternative | 79 km | 32 | 34 | 0 | 29 | 5 |
| Eastern alternative | 72 km | 17 | 25 | 0 | 22 | 36 |
| Southern sub-alternative | 6 km | 23 | 62 | 0 | 0 | 15 |
| R555 sub-alternative | 16 km | 63 | 30 | 0 | 1 | 6 |
| Northern sub-alternative | 12 km | 80 | 20 | 0 | 0 | 0 |
| Turn-in line | 23 km | 21 | 0 | 0 | 46 | 33 |

The western alternative includes approximately 27km of natural area classified as being of High or Very High sensitivity. This includes approximately 4 km of Very High sensitivity area in the extreme northern end of the study area (see Figure 7). The 23 km of High sensitivity area is alongside the north-western side of the proposed dam and road re-alignment on the undulating lowlands.

The eastern alternative includes approximately 42km of natural area classified as being of High or Very High sensitivity. This includes approximately 26 km of Very High sensitivity area along the southern half of the alignment in the rocky hills. The 16 km of High sensitivity area is in the southern end of the study area on the undulating lowlands.

The southern sub-alternative includes approximately 1 km of natural area classified as being of High or Very High sensitivity. This is at the base of some hills next to an existing road and cultivated area and most of the sensitive portions are where the alignment touches the hills.

The R555 sub-alternative includes approximately 1 km of natural area classified as being of High or Very High sensitivity. This is at the base of some hills next to an existing road and cultivated area overlooking the Steelpoort River and most of the sensitive portions are where the alignment touches the hills.

None of the northern sub-alternative includes any areas of natural area classified as being of High or Very High sensitivity.

The turn-in line includes approximately 18 km of natural area classified as being of High or Very High sensitivity. This includes approximately 10.5 km of Very High sensitivity area at the top of the escarpment. The 7.5 km of High sensitivity area is in the southern end of the study area on the lowlands.

Sites where the proposed alignments cross habitats classified as having Very High sensitivity are shown in Figure 7. Where they are shown in dark brown, they represent sites with impacts of potentially high significance, whereas those shown in orange represent sites where the impacts are not likely to be as significant.

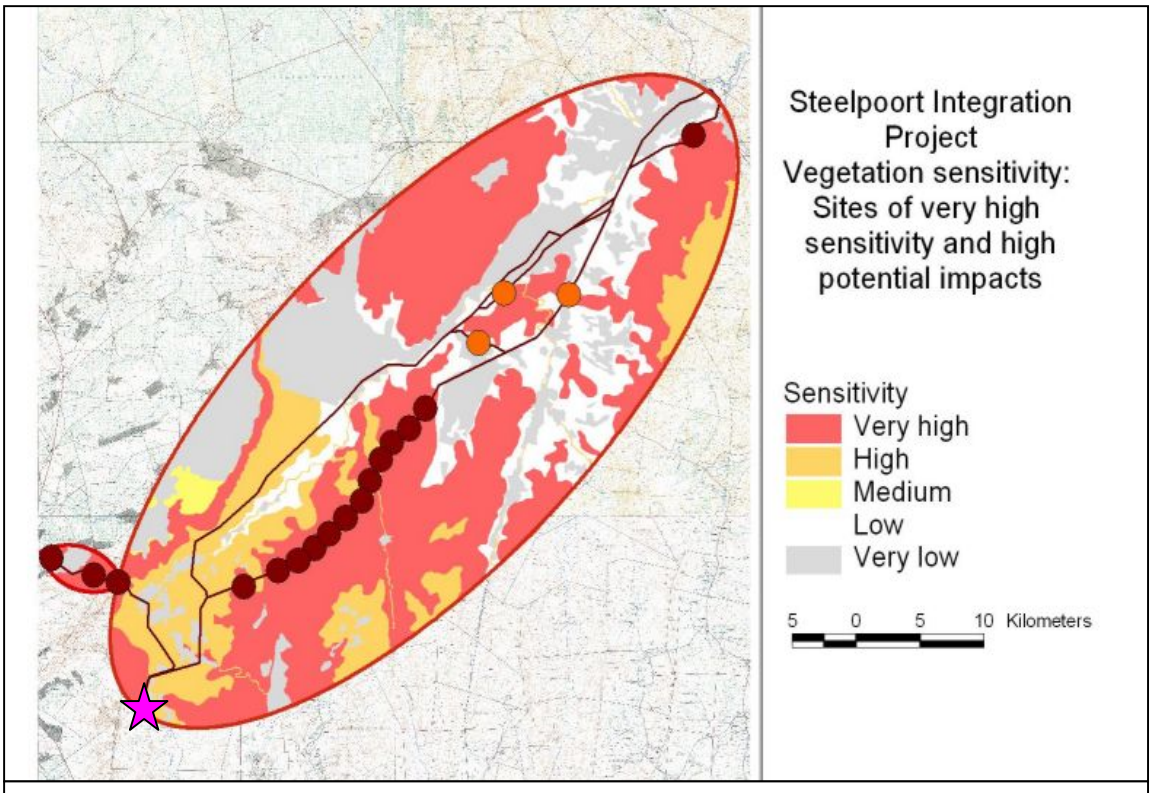


**Figure 7: Habitat sensitivity / conservation value of the study area showing sites where proposed alignment crosses Very High sensitivity areas.**

**Sensitivity of substation site**

The proposed substation site occurs within *Kirkia wilmsii-Acacia caffra* Mountain Bushveld in a part that is classified as having HIGH sensitivity (purple star in figure 7). It is adjacent to some steep mountain slopes classified as having VERY HIGH sensitivity and near to a non-perennial drainage line (200 m away) containing *Acacia gerrardii* woodland. The site is on a moderately steeply sloping landscape and the vegetation is an open woodland. There were signs of agricultural activities nearby and indications of heavy grazing and browsing on the site. In the context of the generally high sensitivity of the remaining areas of natural vegetation in the SCPE, this site has a lower sensitivity score and is therefore less likely to have significant impacts on sensitive habitats or species.

## EVALUATION OF IMPACTS

### Potential impacts

Impacts are described and assessed below. Impacts may arise due to various activities or infrastructure, including the following:

1. towers
2. temporary construction impacts
3. access and service roads impacts
4. clearing within servitude, e.g. to maintain vegetation below 4 m height
5. clearing of the substation site

Potential impacts and issues include the following:

- Destruction or disturbance to sensitive ecosystems: This will lead to localised or more extensive reduction in the overall extent of a particular habitat. Consequences of this may include:
    1. increased vulnerability of remaining portions to future disturbance,
    2. negative change in conservation status of habitat,
    3. general loss of habitat for sensitive species,
    4. loss in variation within sensitive habitats due to loss of portions of it,
    5. general reduction in biodiversity,
    6. increased fragmentation (depending on location of impact),
    7. disturbance to processes maintaining biodiversity and ecosystem goods and services.

  Potential extent: at the scale of the entire powerline or individual structures or infrastructure: local to regional

- Destruction of vegetation in the footprint of tower structures: This will lead to localised reduction in the overall extent of a particular habitat. This may only be an issue if the tower is situated within a sensitive habitat or upon a population of a species of special concern.
  Potential extent: at the scale of individual structures: local

- Fragmentation of sensitive habitats: The possibility of this impact occurring depends on whether the servitude is cleared and whether continuous service roads are constructed. It may therefore arise due to destruction of habitat in such a way as to divide areas of habitat partially or fully into smaller parts. Consequences of this may include:
    1. impaired gene flow within fragmented populations,
    2. breakdown of ecological relationships, e.g. pollinator-plant
    3. breakdown of migration routes,
    4. reduced functional use, e.g. grazing.

  Potential extent: at the scale of the entire powerline or inidividual structures or infrastructure: local to regional

- Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species during the construction and/or operational phase: This may arise if the proposed infrastructure is located where it will impact on such individuals. Consequences of this may include:
    1. negative change in conservation status of affected species,

2. fragmentation of populations of affected species,
3. reduction in area of occupancy of affected species,
4. loss of genetic variation within affected species.

Potential extent: depending on the impact on the species, the impact may occur at the scale of the entire powerline, but lead to a global impact (e.g. change in global conservation status).

- Disturbance of natural vegetation through trampling, compaction by motor vehicles etc.: This may occur around construction sites and in order to access infrastructure. Consequences of this may include:
    1. destruction of vegetation or habitat,
    2. degradation of vegetation or habitat,
    3. loss of sensitive habitats,
    4. loss or disturbance to individuals of rare, endangered, endemic and/or protected species,
    5. fragmentation of sensitive habitats.

  Potential extent: at the scale of the entire powerline or inidividual structures or infrastructure: local to regional

- Impacts on the movement and migration of animal species: This will occur if the infrastructure imposes an insurmountable barrier to movement. Consequences of this may include:
    1. impaired gene flow within fragmented populations,
    2. breakdown of ecological relationships, e.g. pollinator-plant
    3. breakdown of migration routes,

  Potential extent: at the scale of the entire powerline (localised structures are unlikely to casue this impact)): regional

- Increased soil erosion, increase in silt loads and sedimentation: This will occur due to soil disturbance, especially along the steeper slopes, increased run-off from compacted areas etc. Consequences of this may include:
    1. loss of or disturbance to indigenous vegetation,
    2. loss of sensitive habitats,
    3. loss or disturbance to individuals of rare, endangered, endemic and/or protected species,
    4. fragmentation of sensitive habitats,
    5. impairment of wetland function.

  Potential extent: most likely to occur at the scale of inidividual structures or infrastructure, but consequences may have a more regional effect: local to regional

- Establishment and spread of declared weeds and alien invader plants: This may occur in disturbed areas and/or where propagules of these plants are readily available. Consequences of this may include:
    1. loss of indigenous vegetation,
    2. change in vegetation structure leading to change in various habitat characteristics,
    3. change in plant species composition,
    4. change in soil chemical properties,

5. loss of sensitive habitats,
6. loss or disturbance to individuals of rare, endangered, endemic and/or protected species,
7. fragmentation of sensitive habitats,
8. change in flammability of vegetation, depending on alien species
9. hydrological impacts due to increased transpiration,
10. impairment of wetland function.

Potential extent: at the scale of any disturbance, i.e. the entire powerline or inidividual structures or infrastructure: local to regional

- Damage to wetland and riparian areas: This may occur if wetlands are directly affected by the construction of infrastructure. Consequences of this may include:
    1. Impairment of wetland function,
    2. reduction in water quality, potentially leading to impacts on wetland flora and fauna
    3. change in hydrological regime, usually increased runoff

  Potential extent: the impact is likely to occur at the scale of inidividual structures or infrastructure, but the impact may have a more widespread effect: local to regional

- Increased dust during construction: This may affect animals and vegetation in the vicinity. Consequences of this may include:
    1. will cause stress in individuals of various animal species, which may result in them moving away or cause changes in behaviour,
    2. will cause some territorial animals to be displaced,
    3. will result in deposition of dust on vegetation leading to impaired photosynthesis and respiration, potentially causing damage to individual plants.

  Potential extent: at the scale of inidividual structures, infrastructure or activities: local

- Increased noise pollution during construction: This may affect animals in the vicinity. Consequences of this may include:
    1. will cause stress in individuals of various animal species, which may result in them moving away or cause changes in behaviour,
    2. will cause some territorial animals to be displaced

  Potential extent: at the scale of individual structures, infrastructure or activities: local

- Increased risk of veld fires: There is a higher risk of veld fires around construction sites due to the use of fires for cooking, warmth, etc. by construction workers. Consequences of this may include:
    1. damage to sensitive habitats,
    2. damage to populations of sensitive plant species,
    3. loss of vegetation production leading to reduction in available grazing/browsing for wild or domestic animals

  Potential extent: at the scale of inidividual structures, infrastructure or activities, but may spread further: local to immediate surroundings

**Potential impacts along different routes**

Possible impacts, as discussed above, are subjectively assessed for each alternative and the substation site to determine how serious they may. This is done by categorising them as Very High, High, Medium, Low or Very Low for each development scenario. From this it is possible to make a conclusion regarding the preferred development option for consideration in the EIA phase and also identifies those impacts that should be evaluated in the EIA phase for that alternative. The assessments are given in Table 8.

**Table 8: Possible impacts evaluated in terms of potentially how serious each may be for each development alternative, as follows: W=Western alternative, E= Eastern alternative, S= Southern sub-alternative, R= R555 sub-alternative, N= Northern sub-alternative, T= Turn-in line, Sub=Substation.**

| IMPACT | W | E | S | R | N | T | Sub |
|---|---|---|---|---|---|---|---|
| Destruction or disturbance to sensitive ecosystems leading to reduction in the overall extent of a particular habitat | M | VH | L | L | L | M | M |
| Destruction of vegetation in the footprint of tower structures leading to reduction in the overall extent of a particular habitat | M | M | VL | VL | VL | M | n/a |
| Fragmentation of sensitive habitats | M | H | VL | VL | VL | M | L |
| Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species | M | H | VL | VL | VL | M | M |
| Disturbance of natural vegetation through trampling, compaction by motor vehicles etc. leading to degradation or destruction of vegetation or habitat or loss of individuals of rare, endangered, endemic and/or protected species | M | H | L | L | L | M | M |
| Impairment of the movement and/or migration of animal species resulting in genetic and/or ecological impacts | L | M | VL | VL | VL | M | L |
| Increased soil erosion, increase in silt loads and sedimentation | M | M | L | L | L | M | M |
| Establishment and spread of declared weeds and alien invader plants | M | M | M | M | M | M | M |
| Damage to wetland and riparian areas | H | M | VL | M | VL | M | M |
| Increased dust during construction leading to potential damage of habitat or displacement of animals | M | M | M | M | M | M | M |
| Increased noise pollution during construction leading to potential displacement of individuals | M | M | M | M | M | M | M |
| Increased risk of veld fires leading to damage to habitats or loss of individuals of species of concern or loss of vegetation production | M | M | M | M | M | M | M |
| **OVERALL** | **M** | **MH** | **L** | **L** | **L** | **M** | **M** |

## CONCLUSIONS

There are large parts of the study area that are classified as having Very High sensitivity due to the following factors:

1. the vegetation has a high conservation value due to low rates of conservation and high rates of transformation as well as due to the location of the study area within the Sekhukhuneland Centre of Plant Endemism,
2. there is a strong possibility of encountering threatened, endemic, protected or rare species (plants and animals),
3. the vegetation has high local species richness, structural variation and high turnover from one site to another due to high habitat diversity,
4. the topography is complex and moderately steep thus promoting high habitat diversity, and
5. there are important ecological processes operating in these areas.

There are also areas classified as having High sensitivity where these factors do not operate as strongly, but where the vegetation is still in a natural state. A summary of the spatial distribution of areas in different sensitivity classes is given in Figure 6.

The proposed alignments and alignment alternatives cross different proportions of habitats in different sensitivity classes. A summary of these proportions is given in Table 7. Some of the proposed alignments may have significant impacts on sensitive habitats, whereas other alignments are less likely to do so. For example, the eastern alternative crosses a much greater area of habitat classified as having Very High sensitivity than any other alignment. The substation site is situated in habitat classified as having High sensitivity and is therefore less likely to have significant negative impacts on sensitive habitats and species than if it were situated within habitat classified as having Very High sensitivity.

A number of potential impacts were identified and these were subjectively assessed for each development alternative. This identified those impacts that were most likely to apply to that option. These are listed in Table 8.

Mitigation in the first three cases is not possible and avoidance of impacts requires routing the powerline outside of sensitive habitats. In the case of species of special concern, it would be required to study the footprint of the proposed infrastructure in detail to assess the potential for any of these species to occur there. If these species do not occur within this footprint then the impact will not be significant. Damage to wetland and riparian habitats can be avoided by keeping the powerline infrastructure outside of sensitive wetland and riparian habitats.

Ideally, all areas of Very High sensitivity should be avoided. This makes the eastern alternative a very poor one from an ecological point of view. Selection of this alternative introduces four of the five impacts of high significance. The northern sub-alternative is also preferred to the proposed western alignment. The southern and R555 sub-alternatives are both acceptable, although there may be localised impacts on sensitive habitats. The preferred alternative from an ecological point of view is the western one, but using the northern sub-alternative to reach the Merensky substation.

A walk-though survey of the entire preferred route will be undertaken during the site-specific EMP phase after Eskom have surveyed the approved alignment. Impacts will also be assessed in detail at that stage. Further recommendations for the EIA are as follows:

1. The walk-through survey must concentrate on habitats classified as having High or Very High sensitivity. This should be undertaken during the summer in order to be able to assess the floristics of the habitat properly as well as to have a higher probability of detecting species of special concern.
2. The substation site should also be briefly surveyed again during the summer to establish the likelihood of any species of concern occurring there.

## CONSULTATION

The following were consulted during the process of compiling this report:

1. Janine Victor of the Threatened Species Programme, SANBI for updated status of threatened and endemic plant species in Sekhukhuneland

2. Consultation at specialist workshop and during site visit with other specialists.

3. Consultation with Prof Derek Engelbrecht of University of the North regarding impacts on threatened animals.

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**APPENDIX 1: Threatened, rare and declining plant species and plant species endemic to the SCPE.**

Sources:
Threatened, rare and declining plant species: From the database of the SANBI Threatened Species Programme and publication by Siebert et al. 2002d) and includes all plant taxa for which there is some conservation concern. The list also includes a number of species that are not currently considered to be of conservation concern, but are included here due to the fact that they were listed in previous Red Lists (Hilton-Taylor 1996).
Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001) from personal communication with Ms. J.E. Victor of the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria.
Endemic/near endemic plant species: From publication by Siebert et al. 2002d) and includes all plant taxa which are endemic or near endemic to the Sekhukhuneland region.

| Family | Taxon | E | Status | A | B | C | Habitat INDICATE FOR ALL SPECIES |
|---|---|---|---|---|---|---|---|
| PASSIFLORACEAE | Adenia wilmsii | | CR | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| ALLIACEAE | Tulbaghia sp. nov. | √ | CR | | X | | Mountain grassland |
| ARACEAE | Stylochaeton sp. nov. A (Siebert 1845) | √ | CR (not assessed) | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| ASPARAGACEAE | Asparagus intricatus | | DD | X | | X | Dry rocky hills (*Kirkia wilmsii-Acacia caffra* Mountain Bushveld) |
| LOBELIACEAE | Cyphia corylifolia | | DD | | X | | Grassland, Mistbelt Forest. forest margins and scrub. |
| MESEMBRYANTHEMACEAE | Delosperma rileyi | | DD | | X | | Rocky grassland, 1200 -1800 m. |
| MESEMBRYANTHEMACEAE | Delosperma zeedebergii | √ | DD | | X | | Steep rocky slopes, at around 1500 m. |
| ACANTHACEAE | Dyschoriste perrottetii | √ | DD | X | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| ASPARAGACEAE | Asparagus sekukuniensis | √ | EN | | | X | Mountain woodland (*Kirkia wilmsii-Acacia caffra* Mountain Bushveld) |
| EUPHORBIACEAE | Euphorbia barnardii | √ | EN | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| AIZOACEAE | Plinthus rehmannii | | EN | | | X | Grassy plains (*Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld) |
| FABACEAE | Argyrolobium wilmsii | √ | LC | X | | | Mountain grassland and woodland |
| EUPHORBIACEAE | Euphorbia lydenburgensis | √ | LC | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| EUPHORBIACEAE | Euphorbia sekukuniensis | √ | LC | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |

| Family | Taxon | E | Status | A | B | C | Habitat INDICATE FOR ALL SPECIES |
|---|---|---|---|---|---|---|---|
| MALVACEAE | Hibiscus barnardii | √ | LC | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| APOCYNACEAE | Huernia insigniflora | √ | LC | | | X | ?? |
| ANACARDIACEAE | Rhus sekhukhuniensis | √ | LC | X | X | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| ASTERACEAE | Callilepis leptophylla | | LC DECLINING | X | X | | Open grassland |
| HYACINTHACEAE | Eucomis autumnalis clavata | | LC DECLINING | X | X | X | Open grassland, marshes |
| COMMELINACEAE | Aneilema longirrhizum | | LC RARE | X | | | Karroid low-lying areas NW of Burgersfort |
| COMBRETACEAE | Combretum petrophilum | | LC RARE | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| FABACEAE | Elephantorrhiza praetermissa | √ | LC RARE | X | X | X | Mountain woodland and grassland |
| LAMIACEAE | Plectranthus venteri | √ | LC RARE | | X | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| VITACEAE | Rhoicissus sekhukhuniensis | √ | LC RARE | X | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| ASPHODELACEAE | Aloe burgersfortensis | √ | Not assessed | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| CAPPARACEAE | Boscia albitrunca macrophylla | √ | Not assessed | | | X | *Acacia tortilis-Dichrostachys cinerea* Northern Dry Mixed Bushveld |
| CELASTRACEAE | Catha transvaalensis | √ | Not assessed | X | X | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| ASCLEPIADACEAE | Ceropegia distincta subsp. verruculosa | √ | Not assessed | | | X | *??* |
| PASSIFLORACEAE | Adenia fruticosa simplicifolia | | NT | | | X | Near hot springs, Mopane veld, Waterberg quartzites & sandstones, hills, ridges & flats. Water poort. Mopane veld, Mixed bushveld, Sourish mixed bushveld. |
| ASPHODELACEAE | Aloe reitzii reitzii | | NT | X | | | Granite outcrops and rocky slopes in grassland (*Kirkia wilmsii-Acacia caffra* Mountain Bushveld) |
| HYACINTHACEAE | Eucomis montana | | NT | | X | | Mountains, rocky grasslands |
| SCROPHULARIACEAE | Jamesbrittenia macrantha | √ | NT | X | X | X | Mountain woodland and grassland |
| CELASTRACEAE | Lydenburgia cassinoides | | NT | | X | X | Roossenekal to Strydpoort Mountains, exposed norite bedrock and dolomite (Strydpoort Mountain Range) |
| SCROPHULARIACEAE | Nemesia zimbabwensis | | NT (SA); LC (global) | | X | | Associated with rocky outcrops at an altitude of 1800m asl. In Leolo Mts occurs as a lithophyte, with plants sparsely distributed along moist, rocky ledges in the forest where |

| Family | Taxon | E | Status | A | B | C | Habitat INDICATE FOR ALL SPECIES |
|---|---|---|---|---|---|---|---|
| | | | | | | | they grow in pockets of sandy humus. |
| ASPARAGACEAE | Asparagus fourei | √ | VU | | | X | Rocky koppies in mixed bushveld & tends to grow on dolomite outcrops, not norites. |
| CRASSULACEAE | Crassula setulosa var. demunita | √ | VU | X | | | Stony/rocky well drained sandstone soils in full sun. |
| HYACINTHACEAE | Eucomis vandermerwei | | VU | X | | | Grows in rock crevices or under overhanging rocks, in low pH sandy soils derived from quartzitic rocky outcrops. Confined to outcrops on slopes and plateaus of higher peaks (2200-2500 m) covered in short sour montane grassland. Found predominantly on northerly aspects |
| IRIDACEAE | Gladiolus sekukuniensis | | VU | | X | X | 2430CA Leolo mountain foothills, Farm Dsjate 249 KT, 800m E of Motsi River. Alt: 1000m. Rocky (norite), gentle NW slope, loam. Open Kirkia wilmsii - Catha transvaalensis woodlands |
| CELASTRACEAE | Gymnosporia sp. nov. | | VU | | X | | Riparian woodland |
| HYACINTHACEAE | Ledebouria dolomiticola | | VU | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| ANACARDIACEAE | Rhus batophylla | √ | VU | | | X | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| SANTALACEAE | Thesium davidsonae | | VU | | | X | Dolemite |
| SANTALACEAE | Thesium gracilentum | | VU | | | X | Northern escarpment bushveld growing on Serpentine soils |
| ALLIACEAE | Tulbaghia coddii | | VU | X | X | | *Kirkia wilmsii-Acacia caffra* Mountain Bushveld |
| ARACEAE | Zantedeschia jucunda | √ | VU | | X | | Mountain grassland |
| ARACEAE | Zantedeschia pentlandii | √ | VU | X | | | Mountain grassland and woodland |
| | | | | 16 | 18 | 31 | |

**Species previously listed, but no longer of conservation concern**

| Family | Taxon | Status |
|---|---|---|
| ASPARAGACEAE | Asparagus clareae | LC |
| CAPPARACEAE | Boscia foetida minima | LC |
| ACANTHACEAE | Dicliptera fruticosa | LC |
| ORCHIDACEAE | Disa rhodantha | LC |
| STERCULIACEAE | Dombeya autumnalis | LC |
| ACANTHACEAE | Dyschoriste erecta | LC |
| EBENACEAE | Euclea linearis | LC |
| ORCHIDACEAE | Eulophia leachii | LC |
| EUPHORBIACEAE | Euphorbia enormis | LC |
| MALVACEAE | Gossypium herbaceum africanum | LC |
| APOCYNACEAE | Huernia stapelioides | LC |
| SCROPHULARIACEAE | Jamesbrittenia silenoides | LC |
| EUPHORBIACEAE | Jatropha latifolia  angustata | LC |
| EUPHORBIACEAE | Jatropha latifolia  latifolia | LC |
| STERCULIACEAE | Melhania randii | LC |
| POACEAE | Mosdenia leptostachys | LC |
| BUDDLEJACEAE | Nuxia gracilis | LC |
| LAMIACEAE | Orthosiphon fruticosus | LC |
| ANACARDIACEAE | Ozoroa albicans | LC |
| APOCYNACEAE | Pachypodium saundersii | LC |
| RUBIACEAE | Pavetta zeyheri zeyheri | LC |
| ASTERACEAE | Pegolettia senegalensis | LC |
| ACANTHACEAE | Petalidium oblongifolium | LC |
| ANACARDIACEAE | Rhus keetii | LC |
| ANACARDIACEAE | Rhus rogersii | LC |
| ANACARDIACEAE | Rhus wilmsii | LC |
| FABACEAE | Rhynchosia nitens | LC |
| APOCYNACEAE | Stapelia gigantea | LC |
| SANTALACEAE | Thesium multiramulosum | LC |
| MALPIGHIACEAE | Triaspis glaucophylla | LC |

| Family | Taxon | Status |
|---|---|---|
| POACEAE | Tristachya biseriata | LC |

**APPENDIX 2: Threatened, rare and declining animal species of the study area.**

**Appendix 2a: Mammal species with a geographical distribution that includes the study area.** Sources: Friedmann & Daly (2004), Mills & Hes (1997)

| Common name | Species | Habitat | Status | Likelihood of occurrence in the study area |
|---|---|---|---|---|
| African weasel | *Poecilogale albinucha* | Savanna and shrublands, predator on rodents, birds and eggs | DD | HIGH |
| Brown hyena | *Hyaena brunnea* | Scavenger in a wide variety of habitats, including savanna, shrubland and grassland | NT | HIGH |
| Bushveld gerbil | *Tatera leucogaster* | Sandy soils | DD | MEDIUM |
| Dark-footed forest shrew | *Myosorex cafer* | Forest, damp habitats | DD | MEDIUM |
| Darling's horseshoe bat | *Rhinolophus darlingii* | Aerial insectivore, roosting in caves | NT | MEDIUM |
| Forest shrew | *Myosorex varius* | Grassland and marshy areas | DD | LOW |
| Geoffroy's horseshoe bat | *Rhinolophus clivosus* | Aerial insectivore, roosting in caves | NT | MEDIUM |
| Greater dwarf shrew | *Suncus lixus* | Variety of vegetation types, from riverine forest, savanna woodland, thornveld, semi-arid scrub and grassland. Utilizes termite mounds. | DD | HIGH, Previously recorded in study area. |
| Greater musk shrew | *Crocidura flavescens* | Variety of vegetation types | DD | MEDIUM |
| Hildebrandt's horseshoe bat | *Rhinolophus hildebrandtii* | Aerial insectivore, roosting in caves | NT | MEDIUM |
| Honey badger | *Mellivora capensis* | Savanna, shrubland and grassland, generalist predator commensural with humans | NT | HIGH |
| Least dwarf shrew | *Suncus infinitesimus* | Variety of vegetation types from primary forest, montane grassland, savanna grassland and mixed bushveld. Utilizes disused termite mounds. | DD | LOW |
| Lesser dwarf shrew | *Suncus varilla* | Wide variety of habitats, but appears to be reliant on termite mounds | DD | MEDIUM |
| Lesser grey-brown musk shrew | *Crocidura silacea* | Woodland, coastal forest, grassland, rocky areas in savanna | DD | HIGH, Previously recorded in study area. |
| Lesser red musk shrew | *Crocidura hirta* | Wide variety of habitats | DD | MEDIUM |
| Oribi | *Ourebia ourebi* | Mosaic of tall and short grassland, open grasslands with gentle topography | EN | LOW |
| Pangolin | *Manis temminckii* | Grassland, shrubland and savanna, associated with the presence of ants and termites | VU | HIGH, Previously recorded in study area. |
| Reddish-grey musk shrew | *Crocidura cyanea* | Wide variety of terrestrial habitats | DD | MEDIUM |
| Robust golden mole | *Amblysomus robustus* | Belfast/Dullstroom area of eastern Mpumalanga in Moist Sandy Highveld Grassland, subterranean | EN | LOW |
| Rock dormouse | *Graphiurus platyops* | Rocky terrain | DD | HIGH, Previously recorded in study area. |
| Sable antelope | *Hippotragus niger niger* | Water-dependant grazer in woody savanna. Seldom occurs outside reserves | VU | LOW |

| Common name | Species | Habitat | Status | Likelihood of occurrence in the study area |
|---|---|---|---|---|
| Schreiber's long-fingered bat | *Miniopterus schreibersii* | Aerial insectivore, roosting in caves | NT | MEDIUM |
| Serval | *Leptailurus serval* | Moist savanna and tall grass eating small mammals, birds, reptiles, fruit, invertebrates, amphibians, fish | NT | MEDIUM, not previously recorded in study area |
| Sharp's grysbok | *Raphicerus sharpei* | Shrublands and savanna woodlands, low-growing shrub and grass of medium height | NT | MEDIUM, not previously recorded in study area |
| Short-eared trident bat | *Cloeotis percivali* | Aerial insectivore, roosting in caves and subterranean habitats | CR | MEDIUM |
| Short-snouted elephant shrew | *Elephantulus brachyrhynchus* | Savanna, shrubland and grassland with heavy cover of grass and scrub | DD | MEDIUM |
| Single striped mouse | *Lemniscomys rosalia* | Grassland areas with good cover and fallow lands in the savanna biome | DD | HIGH, Previously recorded in study area. |
| Southern African hedgehog | *Atelerix frontalis* | Wide variety of habitats where there is ample ground cover. Avoids mesic habitats. | NT | HIGH, Previously recorded in study area. |
| Spotted-necked otter | *Lutra maculicollis* | Permanent rivers, streams, creeks, eating fish, crabs and frogs | NT | HIGH |
| Sundevall's leaf-nosed bat | *Hipposideros caffer* | Aerial insectivore, roosting in caves | DD | MEDIUM |
| Swamp musk shrew | *Crocidura mariquensis* | Marshy conditions within savanna biome | DD | HIGH, Previously recorded in study area. |
| Temminck's hairy bat | *Myotis tricolor* | Aerial insectivore, roosting in caves | NT | MEDIUM |
| Tiny musk shrew | *Crocidura fuscomurina* | Wide variety of habitats | DD | MEDIUM |
| Water rat | *Dasymys incomtus* | Semi-aquatic, occurring in bogs, marshes, swamps as well as in terrestrial habitats | NT | HIGH, Previously recorded in study area. |
| Welwitsch's hairy bat | *Myotis welwitschii* | Insectivore, roosts in shrubs and trees | NT | HIGH |

Species occurring in Mpumalanga and Limpopo Province, but not in the study area

| Common name | Species | Status |
|---|---|---|
| | | |
| African wild dog | *Lycaon pictus* | EN |
| Anchiete's pipistrelle | *Pipistrellus anchietae* | NT |
| Black rhinoceros | *Diceros bicornis minor* | VU |
| Botswana long-eared bat | *Laephotis botswanae* | VU |
| Bushveld elephant shrew | *Elephantulus intufi* | DD |
| Butterfly bat | *Glauconicteris variegatus* | NT |
| Cheetah | *Acinonyx jubatus* | VU |
| Gambian epauletted fruit bat | *Epomophorus gambianus crypturus* | DD |
| Giant rat | *Cricetomys gambianus* | VU |
| Gunning's golden mole | *Neamblysomus gunningi* | EN |
| Highveld golden mole | *Amblysomus septentrionalis* | NT |
| Hottentot's golden mole | *Amblysomus hottentotus* | DD |
| Juliana's golden mole | *Neamblysomas julianae* | VU |
| Lander's horseshoe bat | *Rhinolophus landeri* | NT |
| Lesser long-fingered bat | *Miniopterus fraterculus* | NT |
| Lesser woolly bat | *Kerivoula lanosa* | NT |
| Lion | *Panthero leo* | VU |
| Maquassie musk shrew | *Crocidura maquassiensis* | VU |
| Meller's mongoose | *Rhyncogale melleri* | DD |

| Common name | Species | Status |
|---|---|---|
| Nyika climbing mouse | *Dendromous nyikae* | NT |
| Peak-saddle horseshoe bat | *Rhinolophus blasii* | VU |
| Roan antelope | *Hippotragus equinus* | VU |
| Rough-haired golden mole | *Chrysospalax villosus* | CR |
| Rufous hairy bat | *Myotis bocagei* | DD |
| Ruppell's horseshoe bat | *Rhinolophus fumigatus* | NT |
| Rusty bat | *Pipistrellus rusticus* | NT |
| Samango monkey | *Cercopithecus mitis labiatus* | EN |
| Selous' mongoose | *Paracynictis selousi* | DD |
| Side-striped jackal | *Canis adustus* | NT |
| Spotted hyena | *Crocuta crocuta* | NT |
| Thomas' pygmey mouse | *Mus neavei* | DD |
| Tsessebe | *Damaliscus lanatus lanatus* | EN |
| White-tailed rat | *Mystromus albicaudatus* | EN |
| Wood's slit-faced bat | *Nycteris woodi* | NT |
| Woodland mouse | *Grammomys dolichurus* | DD |

**Appendix 2b: Reptile species with a geographical distribution that includes the study area.** Sources: Branch (1988)

| Common name | Species | Habitat | Status | Likelihood of occurrence |
|---|---|---|---|---|
| African rock python | *Python sebae natalensis* | Wide range of habitats, but mostly moist, rocky well-wooded valleys. Frequently found in and around water. | Vulnerable | HIGH |
| Yellowbellied house snake | *Lamprophis fuscus* | Old termitaria and under stones. May prefer grassland areas with termitaria | Rare | LOW |
| Striped harlequin snake | *Homoroselaps dorsalis* | Old termitaria and under stones in grassland. | Rare | LOW |
| Swazi rock snake | *Lamprophis swazicus* | Under rock slabs on rock outcrops | Rare | HIGH |
| Beyer's longtailed seps | *Tetradactylus breyeri* | Grassland, possibly sheltering under stones | Rare | LOW |
| Variegated wolf snake | *Lycophidion variegatum* | Rare, nocturnal solitary snake found under rocks, stones and logs in north-eastern Highveld region | Peripheral | HIGH |

Other species occurring in Mpumalanga and Limpopo Province, but not in the study area.

| Common Name | Species |
|---|---|
| Giant girdled lizard | *Cordylus giganteus* |
| Nile crocodile | *Crocodylus niloticus* |
| Natal hinged tortoise | *Kinixys natalensis* |
| Haacke's flat gecko | *Afroedura pondolia haackei* |
| Whyte's water snake | *Lycodonomorphus whytii obscuriventris* |
| Semi-ornate snake | *Meizodon semiornatus* |
| Black whitelipped snake | *Amblyodipsas microphthalma nigra* |
| Muller's velvet gecko | *Homopholis mulleri* |
| Woodbush flat gecko | *Afroedura pondolia multiporis* |
| Richard's blind legless skink | *Typhlosaurus lineatus richardi* |
| Striped blind legless skink | *Typhlosaurus lineatussubtaeniatus* |
| Woodbush legless skink | *Acontophiops lineatus* |
| Whitebellied Limpopo burrowing skink | *Scelotes limpopoensis albiventris* |
| Soutpansberg rock lizard | *Lacerta rupicola* |
| Soutpansberg flat lizard | *Platysaurus relictus* |
| Lang's pink round-head wormlizard | *Chirindia langi* |
| Jalla's sand snake | *Psammophis jallae* |
| Blunttailed worm lizard | *Dalophia pistillum* |

**Appendix 2c: Amphibian species with a geographical distribution that includes the study area.** Sources: Minter et al. (2004)

| Common name | Species | Habitat | Status | Likelihood of occurrence |
|---|---|---|---|---|
| Northern forest rain frog | *Breviceps sylvestris* | Afromontane forest and adjacent North-eastern Mountain Grassland | DD | LOW |
| Giant bullfrog | *Pyxicephalus adspersus* | Seasonal, shallow grassy pans in flat open areas, but also utilizes non-permanent vleis and shallow water on the margins of waterholes and dams | NT | MEDIUM |

**Appendix 2d: Threatened fresh-water fish of South Africa (source: IUCN website (http://www.iucnredlist.org/)**

| Scientific name | Common name | Status | Distribution | Likelihood of occurrence |
|---|---|---|---|---|
| Austroglanis barnardi | Barnard's rock-catfish | CR | Clanwillian, Western Cape | N/A |
| Austroglanis gilli | Clanwilliam rock-catfish | VU | Clanwillian, Western Cape | N/A |
| Austroglanis sclateri | Rock-catfish | DD | Orange-Vaal main stream | N/A |
| Barbus andrewi | Cape whitefish | VU | Berg-Breede River | N/A |
| Barbus bifrenatus | Hyphen barb | LC | Widespread incl eastern Highveld | N/A |
| Barbus brevipinnis | Shortfin barb | VU | Sabie-Sand river system, Mpumalanga | LOW |
| Barbus calidus | Clanwilliam redfin | EN | Clanwilliam | N/A |
| Barbus capensis | Clanwilliam yellowfish | VU | Clanwilliam | N/A |
| Barbus erubescens | Twee river redfin | CR | Clanwillian, Western Cape | N/A |
| Barbus hospes | Namaquab barb | LR/nt | Orange River below Augrabies Falls | N/A |
| Barbus kimberleyensis | Largemouth yellowfish | VU | ??Probably Kimberley | N/A |
| Barbus motebensis | Marico barb | VU | Headwater tributaries of the Marico, Crocodile and Steelpoort branches of the Limpopo River system | HIGH |
| Barbus serra | Clanwilliam sawfin | EN | Clanwillian, Western Cape | N/A |
| Barbus treurensis | Treur river barb | LR/cd | Upper reaches of the Blyde River. Previously known from the Treur and Sabie Rivers. | N/A |
| Barbus trevelyani | Barb border barb | CR | Keiskamma and Buffalo Rivers of the Eastern Cape | N/A |
| Brycinus lateralis | Striped robber | LC | Zambezi, Okavango, Cunene, Buzi Rivers and St Lucia catchment | N/A |
| Carcharhinus leucas | Bull shark | LR/nt | Zambezi | N/A |
| Chetia brevis | Orange-fringed largemouth / river bream | VU | Komati-Incomati system and coastal lakes in Mozambique | LOW |
| Chiloglanis bifurcus | Incomati rock catlet / Incomati suckermouth | CR | Crocodile-Incomati system at altitudes of 900-1200 m. | LOW |
| Chiloglanis swierstrai | Lowveld suckermouth | LR/lc | Lowveld and warmer reaches of the Limpopo, Incomati and Phongolo systems | LOW |

| Scientific name | Common name | Status | Distribution | Likelihood of occurrence |
|---|---|---|---|---|
| Croilia mossambica | Burrowing goby naked goby | LR/nt | Coastal lakes and estuaries in KZN and Mozambique | N/A |
| Eleotris melanosoma | Broadhead sleeper | LR/nt | East coast to Transkei | N/A |
| Galaxias zebratus | Cape galaxias | LR/nt | Cape | N/A |
| Labeo seeberi | Clanwilliam sandfish | CR | Clanwillian, Western Cape | N/A |
| Myxus capensis | Freshwater mullet | LR/lc | East coastal estuaries | N/A |
| Nothobranchius orthonotus | Spotted killifish | VU D2 | Coastal plain from the lower Zambezi south to Mkuze | N/A |
| Opsaridium peringueyi | Dwarf sanjika | VU | Save River system (Zimbabwe) to Phongolo system | LOW |
| Pristis microdon | Freshwater sawfish largetooth sawfish leichhardt's sawfish smalltooth sawfish | CR | East coast to Port Alfred extending inland in major rivers | N/A |
| Pseudobarbus afer | Eastern cape redfin | LR/nt | Coastal rivers from Algoa Bay to Mossel Bay | N/A |
| Pseudobarbus asper | Smallscale redfin | VU | Gamtoos and Gouritz River systems | N/A |
| Pseudobarbus burchelli | Burchell's redfin | EN | Breede River | N/A |
| Pseudobarbus burgi | Berg river redfin | CR | Berg River | N/A |
| Pseudobarbus phlegethon | Fiery redfin | EN | Clanwilliam Olifants River | N/A |
| Pseudobarbus tenuis | Slender redfin | EN | Mountain tributaries of the Gouritz and Keurbooms Rivers | N/A |
| Redigobius dewaali | Checked goby | LR/nt | East coast rivers and estuaries | N/A |
| Sandelia bainsii | Eastern province rocky | EN | Buffalo, Keiskamma, Great Fish and Kowie Rivers | N/A |
| Sandelia capensis | Cape kurper | LR/lc | Eastern and Western Cape coastal rivers. | N/A |
| Serranochromis meridianus | Lowveld largemouth | LR/cd | Sabie-Sand tributary of the Incomati system, coastal lakes of southern Mozambique and Maputaland | LOW |
| Silhouettea sibayi | Sibayi goby | LR/nt | Lake Sibayi and Kosi Bay | N/A |