ECOLOGICAL HABITAT ASSESSMENT FOR THE PROPOSED 26km 132kV KINGBIRD LINE FROM THE GUMENI SUBSTATION TO THE BOSLOOP SUBSTATION, ESKOM DISTRIBUTION DIVISION, NORTHERN REGION; MPUMALANGA PROVINCE

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1. BACKGROUND INFORMATION

Eskom Transmission is responsible for providing a high quality supply of electricity to meet the ever increasing needs of its end users. As a result, its infrastructure of power lines and substations are continuingly being established and expanded upon to support annual load growth. Eskom is planning to build a new 132kV Kingbird distribution line from the recently constructed Gumeni Substation to the south of Machadadorp to the existing Bosloop Substation. The study area is located in the Northern Mpumalanga Lowveld region. The powerline being considered for the project falls within rural areas, largely characterised by intensive commercial agricultural and pastoral land uses. The area is situated close to the small mining town of Machadadorp approximately 17km to the north, with Nelspruit situated approximately 75km to the northwest. There are two main roads that allow general access to the study area and these are R541 and the R36. The need for Eskom's proposed development has been identified by the low voltage service experienced in the 132kV ring supplied from Witkloof substation due to the loss of either the Witkloof-Holnek 132kV line or Witkloof-Wintershoek 132kV line voltages during the transmission and distribution.

Eskom Holdings Limited has, in line with the EIA Regulations, appointed SSI Engineers and Environmental Consultants as the independent consultant to undertake the EIA for the proposed Gumeni-Bosloop 132kV power line located in the Machadadorp areas of Mpumalanga Province. SSI Engineers and Environmental Consultants has appointed Mr C.L. Cook to undertake an ecological habitat assessment as well as faunal habitat assessment to investigate the potential animal (mammals, reptiles and amphibians) related impacts associated with the construction and operation of the proposed Gumeni-Bosloop 132kV power line.

Three alternatives alignments were proposed for the new 132kV distribution line. It must be stressed that due to time as well as financial constraints no comprehensive vegetation or faunal survey were conducted but merely a brief assessment of the current ecological status of the proposed three powerline alignments. By surveying the proposed alignments as well as immediate habitats adjacent to the proposed alignments for specialised habitats, as well as the remaining vegetation and specific habitats, one can make an assumption of the possible presence or absence of threatened plant and animal species. The survey was supplemented by literature investigations; personal records, historic data and previous surveys conducted in the Lydenburg-Machadadorp areas as well as in similar habitats.

1.1 OBJECTIVES OF THE ECOLOGICALSURVEY/ HABITAT ASSESSMENT

- To provide a broad description of the fauna and vegetation occurring along the proposed three 132kV distribution alignments. List the prominent plant species (trees, shrubs, grasses and other herbaceous species of special interest) present for vegetation unit and ecosystem delimitation.
- To identify animal/faunal species (mammals, birds reptiles, amphibians) of conservation importance; which could possibly occur along the proposed three alignments.
- To describe the available habitats on the three Gumeni-Bosloop 132kV power line alignments including areas of important conservation value or areas most likely to form important habitat for remaining threatened plant and animal species.
- To determine potential impacts of the development on the vegetation as well as associated fauna occurring along the proposed Gumeni-Bosloop 132kV power line alignment.
- To provide management recommendations to mitigate negative and enhance positive impacts of the development.

1.2 SCOPE OF STUDY

- A preliminary mammal, reptile and amphibian survey recording sightings and/or evidence of existing fauna and vegetation communities.
- An assessment of the ecological habitats, evaluating conservation importance and significance with special emphasis on the current status of threatened animal species (Red Data Species), occurring or likely to occur within the proposed Gumeni-Bosloop 132kV power line alignment and immediate adjacent areas.
- To rank the three Gumeni-Bosloop 132kV power line alternative alignments on the potential environmental impacts on vegetation as well as associated fauna.
- Identification of potential ecological impacts that could occur as a result of the new 132kv distribution line and assess the significance of these, where possible.
- Investigate feasible and practical management recommendations that should be implemented to reduce or minimize the impacts, should the project be approved.
- Documentation of the findings of the study in a report.

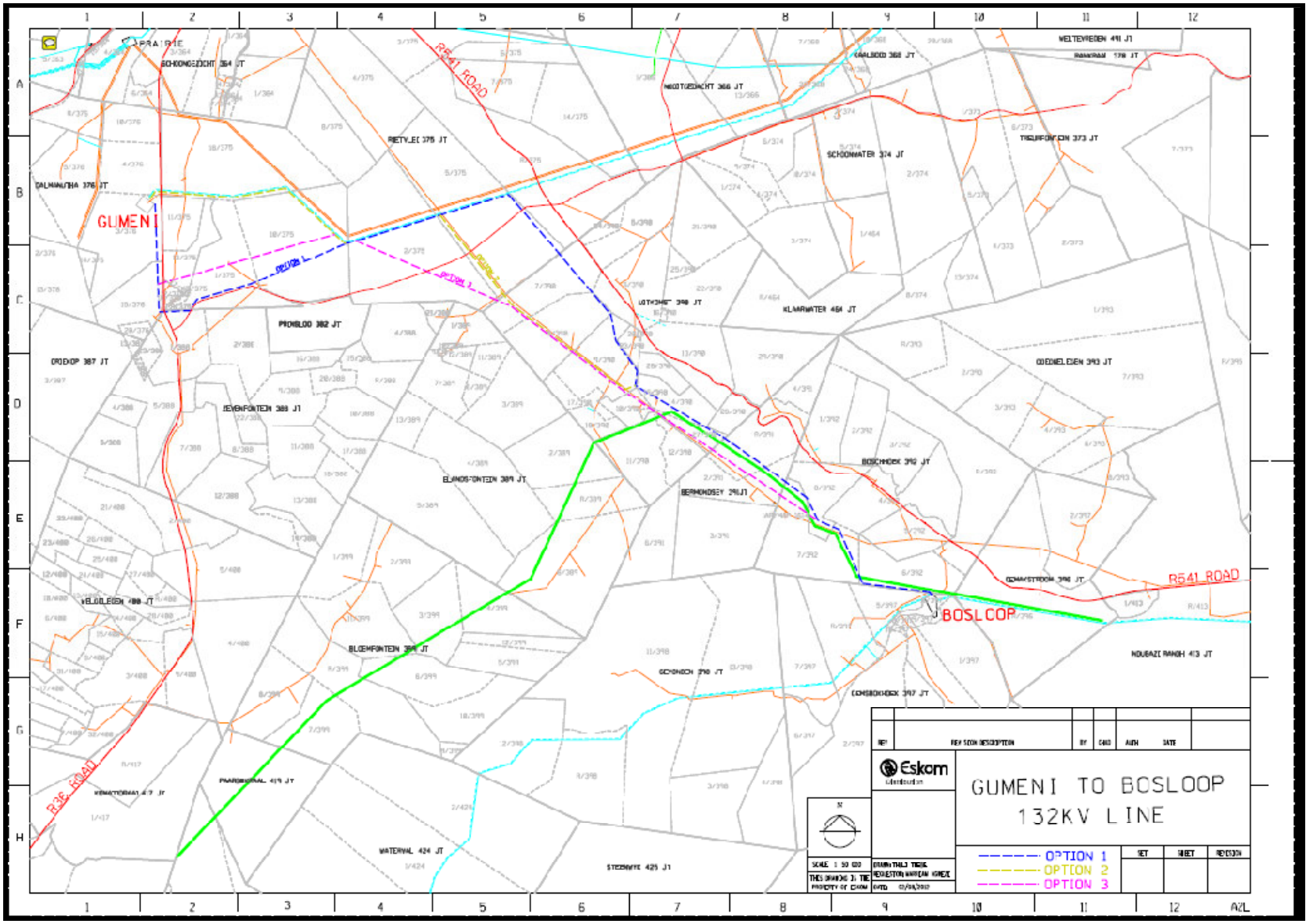


Figure1. Locality map of the proposed Gumeni to Bosloop 132kV Line

2. METHODOLOGY

2.1 Predictive methods

A 1:50 000 map of the study area was provided showing existing infrastructure and the proposed alignments. This was used as far as possible in order to identify potential "hot-spots" along the corridors, e.g. Patches of undisturbed grassland vegetation, river crossings, wetlands (valley bottoms, depressions and hillslope seeps) and dams and agricultural areas. Satellite imagery of the area was obtained from Google Earth was studied in order to get a three dimensional impression of the topography and land use.

2.2 Literature Survey

A detailed literature search was undertaken to assess the current status of threatened fauna that have been historically known to occur in the Machadadorp area. The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description for the vegetation description as well as *National Red List of Threatened Plants of South Africa* (Raimondo *et al,* 2009). *The Mammals of the Southern African Subregion* (Skinner & Chimiba 2005) and *The Red Data Book of the Mammals of South Africa: A Conservation Assessment* (Friedmann and Daly (editors) 2004) for mammals. The *Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter *et al.* 2004) for amphibians. The *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001) and *South African Red Data Book-Reptiles and Amphibians* (Branch 1988) for reptiles.

2.3 Site Investigation Methodology

A preliminary assessment of the status, spatial requirements and habitat preferences of all priority species along the proposed Gumeni-Bosloop 132kV power line as well as potential threats was conducted. For certain faunal species, an estimate of the expected or historical distribution for the area could be extrapolated from published information and unpublished reports, while habitat and spatial requirements were generally derived from the literature. For other species, little of this information was readily available and conservation targets remain speculative. Species assessments will be updated when additional data becomes available and where appropriate, proposed conservation targets will be revised.

Three general habitat sensitivity scans were carried out on the 18th of August and the 5th-6th of October 2011. These site visits did not entail intensive surveying or utilisation of any sampling methods and can rather be viewed as being an opportunity to identify sensitive habitats occurring along the proposed three Gumeni-Bosloop 132kV power line alignments. The proposed alignments were revised and no additional field assessments have been undertaken due to financial constraints.

All animals (mammals (larger), reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as animal tracks (footprints, droppings) to identify animals. The data was supplemented by previous surveys conducted in similar habitats, literature investigations, personal records and historic data. Different habitats were explored to identify any sensitive or specialized species. Habitats explored included Lydenburg and KaNgwane Montane Grasslands (Mucina & Rutherford 2006) in various forms of transformation and degradation (overgrazing, frequent fires, alien vegetation invasion), rivers (perennial and non-perennial), wetlands including mainly channelled valley bottoms and hillslope seepage wetlands as well as artificially created dams on valley bottoms, stumps, moribund termite mounds, abandoned animal burrows, trees and under lose bark material. Mammal names are as used by Skinner and Chimimba (2005), reptile names by Branch (1998) and Alexander and Marais (2007) and amphibian names by Passmore and Carruthers (1995) and Minter *et.al.* (2004)

2.4 Uncertainties in predicting results

- Limitation to a base-line ecological survey for only 3 days (30 hours) during the early summer months (September-October). Heavy rain had fallen prior to the site visits in October. The majority of dams as well as valley bottom wetlands had sufficient surface water and amphibians had initiated their short duration breeding activities.
- The majority of threatened plant species are extremely seasonal only emerging after sufficient heavy early summer rainfall (November-March). Some of the more rare and cryptic plant species may have been overlooked due to their inconspicuous growth forms. Many of the rare and endangered succulent species can only be distinguished (in the field) from their very similar relatives on the basis of their reproductive parts. These plants flower during different times of the year. Multiple visits to any site during the different seasons of the year could therefore increase the chances to record a larger portion of the total species complex associated with the area.
- The majority of threatened plant and animal species are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons/ years.

- Limitation of historic data and available databases for the areas.
- The presence of threatened species on site is assessed mainly on habitat availability and suitability as well as desk research (literature, personal records) and previous surveys conducted in similar habitats between2000-20011).
- As the majority of surrounding suitable habitat occurs on private lands, which are fenced, access is limited especially during nocturnal surveys. Large sections of the alignments could not be surveyed due to lack of access roads especially within the mountainous areas as well as valley bottoms.
- No field surveys were conducted along the revised alternatives (September 2012). The assessment was based on the previous field survey.
- The majority of the red data atlases are outdated especially pertaining to reptiles as well as inadequate coverage of some areas by the atlases.

2.5 Gaps in the baseline data

- Little long-term, verified data of faunal species distribution on micro-habitat level along the proposed powerline alignments.
- Little long-term, verified data on impacts of existing lines in the study area on the vegetation as well as associated fauna.

3. Vegetation and Faunal Habitat Availability

Vegetation structure is generally accepted to be more critical in determining faunal habitat than actual plant composition. Therefore, the description of vegetation presented in this study concentrates on factors relevant to faunal species abundance and distribution, and does not give an exhaustive list of plant species which occur in the study area. No comprehensive vegetation or faunal surveys were conducted due to time and financial constraints and faunal species lists provided in the Appendix are of species most likely to occur on the site using habitat as an indicator of species presence. Vegetation composition of the three alignments consists of **Lydenburg Montane Grassland (Gm 18)** on the northern portions of the alignment and **KaNgwane Montane Grassland (Gm 16)** on the southern portions (east of the Bankspruit) as well as **Eastern Temperate Freshwater Wetlands (AZf 3)** within the valley bottom wetlands (Mucina & Rutherford 2006).

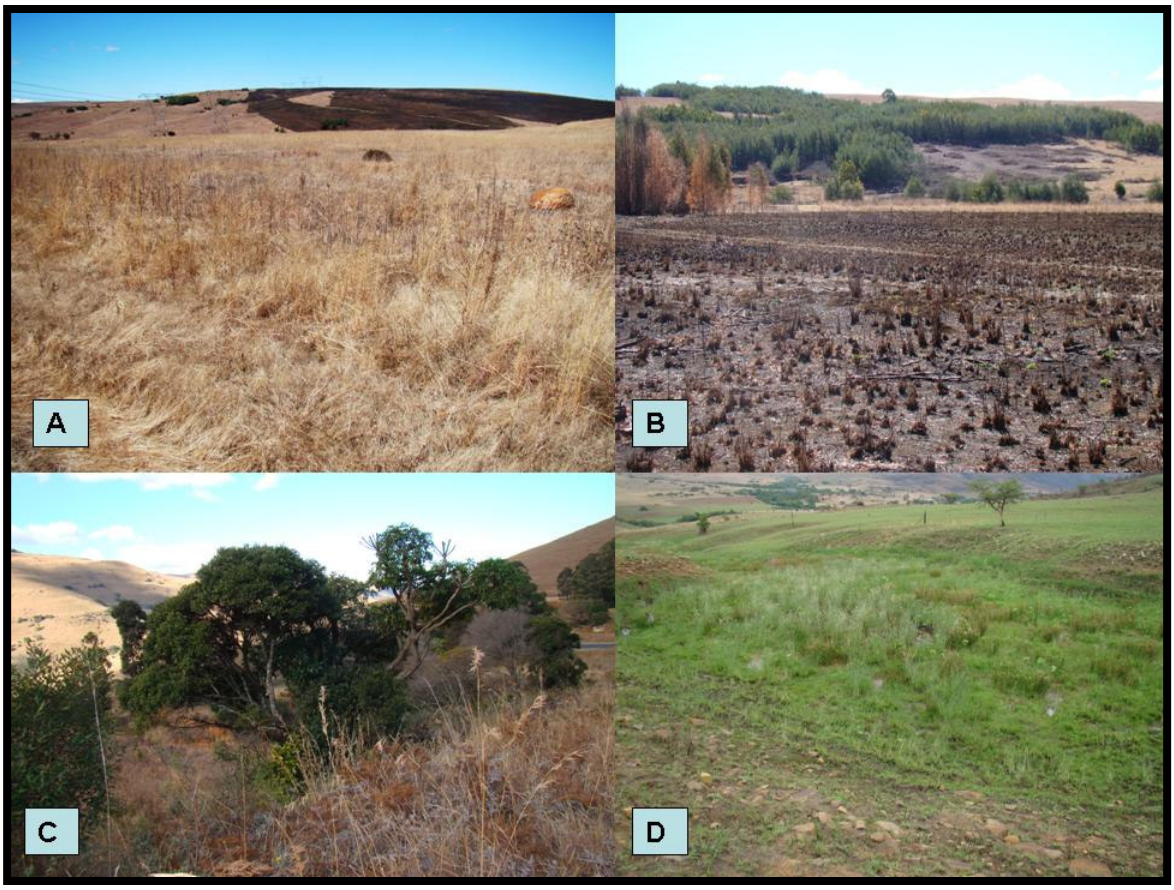


Figure2. A conglomerate of photographs displaying the major habitats observed along the proposed alignments. A: The majority of the northern portions of the alignment are situated within Lydenburg Montane Grasslands. The grasslands are in various stages of transformation and degradation due to surrounding agricultural activities. The majority of the grasslands in the area are extensively utilised for cattle and sheep grazing activities. **B:** Sections of the alignments are situated within transformed grasslands including old or fallow agricultural lands, alien invasive plantations or woodlots and secondary succession grasslands. **C:** Open and closed wooded or forested pockets occur within fire protected kloofs and valleys within the KaNgwane Montane Grasslands as well as along the major river systems (Komati and Bankspruit Rivers) in the area. **D:** Situated within the valley bottoms as well as areas of elevated soil moisture levels are permanent as well as seasonally inundated valley bottom wetlands, hillslope seepage wetlands as well as seasonally inundated depressions/pans.

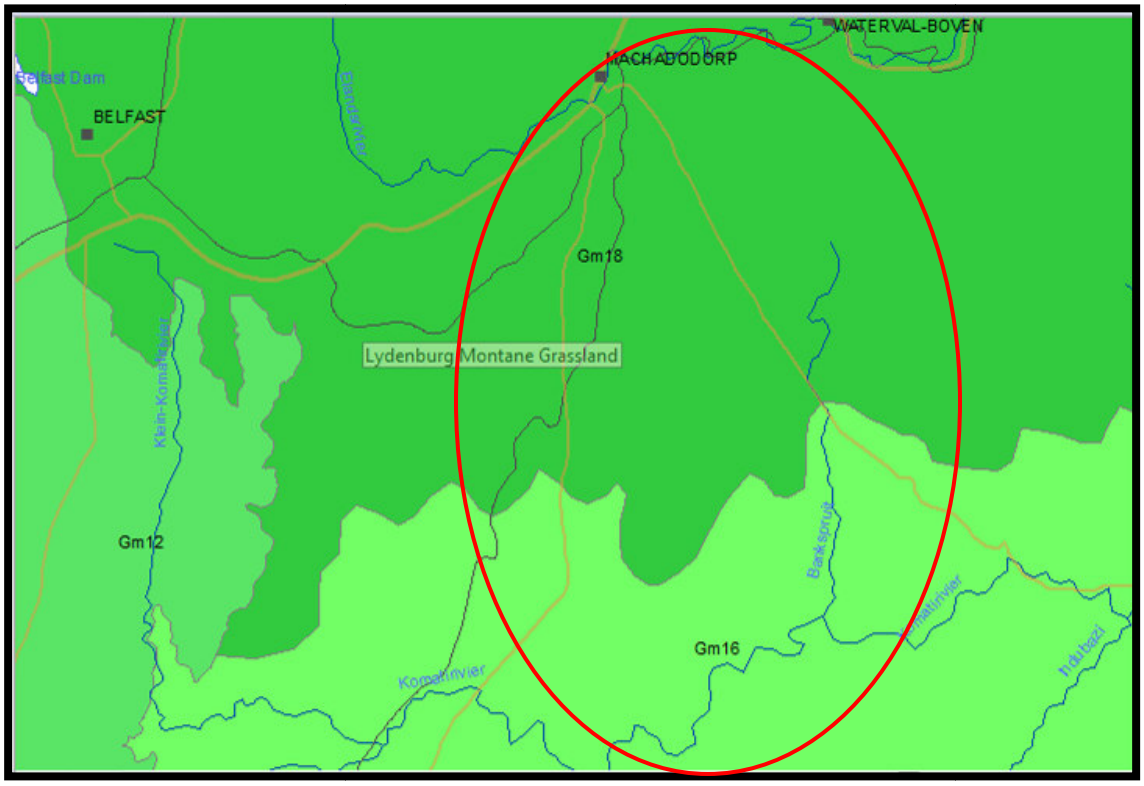


Figure3. Vegetation units according to Mucina & Rutherford (2006) in which the proposed Gumeni-Bosloop 132kV alignments are situated within consists of **Lydenburg Montane Grassland** (Gm 18) within the northern sections towards the Gumeni Substation as well as **KaNgwane Montane Grassland** (Gm 16) in the southern sections stretching towards the Komati River and the Bosloop substation

3.1 LYDENBURG MONTANE GRASSLAND (GM 18)

Lydenburg Montane Grassland (Gm 18) is considered a **centre of plant endemism**[1]. Over 2 266 plant species have been identified with **51 endemics**[2].

Figure4. The northern sections of the proposed alignment around the outskirts of Machadaorp (towards the Gumeni substation) are situated within Lydenburg Montane Grassland vegetation unit.

Distribution in Mpumalanga Province:

From just above Pilgrim's Rest in the north, southwards and westwards skirting Lydenburg, extending to Dullstroom, to Belfast and Waterval Boven in the south. It includes both the Steenkampsberg and Mauchsberg.

[1] Large numbers of endemic plant species with high conservation/biodiversity potential.

[2] Pertaining to a plant or animal species which is naturally restricted to a particular, well-defined area.

Vegetation & Landscape Features

High-altitude plateaus, undulating plains, mountain peaks and slopes, hills and deep valleys of the Northern Escarpment region, supporting predominantly very low grasslands on the high-lying areas. Height of the grass sward increases on the lower slopes. The grassland is very rich in forb[3] species.

Geology & Soils

The geology of the study site can be described as sandstone, mudstone and basalt, with biotite granite outcroppings around koppies. Soils classes are categorized as follows: Red and yellow soils with low to medium base status; Greyish, sandy soils; and soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. The soils are mostly derived from shale and quartzite as well as lavas and dolomites of the Pretoria Group of the Transvaal Supergroup (Vaalian Erathem). In general, the low base status, restricted soil depth, excessive or imperfect drainage status of these soils implies high erodibility and sensitivity to change. Sources of organic material loading are related to alien invasive vegetation and land-use disturbance pressures.

Climate

Orographic precipitation and mists throughout most months of the year support a unique flora, including rich mesophytic[4] plants such as the Orchidaceae[5]. MAP 858 mm (660-1 180 mm), augmented by the frequent mists. Frost days 21 days per year, varying greatly between 3 and 40, generally more frost to the west.

IMPORTANT TAXA

Small Trees:

Protea roupelliae subsp. *roupelliae , Faurea galpinii.*

Low Shrubs:

Phymaspermum acerosum, *Anthospermum rigidum* subsp. *rigidum, CIiffortia repens. Erica cerinthoides, E. woodii, Felicia filifolia* subsp. *filifolia, Gnidia caffra. Helichrysum odoratissimum, H. swynnertonii, Heteromorpha involucrata. Polygala uncinata, Tenrhynea phylicifolia.*

Succulent Shrubs:

Lopholaena disticha (d). *Delosperma lydenburgense.*

[3] A non-woody plant usually only living for 1 or 2 years.
[4] Intermediate between dry and wet soils
[5] Orchidaceae is the Orchid family

Graminoids:

Andropogon schirensis, *Aristida junciformis* subsp. *galpinii*, *Brachiaria serrata Digitaria monodactyla*. *D tricholaenoides,*. *Diheteropogon filifalius, Harpochloa falx, Heteropogon contortus, Hyparrhenia hirta*, *Loudetia simplex*. *Monocymbium ceresiiforme*, *Setaria nigrirostris, Sporobolus centrifugus*, *Themeda triandra*, *Trachypogon spicatus, Tristachya leucothrix*, *Alloteropsis semialata* subsp. *eckloniana, Aristida sciurus, Bulbostylis oritrephes. Ctenium concinnum. Cymbopogon caesius. Diheteropogon amplectens, EIionurus muticus, Eragrostis capensis, E. chloromelas, E. curvula, E. gummiflua, E. plana. E. racemosa, E. seler-antha, Eulalia villosa, Ischyrolepis schoenoides. Koeleria capensis, Microchloa caffra, Panicum ecklonii, P. natalense. Pentaschistis natalensis, Rendlia altera, Schizachyrium sanguineum. Sporobolus pectinatus, Tristachya rehmannii.*

Herbs:

Senecio gerrardii, *Acalypha angustata, A. depressinerva, Alepidea longifolia. Dicoma anomala, Dimorphotheca jucunda. D. spectabilis, Eriosema kraussianum, Gerbera ambigua. Haplocarpha scaposa, Helichrysum caespititium. H. chionosphaerum, H. nudifolium H. rugulosum. H. spiralepis, H. subglomeratum. H. umbraculigerum. Monopsis decipiens. Myosotis afropalustris, Pelargonium luridum. Pentanisia prunelloides* subsp. *latifolia, Polygala amatymbica. Psammotropha myriantha. Rhynchosia monophyl/a, Schistostephium crataegifolium. Sebaea erosa. S. sedoides* var. *confertiflora, Selago procera. Senecio laevigatus. Vernonia hirsuta, V. natalensis, V. oligocephala. Wahlenbergia undulata, Zornia capensis.*

Herbaceous Climber:

Rhynchosia totta.

Geophytic Herbs: *Gladiolus longicollis* subsp. *platypetalus* (d). *Agapanthus raoertus* subsp. *inapertus, A. inapertus* subsp. *intermedius. Clorophytum haygarthii, Corycium dracomontanum,* C. *nigrecens, Disa fragrans, D. versicolor. Disperis renibractea, Gladioulus eckiori;, Habenaria dives*, H. *dregeana, H. lithophila, Haemanthus humilus subsp. Hirsutus, Holothrix scoputaria. Hypoxis costat, H.rigidula* var. *pilosissima, Merwilla natalensis, Pachycarpus trasnvaalensis, Raphionacme galpinii, Satyrium longicauda, Zantedeschia albomaculata* subsp. *macrocarpa.*

Succulent Herb:

Aloe dyeri, Aloe graciflora, Aloe longibracteata, Crassula vaginata

IMPORTANT TAXA (ALL NORTHERN SOURVELD ENDEMICS)

Herbs:

Graderia linearifolia, Helichrysum truncatum. Hemizygia foiiosa, Fnezia integrifolia, Monsonia transvaalensis. Selago compacta, S. villosa. Streptocarpus galpinii, Tetraselago wilmsii.

Geophyric Herbs:

Agapanthus inapertus subsp. *hollandii, A. inapertus* subsp. *parviflorus, A. inapertus* subsp. *pendulus. Gladiolus calcaratus,* G. *exiguus, Watsonia occulta.*

Succulent Herb:

Aloe affinis.

Low Shrubs:

Helichrysum albilanatum, H. mariepscopicum. H. *milleri, H. reflexum, H. rudolfii, Hemizygia albiflora. H. subvelutina. Sutera polelensis* subsp. *fraterna.*

Endemic Taxa

Low Shrubs:

Erica atherstonei. E. holtii, Helichrysum lesliei, H. summa-montanum.

Succulent Shrub:
Khadia alticola.

Herbs:
Crotalaria monophylla. Cymbopappus piliferus. Knowltonia transvaalensis var. *pottiana. Pearsonia hirsuta, Streptocarpus cyaneus* subsp. *longi-tommii, S. hilburtianus.*

Geophytic Herbs:
Disa alticola, D. amoena. D. clavicornis. Eucomis vandermerwei. Gladiolus cataractarum. G. *exiguus.* G, *malvinus. Kniphofia rigidifolia, Riocreuxia aberrans. Schizochilus cecilii* subsp. *transvaalensis. S. lilacinus. Watsonia occulta.* W *wilmsii.*

Succulent Herb: *Crassula setulosa* var. *deminuta.*

Conservation

Lydenburg Montane Grassland is classified as **Vulnerable.** The conservation target is 27%, with 2.4% formally protected within reserves (Gustav Klingbiel. Makobulaan, Mt Anderson, Ohrigstad Dam. Sterkspruit and Verlorenvlei) as well as in a number of private conservation areas (Buffelskoof, Crane Creek, mc, In-de-Diepte, Kaalboom, Kalmoesfontein. Mbesan. Mondi Indigenous Forest. Mt Sheba: Waterval etc.). The level of transformation is relatively high at 23% with mostly alien plantations (20%) and cultivated lands (2%). Erosion potential very low (74%) and low (12%).

Remark1. This unit has an afromontane flora with links to the Zimbabwean highlands in the north (e.g. *Morella microbracteata. Selago procera, Helichrysum swynnertomi)* and the southern Drakensberg in the south (e.g. *Polypodium vulgare. Helichrysum spodiophyllum. Selago compacta, Holothrix scopularia).* It has also been proposed as a centre of plant endemism. Over 2 266 plant taxa have been identified in an area roughly corresponding to that of the Lydenburg Montane Grassland, with a list of 51 endemics. The recognition of two subcentres was also proposed namely the Long Tom Pass and the Steenkampsberg Subcentres. The flora varies between these two areas with the Long Tom Pass region having several elements linking it to escarpment flora of the north, while the Steenkampsberg has several elements linking it to the flora in the south as in Wakkerstroom and southern Drakensberg. Elements linking the Long Tom Pass to the north (Wolkberg and northwards) include *Helichrysum rudolfii. H. mariepscopicum. Dierama adelphicum. Schizochilus cecilii* subsp. *transvaalensis* and *Kniphofia splendida.* The elements linking the Steenkampsberg to the south include: *Aloe modesta, Helichrysum subglomeratum. Brunsvigia natalensis. Habenaria tysonii* and *Disperis oxyglossa.* Furthermore. in the Long Tom Pass area, *Psoralea latifolia* and *Lopholaena disticha are* replaced by *Otholobium wilmsii* and *L. segmentata.*

Remark2.

Small forest and shrub-like thickets are common along drainage lines, faults, and narrow daibase dykes (which are common in the unit).

3.2 KaNgwane Montane Grassland (Gm 16)

Figure5. The southern portion of the proposed alignments to the east and south of the Blankspruit and immediately to the north of the Komati River are situated within the **KaNgwane Montane Grassland** (Mucina & Rutherford 2006). Previously classified as **Piet Retief Sourveld** (VT 63) (Acocks 1953) or **North-eastern Mountain Grassland** (LR 43) (Low & Rebelo 1996).

Distribution

Mpumalanga and Swaziland and marginally into Kwazulu-Natal. Occurs along the gentle slopes of the Escarpment, from the Phongolo Valley in the south, northwards to the Usutu Valley and to the uppermost Lomati Valley near Carolina, including the western grassland areas of Swaziland.

Altitude: Varies between 880-1 740 m.

Vegetation & Landscape Features

Largely comprised of undulating hills and plains that occur on the eastern edge of the Escarpment. This unit is transitional between the Highveld and Escarpment and contains elements of both. The vegetation structure is comprised of a short closed grassland layer with many forbs, and a few scattered shrubs on the rocky outcrops.

Geology & Soils

Mostly on granite of the Mpuluzi Granite (Randian Erathem), Archaean gneiss giving rise to melanic soils, with intrusions of diabase. Land types Ac, Fa and Ba.

Climate

Early summer rainfall, with MAP 910 mm, ranging between 800 and 1 250 mm. This unit has a wide range of frost frequency (3-20 days per year), with most frost days occurring in the western regions.

IMPORTANT TAXA

Granninoids (Grasses)

Alloteropsis semialata subsp. *eckloniana (d), Brachtarla serrata (d), Cyperus obtusiflorus (d), Diheteropogon armplectens (d), D. filifolius (d), Eragrostis racemosa (d), Heteropogon contortus (d), Hyparrhenia hirta (d), Loudetia simplex (d) Monocymbium ceresiiforme (d), Rendlia altera (d), Themeda trandra (d), Trachypogon spicatus (d), Tristachya leucothrix (d), Ancdropogon schirensis, Bewsia biflora, Bulbostylis burchellii, Ctenium concinnum, Cymbopogon caesius, Cyperus obtusiflorus var. obtusiflorus, Digitaria diagonalis, D. tricholaenoides, Eragros cloromelas, E. plana, Eulalia villosa, Panicum ecklonii, P .natalense, Paspalum scrobiculatum, Schizachyrium sanguineum, Setaria nigrigrostris, S. sphacelata.*

Herbs

lpomoea oblongata (d), Acalypha peduncularis, A. villicaulis, Alepidea setifera, Argyrolobium speciosum, Aster harveyanus, Berkheya setifera, Corchorus confusus, Cyathula cylindrica, Dicoma zeyheri, Dimorphotheca jucunda, Eriosema cordatum, Euryops laxus, E. transvaalens,s subsp. setilobus, Helichrysum adenocarpum, H. cephaloloideum, H. nudifolium var. nudifolium, Mohria caffrorum, Pentanista agustifolia, P prunelloides subsp. *latifolia, Ruelia patula, Scistostephium crataegifolium, Senecio panduriformis, Soncnus wilmsii, Thunbergia atriplicifolia, Vernonia natalensis, V. oligocephala*.

Geophytic Herbs

Agapanthus inapertus subsp. *inapertus*, *Boophone disticha, disticha, Cheilanthes deltoidea, C. hirta, Eucomis montana, Gladiolus ecklonii, Habenaria dregeana, Hypoxis iridifolia, H. rigidula* var. *pilosissima, Morea pubiflora, Pteridium aquilinum, Watsonia latifolia, Zantedeschia albomaculata* subsp. *macrocarpa*.

Succulent Herbs: *Aloe integra, A. kniphofioides.*

Small Trees: *Acacia caffra, Faurea rochetiana, Pachystigma macrocalyx*.

Tree Fern: *Cyanthea dregei*

Tall Shrubs: *Calpurnia glabatra, Cephalanthus natalensis, Diospyros lycoides subsp. guerkei, Vernonia tigna*

Low Shrubs: *Heteromorpha involucrate* (d), *Anthospermum rigidum* subs*. rigidum, Asparagus cooperi, A. virgatus, Athrixia phylicoides, Diospyros scabrida var. cordata, Gymnosporia heterophylla, lndigofera comosa, Myrsrine africana, Searsia (Rhus*) *discolor*, *Schistostephium rotundifolium*.

Biogeographically Important Taxa
(Bc-Barberton endemic. N-Northern sour-veld endemic)

Herbs: *Hemizygia modesta*^{BC}, *H. thorncroftii*^{BC}, *Selago stewartii*^{BC}

Geophytic Herb: *Watsonia watsonioides*^{N}

Succulent Herb: *Kleinia galpinii*^{N}

Low Shrub: *Hemrizygia albiflora*^{N}

Endemic Taxa Herbs: *Lotononis difformis, L. spicata, Streptocarpus occultis*

Low Shrub: *Syncolostemon comptonii*

Conservation: Vulnerable. The conservation target is 27% with only 0.4% protected within any formally proclaimed nature reserves (Malalotja, Nooitgedacht Dam and Songimvelo). A number of private conservation areas protect small patches of this unit. lt is well suited for afforestation and 30% has already converted to plantations of alien trees. A further 6% is under cultivation. Erosion potential very low (55%) and low (7%)

Remark: This area occurs on the southern edge of the Barbeton Centre of Endemism (Mucina et al. 2006).

Table1. Dominant plant species observed within the Lydenburg as well as KaNgwane Montane Grasslands.

Trees	**Herbs continued**
**Acacia mearnsii*	*Gerbera ambigua*
**Eucalyptus grandis*	*Gladiolus spp.*
Acacia caffra	*Gladiolus crassifolius*
Acacia sieberiana	*Gnidia kraussiana var. kraussiana*
Cussonia paniculata	*Gomphocarpus fruticosus*
Grasses & sedges:	*Haemanthus humilis subsp. hirsutus*
Themeda triandra	*Haplocarpha scaposa*
Digitaria tricholaenoides	*Helichrysum rugulosum*
Melinis nerviglumis	*Helichrysum caespititium*
Loudetia simplex	*Helichrysum nudifolium var. nudifolium*
Brachiaria serrata	*Hermannia depressa*
Heteropogon contortus	*Hibiscus trionum*
Bulbostylis humilis	*Hypericum lalandii*
Panicum schinzii	*Hypoxis acuminata*
Diheteropogon filifolius	*Hypoxis argentea*
Agrostis lachnantha var. lachnantha	*Hypoxis filiformis*
Festuca caprina	*Hypoxis rigidula*
Trachypogon spicatus	*Indigofera hedyantha*
Arundinella nepalensis	*Ipomoea crassipes*
Hyparrhenia hirta	*Justicia anagalloides*
Hyparrhenia tamba	*Kniphofia porphyrantha*
Eragrostis plana	*Ledebouria cooperi*
Aristida junciformis subsp. galpinii	*Ledebouria ovatifolia*
Panicum natalense	*Lobelia flaccida*
Eragrsotis gummiflua	*Nidorella anomala*
Eragrostis curvula	*Othonna natalensis*
Setaria nigrirostris	*Oxalis obliquifolia*
Paspalum dilatatum	*Pelargonium luridum*
Sporobolus sp.	*Pennisetum thunbergii*
Setaria sphacelata	*Pentanisia prunelloides*
Herbs:	*Psammotropha myriantha*
Acalypha caperonioides var. caperonioides	*Polygala hottentotta*
Albuca setosa	*Pachycarpus transvaalensis*
Arctome hispida	*Scadoxus puniceus*
**Ageratum conyzoides*	*Sebaea sp.*
Anthospermum rigidum ssp. rigidum	*Selago sp.*
Aloe maculate	*Senecio scitus*
Aloe greatheadii var. davyana	**Solanum mauritianum.*
Asclepias affinis	*Seriphium plumosum/ Stoebe vulgaris*
Asclepias fruiicosa	*Sutera sp.*
Asparagus setaceus	*Stachys natalensis*
Aster harveyanus	*Striga elegans*
Berkheya zeyheri ssp. zeyheri	*Tephrosia capensis*

***Boophone disticha* (Red Listed-Declining*)**	*Trachyandra asperata*
Brunsvigia sp.	*Tulbaghia acutiloba*
Bulbine capitata.	*Vernonia natalensis*
**Datura strumarium*	*Wahlenbergia undulata*
Dolichos angustifolius	
Erica cerinthoides	
Cliffortia linearifolia	
Commelina africana var. africana	
Convolvulus thunbergii	
Dianthus transvaalensis	
Crinum sp.	
Crotalaria globifera	
Cyrtanthus contractus	
Dierama sp.	
Delosperma sutherlandii	
Dianthus mooiensis	
Eriosema simulans	
Eulophia hians	
Eulophia leontoglossa	
Eulophia ovalis	
Eulophia nutans	
Euryops laxus	
Elephantorrhiza elephantina	
Felicia fillifolia	

* A taxon is Declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population

Figure6. Species observed within the foot-slopes of a diabase or quartzite rocky outcrop situated on the eastern slopes of a grassland hill (to the east of Gumeni substation) situated within the Lydenburg Montane Grassland vegetation unit included**: A:** Several Poison Bulbs *Boophone distichta* which are currently Listed as 'Declining' mainly due to unsustainable harvesting of the plants for the traditional medicinal practices[*]; B: Several Fire-ball Lilies (*Scadoxus puniceus*) were observed within the broken rocky areas as well as amongst the archaeological ruins ; **C:** Several Dwarf Red-Hot Poker *Kniphofia porphyrantha* were observed within the mid and lower slopes of the rocky hill in protected areas with an elevated soil moisture level. The revised option 2 alignment should be shifted away from this rocky hillslope.

[*] *Boophone disticha* has many medicinal uses, for example the Bushman once used the poison for their arrows, and traditional healers use it to treat pain and wounds. Parts of the plant are used by certain African tribes and also by some Europeans to cure various ailments. The outer covering of the bulb is applied to boils and abscesses. Fresh leaves are used to stop bleeding of wounds. The plants are known to be poisonous to cattle and sheep. The name sore-eye flower refers to the fact that if a person is exposed to the open flowers in a confined space; it may lead to sore eyes and even to a headache.

Red Data Plants

Suitable habitat occurs within the moist rocky hillslopes and valley bottoms for several Red Listed plant species including several terrestrial orchids including species of *Eulophia, Habenaria, Disa, Scizochilus, Branchycorythis, Brownlea* and *Dispersis*. One red listed "Declining" plant species was observed within the rocky hillslopes adjacent to alignment1. As a precautionary measure a suitably qualified grassland specialist should conduct a thorough walk through all primary grasslands (Lydenburg and KaNgwane Montane Grasslands) especially any moist hillslope seeps, valley bottom wetlands and rocky hillslopes (diabase or quartzitic) or rupicolous outcrops occurring along the selected alignment as well as tower footprints; during the appropriate flowering/growing season for the majority of threatened plant species (November-March).

3.3 Streams and Rivers and associated Riparian Zones

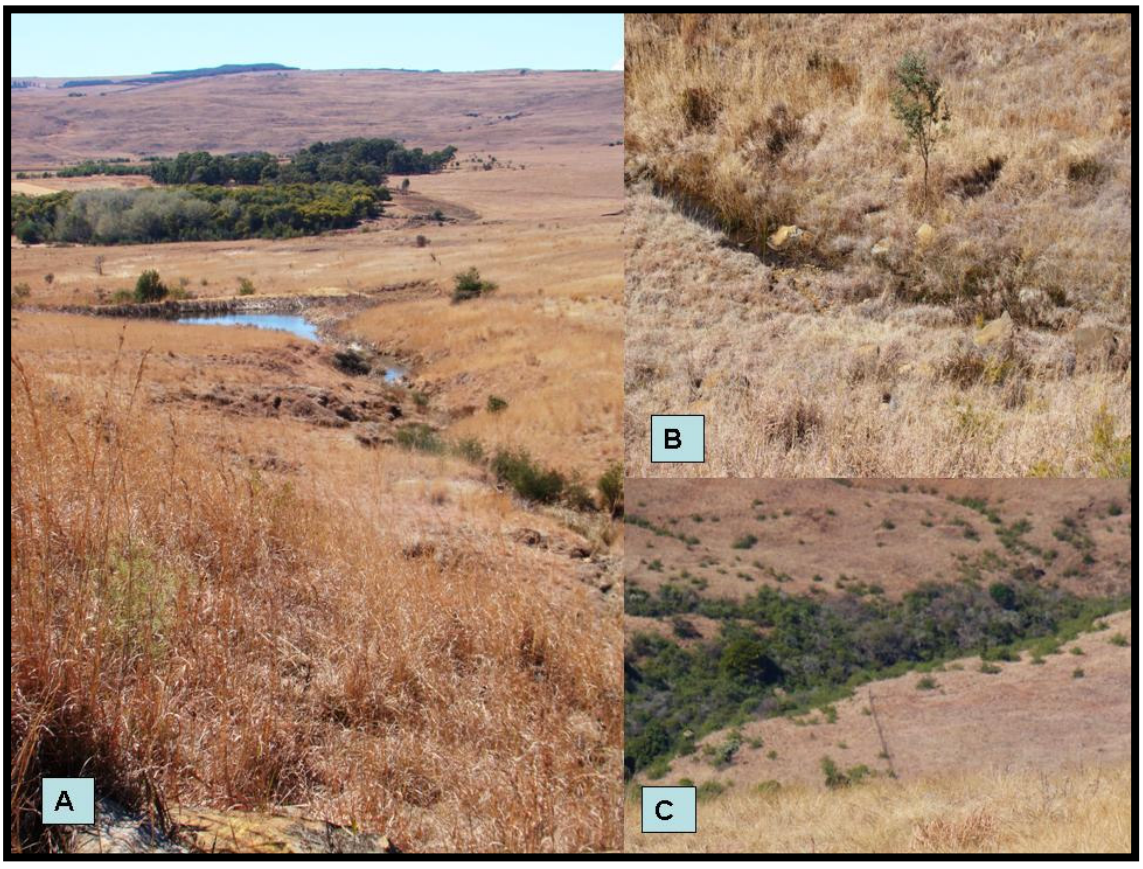
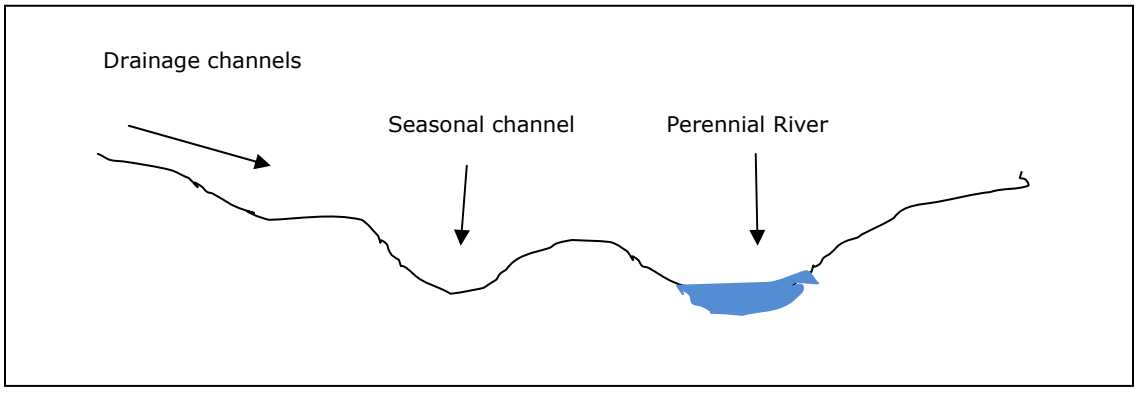


Figure7. A: Option 2 bisects a small non-perennial drainage line approximately 4km east of the Gumeni substation. **B:** The streams and drainage lines in the area are heavily utilized for livestock grazing activities as well as drinking points. Several of the streams and valley bottom wetlands have been artificially embanked for the creation of farms dams. This has resulted in the disruption of the hydrological patters especially downstream from the dams. Alien invasive vegetation observed along the

streams and drainage lines included **Acacia mearnsii, *Eucalyptus camaldulensis, *Populus x canescens, Salyx babylonica, Melia azedarach, *Lantana camara, *Sesbania punicea, *Rubus fruticosus, *Solanum mauritianum* **C:** All of the options bisect wooded non-perennial drainage lines on the Skurweberg towards the Bosloop substation.

The study areas falls within the catchment areas of two major river systems namely the Elands River and the Komati River. The Elands River is situated to the north of Machadadorp and the R541. Option 1 alignment bisects the Bankspruit; which is situated within the valley bottom of the Skurweberg and is a tributary of the Elands River. The Komati and Bankspruit rivers fall within the Inkomati Water Management Areas (WMA) and within the Elands River Catchment area. The Elands River is a major tributary of the Crocodile River. The Crocodile River is a source of fresh water for several towns and is used by industry, rural and the agricultural communities (including tobacco farms). The Elands River in turn, is used for irrigation of vegetables as well as forestry. Both these rivers support a rich diversity of aquatic life. Along with its social and economical importance, the Elands River has immense ecological importance, as it holds great biodiversity including critically endangered biota including the endangered fish species, *Chiloglanis bifurcus*, and a potentially geologically isolated subspecies of *Labeo-barbus polylepis* (O' Brein *et al.* 2008) In-stream habitat modifications are the results of inundation by weirs as well as water quality deterioration due to trout farming activities and urban development (Machadodorp). Encroachment by alien trees, especially wattles, poplars and eucalypts also account for riparian habitat modification (RHP 2001). Several smaller streams or non-perennial drainage lines occur within the valley bottoms of the surrounding mountains. These smaller streams were not surveyed due to inaccessibility as well as access issues pertaining to privately owned lands. Suitable habitat occurs along the smaller non-perennial streams for certain threatened plant species.



The riparian vegetation along the major rivers are characterised by the prominence of the trees *Acacia karroo; Acacia caffra,*Acacia mearnsii, Diospyros lycioides; Englerophytum magalismontanum, Cussonia paniculata, Cussonia spicata,*Melia azedarach, Protea caffra* and *Euclea crispa; Halleria lucida, Pittosporum viridiflorum and the grasses Hyparrhenia tamba; Aristida junciformis Setaria sphacelata; Ischaemum fasciculatum.* Other species prominent include *Lippia javanica, Searsia (Rhus) pyroides, Leucosidea serícea, Microchloa caffra, Hypoxis rigidula, Pelargonium luridum Monopsis decipiens, Themeda triandra Monocymbium ceresiiforme, Eragrostis curvula* on the embankment areas, and **Paspalum dilatatum, Pennisetum thunbergii, Ranunculus multifidus,* and *Schoenoplectus corymbosus* in the channelled valley bottom or stream areas.

Red data species

No red data species were found within this vegetation unit, though suitable habitat exists for several species. As a precautionary measure a walk through by a suitably qualified botanist/ecologist of the preferred alignment as well as tower positions should be undertaken during the EMP phase of the project especially pertaining to the stream and river crossings. Site specific mitigatory measures should be compiled for the river crossings.

3.4 Palustrine Wetlands

Figure8. A: The proposed alignments bisect several seasonally inundated as well as permanent palustrine valley bottom wetlands. **B:** The wetlands are dominated by hygrophilous grass and sedge species. The wetlands within the study area are heavily impacted on by livestock grazing and drinking activities. Extensive overgrazing and trampling of the hygrophilous grass and sedge vegetation within the valley bottom wetlands as well as hillslope seepage wetlands results in the dominance of the dwarf shrub *Seriphium plumosum*. It has been shown that heavy grazing has a detrimental effect on the hydrological state of wetlands, these include: disruption of flow patterns by paths, gully erosion, silting up of pools, encroachment of marginal vegetation into the wetland area, etc. Soil compaction reduces infiltration, which results in higher surface runoff and more rapid loss of water from the catchment. With increased runoff, stream-flow response is more rapid, flooding increases and recharge of groundwater storage falls with the result that baseflow yields also fall. This can increase the risk of soil loss through surface wash and rill erosion (Kotze & Breen 1994). Extensive soil erosion was observed along the valley bottom wetlands. **C:** Grasslands with elevated moisture levels or seasonally and temporary inundated hillslope seepage wetlands were observed on the plateaus of the grassy mountains as well as hillslope surrounding the alignments

Present in the lower-lying valley bottoms of the study area is an azonal vegetation unit known as **Eastern Temperate Freshwater Wetlands** (AZf3; Mucina *et al*. 2006). This vegetation unit is embedded within the Grassland Biome and can best be described as wetland vegetation surrounding bodies of water and periodically flooded areas. It occurs in the Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal Provinces as well as in neighbouring Lesotho and Swaziland around water bodies with stagnant water (lakes, pans, periodically flooded vleis, edges of calmly flowing rivers) with altitudes ranging from 750–2 000 m.

The percentage of area of this vegetation unit that is protected is 4.6% (NSBA) with a conservation target of 24% (NSBA) with 85.1% (NSBA) remaining intact it is classified as least threatened but poorly protected and is conserved in the Blesbokspruit (Ramsar site), Marievale, Olifantsvlei, Seekoeivlei (a Ramsar site), and others.

This unit is found embedded within the Grassland Biome where it occurs in the Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal Provinces as well as in neighbouring Lesotho and Swaziland around water bodies with stagnant water (lakes, pans, periodically flooded vleis, edges of calmly flowing rivers) with altitudes ranging from 750–2 000 m.

The wetlands vegetation primarily comprises grasses and sedges with very few trees and no shrubs present. Vegetation covers 85 % of the total land cover with bare soil comprising ~15% of the total cover. Soils are humus-rich black turf. The topography or slope is between 1~4° and drainage is good along the channelled and un-channelled valley bottoms (above the dams) but poor in the seasonally inundated depressions with conditions becoming moister towards the centre of the wetland. Degraded sections of hillslope seepage wetlands are dominated dense stands of *Hyparrhenia hirta, Hyparrhenia tamba*, *Bidens pilosa, Tagetes minuta,* and *Seriphium plumosum*.

Dominant grass and sedge species are *Phragmites australis, Typha capensis, Schoenoplectus corymbosus*, *Cyperus margaritaceus, Leersia hexandra* and *Mariscus dregeanus.* Indigenous herbs include hydrophilic or moisture-loving species *Persicaria lapathifolium* and *Polygonum attenuata* together with the *Rumex lanceolatus.* The vegetation is dominated by grass and sedge species reaching a height of ~2.5 m (*Typha capensis* and *Phragmites australis*) while the herbaceous component (averaging 40 cm tall) comprises a cover of about 5%, with only one

alien invasive tree species present (**Salyx babylonica, *Acacia mearnsii, *Eucalyptus camaldulensis, *Populus x canescens*). Indigenous herbs were scarce, as they cannot cope with the moist conditions and only specialized wetland herbs are present together with some generalist species.

Table2. Dominant vegetation observed within the palustrine wetland habitats observed along the alignments.

Species	**Herbs**
Trees	*Helichrysum nudifolium*
**Acacia mearnsii*	*Sium repandum*
**Sesbania punicea*	*Limosella longiflora*
Grasses	*Berkheya speciosa*
Leersia hexandra	*Cycnium sp.*
Phragmites australis	*Pycnostachys reticulata*
Andropogon sp.	*Helichrysum rugulosum*
Agrostis eriatha	*Pesricaria lapathifolia*
Sporobolus sp.	*Marsilea sp.*(sterile)
Juncus exsertus	*Mentha aquatica*
Typha capensis	*Rumex lanceolatus*
Phragmites australis	*Dierama pendulum*
Andropogon eucomis	*Cycnium adonense*
Ascolepis capensis	*Epilobium hirsutum*
Isolepis costata	*Gunera perpensa*
Juncus oxycarpus	*Wahlenbergia undulata*
Ficinia scirpioides	*Polygonum attenuata*
Cyperus sp.	*Ranunculus multifidus*
Paspalum urvilii	*Ledebouria cooperi*
Agrostis eriatha	*Chironia purpurescens*
Fuirena pubescens	*Monopsis decipiens*
Setaria sp.	**Cirsium vulgare*
Carex austro-africana	*Centella asiatica*
Schoenoplectus corymbosus	*Hypericum lalandii*
Scirpus ficinioides	*Lobelia flaccida*
	Vernonia hirsuta
	Utricularia arenaria
	Commelina erecta
	**Rorippa nasturtium-aquaticum*

* alien vegetation

The percentage of area of this vegetation unit that is protected is 4.6% (NSBA) with a conservation target of 24% (NSBA) with 85.1% (NSBA) remaining intact it is classified as **least threatened** but poorly protected and is conserved in the Blesbokspruit (Ramsar site), Hogsback, Marievale, Olifantsvlei, Seekoeivlei (a Ramsar site), Wakkerstroom Wetland, Umgeni Vlei, Umvoti Vlei and Pamula Park Nature Reserves. It is also protected in private nature reserves such as the Korsman Bird Sanctuary and Langfontein. The area comprised by this vegetation unit is 556.77 km^2 with some 15% having been transformed to cultivated land, urban areas or plantations. In places intensive grazing and use of lakes and freshwater pans as drinking pools for cattle or sheep cause major damage to the wetland vegetation because of trampling and grazing in the winter months when greens are scarce elsewhere but present in the wetland due to moisture (hydromorphic soils) present there.

Red Data Plants

No red data plant species were recorded during the brief field survey but suitable habitat occurs along the valley bottom wetlands as well as rocky hillslopes and moist hillslope seeps for several threatened plant species. As a precautionary measure a walk through by a suitably qualified botanist of the preferred alignment as well as tower positions should be undertaken during the EMP phase of the project especially pertaining to the valley bottom wetland and hillslope seepage areas to determine the possible presence of any rare or threatened plant species. The walk through should be undertaken during the summer months (November-March) when the majority of plant species are flowering. Site specific mitigatory measures should be implemented for all the wetland crossings occurring along the selected alignment.

3.5 Transformed Grasslands

Figure9. Extensive old or fallow agricultural lands were observed adjacent to the proposed alignments and are dominated by secondary succession grasses such as *Hyparrhenia hirta*, *Eragrostis curvula*, *Cynodon dactylon*. This community primarily comprises grasses and numerous weedy forbs with no indigenous trees or shrubs. Extensive invasion of Black Wattles *Acacia mearnsii* occur especially in hillslopes and valley bottoms which have elevated soil moisture levels. Vegetation cover comprises 50 % of the total land cover. The bare soil cover is comprises ~35% with pale brown loamy sand derived from weathered base rock. The slope is more or less level and drainage is good. Rocks are absent although small chips approximately 1-2 cm in diameter were observed.

Dominant grass species are the anthropogenic species such as *Hyparrhenia hirta*, *Eragrostis curvula, Cynodom dactylon* as well as the exotic *Pennisetum clandestinum (kikuyu). Weeds dominated the herbs component.

Table3: Species found in the fallow or old land community.

Species	**Species**
Trees:	**Succulents:**
**Eucalyptus* sp.	None
**Acacia meamsii*	
	Herbs / cont.:
Grasses & sedges:	**Verbena brasiliensis*
**Pennisetum clandestinum*	*Cleome maculata*
Trichoneura grandiglumis	**Cerastium arabidis*
Hyparrhenia hirta	*Alternanthera pungens*
Cynodon dactylon	**Cosmos bipinnatus*
Cymbopogon plurinodis	*Chamaecrista biensis*
Heteropogon contortus	**Oxalis corniculata*
Tragus berteronianus	**Amaranthus hybridus*
Eragrostis curvula	**Conyza bonariensis*
Aristida congesta subsp. congesta	*Commelina africana*
Herbs:	**Schkuhria pinnata*
Cleome monophylla	**Bidens bipinnata*
Sida rhombifolia	**Datura stramonium*
Corchorus confuses	**Bidens pilosa*
Chenopodium glaucum	**Argemone orochleura*.
**Flaveria bidentis*	
**Datura ferox*	

Arable or cultivated land represents a significant feeding area for certain rodent species such as Highveld Gerbil and Multimammate Mouse through the tilling opening up the soil surface, land preparation makes many insects, seeds, bulbs and other food sources are suddenly accessible. Rodents construct burrows in the sandy soils and attract other predators such as the slender mongoose.

No Red List species, medicinal or rare species were recorded or likely to occur within these transformed vegetation units along the alignments.

3.5 Exotic trees

Figure10. Significant patches of Saligna Gum (*Eucalyptus grandis**) as well as Black Wattle (*Acacia mearnsii**) were observed in the study area, particularly near human settlements. *Acacia mearnsii** is the most prominent invader in the areas as well as in South Africa (Henderson 2007) as well as being the No.1 on the World's Worst Invasive Species. Whilst in general exotic vegetation has little value for most faunal species, in this study area, the lack of other trees means that these stands may be used by some faunal species such as Common Duiker, Porcupine as refuge habitat.

Alien invasive tree species observed included Black Wattle (**Acacia mearnsii*), Saligna Gum (**Eucalyptus grandis*) Grey Poplars (**Populus x canescens*) as well as European Bramble (**Rubus fruticosus*). Dominant grass species are the anthropogenic species such as *Hyparrhenia hirta, Hyparrhenia tamba, Eragrostis curvula, Cynodon dactylon* as well as the exotic **Pennisetum clandestinum* (kikuyu). Weeds dominated the herbs component. No Red List species, medicinal or rare species were recorded or likely to occur within these transformed vegetation units along the alignments.

4. RESULTS OF THE INITIAL FAUNAL SURVEY OR HABITAT ASSESSMENT

Three general habitat sensitivity scans were carried out on site on the 18th August well as 5th- 6th October 2011. These site visits did not entail intensive surveying or utilisation of any sampling methods and can rather be viewed as being an opportunity to identify sensitive faunal habitats occurring along the proposed alignments. Emphasis was placed on the remaining open grassland habitats, and palustrine wetlands including valley bottom wetlands and associated hillslope seepage wetlands. No surveys were conducted within the mountainous areas and steep valleys due to access restrictions (inaccessibility due to no formal roads/tracks as well as privately owned farms). Due to the length of the proposed alignments as well as dense weedy plant and grass species of the transformed grasslands (old agricultural lands, alien invasive woodlots) little time was spent surveying these degraded habitats.

All animals (mammals (larger), reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as animal tracks (footprints, droppings) to identify animals. The majority of mammals were identified by visual observations as well as droppings and various burrow types. The majority of amphibians identified on the site were calling adults as well as incidentally observed adults (under rocks, logs etc) and from dip netting for tadpoles as well as emerging juveniles. Reptiles were actively searched for under suitable refuges such as loosely embedded flat rocks, logs, stumps, dumped building rubble, tyres and carpets and identified by actual specimens observed.

Two red listed bird species were recorded during the brief field survey. A pair of Secretarybirds (*Sagittarius serpentarius*) were observed foraging on arthropods in the grasslands east of the Gumeni substation approximately 500m from the Option 2 alignment. A single adult Secretarybird was observed foraging to the south of the Gumeni substation (Option 1 alignment). A single Southern Bald Ibis (*Geronticus calvus*) was observed foraging in the recently burned grasslands adjacent to the Bosloop substation. Suitable nesting areas occur within the adjacent rocky cliffs. A separate avifaunal survey was conducted by Mr. Andrew Pearson from the EWT.

4.1 MAMMALS

Mpumalanga is faunally diverse with approximately 163 mammal species consisting of 98 smaller and 64 larger species. It is the objective of Mpumalanga Parks Board (MPB) to conserve all of these species *in situ.* The grassland and forest biomes sustain many endemic and red data mammal species. The grassland biome is one of the biomes in which Red Data Book (RDB) insectivore richness is concentrated (Gelderblom, Bronner, Lombard & Taylor, 1995). High mammalian species richness occurs in savannahs, which could be as a result of the wide variety of habitats available. In Mpumalanga Province, savanna areas with the availability of sufficient cover, karst areas, wetlands, pans and a well-managed mosaic of short and tall grassland, are habitats that significantly contribute towards the ecological requirements of certain mammal species.

Certain species in Mpumalanga, towards which conservation efforts for habitat protection should be directed, have been identified. Priority species can be used to flagship or emphasise key habitats, which are of conservation concern. These species thus contribute towards identifying priority areas of conservation importance and in determining the conservation value of land. Anthropogenic land conversion and habitat degradation and fragmentation mainly due to agricultural and mining activities are major threats to the continued existence of endemic and threatened fauna in the province.

No small mammal trappings were conducted due to time constraints and the limitations that the results from single night or brief field surveys would pose. The brief fieldwork was augmented with previous surveys in similar habitats as well as published data. Mammal species recorded within the study area as well as those that may occur within the study area, on the basis of available distribution records and known habitat requirements, are included in the Table4 below. The majority of larger mammal species are likely to have been eradicated or have moved away from the area, as a result of previous agricultural activities, hunting and poaching as well as severe habitat alteration and degradation. The settlements surrounding the site as well as several informal settlements and associated hunting and poaching limits the suitability of the site for larger mammal species. High levels of hunting were noted on and surrounding the site with the use of dogs and wire snares as well as several empty shotgun cartridges. Several dog tracks were observed along the existing Eskom servitudes as well as hunting with dogs was observed during the site visit. The collection or harvesting of wood (stumps) and rock material as well as the frequent burning of the vegetation reduces available refuge habitat an exposes remaining smaller terrestrial mammals to increased predation levels. The use of wire snares for high intensity poaching activities will significantly affect remaining smaller mammal species such as rabbits and mongooses. Secondary access roads and

vehicles (motor cars, motor cycles, quad bikes) which transverse the area and bisect the valley bottom wetlands increase access to the site as well as potential road fatalities. Major road networks (R36 and R541) with high vehicular traffic increase the risk of road fatalities (hedgehogs, hares) of mammals. Smaller mammal species are extremely vulnerable to feral cats and dogs.

The Yellow and Slender mongooses were observed on the site and prey on the smaller rodents, birds, reptiles and amphibians on the site. Animal burrows (Yellow Mongooses, Highveld Gerbil, Multimmamate Mouse and African Molerat) were observed around the sandy sections of the grasslands. An active Antbear burrow system was observed within the foothills approximately 500m to the south-east of Option 1. A Common Duiker was flushed from the dense *Acacia mearnsii* patches opposite Option 2. Several Scrub Hares were flushed from the open grassland habitat. Rocky outcrops were observed as well as steep rocky-cliffs around Option 2 and 3. Suitable habitat occurs for rupicolous mammal species such as Eastern Elephant Shrew, Smith's and Jameson's Red Rock Rabbit and Rock Dormouse.

Table4. Mammal species recorded in the study area during the brief field survey and supplemented from previous surveys conducted on sites to the north and south of the alignment between2008-2011 (introduced species are in bold).

COMMON NAME	SCIENTIFIC NAME
Transvaal free-tailed Bat	*Tadarida ventralis*
Scrub Hare	*Lepus saxatilis*
House Mouse	***Mus musculus***
African (Common) Mole-rat	*Cryptomys hottentotus*
Spiny Mouse	*Acomys spinosissimus*

Four-striped Grass Mouse	*Rhabdomys pumilio*
Pouched Mouse	*Saccostomus campestris*
Natal Multimammate Mouse	*Mastomys natalensis*
Southern Multimammate Mouse	*Mastomys coucha*
House Rat	***Rattus rattus***
Highveld Gerbil	*Tatera brantsii*
Tiny Musk Shrew	*Crocidura fuscomurina*
Reddish-Grey Musk Shrew	*Crocidura cyanea*
Southern African Hedgehog	*Atelerix frontalis*
Striped Polecat	*Ictonyx striatus*
South African Large-spotted Genet	*Genetta tigrina*
Yellow Mongoose	*Cynictis penicillata*
Slender Mongoose	*Galerella sanguinea*

Marsh Mongoose	*Atilax paludinosus*
Black-backed Jackal	*Canis mesomelas*
Cape Porcupine	*Hystrix africaeaustralis*
Scrub Hare	*Lepus sextalis*
Common Duiker	*Sylvicarpa grimmia*
Cape Clawless Otter	*Aonyx capensis*

Habitat available for Sensitive or Endangered Species

According to the "*The Red Data Book of the Mammals of South Africa: A Conservation Assessment*" (Friedmann Y. and Daly B, (editors) 2004) and Skinner and Smithers (1990) as well as *The Mammals of the Southern African Subregion* (Skinner and Chimiba 2005) the study area falls within the distribution ranges of 13 species which are placed into one of known threatened species ((1) Critically Endangered; (1) Endangered, (1) Vulnerable and (2) Near-threatened) as well as 8 species which are presently listed as Lower Risk/conservation dependent. No actual observation of any threatened mammal species were recorded during the brief survey but an active Antbear burrow was recorded to the south-east of Option 2 as well as evidence of foraging activities around Option 1 and Option 3. Limited termite mounds were observed in the open grasslands adjacent to Option 2 alignment and were more abundant to the south of Gumeni substation within the Option 1 alignment. The surrounding grassland rocky hills and wooded kloofs provide suitable habitat for Brown Hyaena as well as several other red data mammal species including Aardvark, Serval, Oribi, African Civet, Honey Badger, African Wild Cat, African Weasel, African Hedgehog, Pangolin as well as Selous' Mongoose. More intensive surveys conducted over several seasons would be required for the entire area to ascertain their possible presence of these highly secretive species as well as a more representative species list of mammal species occurring on the site.

Table5. Mammal species of conservation importance possibly occurring along the proposed Gumeni-Bosloop alignments (using habitat availability and distribution as an indicator of presence)

Species Name	Common name	Endemic to SA	*Conservation Status according to* Friedmann Y.& Daly B, 2004	*Criteria*
ORDER EULIPOTYPHLA				
Amblysomus septentrionalis	Highveld golden mole		*NT*	
Family Chrysochloridae *Chrysospalax villosus*	Rough-haired golden mole	Yes	*CR*	C2a(i), D
ORDER INSECTIVORA				
Family Erinaceidae *Aterlerix frontalis*	Southern African Hedgehog	Yes	*NT*	
ORDER RODENTIA				
Family Muridae *Dasymys incomtus*	Water rat		*NT*	
Mystromys albicaudatus	White-tailed rat	Yes	*EN*	A3c
ORDER CARNIVORA				
Family Hyaenidae *Proteles cristatus*	Aardwolf		*LC*	
Subfamily Mustelinae *Poecilogale albinucha*	Striped Weasel		*DD*	
***KEY**:* ***EX** = Extinct* ***EW** = Extinct in the wild* ***CR** = Critically Endangered*				

Species Name	Common name	Endemic to SA	*Conservation Status according to* Friedmann Y.& Daly B, 2004	*Criteria*
***EN** = Endangered* ***VU** = Vulnerable* ***LR** = Lower Risk* ***NT** = Near Threatened* ***LC** = Least Concern* ***DD** = Data Deficient* ***NE** = Not Evaluated*				

White-tailed Mouse (*Mystromys albicaudatus*) (A.Smith, 1834)

Distribution

White-tailed Mice are confined to the subregion. They occur in the southern, western, eastern and north-eastern parts of the Cape province, in Kwazulu-Natal, the Free State, the south-western and southern parts of Gauteng and Swaziland.

Habitat Preference

In the eastern parts of their distribution range, they follow very closely the savanna grassland zone, but are not confined to this, occurring in the Karoo and in the south-west, in the Cape Macchia Zone (Smithers and Skinner, 1991). In the former Transvaal they were recorded in area of dense grass and sandy soils, but also from rocky areas with good grass cover (Rautenbach 1982). In Kwazulu-Natal they were caught in similar habitat to that in Lesotho being collected in short sparse grassland on a gentle stony slope (Taylor, 1998). They are nocturnal and terrestrial, living in burrows or cracks in the soil (de Graaf, 1981). They appear to be cold adapted and remain inactive during the day in the thermally buffered microenvironment of their burrows (Downs & Perrin, 1995).

Food

Their diet includes insects, seeds and green vegetable matter.

Reproduction

Roberts (1951) stated that they breed throughout the year, but this remains to be confirmed under natural conditions (Skinner and Smithers, 1991).

South African Hedgehog *Atelerix frontalis* (A.Smith, 1831)

Distribution (Southern African Sub-region)

They occur in Namibia, Botswana, Zimbabwe, Lesotho and South Africa. The South African distribution includes the Gauteng, Free State, Limpopo and Cape Provinces (Skinner and Smithers, 1991).

Habitat

Hedgehogs occur in such a wide variety of habitats that it is difficult to assess its habitat requirements. The one factor that is common to all the habitats in which they occur is dry cover, which they require for resting places and breeding purposes. Habitat must provide a plentiful supply of insects and other foods. Suburban gardens provide these requirements and this may explain their occurrence in this type of habitat. Hedgehogs are predominantly nocturnal, becoming active after sundown, although, after light rains at the commencement of the wet season, they may be active during daylight hours (Skinner and Smithers, 1991).

Food

Hedgehogs are omnivorous feeding predominantly on invertebrates such as beetles, termites, centipedes, millipedes, moths and earthworms. They will take small mice, lizards and the eggs and chicks of ground-living birds as well as frogs, slugs and some vegetable matter, including fungi (Skinner and Smithers, 1991).

Reproduction

Seasonal breeders, with young being born during the warm, wet summer months from October to March (Skinner and Smithers, 1991).

Highveld golden mole

Amblysomus septentrionalis is a cryptic species, which was formerly included in *A. hottentotus* (Bronner, 1996). The Highveld golden mole can, at this stage, be regarded as a Mpumalanga endemic. Current distributional data available (Bronner, 1996) indicates that southern Mpumalanga is the core of distribution within South Africa. Highveld golden moles are found in various grassland veld types at elevations above 700m a.s.l. and mean annual rainfall above 500 mm (Rautenbach, 1982). They normally occur on level ground that is soft, sandy or sandy loam. Specimens have also been collected from black clayey soils (Rautenbach, 1982) such as those found within the valley bottom wetlands and hillslope seepage areas along the alignments

The Highveld golden mole has so far been recorded from nine fragmented localities (22^{+}records) from the southern part of Mpumalanga. The areas in which *A. septentrionalis* occur are small, but populations within these areas seem to have relative high densities. Modelling predicted a relatively widespread distribution throughout the highveld areas of southern Mpumalanga and included the Nooitgedacht, Jericho Dam and Paardeplaats Nature Reserves as areas of potential occurrence.

Amblysomus septentrionalis is adaptable and can coexist with man. However, changing land-use practices and mismanagement of grassland habitat threaten these populations. Other anthropogenic factors such as hunting by domestic dogs and pesticides could also affect the populations.

Rough-haired golden mole (*Chrysospalax villosus*) (A. Smith, 1833)
(*Chrysospalax villosus rufopallidus*) (Roberts, 1924)
(*Chrysospalax villosus rufus*) (Meester, 1953)

Both *C. v. rufopallidus* and *C. v. rufus* are endemic to and known from restricted areas in the Mpumalanga province. The Rough-haired golden mole is a grassland specialist. According to Roberts (1951), it prefers meadow-like or dry substrate on the fringes of damp vleis and marshes. It also often occurs in suburban areas (Taylor 1998) and seems to be adaptable. A high degree of sub-speciation occurs due to the localised distribution of this uncommon species. Five records (dating back to the 1910's and the 1920's) exist for *C. v. rufopallidus* and all the specimens were collected from the Wakkerstroom municipal area. *C. v. rufus* is known from six records (dating back to the 1920's and 1950's) in the Belfast and Sabie regions in the northern part of the province.

Distribution

Recorded from the extreme western parts of the Western Cape through southern and central Kwazulu-Natal into Gauteng (Witbank, Springs, Pretoria and Johannesburg) and into Mpumalanga as far as Sabie and Graskop. (Skinner and Chimimba 2007).

Habitat

Grassland, with a preference for the use of dry ground on the fringes of marshes or damp vleis (Skinner and Smithers, 1991). Specimens from Kwazulu-Natal have been collected in suburban gardens and along the edge of a golf course adjoining a small stream (S, Maree & G.N. Bronner, unpubl. data). They apparently do not make subsurface runs like other golden moles, but excavate burrows, the entrances to which are characterized by loose piles of soil thrown up at the sides and back and which are left open when they leave the burrows to forage. Roberts (1951) thought

they lived in chambers within their burrow systems from which they emerge only after rain. From the entrances, through repeated use, tracks are formed to feeding areas, which are marked by the disturbance of the soil in rooting with the horny pad on their noses. If suddenly alarmed when out of the burrows they quickly return to their shelter. In captivity, Roberts (1951) noted that, irrespective of the direction in which they faced, when they were disturbed their reactions were so rapid and the location of the burrow entrance apparently so well known that it was difficult to follow them as they sought refuge within it.

Food

Consists predominantly of insects and earthworms. They emerge from the burrows to feed on the surface normally after rain when they become particularly active (Skinner and Smithers, 1991).

Reproduction

Very little information is known about this aspect of their life history. Roberts (1951) recorded a female with two foetuses, but gave no date of recover of specimen.

Threats include loss and/or degradation of grassland habitat through land modification and mismanagement of natural grassland and wetland areas. Trampling, overgrazing and burning of vegetation around vleis or marshes in winter could impact negatively on populations. Populations are vulnerable to anthropogenic factors such as hunting by domestic dogs (Taylor, 1998) or poisoning through insecticides. Suitable habitat occurs adjacent to the fringes of the valley bottom wetlands for Rough-haired Golden Moles. Burrows (most likely crabs) were observed adjacent to the valley bottom wetlands.

Figure11. An active Antbear burrow system was observed to the south-east of the Option 2 alignment within the lower slopes of a rocky hillslope. Evidence of recent foraging activities on several termite mounds were observed within the surrounding grasslands adjacent to Option 1 and Option 3.

Antbear (*Orycteropus afer*) (Pallas, 1766)
Although distributed throughout almost the entire country, the antbear occurs in low densities. They avoid rocky and dense woodland areas. Taylor (unpublished data) noticed that steep areas are not frequented by antbears, but may form part of their home ranges. Within their wide distribution there are many areas where they are locally absent, either due to unsuitable terrain or lack of food (Skinner & Smithers, 1990). The Antbear is particularly associated with heavily utilised grasslands where there are termite populations. In the southern Free State the mean home range sizes of Aardvarks to be 3.5 km^2 (Taylor, unpublished data). Known localities were used to model their potential distribution.

This species occurs throughout most of the untransformed areas of the Mpumalanga province, on private as well as state-owned land. A single female will only produce one offspring, rarely twins, per annum (Smithers, 1986). Maintenance of the currently untransformed areas will therefore possibly not contribute to an increase in population numbers, but will only contribute towards the stabilisation of this species, provided that certain human threats are minimised. Evidence of Antbear foraging activities were observed in the grasslands adjacent to Option 2 and Option 3.

Antbears or Aardvarks conservation status has been downgraded to Least Concern (LC) (Smithers & Chimiba 2005).

Aardwolf (*Proteles cristatus*) (Sparrman, 1783)
This species occurs throughout South Africa in low numbers. They seem to prefer areas with an annual rainfall below 800mm and avoid densely vegetated areas (Smithers, 1986) and will only occur where adequate food sources are available. The Aardwolf is vulnerable to livestock farmers killing them mistakenly believing that they kill small domestic stock. Large numbers are killed on the roads. They specialise on *Trinervitermes* termites and are therefore also vulnerable to the poisoning of these termites.

African Striped Weasel (*Poecilogale albinucha*) (Gray, 1864)
Four subspecies have been described, but Skinner & Smithers (1990) report a lack of sufficient evidence to support this. Therefore, the subspecies have not been recognised for this study. The African striped weasel most often occurs in savanna and moist grassland with an annual rainfall of above 600mm. Very few observations have been made on this species in the wild. The modelled data shows a uniformly fragmented distribution throughout the province except for the Lowveld region, with a higher occurrence in typical habitat towards the central grasslands and the south-eastern portion of the Usutu River catchment. Moist grassland associated with perennial and non-perennial pans and palustrine wetlands form an important part of their habitat. This explains the predicted occurrence for the central parts of Mpumalanga. Suitable habitat occurs along the palustrine valley bottom wetlands as well as seasonally inundated depressions/pans for Striped Weasels. The conservation status of African Striped Weasels have been downgraded from Rare to Least Concern (LC).

According to Smithers (1986) there is little evidence of a decline in either range or numbers of African Striped Weasel. However, they are a secretive species unknown to occur near human settlements and activities and thus it can be accepted that there has been a decline in their habitat. This species feed almost entirely on rodents and insects and are thus sensitive to pressures of intensive agriculture and grazing, which cause a reduction in availability of prey species. Land transformation will continue to play a role in the decline of this species. Their inability to coexist in close proximity to humans will also ensure that they are excluded from areas bordering transformed or developed areas.

The site was also surveyed for the following wetland associated mammals:

Cape Clawless Otters (*Aonyx capensis*)
The latrine of a Cape Clawless Otter was observed on the banks of the an artificially created dam. The permanent dams with dense reed invaded margins offers suitable refuge habitat for remaining Cape Clawless Otters. Suitable foraging areas occur along the rivers and streams. The surrounding dams certain suitable prey items including crabs, frogs, fish and other aquatic life. The presence of several hunting dogs and wire snares on and around the site and neighbouring properties is an immediate threat to remaining Cape Clawless Otters.

Spotted-necked Otter (*Lutra maculicollis*)
Spotted-necked otters are adapted ideally to an aquatic life and are confined to the larger river systems, dams, lakes and swamps which have extensive areas of open water. No suitable habitat occurs for this species on the actual site or surrounding area.

Water or Marsh Mongoose (*Atilax paludinosus*)
The scats of Water/ Marsh Mongoose were observed around several of the dams. The dense reed beds on the margins of dams offer suitable refuge habitat for Marsh Mongooses. The dams provide favourable foraging areas for the Marsh Mongoose. Prey items include frogs, fish and other aquatic life. The high human presence as well as several dogs and wire snares on and around the site and neighbouring properties is an immediate threat to remaining Marsh Mongooses.

Rough-haired Golden Mole (*Chrysopalax villosus*)
Suitable habitat occurs on the site in the form of the shallow sandy soils above the inflow and margins or fringes of the hydrophilic grass/sedge seepage and valley bottom wetlands. The majority of areas surrounding the dams are severely disturbed by cattle drinking activities.

African Marsh Rat or Water Rat (*Dasymys incomtus*)
Limited suitable habitat occurs along the reed beds around permanent dams as well as among the semi-aquatic grasses of the seepage wetlands as well as in the dense hydrophilic grasses along the inflow and around the margins of dams.

Angoni Vlei Rat (*Otomys angoniensis*)
Limited suitable habitat occurs along the reed beds around permanent dams as well as among the semi-aquatic grasses of the inflow seepage wetland as well as in the dense hydrophilic grasses along the valley bottom wetlands.

Vlei Rat (*Otomys irrotatus*)

Suitable habitat exists on the site along the reed beds around permanent irrigation dams as well as among the semi-aquatic grasses and seepage and valley bottom wetland areas o. No runs or saucer shaped nests were observed on higher lying ground or in clumps of grass. Feeding areas were noted (short discarded grass stems) around the seepage wetland around certain valley bottom wetlands on the site.

Suitable habitat remains along the valley bottom wetlands, rivers and streams for certain wetland mammal species including Cape Clawless Otter, Marsh Mongoose, Vlei Rats and Water Rat.

No evidence or actual sighting of any endangered mammal species were observed during the brief survey. The majority of larger mammal species have disappeared or located suitable habitats away from the area, due to high levels of human activities a well as uncontrolled hunting and poaching as well as habitat alteration and degradation. Smaller mammal species are extremely vulnerable to snares and poaching activities as well as feral cat (*Felis cattus*) and dog populations. Continual habitat destruction, alteration and human disturbances will result in the disappearance of the majority of sensitive or secretive mammal species. It must be stressed however that the above-mentioned species are extremely difficult to observe and even more intensive surveys may not determine their presence, especially pertaining to the Rough-haired and Highveld Golden Moles as well as White-tailed Mouse.

4.2 AMPHIBIANS

Amphibian surveys by Jacobsen (1989), as well as recent and current surveys suggest that 51 species of amphibians currently occur in the Province of Mpumalanga. The present study concentrated mainly on Red Data species and species that are threatened or have relatively restricted distributions. Eight species are considered as important for setting conservation priorities. In Mpumalanga*: Vandijkophrynus* (*Bufo*) *gariepensis nubicolus* (Karroo toad), *Hadromophryne* (*Heleophryne*) *natalensis* (Natal Cascade Frog/Natal Ghost Frog), *Hemisus guttatus* (Spotted shovel-nosed Frog), *Hyperolius semidiscus* (Yellow-striped Reed Frog); *Strongylopus wageri* (Plain Stream Frog), Giant Bullfrog (*Pycicephalus adspersus*), Greater Leaf-folding Frog (*Afrixalis fornasinii*) and Whistling Rain Frog (*Breviceps sopranus*).

The amphibian populations in Mpumalanga are faced with several environmental threats. Habitat destruction and alien vegetation resulting in fragmentation of populations is probably the major threats facing all frog species. Forestry and agriculture have already resulted in the rapid destruction and fragmentation of the habitat of populations of the species discussed here. Overgrazing and severe fires in the grassland catchment areas result in extensive silting up of streams and wetlands, threatening the breeding habitat of these frogs. The biphasic life cycle of most frogs, as well as their semi-permeable skin makes them particularly vulnerable to pollutants and other environmental stresses. Consequently frogs can be used as environmental biomonitors to indicate the quality of the environment. Chemical pollution and acidification constitute a major threat to frog populations. Heavy metals such as aluminium, cadmium, copper, zinc and iron are all toxic to amphibians. It can be inferred from studies on fish that nickel, lead and manganese will also have deleterious effects on frog populations (Bishop 1996).

Herbicides and pesticides often cause developmental abnormalities or mortalities. A recent report has shown that widely used and apparently safe herbicides containing the active ingredient glyphosphate are extremely toxic to tadpoles and frogs (Bishop 1996). These herbicides are widely used in plantations, as well as in nature reserves for alien plant control and the making of firebreaks.

Another threat to the continued survival of these frog species, is the damming of rivers, streams and wetlands. In many cases this action is followed by the introduction of alien fish species, with their associated parasites, for angling purposes in these dams. The preferred breeding habitat of five of the species discussed is natural, shallow, ephemeral pools and streams in palustrine wetlands. Deeper man-made dams and weirs alter and shrink the breeding habitat of these

frogs considerably. Invasive predator fish species may also be a threat to the survival of the species.

No actual survey was undertaken due to extreme time constraints for an adequate herpetological survey. The majority of species in Mpumalanga Province are classified as explosive breeders completing their short duration reproductive cycle in the early summer months between (November-January). These frog species only emerge after the first heavy summer rainfalls and are dormant during the cold winter months. Explosive breeding frogs utilise ephemeral pans or inundated grasslands for their short duration reproductive cycles.

Figure12. A Tremelo Sand Frog (*Tomopterna cryptotis*) was observed under piece of driftwood adjacent to a seasonally inundated depression within a valley bottom wetland.

The brief amphibian survey was undertaken for 3 days (no nocturnal surveys) during the early summer months (August-October). Six frog species were recorded namely Common Caco (*Cacosterum boettgeri*), Bubbling Kassina (*Kassina senegalensis*), Common Plattana (*Xenopus laevis*), Tremelo Sand Frog (*Tomopterna cryptotis*) Guttural Toad (*Amietophrynus* (*Bufo*) *gutturalis*) and Common River Frog (*Amietia angolensi*s). The majority of frog species recorded are common and widespread and typical of a perennial stream as well valley bottom wetland environment. Comprehensive herpetological surveys can only be undertaken throughout the duration of the wet season (November-March). It is only during this period that accurate frog lists can be compiled.

HABITAT AVAILABLE FOR SENSITIVE OR ENDANGERED SPECIES

Figure13. Giant Bullfrogs have been recorded from grid squares to the north (Loskop Dam) as well as to the west of the site. Several migrating juvenile bullfrogs were observed within a colliery in the Middleburg area (2009).

Giant Bullfrog *(Pyxicephalus adspersus)*

As the largest southern African frog, it spends most of the year underground encased in a transparent cocoon, emerging only after heavy thunderstorms in summer. The Bullfrog breeds in shallow, temporary rain-filled pans and small wetlands in grassland and savanna (Passmore and Carruthers 1995), as well as in the Great Karroo (SAFAP). Although the species occurs widespread in southern Africa (Lambiris 1988), the populations in Mpumalanga are threatened by habitat degradation and fragmentation.

The predicted distribution of *P. adspersus* was determined using environmental variables such as elevation (800 to 1700 m a.s.l.) and mean annual rainfall of less than 750 mm. It is absent from high lying areas with high rainfall. These habitats are estimated to be more than 40% transformed. Loskopdam Nature Reserve is the only provincial protected reserve where the Giant Bullfrog was recorded (Jacobsen et al 1986). For this reason the species is considered **vulnerable** in the Mpumalanga Province.

The Giant Bullfrog is currently assigned as a near-threatened species (IUCN Red List category). Giant Bullfrogs have been recorded from the adjacent grid squares (Middleburg area) during previous surveys as well as during the South African Frog Atlas Project (SAFAP). Specimens recorded were of road fatalities, migrating adult males as well as potential breeding localities in the Middleburg area. Bullfrog density commonly varies within certain habitats (open grassland habitat). High densities are often associated with specific microhabitats or patches (hygrophytic or aquatic ephemerophytic grass and sedge dominated temporary pans) that can be identified and randomly sampled. Emphasis must be placed on remaining natural open grassland habitats (important migratory and foraging areas) as well as seasonal wetlands (drainage and marshland vegetation) surrounding the alternative alignments. A seasonal pan was observed approximately 500m to the south of Option 2 alignment. The seasonal wetland habitats offer the most suitable breeding habitat for Giant Bullfrogs in the area. No Giant Bullfrogs were observed during the brief field survey or during previous surveys conducted in the Watervalboven, Lydenburg, Witbank, Secunda and Bethal areas or are likely to occur along the alignments.

4.3 REPTILES

Most current knowledge of the reptiles of Mpumalanga is based on a survey done by N.H.G. Jacobsen (1989) providing a detailed account of all reptiles in the then Transvaal province. This survey resulted in descriptions of life histories, habitat requirements and conservation status and maps of the known distributions. Jacobsen's (1989) survey revealed that 154 reptiles occur in the Mpumalanga Province and of these, 86 species are threatened. However, many of these threatened reptiles have relatively wide distributions and thus this study was restricted to Red Data species and species that are largely restricted to Mpumalanga.

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe during field surveys. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Due to human presence in the area coupled with increased habitat destruction and disturbances around the alternative sites are all causal factors in the alteration of reptile species occurring on the site and surrounding areas. Scattered low-lying rock outcrops occur within the grasslands throughout the site and provide favourable refuges for certain snake and lizard species (rupicolous species). Several large termite mounds *Trinervitermes haberlandii* were observed along and around the proposed alignment 2 and 3. Termite mounds offer important refuges for numerous frog, lizard and snake species. Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). These mass emergences coincide with the first heavy summer rains and the emergence of the majority of herpetofauna. Termite mounds also provide nesting site for numerous snakes, lizards (varanids) and refuge habitats for several smaller mammals (shrews) and frogs. No indigenous tree species were observed. Trees including stumps, bark and holes are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors).

The indiscriminate killing of all snake species as well as the illegal collecting of certain species for private and the commercial pet industry reduces reptile populations especially snake populations drastically. The frequent burning of the site will have a high impact on remaining reptiles. Fires during the winter months will severely impact on the hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

Figure14. Several archaeological ruins as well as artificial rock piles (land clearing) provide suitable habitat for rupicolous reptile species.

Reptile species recorded from the rocky areas along alignments included Yellow-Throated Plated Lizard (*Gerrhosaurus flavigularis*), Montane Speckled Skink (*Trachylepis* (*Mabuya*) *punctatissima*), Variable Skink (*Trachylepis* (*Mabuya*) *varia*) Ground Agama (*Agama aculeata*), Cape Thick-toed Gecko (*Pachydactylus capensis)*.

HABITAT AVAIALBLE FOR SENSITIVE OR ENDANGERED SPECIES

Table6. Threatened reptile species likely to occur along the alignments according to habitat availability.

COMMON NAME	SCIENTIFIC NAME	SA RED DATA STATUS	IUCN STATUS
Southern African Python	*Python natalensis*	Vulnerable	*Vulnerable
Swazi Rock Snake	*Lamprohis swazicus*	Rare	Near-threatened
Yellow-bellied House Snake	*Lamprophis fuscus*	Rare	Near-threatened
Striped Harlequin Snake	*Homoroselaps dorsalis*	Rare	Near-threatened

*It is unlikely that pythons will retain this threat classification when reassessed using the latest IUCN criteria, since it appears to be relatively common in certain areas and has a widespread distribution (Alexander and Marais 2007).

Southern African Python *(Python natalensis)*

The Southern African Python (*Python natalensis*) is protected in South Africa (SA RDB, Vulnerable) and their numbers have declined due to habitat destruction, killed for their skins (fashion), 'muti', illegally collected for pets and the pet industry. The majority of pythons are indiscriminately killed due to fear and ignorance or due to road fatalities. Pythons have been recorded from the Lydenburg Grid Square (2530AB).

Habitat and Ecology: Pythons live in a wide variety of habitats, but are most common in moist, rocky, well-wooded valleys. They are frequently found in and around water, in which they bask and ambush food. They are also excellent climbers. They hunt mainly at night or in the twilight, but can also be found basking, and occasionally even hunting during the day. The diet of juveniles consists mainly of small rodents and ground living birds, although they will also take fish and water or nile monitors (leguaans). The adults feed mainly on medium-sized mammals, including dassies, hares, cane rats, duikers, etc. The larger specimens will take larger mammals, and there are accurate, and often graphically illustrated, reports of

Southern African Pythons killing and swallowing very large prey items. The largest recorded prey item for any large constrictor is that of a 59 kg impala swallowed by a 4.88 m African python (Rose, 1955). Other records include, among many others, a 6 m python consuming 6 goats (Taylor, 1981), a 5 m python that ate a pointer watchdog and two of her puppies (Jensen, 1980), and a 4.28 m python devouring a six-month old female impala (illustrated in Branch, 1984). F. W. FitzSimons (1930) even records pythons killing leopards, and a python constricting a crocodile is illustrated in Halliday and Adler (1986).

The python is the only African snake large enough to consider humans edible, albeit very rarely. There are a number of anecdotal reports of human predation by pythons. In addition to the dangers of constriction, pythons have a mouthful of large, recurved and needle-sharp teeth that can deliver a powerful and lacerating bite. Adults are also irrasible, and rarely settle well into captivity.

Man is now the python's main predator, killing them for food, 'muti', skins and, short-sightedly, to rid himself of a 'pest'. Other enemies include crocodiles, honey badgers or ratels, mongoose and meeerkats, etc. Pienaar, *et al.* (1983) record a young python (825 mm) in the stomach of a Cape File snake. Pythons are often killed crossing roads, and when engorged with food they are especially vulnerable to attacks by packs of wild dogs and hyaenas.

Many African tribes prize python fat and skin for use in tribal medicines and witchdoctor's 'muti', whilst a large python represents a tasty and substantial food item (see photograph in Patterson and Bannister, 1987). All pythons, but particularly juveniles, are desired by the pet trade, and would find a ready market if not protected by law. Pythons are frequently electrocuted on the lower wires of electric fences which are erected around the increasing number of game farms.

Suitable habitat occurs within the wooded ravines and riparian areas of the Komati River for pythons; especially adjacent to the proposed Option 3 alignment.

Swazi Rock Snake (*Lamprophis swazicus*)

This is a poorly known restricted species with limited records. Specimens are usually found in narrow rock crevices and under exfoliating rock flakes on rocky outcrops. Specimens observed in the Wolkberg were discovered under large loosely embedded rocks on rocky outcrops surrounded by mountain grassland (*pers.obs.* 2009). The major threat to the species is the destruction of habitat through afforestation of the eastern escarpment. Suitable habitat remains under loosely embedded rock material on the rocky hillslopes, rocky cliffs as well as artificial rock piles and stone walls of the archaeological sites for Swazi Rock Snake.

Yellowbellied House Snake (*Lamprophis fuscus*)

A rare, endemic species known from widely scattered; and varied habitats. Specimens have been collected under stones as well as moribund termite mounds. An unconfirmed record was located during the excavation of a moribund termite mound during the construction of Monte Casino in Fourways, Gauteng (*pers.obs*.). The destruction of termite mounds during land clearing agricultural activities as well as during maintenance of the current Eskom servitudes are the major threats to this secretive species within the study area. Suitable habitat remains under loosely embedded rocks on the rocky hillslopes especially adjacent to the Bosloop substation as well as artificial rock piles (land clearing) as well as artificial stone walls of the archaeological sites.

The Striped Harlequin Snake (*Homoroselaps dorsalis*), which is categorised as Rare in the out-dated Red Data List (Branch 1988) and is currently listed as Near-Threatened (NT) by the IUCN (World Conservation Monitoring Centre, 1996), though this assessment is also out-of-date. The conservation status of *H. dorsalis* will be reviewed in coming months by the South African Reptile Conservation Assessment (SARCA). Striped Harlequin Snakes have been recorded from the adjacent grid squares to the north (SARCA virtual museum). Prefers grassland and are endemic to the highveld of the Free State, Kwazulu-Natal, Swaziland, Limpopo and Gauteng. These snakes are very secretive and are only known from a few specimens. They burrow in loose soil and forage underground in tunnels and cracks, and are usually exposed in abandoned termitaria or under stones. They feed exclusively on thread snakes (*Leptotyphlops*) which they catch underground (Branch 1998).

Figure15. Limited moribund termite mounds occur and several large mounds have recently been destroyed during the clearing of vegetation along the servitudes of the current Eskom transmission and distribution lines. Eskom's current policy of mowing the grasses under the powerlines with a tractor needs to be re-addressed; especially within primary Lydenburg or KaNgwane Montane Grasslands containing termite mounds, rocky outcrops, hillslope seeps and valley bottom wetlands.

According to the habitat description (moribund/old termite mounds and scattered loose rock) provided for this species by Broadley (1990) and Branch (1988); suitable habitat exists in the form of moribund termite mounds as well as limited scattered loosely embedded rock in certain areas of the alignments (especially the moribund termite mounds) for the Striped Harlequin Snake. One specimen of Striped Harlequin Snakes has been recorded from the Lydenburg Montane Grassland vegetation unit and four from the KaNgwane Montane Grassland vegetation unit. Ideally the preferred alignment should be adjusted to avoid any major rocky outcrops or rocky hillslopes. No rock material must be removed from the site or used for construction activities. As a precautionary measure a thorough summer walk through should be conducted by a suitably qualified herpetologist prior to construction activities throughout any rocky areas along the selected alignment; especially within the construction footprint of the proposed towers.

5. SENSITIVE HABITATS AROUND THE PROPOSED ALIGNMENTS

5.1 LYDENBURG AND KaNGWANE MONTANE GRASSLANDS

- Grasslands in the Mpumalanga Province are highly threatened by afforestation, urbanization, industrialisation and agricultural activities. Only a small fraction of this vital habitat has been formerly conserved. These areas form vital habitats for numerous endemic as well as threatened plant as well as several threatened animal species.

- Lydenburg Montane Grassland is currently listed as **Vulnerable.** The conservation target is 27%, with 2.4% formally protected within reserves (Gustav Klingbiel. Makobulaan, Mt Anderson, Ohrigstad Dam. Sterkspruit and Verlorenvlei) as well as in a number of private conservation areas (Buffelskoof, Crane Creek, mc, In-de-Diepte, Kaalboom, Kalmoesfontein. Mbesan. Mondi Indigenous Forest. Mt Sheba: Waterval etc.). The level of transformation is relatively high at 23% with mostly alien plantations (20%) and cultivated lands (2%).
- KaNgwane Montane Grassland is currently listed as **Vulnerable**. The conservation target is 27% with only 0.4% protected within any formally proclaimed nature reserves (Malalotja, Nooitgedacht Dam and Songimvelo). A number of private conservation areas protect small patches of this unit. It's

well suited for afforestation and 30% has already converted to plantations of alien trees. A further 6% is under cultivation.

- All remaining primary grasslands and especially the rocky hillslopes and outcrops must be considered as a sensitive environment. Activities in all remaining open grasslands must be restricted to the existing servitudes. Access to surrounding open grassland must be strictly managed to prevent possible poaching, harvesting of medicinal plants and disturbances to remaining fauna. No driving of vehicles through open grassland. No new roads must be created through primary open grassland.

5.2 RIDGES AND HILLS

Ridges are characterized by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and variations thereof), slopes and altitudes all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. The temperature and humidity regimes of microsites vary on both a seasonal and daily basis (Samways & Hatton, 2000). Moist cool aspects are more conducive to leaching of nutrients than warmer drier slopes (Lowrey & Wright, 1987). Variation in aspect, soil drainage (Burnett *et al.*, 1998) and elevation/altitude (Primack, 1995) have been found to be especially

important predictors of biodiversity. It follows that ridges will be characterized by a particularly high biodiversity, as such their protection will contribute significantly to the conservation of biodiversity in the area as well as the rest of Mpumalanga Province. For example, a wide variety of bird groups utilize ridges, koppies and hills for feeding, roosting and breeding. These groups include some owls, falcons, nightjars, swifts, swallows, martins, larks, chats, thrushes, cisticolas, pipits, shrikes, starlings, sunbirds, firefinches, waxbills, buntings, canaries, eagles and vultures.

Ridges provide important habitat for sensitive species such as bats (roosting sites) and the eastern rock elephant shrew. Ridges and kloofs also form caves, an important habitat for highly specialized animals, e.g. bats. Variable microclimate conditions have resulted in a vast array of invertebrate communities associated with the high plant diversity characterizing ridges. Hills and koppies generally have more insects (both in terms of individuals and species) than the immediate surroundings (Samways & Hatton, 2000). All rocky ridges and hills must be considered as a sensitive habitat with unique vegetation as well as fauna. The proposed Option 2 and Option 3 transverse rocky ridges as well as summits of mountains adjacent to the Komati River.

5.3 WOODLAND KLOOFS AND DRAINAGE LINES

The closed woodland vegetation units found within the ravines and riparian areas of rivers and drainage lines offer important habitat for several animal species especially birds. These sensitive habitats have a diverse floristic component. Option 2 and especially Option 3 bisects significant patches of closed woodland and forested kloofs adjacent to the Komati River.

5.4 RIVERS AND STREAMS

The perennial rivers including the Elands and Komati as well as non-perennial Bankspruit as well as seasonal drainage lines are considered to be of conservation importance for the following reasons:

- The indigenous vegetation of riverine wetlands within the old Transvaal Province, and wetlands in general throughout the Grassland Biome, is in danger of being completely replaced by alien invasive species (Henderson & Musil 1997, Rutherford & Westfall 1994). Any remaining areas of indigenous riparian vegetation or marshland vegetation within Mpumalanga and Gauteng must therefore be regarded as of high conservation importance.
- Rivers and drainage lines are longitudinal ecosystems, and their condition at any point is a reflection of not only upstream activities, but also of those within adjacent and upstream parts of the catchment (O'Keefe 1986). Any impact on the riverine area within the study area is therefore also likely to impact on upstream and downstream areas.
- Riparian zones have the capacity to act as biological corridors connecting areas of suitable habitat in birds (Whitaker & Metevecchi, 1997), mammals (Cockle & Richardson 2003) reptiles and amphibians (Maritz & Alexander 2007). Riparian zones may act as potential refugia for certain fauna and could allow for possible recolonisation of rehabilitated habitats. The riparian vegetation plays a vital role in the re-colonisation of aquatic macro-invertebrates as well as reptiles and amphibians (Maritz & Alexander 2007). The riparian vegetation provides vital refuge, foraging and migratory passages for species migrating to and away from the rivers. The riparian zone comprises plant communities contiguous to and affected by surface and subsurface hydrological features of perennial or intermittent water bodies (rivers and streams).
- The riparian vegetation is dependant on the river for a number of functions including growth, temperature control, seed dispersal, germination and nutrient enrichment. Riparian vegetation comprises a distinct composition of species, often different from that of the surrounding terrestrial vegetation. Tree species are positioned according to their dependence or affinity for water, with the more mesic species (water-loving) being located closest to the river channel, often with their roots in the water, and the less water-loving terrestrial species further away from the river.

The riparian zone, of which vegetation is a major component, has a number of important functions including:

- enhancing water quality in the river by the interception and breakdown of pollutants;
- interception and deposition of nutrients and sediments;
- stabilisation of riverbanks and macro-channel floor;
- flood attenuation;
- provision of habitat and migration routes for fauna and flora;
- provision of fuels, building materials and medicines for communities (if done on a sustainable basis); and
- recreational areas (fishing - rod and line not shade or gill nets; bird watching; picnic areas etc.).
- All the rivers and streams must be considered as sensitive habitats due to ecological functioning as well as providing suitable habitat as well as biological or dispersal corridors for remaining faunal species.

5.5 PALUSTRINE WETLANDS

- Wetlands are characterized by hydric soils and slow flowing water and tall emergent vegetation, and provide habitat for many plant and animal species. The conservation status of many of the threatened plant and animal species that are dependant on wetlands reflects the critical status of wetland nationally, with many having already been destroyed.

- Indigenous marshland vegetation such as that found within the valley bottom wetlands and hillslope seepage wetlands and seasonally inundated depressions/pans in the study area, comprises a habitat which is restricted in extent, highly productive and which contains a high diversity of plants and animals, many of which are restricted or heavily dependant on such habitat.
- The conservation status of many of the faunal species that are dependant on wetlands reflects the critical status of wetland nationally, with many having already been destroyed. In this study area wetlands, including seasonal seepage wetlands are important habitats for species such as Highveld Golden Mole and Rough-haired Golden Mole. All remaining wetlands (permanent and seasonal) and their associated indigenous grassland and sedge dominated vegetation must be considered as a sensitive habitat (see separate Specialist Wetland Assessment report undertaken by Royal HaskoningDHV (formerly SSI) Specialist Aquatic Unit for site specific wetland mitigatory measures).

6. EVALUATION OF THE PREFERRED ALIGNMENTS

As mentioned previously, three revised alignments have been identified for the new 132kV Kingbird line between Gumeni Substation and Bosloop Substation. Factors considered in evaluating and determining the order of preference of the three corridors in terms of vegetation and faunal impacts are listed and discussed below:

Line Option 1:

- From the Gumeni substation the alignment runs in a southerly direction along the R36 for 2.44km within transformed grassland road reserves.
- Bisects several valley bottom wetlands and associated moist grasslands/hillslope seeps, the Bankspruit and the Skurweberge.
- The majority of the surrounding grasslands as well as valley bottom wetlands have been heavily impacted from surrounding agricultural activities including extensive overgrazing and trampling within the valley bottom wetlands.
- Large areas are situated adjacent to existing roads (R541), powerlines as well as formal and informal access road (farm tracks).
- Follows and existing line over the Skurweberg until the Bosloop Substation as well as within close proximity of an access road up the Skurweberg.
- If the proposed new line is situated within close proximity (<20m) from the existing lines it will significantly reduce potential impacts on remaining fauna as well as limit disturbances of adjacent grasslands and wetlands as existing maintenance roads occur and the majority of sensitive faunal species would have located suitable habitat away from the current line.
- This is the second most preferred option from an ecological perspective.

Line Option 2:

- This alternative runs to the east of Gumeni substation and follows and existing line for approximately 7.2km.
- The existing line runs in close proximity (within 50m) and the proposed line bisects a patch of moist rocky hillslope grassland were several red listed *Boopkone disticha* were observed
- From the existing line option 2 diverts in a southerly direction through open grasslands and seasonal wetlands within the valley bottoms. The open grasslands are in various stages of degradation (overgrazing, altered fire regime) and transformation (fallow lands, alien invasive woodlots).
- The line option bisects large areas of open grassland as well as several valley bottom wetlands.
- This is the least or third preferred option from an ecological perspective.

Line Option 3:

- From Gumeni Substation the line runs parallel to the R36 for approximately 1.8km, then moving east, through mainly grassland in various stages of degradation and transformation.
- Passes through relatively undisturbed grassland areas as well as within close proximity to two artificially created dams along the valley bottom wetlands.
- The majority of the alignments is situated within transformed or degraded grasslands and bisects the narrower sections of the valley bottoms.
- This is the preferred option from an ecological perspective.

In order to rank these alternatives a table was compiled and the three corridors given a rating on a scale of 1 to 5, with 1 being the least preferred and 5 being the most highly preferred option.

Table7: Preference rating for the 3 alternatives alignments.

Line Option	Preference Rating
1	**3**
2	**2**
3	**4**

As can be seen from the discussions and table above, line option 3 is slightly preferred over Option 1. Alternative bisects a patch of moist rocky hillslope grassland were several red listed (Declining) *Boopkone disticha* were observed. It also bisects large open grassland areas as well as hillslope seepage wetlands, rocky cliffs and wooded ravines and drainage lines and is the least favourite option. A thorough walk-through must be conducted on the selected alignment by a suitable qualified botanists as well as ecologist. No towers must be placed within 32m on any wetland habitat. The new line should be placed as close as possible to the existing transmission line (<20m) when it bisects the Skurweberg towards the Bosloop substation in order to reduce the potential impacts on the surrounding grasslands (especially rocky outcrops), wooded gorges and drainage lines as well as valley bottom wetland crossings.

7. GENERIC DESCRIPTION OF POTENTIAL IMPACTS OF POWER LINES ON ASSOCIATED FAUNA

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in Southern Africa are electrocution of birds (and other animals) and disturbance and habitat destruction during construction and maintenance activities.

7.1 Habitat destruction and disturbance

During the construction phase and maintenance of powerlines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on fauna breeding, foraging and roosting in or in close proximity of the servitude, both through modification of habitat and disturbance caused by human activity.

Mitigation and Recommendations

The following general recommendations are made to minimise the impacts of the powerline construction on threatened plant and animal species:

- As a precautionary measure a thorough walk through of the selected alignment as well as tower positions should be conducted during the EMP phase of the project by a suitable qualified botanist as well as zoologist. The walkthrough should focus on the presence of any threatened plant or animal species within or in close proximity to the construction areas (tower supports) as well as for the presence of any animal burrows (including spiders and scorpions), rocky outcrops, logs, stumps and other debris. *In situ* conservation measure should be compiled together with the relevant conservation authorities (MDALA) for the adequate protection of any threatened plant species observed during the walkthrough.
- Close site supervision must be maintained during construction of the powerline.
- During the **CONSTRUCTION** phase workers must be limited to areas under construction and access to the undeveloped areas, especially the surrounding

open grassland and valley bottom wetland areas must be strictly regulated ("no-go" areas during construction activities).

- Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) water in the area. Mobile toilets must be provided in order to minimise unauthorised traffic of construction workers outside of the designated areas.
- All temporary stockpile areas including litter and dumped material and rubble must be removed on completion of construction. All alien invasive plant should be removed from the site to prevent further invasion.
- Access to the powerline servitude must be restricted. Access to the powerline servitude should ideally be fenced off and gated along the main access roads. No quad-bikes, motorcycles or off road vehicles and illegal hunting should be permitted in the adjacent properties.
- Firearms or any other hunting weapons must be prohibited on site.
- Contract employees must be educated about the value of wild animals and the importance of their conservation.
- Educational programmes for the contractor's staff must be implemented to ensure that project workers are alerted to the possibility of snakes being found during vegetation clearance. The construction team must be briefed about the management of snakes in such instances. In particular, construction workers are to go through ongoing refresher courses to ensure that threatened snakes, such as pythons, are not killed or persecuted when found.
- Severe contractual fines must be imposed and immediate dismissal on any contract employee who is found attempting to snare or otherwise harm wild animals.
- No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site.
- No specific recommendations are made for the protection of burrowing red data mammals. Consideration could be given to rescuing the animals where there burrows are found in advance of construction. This is not recommended as a general prescription since the chances of digging out live Aardwolf or Antbear are small. Aardwolf are likely to vacate their burrows in the face of the advancing construction. There is also a risk associated with capturing animals dug out of burrows, and holding them in captivity. If a section of many active burrows is found then mitigation could be considered (minor deviation to the powerline alignment or rescue operation for the animals).

7.2 VEGETATION/FLORA

Protected or endangered species may occur along the line route. Special care should be taken not to damage or remove any such species unless absolutely necessary. Permits for removal must be obtained from Provincial Nature Conservation should such species be affected. All plants not interfering with the operation of the line shall be left undisturbed. Collection of firewood and traditional medicinal plants is strictly prohibited. No area should be cleared of trees, bushes and other vegetation for the purpose of a camping site.

Management objective

- Minimal disturbance to vegetation where such vegetation does not interfere with construction and operation of the line
- No unnecessary destruction to surrounding vegetation
- Protection of any protected or endangered plant species
- Prevention of litigation concerning removal of vegetation

Measurable targets

- Adequate protection of any endangered or threatened plant or tree species
- No litigation due to removal of vegetation without the necessary permits

Mitigation and recommendation

Remaining indigenous bulbous geophytes and Aloes should be retained or replanted wherever possible. Where herbicides are used to clear vegetation, specimen-specific chemicals should be applied to individual plants only. General spraying should be prohibited.

All alien vegetation should be eradicated over a five-year period. Invasive species (*Acacia mearnsii, Populus x cenescens, Eucalyptus grandis*) should be given the highest priority. No dumping of any materials in undeveloped open areas and neighbouring properties. Activities in the surrounding open undeveloped areas (especially open grasslands) must be strictly regulated and managed.

The construction of the proposed Gumeni-Bosloop 132kV powerline could result in limited opening-up of the vegetal cover during the construction phase. The opening up of existing vegetated areas, thereby creating corridors along which animals can move, may result in increased predation levels on small mammals, reptiles, amphibians, arachnids and scorpions along these corridors. The limitation of the disturbance of vegetation cover as well as any rocky outcrops, logs, stumps, termite mounds within sensitive areas will ameliorate this impact. Impact will be short-long term depending on the amount of vegetation to be cleared. Excessive habitat destruction during construction could reduce the amount of habitat available. This

impact is anticipated to be localised, of a long-term nature and of low significance, provided that appropriate mitigation measures are implemented (e.g. the limitation of vegetation clearance within sensitive areas).

7.3 VEGETATION CLEARANCE

Management objective

- Minimise damage to surrounding vegetation
- Minimise damage to topsoil
- Successful rehabilitation of barren areas

Measurable targets

- No damage to vegetation outside the poerline servitude
- No loss of topsoil
- No visible erosion three months after completion of the contract
- All disturbed areas successfully rehabilitated three months after completion of the contract

The object of vegetation clearing is to trim, cut or clear the minimum number of trees and vegetation necessary for the safe mechanical construction and electrical operation of the distribution line. Only an 8m strip may be cleared flush with the ground to allow vehicular passage during construction. No scalping shall be allowed on any part of the servitude road unless absolutely necessary. The removal of all economically valuable trees or vegetation shall be negotiated with the Landowner before such vegetation is removed.

Vegetation clearing on tower sites must be kept to a minimum. Big trees with large root systems shall be cut manually and removed, as the use of a bulldozer will cause major damage to the soil when the root systems are removed. Stumps shall be treated with herbicide. Smaller vegetation can be flattened with a machine, but the blade should be kept above ground level to prevent scalping. Any vegetation cleared on a tower site shall be removed or flattened and not be pushed to form an embankment around the tower.

No vegetation clearing in the form of de-stumping, scalping or uprooting shall be allowed on river- and stream banks (riparian zone). Vegetation shall only be cut to allow for the passage of the pilot-cables and headboard. Trees and vegetation not interfering with the statutory clearance to the conductors can be left under the line. Dense vegetation under the line which could cause a fire hazard, particularly in the middle third of the span in the vicinity of the lowest point of the conductors, will be considered as a separate case. With permission of the landowner, the total servitude under the line and up to 5m outside the outer phases can be cleared.

Protected or endangered species of plants shall not be removed unless they are interfering with a structure. Where such species have to be removed due to interference with a structure, the necessary permission and permits shall be obtained from Provincial Nature Conservation. All protected species not to be removed must be clearly marked and such areas fenced off if required.

Disturbed areas of natural vegetation as well as cut and fills must be rehabilitated immediately to prevent soil erosion.

The use of herbicides shall only be allowed after a proper investigation into the necessity, the type to be used, the long-term effects and the effectiveness of the agent. Eskom's approval for the use of herbicides is mandatory. Application shall be under the direct supervision of a qualified technician. All surplus herbicide shall be disposed of in accordance with the supplier’s specifications.

Upon completion of the stringing operations and before handover, the servitude must be inspected and all vegetation interfering with the safe operation of the line shall be removed / cut down. All alien vegetation in the total servitude and densifiers creating a fire hazard shall be cleared and treated with herbicides. Ideally the mowing or cutting of grasses should be restricted to the transformed grassland areas and not within the valley bottom wetlands and hillslope seepage areas. The removal of rank grassland vegetation could have a potentially negative impact on secretive species such as the African Grass Owl which prefers rank grassland for nesting and roosting activities.

It is recommended that a contractor for vegetation clearing should comply with the following parameters:

- the contractor must have the necessary knowledge to be able to identify protected species as well as species not interfering with the operation of the line due to their height and growth rate. A photographic guide will have to be compiled.
- the contractor must also be able to identify declared weeds and alien species that can be totally eradicated.
- the contractor must be in possession of a valid herbicide applicators license.

7.4 REVEGETATION

Where necessary a suitable mixture of grass seed shall be used to re-seed damaged areas. Badly damaged areas shall be fenced in to enhance rehabilitation. Areas to be rehabilitated must be planted with a mixture of endemic pioneer grass species endemic to the area, as soon as the new growing season starts. To get the best results in a specific area, it is a good idea to consult with a vegetation specialist or the local extension officer of the Dept of Agriculture. Seed distributors can also give valuable advice as to the mixtures and amount of seed necessary to seed a certain area. Re-seeding, as well as fencing in of badly damaged areas, will always be at the discretion of the Environmental Control Officer, unless specifically requested by a Landowner.

Management objective

- Minimise damage to topsoil and environment at tower positions
- Successful rehabilitation of all damaged areas
- Prevention of erosion

Measurable targets

- No loss of topsoil due to construction activities
- All disturbed areas successfully rehabilitated within three months of completion of the contract
- No visible erosion scars three months after completion of the contract

A mixture of seed can be used provided the mixture is carefully selected to ensure the following:

a) Annual and perennial plants are chosen.
b) Pioneer species are included.
c) All the plants shall not be edible.
d) Species chosen will grow in the area without many problems.
e) Root systems must have a binding effect on the soil.
f) The final product should not cause an ecological imbalance in the area.

CONSTRUCTION PHASE

- Disturbed areas of natural vegetation as well as cut and fills must be rehabilitated immediately to prevent soil erosion.
- Re-seeding shall be done on disturbed areas as directed by the Environmental Control Officer.

7.5 Surrounding Farming Activities

Domestic Livestock

Construction activities must be planned carefully so as not to interfere with the calving and lambing season for most animal species. The Contractor's workforce will have to be very careful not to disturb the animals as this may lead to fatalities which will give rise to claims from the Landowners. Interference with any wildlife without the applicable permits shall not be allowed. The Contractor shall under no circumstances interfere with livestock without the Landowner being present. This includes the moving of livestock where they interfere with construction activities. Should the Contractors workforce obtain any livestock for eating purposes, they must be in possession of a written note from the Landowner. Speed limits must be restricted especially on farm roads (30km/hr) preventing unnecessary road fatalities of surrounding livestock.

Management objective

- Minimise disruption of surrounding farming activities
- Minimise disturbance of fauna
- Minimise interruption of breeding patterns of fauna

Measurable targets

- No hunting and poaching or intentional killing of animals (including snakes, scorpions, spiders)
- No stock losses where construction is underway
- No complaints from Landowners or Nature Conservation
- No litigation concerning stock losses and animal deaths

7.6 ACCESS ROADS

Planning of access routes must be done in conjunction between the Contractor, Eskom and the Landowner. All access to private farmland must be negotiated in advance with land-owners. All agreements reached shall be documented in writing and no verbal agreements should be made. The condition of existing access / private roads to be used shall be documented with photographs.

The Contractor shall properly mark all access roads. Markers shall show the direction of travel as well as tower numbers to which the road leads. Roads not to be used shall be marked with a "**NO ENTRY**" sign. Unnecessary traversing of agricultural and natural open land is discouraged. Where required, speed limits shall be indicated on the roads (30km). All speed limits shall be strictly adhered to at all time.

Vehicle access to the powerline servitude must as far as possible be limited to existing roads. If a new access roads need to be constructed it should follow cleared

areas such as cattle pathways. If option 1 is selected the majority of the alignment follows existing lines as well as maintenance roads.

7.7 DANGEROUS ANIMALS

Numerous dangerous wild animals and arachnids and scorpions occur around the substation site and along the proposed loop-in-line and thus safety measures must be implemented to ensure the safety of the contractors and sub-contractors.

ARACHNIDS

During the construction phase care must be taken not to destroy any trap-door or baboon spider burrows. Prior to excavations a thorough inspection of the cleared areas must be undertaken to determine the presences of any baboon spider burrows, loosely embedded rocks or stumps in the proposed cleared areas. Several species of Baboon and Trapdoor species have been recorded in the area.

Conservation

Of the mygalomorphs, it is mainly the larger Baboon Spiders that are in great demand as pets and are consequently regarded as commercially threatened by the International Union for Conservation of International Trade in Endangered Species (CITES) (De Wet & Schoonbee 1991). The genera *Ceratogyrus, Harpactira* and *Pterinochilus* were added to schedule V11 of the Transvaal Provincial Nature Conservation Ordinance of 1983 as Protected Invertebrate Animals. Escom must ensure that no baboon spiders are illegally collected or intentionally destroyed throughout all stages of the project.

Scorpions

Several species of scorpions are recorded from the area. These scorpions construct burrows or scrapes under rocks as well as found under loose bark, wood piles and other surface debris. The majority of these scorpions possess a painful sting they are not of medical importance except *Parabuthus spp.* which are amongst South Africa's most venomous scorpion species. Care should be taken when removing stumps, logs or rock material. Any scorpions encountered on the site should be left alone and allowed free access away from the activity or safely removed from the area. No scorpions should be intentionally killed. Standard precautions or safety measures includes wearing sturdy leather boots and gloves in the field and close inspection of sleeping areas and bedding, clothes, shoes etc. for any scorpions. Stings from mildly venomous scorpions cause localised pain and swelling, with little systematic reaction. The affected limb should be immobilized and an ice pack should be applied, if possible, to the site of the sting. The site of the sting should be cleaned and never cut open. Venom sprayed in the eyes (certain *Parabuthus* species are able to spray venom) produces an intense burning sensation and may result in temporary

blindness if the eyes are not washed out thoroughly with clean water or some other neutral liquid such as milk

SNAKES

Several venomous snake species occur along the proposed route including Southern or Bibron's Burrowing Asp (*Actractaspis bibronii*), Mozambique Spitting Cobra (*Naja mossambica*), Puff Adder (*Bitis arietans*), Rinkhals (*Haemachatus haemachatus*), Common or Rhombic Night Adder (*Causus rhombeatus*). General avoidance of snakes if the best policy if encountered. Snakes should not be harmed or killed and allowed free movement away from the area. Safety precaution measure must be implemented especially during the vegetation clearance phase which could result in encounters with several venomous snake species. Appropriate foot wear (sturdy leather boots) should be worn in the field.

7.8 Fire Prevention

The frequent burning of the vegetation will have a high impact on remaining reptile species. Fires during the winter months will severely impact on the hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

Management objective

- Minimise risk of veld fires
- Minimise damage to grazing
- Prevent runaway fires

Measurable targets

- No veld fires started by the Contractor's work force
- No claims from Landowners for damages due to veld fires
- No litigation

Mitigation and recommendations

No open fires shall be allowed on site under any circumstance. The Contractor shall have fire-fighting equipment available on all vehicles working on site, especially during the winter months.

7.9 Threatened animals

At a local scale the study site and surrounding areas comprises suitable habitat for certain threatened animal species. The high levels of habitat transformation as well as anthropogenic activities around the alignments (especially Option 1 and 2) significantly reduces the likelihood of any major populations of threatened faunal species.

Mitigation and recommendations

As a precautionary mitigation measure it is recommended that the developer and construction contractor as well as an independent environmental control officer should be made aware of the possible presence of certain threatened animal species (Highveld Golden Mole, Rough Haired Golden Mole) prior to the commencement of construction activities. In the event that any of the above-mentioned species are discovered relevant conservation authorities should be informed and activities surrounding the site suspended until further investigations have been conducted. If any Golden Moles are unearthed during any phase of the development, a mammologist should immediately be brought to the site to evaluate the importance of the record and recommend mitigation measures where necessary.

8. IMPACT RANKING OF POTENTIAL IMPACTS TO ASSOCIATED FAUNA

The activities associated with a given development project may have impacts during the construction and/or operational phases. In this report, the assessment of impacts was divided into three phases associated with a project. These are i) the *status quo* or present situation taking consideration of existing impacts not associated with the proposed development, ii) the *construction phase* including surveying and other activities associated with the planning of the project, construction and all the activities associated with construction until the contractor leaves the site and iii) the *operational phase* which includes all activities associated with the operation and maintenance of the proposed development. The criteria against which the activities were assessed are presented below.

Assessment criteria

Extent of the impact:

The spatial scale of the impacts are described as either:

- local (i.e. within the boundaries of the alignment or site),
- regional (i.e. the impact could affect the greater Bethal-Trichardt area and other nearby towns and villages, conservation areas etc.), or
- national (i.e. South Africa)

Intensity of the impact

The intensity or severity of the impacts within the context of all the activities and other impacts associated with the project and is indicated as either:

- **low** (i.e. where the impact affects the environment in such a way that physical, biological, cultural, social and economic functioning and processes are not affected),
- **medium** (i.e. where the affected environment is altered but physical, biological, cultural, social and economic functioning and processes continue albeit in a modified way), or
- **high** (where physical, biological, cultural, social and economic functioning and processes are altered to the extent that they will temporarily or permanently cease).

Probability of occurrence

The likelihood of the impact actually occurring throughout or during any stage of the life cycle of the activity, is indicated as either:

- **improbable** (the possibility of the impact materialising is very low as result of design or historic experience),
- **probable** (there is a distinct possibility that the impact will occur and mitigation measures are required),
- **highly probable** (it is most likely that the impact will occur), or
- **definite** (the impact will occur regardless of the implementation of any prevention measures and mitigatory measures are required to contain the effect).

Duration of the impact

The life span of the impact is described as either:

- short term, the impact will either disappear with mitigation or will be mitigated through natural processes (0-5 years),
- medium term (6-15 years),
- long term (where the impact will last the entire operational life of the powerline, but would be mitigated by direct human action or by natural processes thereafter), or
- permanent (the impact will persist beyond the operational life of the powerline).

Significance of the impact

Based on a synthesis of the information contained in points i - iv above, the potential impacts are assessed in terms of the following significance criteria:

- **low** (i.e. where the impact would not have any influence on the decision to continue with the proposed project)
- **moderate** (i.e. where the impact should influence the decision to continue with the proposed development in the area unless it is effectively mitigated to acceptable levels),
- **high** (i.e. where the impact must influence the decision to continue with the proposed development regardless of any mitigation measures).

Table8. Summary table of ranking of potential impacts of the proposed Option 1 alignment on vegetation and associated fauna.

POTENTIAL IMPACT	INTENSITY	EXTENT	PROBABILITY OF OCCURENCE	DURATION	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Loss of Protected or rare plant species	Medium-High	Localized along powerline and access roads servitude.	Probable	Short-Long Term during construction and maintenance	Medium-High	Low
Loss of Faunal Habitat	Medium-High	Localized along powerline and servitude.	Definite	Short-long term	Medium-High	Medium-low
Threatened Fauna	Medium-Low	Local	Probable	Short-Long Term during construction and maintenance	Medium	Low
Increased Human Presence	Medium-Low	Local	Highly Probable	Short-Long Term during construction and maintenance	Medium	Low
Vegetation Clearance	Medium-low	Local	Definite	Short-term during construction and maintenance	Medium	Low
Re-vegetation	Medium-Low	Local	Probable	Short duration	Medium	Low
Disturbances to Livestock	Medium-Low	Local	Probable	Short-Long Term Duration	Medium-Low	Low
Fire	Medium-High	Local and adjacent grassland areas	Probable	Short-Long Term Duration	Medium-High	Low

Table9. Summary table of ranking of potential impacts of the proposed Option 2 alignment on vegetation and associated fauna.

POTENTIAL IMPACT	INTENSITY	EXTENT	PROBABILITY OF OCCURENCE	DURATION	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Loss of rare or protected plant species	Medium-High	Localized along powerline and access roads servitude.	Probable	Short-Long Term during construction and maintenance	Medium-High	Medium
Loss of Faunal Habitat	Medium-High	Localized along powerline and servitude.	Definite	Short-long term	Medium-High	Medium
Threatened Fauna	Medium-High	Local	Probable	Short-Long Term during construction and maintenance	Medium-High	Medium
Increased Human Presence	Medium-High	Local	Highly Probable	Short-Long Term during construction and maintenance	Medium-High	Medium
Vegetation Clearance	Medium-High	Local	Definite	Short-term during construction and maintenance	Medium-High	Medium
Re-vegetation	Medium-Low	Local	Probable	Short duration	Medium	Low
Disturbances to Livestock	Medium-Low	Local	Probable	Short-Long Term Duration	Medium-Low	Low
Fire	Medium-High	Local and surrounding grassland areas	Probable	Short-Long Term Duration	Medium-High	Low

Table10. Summary table of ranking of potential impacts of the proposed Option 3 alignment on vegetation and associated fauna.

POTENTIAL IMPACT	INTENSITY	EXTENT	PROBABILITY OF OCCURENCE	DURATION	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Loss of rare or protected plant species	Medium-High	Localized along powerline and access roads servitude.	Probable	Short-Long Term during construction and maintenance	Medium-High	Medium
Loss of Faunal Habitat	Medium-High	Localized along powerline and servitude.	Definite	Short-long term	Medium-High	Medium
Threatened Fauna	Medium-Low	Local	Probable	Short-Long Term during construction and maintenance	Medium-High	Medium
Increased Human Presence	Medium-High	Local	Highly Probable	Short-Long Term during construction and maintenance	Medium-High	Medium
Vegetation Clearance	Medium-High	Local	Definite	Short-term during construction as well as maintenance	Medium-High	Medium
Re-vegetation	Medium-Low	Local	Probable	Short duration	Medium	Low
Disturbances to Livestock	Medium-Low	Local	Probable	Short-Long Term Duration	Medium-Low	Low
Fire	Medium-High	Local and surrounding grassland areas	Probable	Short-Long Term Duration	Medium-High	Low

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10. APPENDIX

Table11. List of frog species recorded during current and previous surveys and of species likely to occur on the site.

Common Name	Species	Breeding Requirements
*Common River Frog	*Amietia angolensis*	Rivers and permanent water
T*remolo Sand Frog	*Tomopterna cryptotis*	Shallow permanent streams or vleis in grassland
Natal Sand Frog	*Tomopterna natalensis*	Shallow permanent streams or vleis in grassland
Bubbling Kassina	*Kassina senegalensis*	Open vleis, pans, dams in grassland
*Common Caco/ Boettger's Caco	*Cacosternum boettgeri*	Marsh, vleis, inundated grassland
Bronze Caco	*Cacosternum nanum nanum*	Small ponds, dams, vleis, streams, rain polls alongside roads, inundated grassland or pastures.
*Guttural Toad	*Amietophrynus gutturalis*	Open vleis, pans, ponds, dams, slow streams
Raucous Toad	*Amietophrynus rangeri*	Large permanent water bodies or farm dams and along ponds formed in drainage lines
Northern Pygmy Toad	*Poytonophrynus fenoulheti*	Temporary pools or shallow rain pools in flat rocky outcrops
*Common Plattana	*Xenopus laevis*	Open vleis, pans, ponds, dams, slow streams
Red Toad	*Schismaderma carens*	Permanent or semi-permanent pools. Breeds in deep water (>30cm)
Bushveld Rain Frog	*Breviceps adspersus*	Terrestrial breeder undergoing their entire larval development underground
Mozambique Rain Frog	*Breviceps mossambicus*	Terrestrial breeder undergoing their entire larval development underground
Snoring Puddle Frog	*Phrynobatrachus natalensis*	Temporary pans and pools, vleis, dams and slow-flowing streams
Dwarf Puddle Frog	*Phrynobatrchus mababiensis*	Stagnant water on the edges of grassy pans, vleis, marshes, small dams and ponds and in the backwaters of slow-flowing streams.
Plain Grass Frog	*Ptychadena anchietae*	Temporary pans, shallow pools in watercourses, borrow pits, waterholes as well as permanent

		vleis and dams
Striped Grass Frog	*Ptychadena porosissima*	Vleis, inundated grassland and sedge pans
Sharp-nosed Grass Frog	*Ptchadena oxyrynchus*	Vleis, inundated grassland, temporary pools such as roadside puddles and pools on rock outcrops
Striped Stream Frog	*Strongylopus fasciatus*	Grassy areas and reed beds along streams, rivers as well as vleis
Clicking Stream Frog	*Strongylopus grayii*	Out of water up to 30cm from the edge of watercourse
Brown-backed Tree Frog	*Leptopelis mossambicus*	Eggs are laid in burrows near the water edge of stagnant marshes
Painted Reed Frog	*Hyperolius marmoratus*	Reed beds along rivers, streams and dams

*recorded during brief field survey.

Table12. List of reptile species recorded during previous surveys as well as current survey.

Common Name	**Scientific Name**
Marsh or helmeted Terrapin	*Pelomedusa subrufa*
Leopard Tortoise	*Geochelone pardalis*
Savannah Hinged Tortoise	*Knixys beliana*
*Cape Skink	*Trachylepis capensis*
*Striped Skink	*Trachylepis punctatissima*
*Wahlberg's Snake-eyed Skink	*Panapsis wahlbergii*
*Variable Skink	*Trachylepis varia*
Cape Rough-scaled Lizard	*Ichnotropis capensis*
Flap-neck Chamaeleon	*Chamaeleo dilepis*
*Transvaal Thick-toed gecko	*Pachydactylus affinis*
*Cape Thick-toed Gecko	*Pachydactylus capensis*
Cape Dwarf Gecko	*Lygodactylus capensis*
Delalande's Sandveld Lizard	*Nucras lalandii*

Transvaal Grass Lizard	*Chamaesaura aenea*
*Yellow-throated Plated Lizard	*Gerrhosaurus flavigularis*
Transvaal Girdled Lizard	*Cordylus vitttifer*
Nile Monitor	*Varanus niloticus*
Rock or White-throated Monitor	*Varanus albigularis*
Southern Tree Agama	*Acanthocerus atricolis*
*Ground Agama	*Agama aculeata aculeate*
Herald or red-lipped Snake	*Crotaphopeltis hotamboeia*
Rinkhals	*Haemachatus haemachatus*
Mole Snake	*Pseudapsis cana*
Rhombic Night Adder	*Causus rhombeatus*
Puffadder	*Bitis arietans*
Snouted Cobra	*Naje annulifera*
Mozambique Spitting Cobra	*Naja mossambica*
Common Egg Eater	*Dasypeltis scabra*
Brown House Snake	*Lamprophis fuliginosus*
Aurora House Snake	*Lamprophis aurora*
Cape Wolf Snake	*Lycophidion capense*
Spotted skaapsteker	*Psammophylax rhombeatus*
Striped Skaapsteker	*Psammophylax tritaeniatus*
Black-headed Centipede Eater	*Aparallactus capensis*
Spotted Bush Snake	*Philothamnus semivariegatus*

Boomslang	*Dispholidus typus*
Spotted Harlequin Snake	*Homoroselaps lacteus*
Southern Stiletto Snake	*Atractaspis bibronii*
Short-snouted Whip Snake	*Psammophis brevirostris*
Crossed Whip Snake	*Psammophis crucifer*
Spotted Rock Snake	*Lamprophis guttatus*
Common Brown Water Snake	*Lycodonomorphus rufulus*
Sundevall's Shovel-snout	*Prosymna sundevalli*
Green Water Snake	*Philothamnus hoplogaster*
Common Slug-eater	*Duberria lutrix*
Common Wolf Snake	*Lycophidion capense*
Delalande's Beaked Blind Snake	*Rhinotyphlops lalandei*
Bibron's Blind Snake	*Typhlops bibronii*
Long-tailed Worm Snake	*Leptotyphlops longicaudatus*
Peter's Worm Snake	*Leptotyphlops scutifrons*
Incognito Worm Snake	*Leptotyphlops icognitus*
Jacobsen's Worm Snake	*Leptotyphlops jacobseni*

* observed during brief field survey

Table13. Mammal species recorded during initial faunal survey and supplemented with previous field surveys conducted in similar habitat (2001-2011)

COMMON NAME	**SCIENTIFIC NAME**
Rusty Pipistrelle	*Pipistrellus rusticus*
Transvaal free-tailed Bat	*Tadarida ventralis*
Egyptian free-tailed Bat	*Tadarida aegyptiaca*
Cape Serotine Bat	*Eptesicus capensis*
Schreibers' Long-Fingered Bat	*Miniopterus schreibersii*
Geoffroy's Horseshoe Bat	*Rhinolophus clivosus*
Eastern Rock Elephant-Shrew	*Elephantulus myurus*
*Scrub Hare	*Lepus saxatilis*
House Mouse	*Mus musculus*
African (Common) Mole-rat	*Cryptomys hottentotus*
Greater Canerat	*Thryonomys swinderianus*
Woodland Dormouse	*Graphiurus murinus*
Rock Dormouse	*Graphiurus platyops*
Spiny Mouse	*Acomys spinosissimus*
Single Striped Mouse	*Lemniscomys rosalia*
*Four-striped Grass Mouse	*Rhabdomys pumilio*
Desert Pygmy Mouse	*Mus indutus*
Pouched Mouse	*Saccostomus campestris*

*Natal Multimammate Mouse	*Mastomys natalensis*
Southern Multimammate Mouse	*Mastomys coucha*
Namaqua Rock Mouse	*Micaelamys namaquensis*
Angoni Vlei Rat	*Otomys angoniensis*
Vlei Rat	*Otomys irroratus*
Grey Climbing Mouse	*Dendromus melanotis*
Chestnut Climbing Mouse	*Dendrobus mystacalis*
African Marsh Rat	*Dasymys incomtus*
House Rat	**Rattus rattus**
*Bushveld Gerbil	*Tatera leucogaster*
*Highveld Gerbil	*Tatera brantsii*
Forest Shrew	*Myosorex varius*
Swamp Musk Shrew	*Crocidura mariquensis*
Tiny Musk Shrew	*Crocidura fuscomurina*
Reddish-Grey Musk Shrew	*Crocidura cyanea*
Lesser Grey-brown Musk Shrew	*Crocidura silacea*
South African Ground Squirrel	*Xenus inauris*
Southern African Hedgehog	*Atelerix frontalis*
Striped Polecat	*Ictonyx striatus*

Small-spotted Genet	*Genetta genetta*
* South African Large-spotted Genet	*Genetta tigrina*
*Marsh Mongoose	*Atilax paludinosus*
Dwarf Mongoose	*Helogale parvula*
*Yellow Mongoose	*Cynictis penicillata*
*Slender Mongoose	*Galerella sanguinea*
White-Tailed Mongoose	*Ichneumia albicauda*
Lesser Bushbaby	*Galago moholi*
Black-backed Jackal	*Canis mesomelas*
*Cape Porcupine	*Hystrix africaeaustralis*
Smith's Red Rock Rabbit	*Pronolagus saundersiae*
Springhare	*Pedetes capensis*
Aardwolf	*Proteles cristatus*
African Wild Cat	*Felis sylvestris* (*lybica* group)
Serval	*Leptailurus serval*
Caracal	*Felis caracal*
African Clawless Otter	*Aonyx capensis*
African Striped Weasel	*Poecilogale albinucha*
Striped Polecat	*Ictonyx striatus*
*Common Duiker	*Sylvicarpa grimmia*

Klipspringer	*Oreotragus oreotragus*
Steenbok	*Raphicerus campestris*
Grey Rhebok	*Pelea capreoulus*
Mountain Reedbuck	*Redunca fulvorufula*
*Chacma Baboon	*Papio cynocephalus ursinus*
*Vervet Monkey	*Ceropithecus aethiops*

*bserved during brief field survey (Feb-March 2007)