HERPETOLOGICAL HABITAT SENSITIVITY SCAN FOR THE PROPOSED ESTABLISHMENT OF THE ANDERSON-DINALEDI 400kV TRANSMISSION LINE BETWEEN THE PROPOSED NEW ANDERSON SUBSTATION AND THE EXISTING DINALEDI SUBSTATION (BRITS); NORTH WEST AND GAUTENG ROVINCES

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EXECUTIVE SUMMARY

Eskom Holdings Limited is proposing the construction of a new 400kV Transmission Line as part of their Tshwane Strengthening Scheme Project. The proposed powerline will be approximately 40km in length and will run between the proposed new Anderson Substation, which will be located to the north of the N4 highway), located in Hartebeespoort, to the existing Dinaledi Substation which is located approximately 8km North East of Brits. The proposed powerline will be constructed in the following two Municipal Areas: Madibeng Local Municipality (North West) and the City of Tshwane Local Municipality (Gauteng). The proposed substation is earmarked for construction within the Madibeng Local Municipality. The Dinaledi Substation is located on Portion 843 of the Farm Roodekopjes of Zwartkopjes 427 JQ, which is located approximately 8km North East of Brits. Three alternative powerline routes have been identified for the proposed transmission lines. A 1km buffer area has been placed around each alternative route, which will form the study area/corridor to be investigated. According to Mucina and Rutherford (2006), the North West Province encloses two major biomes, viz. the Grassland Biome and the Savanna Biome. The study area falls within the following vegetation types, namely Andesite Mountain Bushveld, Gauteng Shale Mountain Bushveld, Gold Reef Mountain Bushveld, Marikana Thornveld, Moot Plains Bushveld, and Norite Koppies Bushveld.

The proposed transmission lines will traverse through the Magaliesberg mountain range, which is a very unique mountain range of great ecological, geological and cultural importance and value. In order to preserve this uniqueness of the mountain, a section of the Magaliesberg was proclaimed a Protected Natural Environment (PNE) in Administrator's Notice 126 of 4 May 1994 in accordance with section 16 of the Environment Conservation Act, 1989 (Act 73 of 1989) and the two provincial departments responsible for controlling and managing the MPNE are the North West Department of Agriculture, Conservation and Environment (NW-DACE) and Gauteng Department of Agriculture, and Rural development (GDARD).

The preliminary herpetological survey/ habitat assessment focused on the description of the available and sensitive habitats along the proposed Anderson-Dinaledi 400kV Transmission Line alternatives as well as new Anderson substation; with special reference to the current status of threatened amphibian and reptile species occurring, or likely to utilize the areas within and surrounding the proposed alignment. It must be stressed that no actual amphibian or reptile surveys were conducted due incorrect timing of survey (late winter months August) as well as large length of the alignment (40km) as well as sever time and financial constraints. Access was also restricted due to several fenced off private properties.

According to the Southern African Frog Atlas Project (SAFAP) fourteen frog species have been recorded for the combined locus 2527DB and 2527DD quarter degree grid squares. Giant Bullfrogs have been recorded around the Magaliesburg-Brits area during the South African Frog Atlas Project as well as by the consultant. The majority of records are of road fatalities of migrating or dispersing males. There is a high occurrence of suitable habitat for Giant Bullfrogs in North-west Province and although they appear to be relatively abundant in the province; the Giant Bullfrog is severely impacted on by the degradation of the wetland habitat in the province. The Giant Bullfrog (*Pyxicephalus adspersus*) is a protected frog species whose conservation status is currently listed as **"near threatened"** (Minter et al. 2004)∗.

Anderson Substation Site

AMPHIBIANS

No suitable Giant bullfrog breeding habitat was observed on the site. The transformed and heavily degraded grasslands offer limited suitable foraging, dispersal and aestivation habitat for Giant Bullfrogs. A few scattered termite mounds were observed on the southern portions of the site. Under C-Plan version 3 (latest version i.e. version 3.3), no specialist studies for any species of amphibian are requested for consideration in the review of a development application in Gauteng Province.

REPTILES

The proposed Anderson substation site offers no suitable habitat for the Southern African Python (*Python natalensis*) and marginally suitable habitat for the Striped Harlequin Snake (*Homoroselaps dorsalis*) in the form of scattered moribund termite mounds. Under C-Plan version 3 (latest version i.e. version 3.3), no specialist studies for any species of reptile are requested for consideration in the review of a development application in Gauteng Province.

Anderson-Dinaledi 400kV Transmission Line

AMPHIBIANS

No major breeding habitats ((hydrophilic grass and sedge dominated seasonal pans) of Giant Bullfrogs were observed along the proposed Anderson-Dinaledi 400kV Transmission Line alternatives. The majority of the wetland habitats along the alternative alignments are artificially created dams. These dams offer marginally suitable breeding habitat for Giant Bullfrogs in the form of the shallow seasonally inundated margins but often contain permanent fish predators which restrict the breeding success). The open thornveld and grassland plains with several termite mounds offer suitable foraging as well as dispersal

∗ The regional conservation status (South Africa) of the Giant bullfrog is currently being re- valuated (pers.com. Dr C.Yetmen).

areas for remaining Giant Bullfrogs The alluvial sand deposits along certain sections of the servitude have soft sandy soils suitable for burrowing and aestivation. Burrowing generally takes place some distance away from the breeding site with females travelling further to burrow (up to 1km).

REPTILES

Southern African Python (*Python natalensis*)

Southern African Pythons have been recorded from the Magaliesburg Protected Natural Environment (MPNE). The granitic outcrops to the north of the Magaliesburg offers favorable habitat for Southern African Pythons in the form of the rocky mountainous areas, wetland habitats as well as open and closed woodland vegetation units. The present granite mining activities as well as surrounding human settlements severely restricts the likelihood of significant populations remaining. Several private properties and farms have electric fences with low-lying strands approximately 15cm from the ground which severely restricts the likelihood of any large adult pythons on the site.

No Southern African Pythons or evidence of pythons was observed during the brief field survey. Remaining Python populations would have been impacted on during the previous agricultural activities. According to the information provided by a landowner, a python was recorded two years ago at the Farm Rietfontein 484 JQ. The python was unfortunately killed. As a precautionary measure an educational programme on Southern African Pythons should be implemented for all staff and contractors working on the project. If any pythons are discovered on the site during construction activities the relevant conservation authorities should be informed and the python relocated in suitable habitat away from the site (Magaliesburg Protected Natural Environment (MPNE).

Striped Harlequin Snake (*Homoroselaps dorsalis*)

The Striped Harlequin Snake (*Homoroselaps dorsalis*), which is categorised as Rare in the outdated Red Data List (Branch 1988) has been recorded from the grid squares in which the alignments are situated (SARCA). 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 along the alignment as well as loosely embedded rocks on the mid to lower slopes on the Magaliesburg for the Striped Harlequin Snake.

All large and especially moribund or abandoned termite mounds and any major rocky outcrops should ideally be conserved. This is especially pertinent during the construction phase. The towers should ideally be erected away from any rocky outcrops or moribund termite mounds. If however any moribund termite mounds have to be destroyed; a rescue and relocation project should be implemented for any termite mounds and loosely

embedded rocky material in the areas proposed for the towers or access roads. This is especially pertinent for the towers on the grassy hills where termite mounds and rock outcrops remain. Specimens discovered can be relocated away from the disturbances as well as increasing the information basis of what reptile species are utilising the moribund termite mounds along the alignment.

Blunt-tailed Worm Lizard (*Dalophium pistillum*)

By far the largest local worm lizard with a broad horizontal 'spade' that is covered by a single horny shield. Only known for a few localities in South Africa near Vryheid in the Northern Cape Province and between Vaalwater and the Waterberg in Limpopo Province (Branch 1988). A fossorial species occurring in varied habitats from Kalahari Sand to coastal alluvium. As minimal soil disturbances should occur mainly around the pylons no significant impact is expected on any Blunt-tailed Worm Lizard populations.

Nile Crocodile (*Crocodylus niloticus*)

Although Nile Crocodiles (*Crocodylus niloticus*) historically (in the early 19th century) occurred in abundance in the rivers around Magaliesburg; none remain today. Crocodile farms are however growing in popularity (Carruthers 1990)

Preferred Alignment

During the preliminary herpetological habitat assessment or sensitivity scan the majority of habitats and vegetation along the proposed western alignment; except for the Magaliesburg Natural Protected Environment (MNE) and a few scattered granitic hills and outcrops; has been transformed through agriculture, formal settlements and other forms of infrastructure development, such as powerlines, roads (R511) and Telkom lines. The Eastern route is regarded as the route alternative that would pose the great threat to the overall biodiversity of the area during construction of the proposed transmission line as it traverses through the sensitive areas (rocky cliffs) of the Magaliesburg Natural Protected Environment, Wonderboom Municipal Nature reserve. It is recommended that the transmission line follow the western route. The southern, eastern or western deviations will not ameliorate any potential impacts on the hepetofuana. The main reason for the recommendation of the western alignment is that there are existing powerlines along the majority of the proposed alignment and higher levels of anthropogenic disturbances along this route. The establishment of new transmission line servitudes along a formerly undisturbed area will have greater impact on herpetofauna diversity than if following adjacent to existing servitudes. From an ecological perspective the western route is considerably more degraded than the eastern route. The western route also traverses less natural Marikana Thornveld, the most threatened vegetation type transverse than the alternative alignments.

General Faunal Mitigatory Measures

The construction of the proposed Anderson-Dinaledi 400kV Transmission line will most-likely 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 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). Prior to construction and vegetation clearance a suitably qualified zoologist (herpetologist) should undertake a walk-through of the preferred alignment and closely examine the proposed tower/pylon construction areas (concrete supports) for the presence of any animal burrows (including spiders and scorpions), rocky outcrops, logs, stumps and other debris and relocate any affected animals to appropriate habitat away from the servitude or tower.

DETAILS OF SPECIALIST

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Appointment of specialist

Clayton Cook was commissioned by Nemai Consulting to provide specialist consulting services for the Environmental Impact Assessment for the proposed Anderson-Dinaledi 400kV Transmission Line between the proposed new Anderson Substation (Broederstroom) and the existing Dinaledi Substation (Brits), situated on the northern boundary of the Gauteng Province and the North West Province. The consulting services comprise a description of herpetofauna (reptile and amphibian) species likely to occur along the proposed powerline servitude as well as a habitat assessment of the potential for threatened herpetofauna (reptile and amphibian) species.

Summary of expertise

Clayton Cook:

- Registered professional member of The South African Council for Natural Scientific Professions (Zoological Science), registration number 400084/04.
- Faunal and Specialist Herpetological consultant since 1997.
- Conducted over 150 preliminary faunal surveys and over 50 specialist surveys as a faunal consultant.
- Regional Organiser for Gauteng Province for the South African Frog Atlas Project 1999-2003.
- Published a scientific paper on *Pyxicephalus adspersus*, 8 scientific conference presentations, co-wrote the species accounts for the genus *Pyxicephalus* for the Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland South African as well as co-author of the W.R.C Report No. 1258/1/06 on “A Biophysical framework for The Sustainable Management of Wetlands In Limpopo Province With Nylsvley as a Reference Model”.
- Attended 5 national and international herpetological congresses & 1 expert workshop, lectured zoology and botanical science at University of Limpopo (2001-2004).
- Lead Researcher of a 3 year W.R.C. project on the current status of frog species as well as the use of tadpoles as bio-indicators of wetland systems in the Kruger National Park (2009-2012).

- Participant in the South African Reptile Conservation Assessment (SARCA) for the Magoebaskloof-Wolkberg area (April 2008).

Independence*:*

Clayton Cook have no connection with the proponent of the development and is not a subsidiary, legally or financially, of the proponent, remuneration for services by the proponent in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. The percentage work received directly or indirectly from the proponent in the last twelve months is approximately 0% of turnover.

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1. INTRODUCTION

Eskom Holdings Limited is proposing the construction of a new 400kV Transmission Line, and a proposed new 400kV Substation as part of their Tshwane Strengthening Scheme Project. The proposed powerline will be approximately 40km in length and will run between the proposed new Anderson Substation, which will be located immediately to the north of the N4 highway in the Hartebeespoort area, to the existing Dinaledi Substation which is located on Portion 843 of the Farm Roodekopjes of Zwartkopjes 427 JQ; approximately 8km North East of Brits. The proposed powerline will be constructed in the following two Municipal Areas: Madibeng Local Municipality (North West) and the City of Tshwane Local Municipality (Gauteng). The proposed substation is earmarked for construction within the Madibeng Local Municipality.

The proposed powerline requires a servitude width of 55m (27.5m on either side of the centre of the powerline). Generally, the pylons to be used for the powerline can be spaced at 350m to about 550m apart, depending on the type of pylon used, location of the bend points, topography and sensitive areas. The type of Pylons used is dependent on bend points, conductor configuration, voltage level and topography. A minimum vertical of clearance of 8.1m between the line and the ground will be required after construction.

The preliminary herpetological survey/ habitat assessment focused on the description of the available and sensitive habitats along the proposed Anderson-Dinaledi 400kV Transmission Line with special reference to the current status of threatened amphibian and reptile species occurring, or likely to utilize the areas within and surrounding the proposed alignment as well as new substation site. It must be stressed that no actual amphibian or reptile surveys were conducted due incorrect timing of survey (late winter months August) as well as large length of the alignment (40km) as well as sever time and financial constraints. Access was also restricted due to several fenced private properties.

Due to the secretive nature of associated threatened herpetofuanal species, namely the Giant Bullfrog, Striped Harlequin Snake and Southern African Python no specialised surveys or techniques have been undertaken; but merely an assessment of available and specialised habitats. By surveying selected natural areas along the proposed alignment for any specialised habitats, as well as the current environmental status of the remaining habitats, one can make an assumption of the possible presence or absence of any threatened species. The survey was heavily supplemented by previous surveys conducted between 1999-2012 by the consultant within the Skurweberg, Magaliesburg and Brits areas.

Location

Three alternative powerline routes have been identified (refer to the locality map Figure 1 below). A 1km buffer area has been placed around each alternative route, which will form the study area/corridor to be investigated during the Scoping and EIA Phase. During the EIA Phase a preferred study area/corridor will be selected. The Department of Environmental Affairs (DEA) may authorise the identified preferred corridor, the Department may authorise one of the other corridors, or the Department may request that additional information be submitted in order to make a decision regarding the proposed project. Once DEA authorises a corridor, a summer season walk down survey will be undertaken by suitably qualified specialists (herpetologist) in order to determine the exact location of the powerline as well as pylon positions.

Surrounding Land Usage

The areas surrounding the proposed powerline alignments consists mainly of agricultural holdings with various agricultural activities evident, vacant land, as well as mining properties as well as conservation areas such as the Magaliesburg. Weather was generally sunny and warm with temperatures reaching 24°C during site visit. No rain had fallen during the week of the survey.

Climate

The climatic region into which the site falls is categorized as the Northern Transvaal climatic region which receives an annual precipitation of between 600 mm and 700 mm (MAP 600-700 mm). Summer-rainfall (Nov-March) area with vary dry winters Frost frequently in winter. Effectively three seasons, namely a cool dry season from May to mid-August, a hot-dry season from mid-August to about October and a hot-wet season from about November to April. Temperatures vary between -3.3°C and 35.3°C. The average daily maximum and minimum temperature for this region is 32ºC and 18ºC (respectively) in January and 22ºC and 4ºC (respectively) in July.

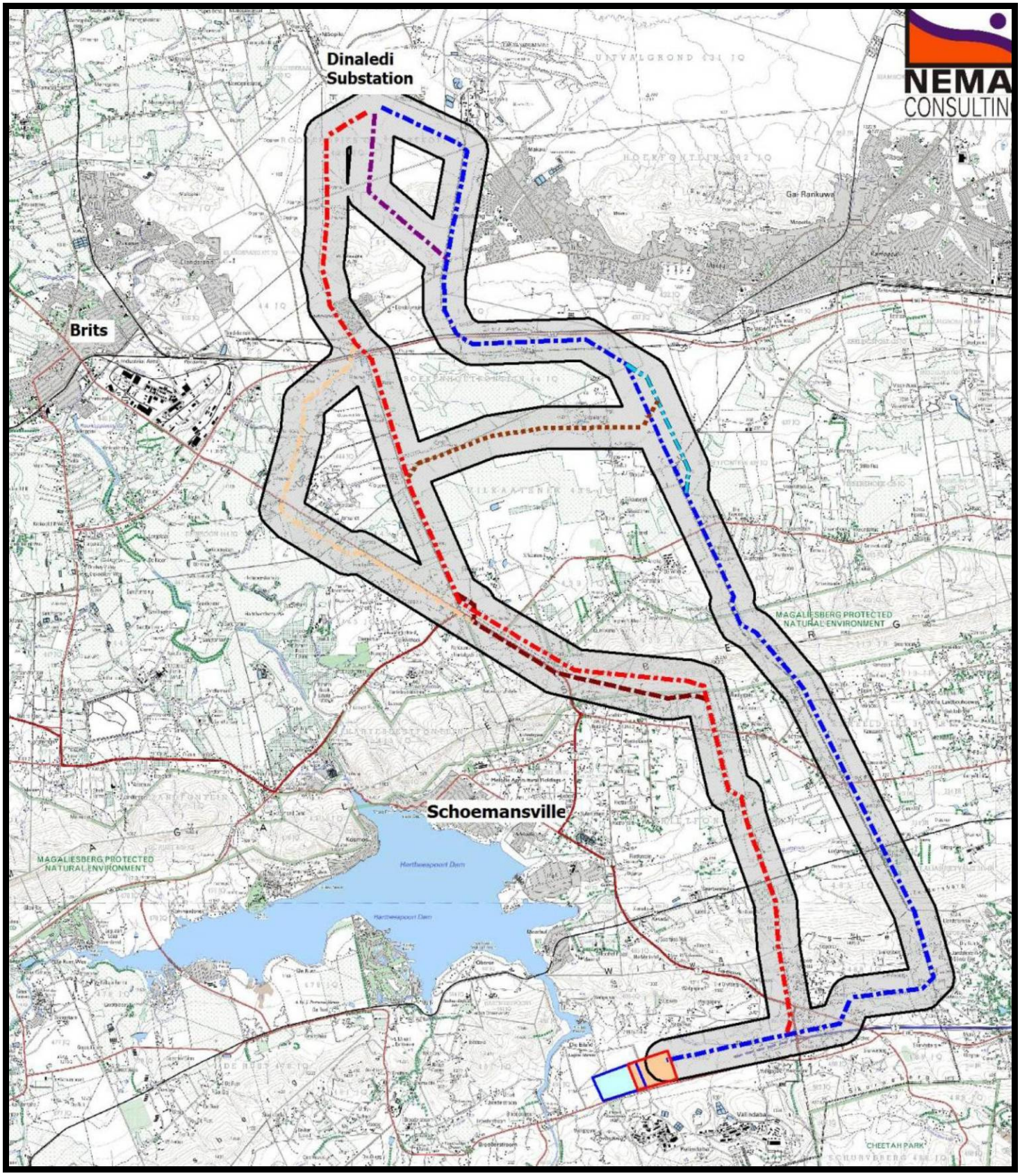

Figure1. Locality map of proposed Anderson-Dinaledi 400kV Transmission Line.

2.1 Objectives of the herpetological habitat assessment

- To provide a description of the amphibian and reptile species occurring within the proposed Anderson-Dinaledi 400kV Transmission Line servitude.
- To provide a description of threatened amphibian and reptile species occurring or likely to occur within the Anderson-Dinaledi 400kV Transmission Line servitude.
- To describe the available habitats on site including areas of important conservation value or areas most likely to form important habitat for remaining threatened amphibian and reptile species.
- To determine potential impacts of the proposed Anderson-Dinaledi 400kV Transmission Line development on the herpetofuana.
- To provide management recommendations to mitigate negative and enhance positive impacts of the project.

2.2 Scope of study

- A preliminary herpetological survey recording sightings and/or evidence of reptile and amphibian species.
- An assessment of the ecological habitats, evaluating conservation importance and significance with special emphasis on the current status of threatened amphibian and reptile species (Red Data Species), within the proposed Anderson-Dinaledi 400kV Transmission Line servitude.
- Literature investigations with which to augment field data were necessary.
- Identification of potential ecological impacts that could occur as a result of the powerline development 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.

2.3 Constraints and Limitations

- Limitation to a base-line ecological survey for only 1 day (8 hours) during the late winter months (August).
- Access was restricted to certain privately owned properties as well as mining and agricultural areas.
- The majority of amphibian species in Gauteng and North-West Provinces 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.

- The majority of threatened reptile species are secretive and difficult to observe even during intensive field surveys (pit-fall trapping) conducted over several years (especially the rare Striped Harlequin Snake).
- Limitation of historic data and available databases. Insufficient knowledge on detailed habitat requirements (migratory, foraging and breeding habitats) of the majority of threatened herpetofaunal species; especially the Striped Harlequin Snake.
- 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 the Skurweberg, Magaliesburg and Brits areas between the period of 1999-2012).

3. METHODOLOGY

3.1 Predictive methods

A 1:50 000 map of the study area was provided showing existing infrastructure on and around the proposed Anderson-Dinaledi 400kV Transmission Line alignments and the proposed new Anderson Substation site. This was used as far as possible in order to identify potential "hot-spots" or specialised habitats e.g. Patches of undisturbed bushveld and grassland vegetation, mountains, river/drainage line crossings, wetlands 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.

3.2 Literature Survey

A detailed literature search was undertaken to assess the current status of threatened amphibian and reptiles that have been historically known to occur in the area. The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description. *A Complete Guide to the Frogs of Southern Africa* (du Preez & Carruthers 2009) and *The Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter et al. 2004) for amphibians. Distribution data were extracted from the Southern African Frog Atlas Project (SAFAP) virtual museum data base. *A reptile survey of the Transvaal* (Jacobsen 1989). The *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001), *A Complete Guide to the Snakes of Southern Africa* (Marais 2004), *Reptiles of Southern Africa* (Alexander & Marais 2007), *Tortoises, Terrapins and Turtles of Africa* (Branch 2008) and *South African Red Data Book-Reptiles and Amphibians* (Branch 1988) for reptiles. Distribution data were extracted from the Southern African Reptile Conservation Assessment (SARCA) virtual museum data base (available at http://www.saherps.net/sarca/sp-summary.php).

3.3 Site Investigation Methodology

A preliminary assessment of the status, spatial requirements and habitat preferences of all priority amphibian and reptile species likely to occur along the proposed Anderson-Dinaledi alignment as well as potential threats was conducted. For certain 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 such as the highly secretive Striped Harlequin Snake, 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.

All reptile and amphibian species recorded during the initial site visit as well as previous surveys were documented and listed below. The data was heavily supplemented by a preliminary species list compiled for the site from previous surveys such as the South African Frog Atlas Project (SAFAP) as well as previous surveys conducted in similar habitats, literature investigations, personal records and historic data. Different habitats were explored to identify any sensitive or specialised species. Habitats explored included the open and closed wooded areas, hills and rocky grasslands, logs and stumps, loosely embedded rocks and rock piles. No termite mounds were surveyed in order to minimise disturbances to remaining reptile and smaller mammal species. Reptile names used are by Branch (2001), Alexander and Marais (2007) and amphibian names by Du Preez and Carruthers (2009).

3.4 Vegetation

North West Province encloses two major biomes, viz. the Grassland Biome and the Savanna Biome. Mucina & Rutherford (2006) classified the study area as comprised of the following vegetation type units, namely **Andesite Mountain Bushveld**, **Gauteng Shale Mountain Bushveld**, **Gold Reef Mountain Bushveld**, **Marikana Thornveld**, **Moot Plains Bushveld**, and **Norite Koppies Bushveld**, (Mucina & Rutherford 2006).

Table1. Vegetation types found in the study area with associated landscape and conservation status according to Mucina et al. (2006).

VEGETATION TYPE	ASSOCIATED LANDSCAPE CHARACTER	CONSERVATION STATUS
Andesite Mountain Bushveld	Undulating landscape with hills and valleys.	Least Threatened
Gauteng Shale Mountain Bushveld	Low broken ridges varying in steepness with high surface rock cover.	Vulnerable
Gold Reef Mountain Bushveld	Rocky hills and ridges often west-east trending.	Least Threatened
Marikana Thornveld	Valleys and slightly undulating plains with some low hills.	Endangered
Moot Plains Bushveld	Plains and some low hills.	Vulnerable
Norite Koppies Bushveld	Plains, koppies and noritic outcrops.	Least Threatened

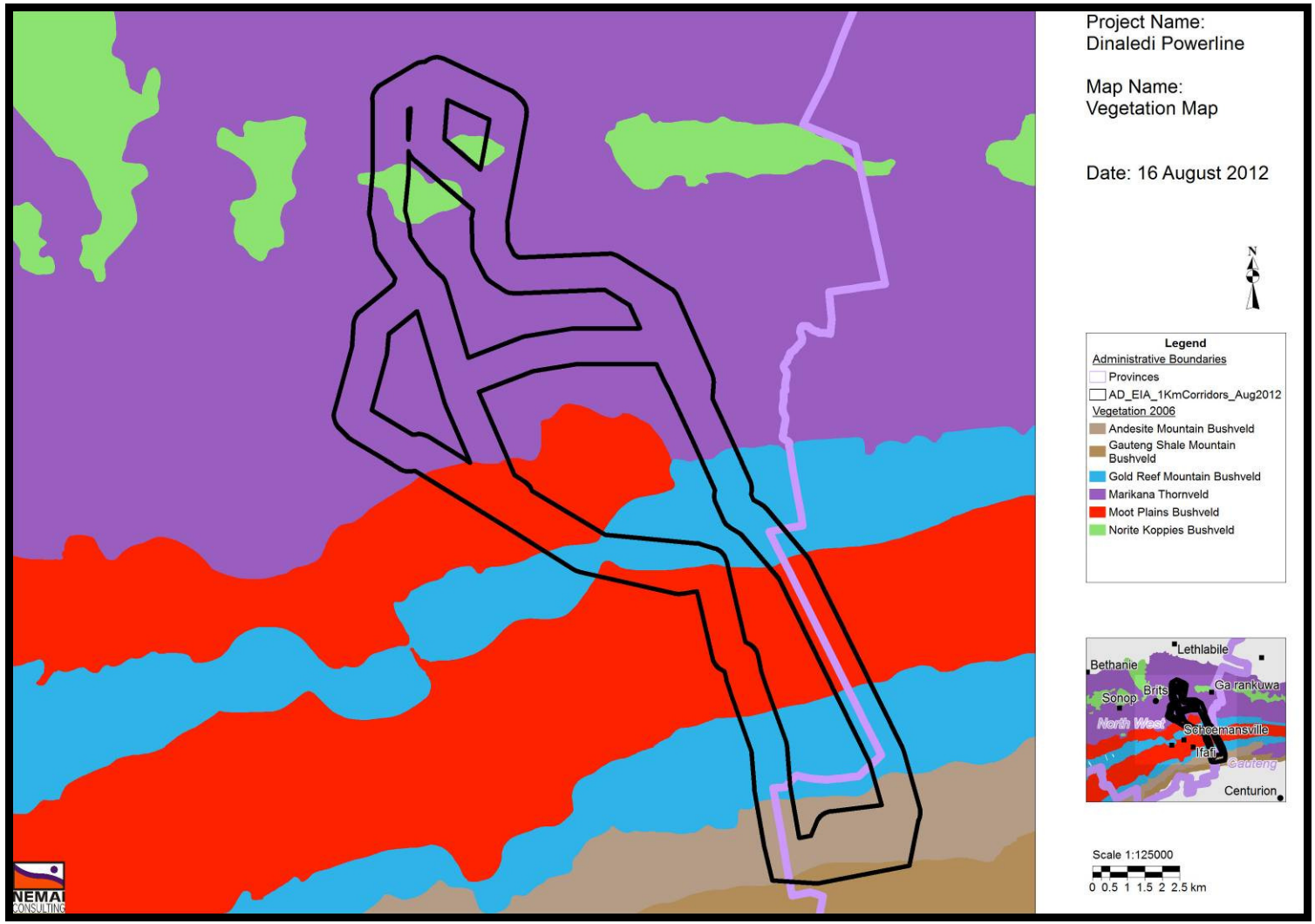

Figure2. Vegetation map of the proposed Anderson-Dinaledi alignments.

Figure3. The eastern alignment bisects open Marikana Thornveld situated on the lower-lying plains to the north of the Magaliesburg and to the east of Brits.

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 herpetofauna abundance and distribution, and does not give an exhaustive list of plant species which occur in the study area. Large areas of the proposed development area consist of transformed thornveld or current and old agricultural lands. The remnant patches of Marikana Thornveld cannot be considered to be entirely natural as various anthropogenic impacts have affected species diversity and richness.

General observations applicable across the vegetation of the entire site are as follows:

- The open woodland areas were defined using the occurrence of *Acacia karroo*, *Acacia caffra*, *Acacia nilotica, Acacia tortilis*, *Combretum apiculatum*, *Combretum molle*, *Gymnosporia heterophylla* and *Dombeya rotundifolia*.
- The riparian area was defined using the occurrence of *Celtis africana* and *Combretum erythrophyllum.*
- Weed and alien invader floral species where observed on site where both medium in diversity and abundance. Several invasive species have recently been cleared along the river.

- Basal cover was moderate to high throughout the majority of the alignments which would indicate that utilisation for grazing either no longer occurs or at low intensity;
- Forb species diversity was moderate to low; except for the Magaliesburg; due to previous utilisation of the alignments and present servitudes for cattle grazing activities;
- Developed portions of the alignments as well as current and previous lands showed the most sign of transformation from the natural state with more weed and invaders evident in conjunction with ornamental garden species around the existing dwellings.

Dominant tree species recorded along the closed woodland unit included *Acacia karroo, Acacia caffra, Combretum apiculatum* subsp *apiculatum, Combretum molle, Combretum erythrophyllum*, *Celtis africana*, *Dombeya rotundifolia, Searsia (Rhus) lancea. Searsia* (*Rhus*) *leptodictya, Searsia* (*Rhus*) *pyroides, Gymnosporia heterophylla, Maytenus polyacantha*

Dominant tree species recorded along the riparian zone of the Crocodile River included *Acacia karroo, Acacia caffra, Combretum molle, Combretum erythrophyllum*, *Celtis africana*, *Dombeya rotundifolia, Searsia (Rhus) lancea.*

Shrubs were recorded mainly along the riparian zone of the Crocodile River included *Euclea cripsa* subsp. *crispa*, *Olea europaea* subsp. *africana*, *Ehretia rigida* subsp. *rigida*, *Searsia (Rhus) pyroides* var. *pyroides*, *Asparagus cooperi.*

Several **geophytic herbs** *Ledebouria revoluta* and *Ornithogalum tenuifloium* were recorded. The **perennial herb** *Sansevieria aetheopica* was dominant under the shade of the *Acacia* trees. Several *Aloe greatheadii* were observed in the trampled areas on the site.

Gramminoids (Grasses) included *Imperata cylindrica, Hyparrhenia hirta, Hyparrhenia tamba, Themeda triandra, Eragrostis lehmanniana, Setaria sphacelata, Aristida scabrivalvis, Heteropogon contortus. Melinis repens, Cynodon dactylon. Microchloa caffra. Hyperthelia dissoluta.*

Alien invasive vegetation recorded on the site included *Cereus jamacaru, Melia azedarcah, Solanum mauritianum, Morus alba, Arundo donax, Opuntia ficus-indica, Lantanna camara.*

4. RESULTS OF THE PRELIMINARY HERPETOLOGICAL HABITAT ASSESSMENT

4.1 AMPHIBIANS

Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried 1989) and are such worthy of both research and conservation effort. This is made additionally relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but as yet is poorly understood (Wyman 1990; Wake 1991). Amphibians have declined dramatically in many areas of the world. These declines seem to have worsened over the past 25 years and amphibians are now more threatened than either mammals or birds, though comparisons with other taxa are confounded by a shortage of reliable data. Most frogs have a biphasic life cycle, where eggs laid in water develop into tadpoles and these live in the water until they metamorphose into juvenile fogs living on the land. This fact, coupled with being covered by a semi-permeable skin makes frogs particularly vulnerable to pollutants and other environmental stresses. Consequently frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment. The Giant Bullfrog (Pyxicephalus adspersus) has been chosen as a flagship species for the grassland eco-region (Cook in le Roux 2002)

Breeding in African frogs is strongly dependent on rain, especially in the drier parts of the country where surface water only remains for a short duration. The majority of frog species in Gauteng and North-West Provinces can be classified as explosive breeders. Explosive breeding frogs utilise ephemeral pans or inundated grasslands for their short duration reproductive cycles. The general type of reproductive habitat chosen has a strong influence on the entire developmental strategy followed by many species. Most anuran larvae within Gauteng and North-West provinces inhabit temporary habitats that range from small pools to larger artificial dams/pans situated in lower lying areas or depressions. Unpredictable temporal and spatial distributions and cyclic patterns of nutrient availability are common features of these habitats. Others develop in more complex permanent aquatic habitats as temporary invaders in established communities such as rivers (Crocodile and Swartspruit), streams and the artificially created dams. Numerous physical (e.g. distance from shore, oxygen concentration, substrate qualities, water depth and flow rate, site duration, and temperature) and biological (e.g. presence and distribution of vegetation, other tadpoles, other organisms including predators, and the phenology of all organisms) factors influence the spatial and temporal distribution of tadpoles among microhabitats. During this brief survey; fieldwork was augmented with species lists compiled from personal records (1999-2012); data from the Brits-Magaliesburg area collected for the South African Frog Atlas Project (SAFAP) (1999-2003) and published data, and the list provided in Table 2 below is

therefore regarded as likely to be fairly comprehensive.

Table2. Frog species recorded by the Southern African Frog Atlas Project (SAFAP) for the combined locus 2527DB and 2527DD quarter degree grid squares.

Family	**Genus**	**Species**	**Common name**	**Red list category**	**Atlas region endemic**
Breviceptidae	*Breviceps*	*adspersus*	Bushveld Rain Frog	Least Concern	0
Bufonidae	*Amietophrynus*	*garmani*	Eastern Olive Toad	Least Concern	0
Bufonidae	*Amietophrynus*	*gutturalis*	Guttural Toad	Least Concern	0
Bufonidae	*Poyntonophrynus*	*fenoulheti*	Northern Pygmy Toad	Least Concern	0
Bufonidae	*Schismaderma*	*carens*	Red Toad	Least Concern	0
Hyperoliidae	*Kassina*	*senegalensis*	Bubbling Kassina	Least Concern	0
Microhylidae	*Phrynomantis*	*bifasciatus*	Banded Rubber Frog	Least Concern	0
Phrynobatrachidae	*Phrynobatrachus*	*natalensis*	Snoring Puddle Frog	Least Concern	0
Ptychadenidae	*Ptychadena*	*anchietae*	Plain Grass Frog	Least Concern	0
Pyxicephalidae	*Amietia*	*angolensis*	Common or Angola River Frog	Least Concern	0
Pyxicephalidae	*Cacosternum*	*boettgeri*	Common or Boettger's Caco	Least Concern	0
Pyxicephalidae	*Pyxicephalus*	*edulis*	African Bullfrog	Least Concern	0
Pyxicephalidae	*Tomopterna*	*cryptotis*	Tremelo Sand Frog	Least Concern	0
Pyxicephalidae	*Tomopterna*	*natalensis*	Natal Sand Frog	Least Concern	0

Figure4. A conglomerate of photographs displaying frog species likely to occur along the alignments in suitable habitat A: Banded Rubber Frog (*Phrynomantis bifasciatus*); **B:** Giant Bullfrog (*Pyxicephalus adspersus*); **C:** Eastern Olive Toad (*Amietophrynus garmani*); **D:** Tremelo Sand Frog (*Tomopterna cryptotis*); **E:** Plain Grass Frog (*Ptychadena anchietae*); **F:** Bubbling Kassina (*Kassina senegalensis*); **G:** Boettger's Caco (*Cacosternum boetgeri*) and **H:** Bushveld Rain Frog (*Breviceps adspersus*).

Threatened Amphibian Species

GIANT BULLFROG (*PYXICEPHALUS ADSPERSUS*)

Giant Bullfrog, Bullfrog, African Bullfrog, Highveld Bullfrog, Giant Pyxi, Groot Brulpadda (Afrikaans), Letlametlu (Pedi, Shangaan), Marokolo (Sesotho), Lentsoeta (Sesotho)

The Giant Bullfrog (*Pyxicephalus adspersus*) is the largest Southern African frog, with adult males reaching over 250 mm in body length and weighing well over a kilogram. Bullfrogs emerge after the first heavy summer rains to breed and feed. Giant Bullfrogs occur over large areas ranging from Somalia in the north, through the eastern savannah regions of the continent, extending across to Angola and northern Namibia and south to Beaufort West in the Cape Province. Although they are well distributed they are rarely seen, spending the

majority of their lives underground in a dormant state known as aestivation. During this dormant period, bullfrogs remain inactive in a water proof “cocoon” composed of several layers of its own sloughed-off skin. The entire body except for the nostrils are covered by the protective cocoon. The cocoon prevents water loss (evaporation) during the dry periods. Bullfrogs can remain buried in their cocoons for several years before they emerge.

Figure5. A juvenile bullfrog in aestivation showing the cocoon composed of several skin layers. Any Giant Bullfrogs unearthed during aestivation should be placed within a cooler box filled with moist vermiculite and released in suitable habitat during the summer wet season.

Large-scale adult emergences occur after heavy summer downpours and adults breed explosively during daylight hours in shallow margins of temporary rain-filled depressions. Bullfrogs require these shallow seasonal habitats to breed successfully in as the eggs are fertilized externally. A typical breeding pond will contain numerous adult males who aggressively defend a small territory from other intruding male bullfrogs. This ensures that the largest, strongest males are able to defend the best breeding areas around the pan (Cook *et al*. 1996).

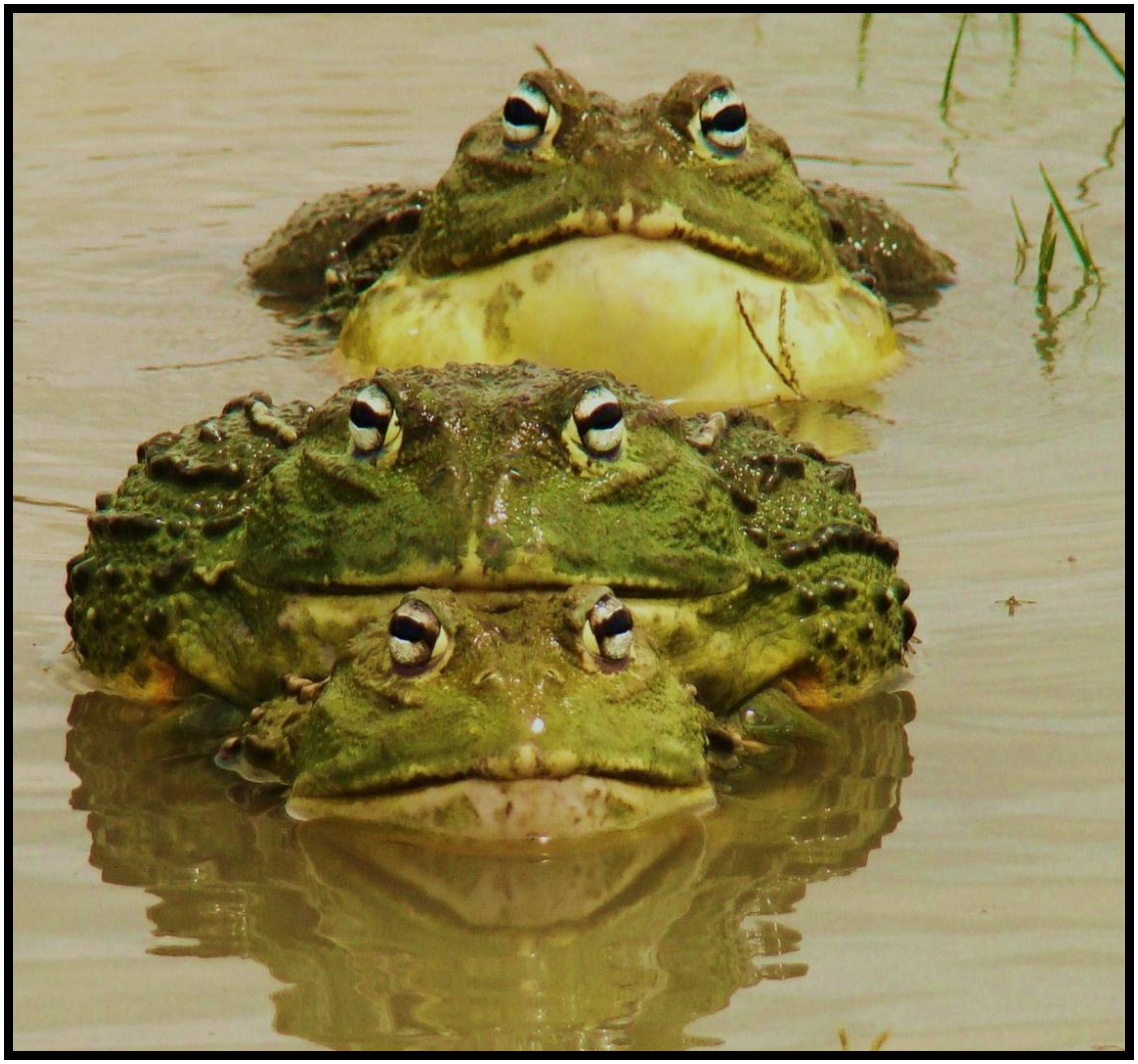

Figure6. Giant Bullfrogs are extreme explosive breeders completing their short-duration breeding events usually within 10 hours. Bullfrog breeding activity is initiated by heavy downpours during the wet summer moths.

Bullfrogs have an extremely short breeding period which usually only lasts for a single day (10 hours or less). Giant Bullfrogs may breed more than once during a single wet season if climatic conditions (sufficient rainfall) are favourable. The eggs are laid in the males' territory and are guarded by the male against potential predators. Clutch sizes range between 2000-6000 eggs. The eggs develop quickly in the shallow warm water and tadpoles emerge after 48 hours. Adult male bullfrogs are known to remain with their tadpoles throughout their larval period (28-32 days). If the adult males are removed the tadpoles become extremely vulnerable to predation. Adult male bullfrogs also construct channels to allow cooler water to enter into the evaporating territories. These channels act as passages for the tadpoles to move into deeper sections of the breeding sites.

Figure7: A collage of photographs displaying the reproductive cycle of the Giant Bullfrog: A: Amplectant pairs lay eggs in shallow water between 2-5cm deep; **B:** Tadpoles form characteristic aggregates or schools in the shallow water and **C:** develop rapidly in the warm, nutrient rich water. **D:** The tadpoles reach Gosner stage 42 between 20 and 28 days; **E:** The tail is fully absorbed (Gosner stage 46) at approximately 30-32 days. **F:** The emerging juveniles disperse up to several kilometres away from the breeding localities

Figure8. Giant Bullfrog tadpoles form characteristic schools or aggregates within the shallow waters of selected breeding sites. Only other species of frog which form aggregates or schools are Red Toads *(Schismaderma carens*). Their tadpoles are usually found in deeper (>1m) reed invaded wetlands and are darker in colour and have a horse-shoe shaped skin fold from behind the eyes to the middle of the body.

Bullfrog tadpoles form characteristic schools or aggregates. The tadpoles are adapted to these harsh unpredictable seasonal habitats and develop quickly in the shallow nutrient rich warm water. Bullfrog tadpoles can tolerate extreme water temperatures of up to 40°C. When the seasonal ponds start drying up bullfrogs bury themselves backwards into the moist margins of the pans or migrate away from the pan to sandier soils. Bullfrog burrows may extend for well over a metre (Cook *et al*. 1996).

Figure9. Typical adult Giant Bullfrog burrows. Burrows depths vary between 30cm up to a metre in depth depending on soil substrate. Adult males and females show strong philopatric tendencies, i.e. they return to the same burrow throughout their lifetime unless they are physically prevented from doing so. This has important implications for conservation management (Yetman 2006).

Bullfrogs are opportunistic feeders and will prey upon any creature small enough to swallow including small mammals, birds, snakes, lizards even other frog species. Large invertebrates such as grasshoppers, millipedes and locusts form the majority of their staple diet. Bullfrogs feed intensively during the summer months to provide enough fat storage for their dormant period underground.

Our fragile ecosystem is ever increasingly being threatened by the onslaught of pesticides, fertilizers and pollutants, which in turn are killing the natural predators of problem animals such as grasshoppers, locusts, mosquitoes and rodents. A viable colony of bullfrogs will reduce the incidence of these pests. They are excellent bio-indicators for determining the condition of grasslands, as they are extremely sensitive to water quality and habitat integrity and will only reproduce successfully in suitable habitat (shallow seasonal pans or depressions). They require large areas of open grassland for foraging and migration.

Bullfrogs have a potential pharmaceutical value as they have an incredibly effective fungicide protecting their injuries from bacterial infection.

Jacobsen (1982) reported that Giant Bullfrog numbers were declining in Gauteng, North West, Limpopo and Mpumalanga provinces, which at that time, formed part of the Transvaal Province. Boycott (2001) declared the species to be officially extinct in Swaziland. Harrison et. al. (2001) estimated that the area of its habitat and population sizes had declined by more than 50% over the past 100 years, particularly in regions subjected to extensive crop agriculture or urban and industrial development, such as Gauteng, Free State and North-West Provinces. Major road networks bisect suitable breeding and foraging areas resulting in mass road fatalities of migrating adult and juvenile bullfrogs. Fences and walls also prevent the natural migration of adult and juveniles from foraging areas and suitable breeding sites (habitat fragmentation). Habitat deterioration due to changes in the seasonality of wetland sites (damming or increased surface run-off), deterioration of water quality due to pesticides and pollutants lead to the disappearance of bullfrog populations. Human predation of adult bullfrogs is another causal factor in population declines. This is especially prevalent in the rural parts of Southern Africa (Limpopo as well as in Gauteng/Hammanskraal). Bullfrogs are also caught illegally for the local and international pet industry.

4.2 HABITAT AVAILABILITY FOR THREATENED AMPHIBIAN SPECIES

The well-defined life history pattern and specific habitat requirements of *P. adspersus* allows for easy identification of critical environmental requirements necessary to sustain populations. The following are critical habitat components for the species:

1. **Temporary pools that are large enough to hold water for approximately a month**: Wetlands including seasonally inundated grassland, pans or depressions should be shallow, at least in part, because the adult males require a water depth of approximately 5 to 10 cm for calling and for territorial defence. Giant Bullfrogs have external fertilisation and therefore the water must be shallow enough to permit the considerably smaller females to lift her abdomen and cloaca out of the water (2-5cm). Wetlands should ideally be temporary, as permanent water attracts permanent predators and also prohibits the territorial male frogs from burrowing into the wetlands substrate for aestivation. Ideally, wetlands should hold water for about 30-35 days a year and filling of wetlands must be associated with heavy downpours. No seasonal pans were observed along the western alignment. The majority of the wetland habitats along the alternative alignments are artificially created dams. These dams offer marginally suitable breeding habitat in the form of the shallow seasonally inundated margins but often contain permanent fish predators which restrict the breeding success.

2. **Breeding pans must be accessible to frogs**: At least a portion of the wetland or pan edge must be devoid of reed-beds and other bullfrog barriers. (e.g. *Phragmites australis, Arundo donax** and *Typha capesnis* reed-beds can act as an impenetrable barrier, prohibiting *P. adspersus* gaining access to the water.) Several of the wetlands habitats along the alignments are dominated by dense stands of Common Reeds (*Phragmites australis*) as well as Bull-rushes (*Typha capensis*). Several of the seepage wetlands are invaded by dense stands of the alien invasive Grey Poplars (*Populus x canescens*) and offer no suitable breeding habitat for Giant Bullfrogs and frogs in general.

3. **The substrate must be suitable for aestivation**: Adult as well as juvenile *P. adspersus* spend most of their time below ground in a torpid state. They dig their own burrows or utilise other animals burrows such as crabs or gerbils. Burrow depth varies according to soil type and may measure between 30cm to a metre in depth. Bullfrogs often bury themselves in the soft sand soils adjacent to secondary roads making them extremely vulnerable to scraping activities. The granite-based Glenrosa surface soils are sandy and friable with relatively high moisture retention properties. This soil type is particularly suited for use by Giant Bullfrogs for underground hibernation-aestivation during the dry, non-breeding season (Carruthers 2009). The alluvial sand deposits along certain sections of the servitude have soft sandy soils suitable for burrowing and aestivation. Burrowing generally takes place some distance away from the breeding site with females travelling further to burrow. Certain larger territorial males may burrow within the clay soils adjacent to the breeding habitat. The high clay content retards water loss from the frogs. Thick root mats of *Phragmites australis* and *Typha capensis* reed beds can also prevent frogs from burrowing into the substrate.

4. **Frogs must have sufficient foraging areas**: Generally, open grassland with termite mounds is the preferred habitat for foraging, and ideally, this should be adjacent to the breeding habitat.

4.2.1 ANDERSON SUBSTATION SITE

No suitable Giant bullfrog breeding habitat was observed on the site. The transformed and heavily degraded grasslands offer limited suitable foraging, dispersal and aestivation habitat for Giant Bullfrogs. Under C-Plan version 3 (latest version i.e. version 3.3), no specialist studies for any species of amphibian are requested for consideration in the review of a development application. The Giant Bullfrog (*Pyxcicephalus adspersus*) has been removed following re-assessment of the species' status in South Africa. The species is not truly Near Threatened in South Africa (no quantitative analysis of the Giant Bullfrog distribution against the IUCN criteria can consider them as such) and the most recent evaluation of the status of the Giant Bullfrog in December 2009 did not consider the species sufficiently threatened to be listed as Near Threatened (Prof. Louis du Preez, pers. comm.)∗.

Given the current objectives of Gauteng's C-plan i.e. to be used to protect representative habitat and generate specialist studies for threatened faunal species, the Giant Bullfrog does not qualify for inclusion as a species-specific layer requiring specialist assessments. As per the C-Plan approach, the conservation of the Giant Bullfrog and of amphibians in general will be met by the protected area network as well as the designation of priority habitats i.e., pans or quaternary catchments, with associated restrictions on land use (refer to "Wetlands" section). The wetland and a protective buffer zone, beginning from the outer edge of the wetland temporary zone, must be designated as sensitive (GDARD Requirements for Biodiversity Assessments: Version 2; 2012).

The current buffer zones around wetlands (30m for wetlands occurring inside urban areas and 50m for wetlands occurring outside urban areas) are totally in adequate to conserve core terrestrial habitat for the majority of frog species occurring in Gauteng Province; especially the Giant Bullfrog which requires large open areas to forage in.

∗ It is the opinion of the specialist consultant that dramatic population declines have occurred within Gauteng Province over the past 25years and Giant Bullfrogs are worthy of conservation efforts. The status of the Giant Bullfrog on a regional scale South African scale is currently being revised (pers. comm. Dr. C. Yetman).

4.2.3 ANDERSON-DIANLEDI 400kV TRANSMISSION LINE

There is a high occurrence of suitable habitat for Giant Bullfrogs in North-west Province and although they appear to be relatively abundant in the province; the Giant Bullfrog is severely impacted on by the degradation of the wetland habitat in the province. The Giant Bullfrog (*Pyxicephalus adspersus*) is a protected frog species whose conservation status within North-west Province is currently listed as "**near threatened'**.

Giant Bullfrogs have been recorded around the Magaliesburg-Brits area during the South African Frog Atlas Project. No suitable breeding habitat was observed along the proposed alignments although certain open grassland and bushveld areas to the north and south of the Magaliesburg could potentially offer suitable foraging, dispersal and aestivation habitat for Giant Bullfrogs.

4.3 REPTILES

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Large areas surrounding the site have resulted in increased habitat modification and transformation as well as increased human presence and associated disturbances (illegal reptile collecting, indiscriminate killing of all snake species, frequent fires) surrounding the site coupled with increased habitat destruction and disturbances on the neighbouring properties are all causal factors in the alteration and disappearance of reptile diversity in the area.

The Magaliesburg mountainous ridge contains large rocky outcrops and cliffs around the crests and provides favourable refuges for certain snake and lizard species (rupicolous species). Termite mounds were present on the lower rocky lower slopes of the Magaliesburg increasing in abundance along the mid slope. Most of the termite mounds were small but some larger mounds were also present on the plains extending northwards towards Brits. Some large mounds were moribund or had been damaged by previous foraging by Antbears as well as gouging by cattle. This resulted in the exposing of tunnels into the interior of the termite mound. Moribund (old) termite mounds offer important refuges especially during veld fires as well as cold winter months for numerous frog, lizard, snake and smaller mammal 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. No termite mounds were destroyed during the brief field survey. All overturned rock material was carefully replaced in its original position.

Figure10. A collage of photographs displaying the granitic outcrops and low-lying rocky sheets to the north-east of Brits. Several granite mines within the area are an immediate threat for remaining rupicolous reptile species.

The rocky crests and slopes of the Magaliesburg ridge contain low-lying rocky outcrops as well as large granitic outcrops towards Brits and offer favourable habitat for several rupicolous reptile species. Reptile species recorded from under loosely embedded rocks or low-lying rocky areas included Yellow-Throated Plated Lizard (*Gerrhosaurus flavigularis*), Montane Speckled Skink (*Trachylepis* (*Mabuya*) *punctatissima*), Variable Skink (*Trachylepis (Mabuya) varia*) Ground Agama (*Agama aculeate distanti*) and Transvaal Thick-toed Gecko (*Pachydactylus affinis)*.

Trees including stumps; bark and holes in trees are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors). Reptile species recorded in the open and closed *Acacia caffra* woodland areas included Flap-neck Chameleon (*Chamaeleo dilepis*) and Cape Dwarf Gecko (*Lygodactylus capensis*). Limited logs and stumps were observed in the closed and open woodland areas opposite the proposed alignment. Reptiles recorded under logs included Wahlberg's Snake Eyed Skink (*Panapsis walbergii*) and Variable Skink (*Trachylepis varia*).

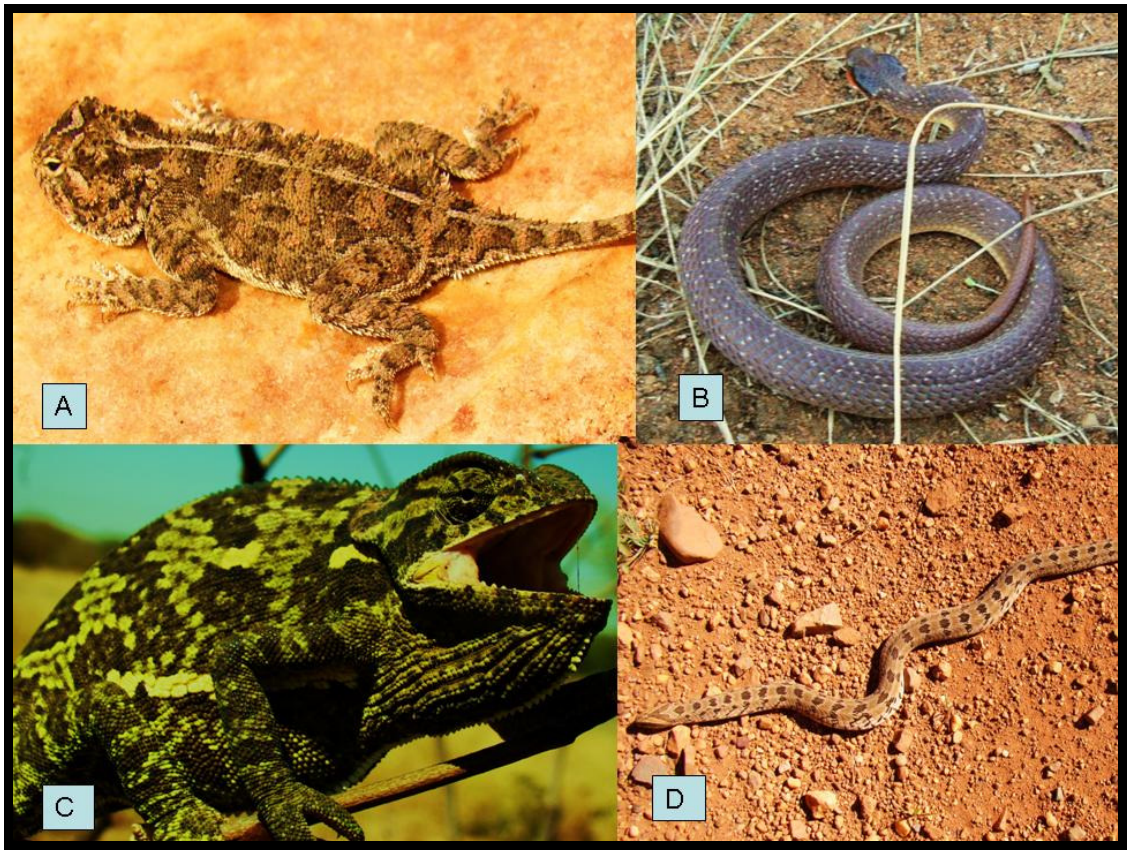

Figure11: Reptile species recorded along the proposed alignments included **A:** Distant's Ground Agama (*Agama aculeata distanti*); **B:** Herald Snake (*Crotaphopeltis hotamboeia*); **C:** Flap-necked Chameleon (*Chamaeleo dilepis*); **D:** Rhombic Night Adder (*Causus rhombeatus*).

Figure12. Reptile species recorded (*) or likely to occur on the site. A: Rock Monitors (*Varanus albigularis*) and **B:** Nile Monitors* (*Varanus niloticus*) may still occur around the alignment. Both species are hunted and killed due to raiding chicken runs as well as for food. **C:** South African Python (*Python natalensis*); especially dispersing juveniles could remain in the open and closed woodland vegetation within the Magaliesburg and adjacent granitic outcrops around the Brits area. **D:** A female Southern Tree Agama* (*Acanthocercus atricollis*) was observed on the trunk of an *Acacia robusta*. Due to extensive habitat transformation and degradation as well as high levels of human activities alteration to the original reptile species composition (especially snakes) has already occurred. Remaining reptile species are restricted to the rocky hills as well as scattered large trees as well as remnant Marikana Thornveld.

Table3. A list of reptile species observed on the site as well as species likely to occur on the site using habitat as an indicator of presence; is presented below. The list has been heavily supplemented by previous surveys along the proposed alignments (species in bold) as well as by species distributions and habitat requirements by Branch (2001) and Alexander & Marais (2007).

Common Name	Scientific Name	Habitat Requirements
Marsh or helmeted Terrapin	*Pelomedusa subrufa*	Artificially created dams along the central valley bottom including the golf course dam.
Leopard Tortoise	*Stigmochelys* (*Geochelone*) *pardalis*	Suitable habitat along the foot of the mountainous Magaliesburg .
Savanna Hinged Tortoise	*Kinixys belliana*	Rupicolous outcrops
Delalande's Beaked Blind Snake	*Rhinotyphlops lalandei*	Fossorial found in soil under rocks or logs, in moribund termite mounds.
Peter's Thread Snake	*Leptotyphlops scutifrons*	Fossorial found in soil under rocks or logs, in moribund termite mounds.
Incognito Worm Snake	*Leptotyphlops incognitus*	Fossorial found in soil under rocks or logs, in moribund termite mounds.
Jacobsen's Worm Snake	*Leptotyphlops jacobseni*	Fossorial found in soil under rocks or stones, in moribund termite mounds.
Cape Skink	*Trachylepis capensis*	Terrestrial digging tunnels in loose sand at the base of bushes or boulders, also favours dead trees and fallen Aloes.
Montane Speckled Skink	*Trachylepis punctatissima*	A mostly rock-living diurnal skink the Spotted Skink often occurs in association with man-made structures where it is able to find refuge and food and may be unwittingly translocated in boxes, firewood and other items where it has taken refuge
Wahlberg's Snake-eyed skink	*Panapsis wahlbergii*	Amongst grass roots under rotting logs and around stones and old termitaria (Moribund) on broken ground. Eats termites and other small insects.

Rainbow Skink	*Trachylepis margatifer*	Rupicolous species on exposed granite domes and other hard rock faces (paragneiss and some sandstone). Very active and males are territorial.
Variable Skink	*Trachylepis varia*	Another terrestrial and diurnal skink, the Variable Skink is widespread although not very frequently recorded from disturbed habitats. It occupies a wide variety of habitats where there is sufficient vegetative cover. It takes refuge in a wide range of shelters including under rocks on soil, in crevices, under building rubble and in the burrows of other animals.
Common Rough-scaled Lizard	*Ichnotropis squamulosa*	Active hunters on sandy flat clearings and dig branching burrows in soft sand, usually at the base of *Acacia* trees as well as grass tussocks.
Spotted Sand Lizard	*Pedioplanis lineoocellata*	Prefer flat rocky veld. Shelter is small burrows dug underneath a flat rock.
Transvaal Grass Lizard	*Chamaesaura aenea*	Grasslands on mountainous slopes as well as rocky grasslands.
Flap-neck Chameleon	*Chamaeleo dilepis*	Adults are arboreal and usually found in trees and shrubs but hatchlings appear to favour perching on grass stems. The open and closed Acacia woodlands offer suitable habitat.
Transvaal Thick-toed gecko	*Pachydactylus affinis*	Rocky outcrops and old termite mounds.
Cape Thick-toed Gecko	*Pachydactylus capensis*	Rocky outcrops, under logs and old termite mounds as well as houses.
Cape Dwarf Gecko	*Lygodactylus capensis*	Well-wooded savanna but also thrives in urban areas.

Bibron's Gecko	*Pacydactylus bibronii*	Rocky outcrops, under logs as well as houses.
Yellow-throated Plated Lizard	*Gerrhosaurus flavigularis*	A common and widespread terrestrial lizard, usually associated with a dense ground cover. They dig burrows at the base of bushes, under boulders and also under rubbish piles. The often take refuge in the burrows of other animals
Transvaal Girdled Lizard	*Cordylus vitttifer*	The Transvaal Girdled Lizard is rupicolous and restricted to rocky outcrops, inhabiting fissures between rocks and under rocks.
Distant's Ground Agama	*Agama aculeata distanti*	Terrestrial but will often climb in a low shrub to bask. A short hole dug at the base of a bush or under a rock serves as a retreat.
Southern Rock Agama	*Agama atra*	Rupicolous living on rocky outcrops and even shelter under the bark of a tree.
Transvaal Girdled Lizard	*Cordylus vittifer*	Rupicolous outcrops usually within fissures and crevices.
Rock Monitor	*Varanus albigularis*	Terrestrial but will often climb trees and may spend a large proportion of their time on rocky outcrops. They usually have a retreat in a rock fissure, a hole in a tree, animal burrows or in a termitarium.
Water Monitor	*Varanus niloticus*	Terrestrial semi-aquatic lizards usually found close to water.
Southern Stiletto Snake or Bibron's Burrowing Asp	*Atractaspis bibronii*	A burrowing (fossorial) species usually found in deserted (moribund) termite mounds, under rotting logs or beneath sun-warmed rocks.
Common Purple-glossed Snake	*Amblyodipsas polylepis*	A burrowing (fossorial) species usually found in deserted (moribund) termite mounds, under rotting logs or in animal burrows.

Herald or red-lipped Snake	*Crotaphopeltis hotamboeia*	A common and widespread nocturnal snake, the Herald Snake on frogs and toads which it finds around houses and in moister areas. Takes refuge under rocks and in moribund termitaria and in building rubble but may rest up by day in a variety of cover.
Rinkhals	*Haemachatus haemachatus*	The Rinkhals is a widespread snake primarily inhabiting moister areas in Highveld grassland in Gauteng. Although formerly common in parts of the province, its habitat has been depleted by urban expansion. It tends to inhabit the burrows of other animals and is mostly nocturnal although basking in the sun during the day. Feeds mostly on amphibians and rodents
Mole Snake	*Pseudapsis cana*	Adults may reach 2m in length but are mostly smaller in this area. A diurnal snake they feed on mice and rats and also African Molerats which are widespread, also occurring on the site. It takes refuge within the burrows of other animals.
Rhombic Night Adder	*Causus rhombeatus*	Favours damp environments in moist savanna where it seeks refuge in old termite mounds, under logs and large flat stones as well as amongst building rubble.
Puff Adder	*Bitis arietans*	Puff Adders are common throughout southern Africa, except for mountain tops, true desert and dense forests.
Horned Adder	*Bitis caudalis*	Rare within Magaliesburg which is the south-eastern extremity of its distribution range.
Snouted Cobra	*Naja annulifera*	Arid and moist savanna

Mozambique Spitting Cobra	*Naja mossambica*	The most common of the region's cobras found in moist savanna where it favours broken rocky grassland, hollow logs, termite mounds and animal burrows. Often close to water.
Common Egg Eater	*Dasypeltis scabra*	
Brown House Snake	***Lamprophis fuliginosus***	Frequents human habitation as well as under loosely embedded rocks.
Aurora House Snake	*Lamprophis aurora*	Favours moist grassland habitat adjacent to wetlands/valley bottom; often use moribund termite mounds in grassland; loosely embedded rocks
Common or Rhombic Egg Eater	*Dasypeltis scabra*	A common and widespread nocturnal snake, the Common Egg-eater is largely dependent on dead termitaria on the Highveld where little other cover is available. It will also shelter under rocks, in crevices, under building rubble and in a variety of other refuges when available. The snake is dependent on bird's eggs as a source of food which they locate by means of a fine sense of smell.
Spotted skaapsteker	*Psammophylax rhombeatus*	A common and widespread diurnal snake mostly in highveld grassland it feeds on lizards and small rodents. It is often seen foraging in rocky and moist areas but takes refuge under rocks, in dead termitaria, old building rubble and animal burrows sometimes in the company of other snakes. Feeds mostly on frogs, lizards and rodents

Striped Skaapsteker	*Psammophylax tritaeniatus*	A common and widespread diurnal snake mostly in highveld grassland it feeds on lizards and small rodents. It is often seen foraging in rocky and moist areas but takes refuge under rocks, in dead termitaria, old building rubble and animal burrows sometimes in the company of other snakes. Feeds mostly on frogs, lizards and rodents
Cape or Black-Headed Centipede Eater	*Aparallactus capensis*	A burrowing (fossorial) species usually found in deserted (moribund) termite mounds, under rotting logs or beneath sun-warmed rocks.
Boomslang	*Dispholidus typus*	Arboreal and mainly diurnal
Southern African Python	*Python natalensis*	Rarely recorded within the rocky Magaliesburg mountainous areas, wetland habitat and the open and closed woodland vegetation units
Spotted Bush Snake	*Philothamnus semivariegatus*	River banks, shrubs and bushes. It often enters houses and outbuildings.
Striped Harlequin Snake	*Homoroselaps dorsalis*	Rare and seldom seen. Found mainly in moist savanna and grassland. It inhabits moribund termite mounds as well as under loosely embedded rocks..
Southern Stiletto Snake	*Atractaspis bibronii*	Arid and moist savanna. A burrowing species usually found in deserted termite mounds, under rotting logs or beneath sun-warmed rocks.
Short-snouted Whip Snake	*Psammophis brevirostris*	Grassland and moist savanna that dashes for cover when disturbed. May also venture into low shrubs to bask.
Crossed Whip Snake	*Psammophis crucifer*	Moist savanna seeking refuge under stones or disused termitaria.
Common Brown Water Snake	*Lycodonomorphus rufulus*	A nocturnal, aquatic snake confined to damp localities near streams and rivers.

Sundevall's Shovel-snout	*Prosymna sundevalli*	Found in old termite mounds and under rocks
Common Slug-eater	*Duberria lutrix*	Grassland species that favours damp localities often found under rocks, logs, grass tufts and vegetation.
Common or Cape Wolf Snake	*Lycophidion capense*	Moist savanna and grassland and is fond of damp localities and is often found under stones, logs, piles of thatch grass, rubbish heaps or in deserted termite mounds.

***Reptiles recorded during brief previous surveys and likely to occur along the proposed alignment (2007- 20012). Actual species lists will most likely contain fewer species due to high levels of human disturbances around the proposed alignment.**

4.4 HABITAT AVAILABLE FOR SENSITIVE OR ENDANGERED REPTILE SPECIES

4.4.1 ANDERSON SUBSTATION SITE

The proposed Anderson substation site offers no suitable habitat for the Southern African Python (*Python natalensis*) and marginally suitable habitat for the Striped Harlequin Snake (*Homoroselaps dorsalis*) in the form of scattered moribund termite mounds. Under C-Plan version 3 (latest version i.e. version 3.3), no specialist studies for any species of reptile are requested for consideration in the review of a development application in Gauteng Province.

4.4.2 ANDERSON-DINALEDI TRANSMISSION LINE

There is a high occurrence of suitable habitat for four Red Data reptile species in the NW Province. Suitable habitats for the Southern African python but numerous rural settlements are situated in close proximity to the koppies and ridges, and the pythons are hunted for bush meat. Large scale granite mining is also an immediate threat to remaining python populations. Four red listed reptile species have been recorded from the 2527DB and 2527DD QDGS.

Table4. Red data reptile species for the 2527DB and 2527DD QDGS.

ENGLISH NAME	SCIENTIFIC NAME	STATUS
Southern African Python	*Python natalensis*	Vulnerable
Striped Harlequin Snake	*Homoroselaps dorsalis*	Near-threatened
Blunt-tailed worm lizard	*Dalophia pistillum*	Data Deficient
Nile Crocodile	*Crocodylus niloticus*	Vulnerable

SOUTH AFRICAN PYTHON (*PYTHON NATALENSIS*)

The Southern African Python inhabits a wide range of habitats, including savanna woodland and grassland, forest, savanna, semi-desert, rocky areas and the edges of marshes, lakes and rivers, being particularly associated with areas of permanent water. It also readily adapts to disturbed habitats and so is often found around human habitation.

Like all pythons, the Southern African Python is non-venomous and kills its prey by constriction. After gripping the prey, the snake coils around it, tightening its coils every time the victim breathes out. Death is thought to be caused by cardiac arrest rather than by asphyxiation or crushing. The Southern African Python feeds on a variety of large rodents, monkeys, antelopes, fruit bats, monitor lizards and even crocodiles, and on rats, poultry, dogs and goats in suburban areas. A few cases are also known of this python hunting humans (Branch and Haacke 1980).

Southern African Pythons are oviparous, laying between 20 and 100 hard-shelled, elongated eggs in an old animal burrow or termite mound. The female shows a surprising level of maternal care, coiling around the eggs, protecting them from predators and possibly helping to incubate them, until they hatch around 90 days later. Individuals may live for over 12 years in captivity.

People are often fearful of large pythons and may kill them on sight, though unprovoked attacks on humans are very rare, despite the fact that this species is often found around human habitation. The Southern African Python may also be threatened by hunting for food and leather in some areas. It is also collected for the pet trade, although it is not generally recommended as a pet due to its large size and unpredictable temperament. Little information is available on levels of international trade in this species. Habitat destruction as well as electric fences and roads are major threats for remaining pythons in the immediate area.

The Southern African Pythons (*Python natalensis*) are protected in South Africa and is listed as (**SA RDB, Vulnerable**) in the outdated South African Red Data Book (Branch 1988) and is listed on Appendix II of the Convention on International Trade in Endangered Species (CITES). These ratings are based on the fact that Southern African Pythons are specifically exploited for human consumption. It is unlikely that this species will retain this threat classification using the latest IUCN criteria, since it appears to be relatively common in certain areas (Limpopo, Mpumalanga Lowveld) and is widespread throughout Southern Africa. Declines of Python numbers are mainly due to habitat destruction, killed for their skins (fashion) as well as for fat for the muti trade, 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. A more recent cause of mortality is electrocution on electric game fences.

The rapid expansion of the game farm industry in southern Africa could result in electric fences becoming a threat to populations in the future (Alexander and Marais 2007).

Southern African Pythons have been recorded from the Magaliesburg Protected Natural Environment (MPNE). The granitic outcrops to the north of the Magaliesburg offers favorable habitat for Southern African Pythons in the form of the rocky mountainous areas, wetland habitats as well as open and closed woodland vegetation units. The present granite mining activities as well as surrounding human settlements severely restricts the likelihood of significant populations remaining. Several private properties and farms have electric fences with low-lying strands approximately 15cm from the ground which severely restricts the likelihood of any large adult pythons on the site.

No Southern African Pythons or evidence of pythons was observed during the brief field survey. Remaining Python populations would have been impacted on during the previous agricultural activities. According to the information provided by a landowner, a python was recorded two years ago at the Farm Rietfontein 484 JQ. The python was unfortunately killed. As a precautionary measure an educational programme on Southern African Pythons should be implemented for all staff and contractors working on the project. If any pythons are discovered on the site during construction activities the relevant conservation authorities should be informed and the python relocated in suitable habitat away from the site (Magaliesburg Protected Natural Environment (MPNE).

Striped Harlequin Snake (*Homoroselaps dorsalis*)

Figure13. The Striped Harlequin Snake (*Homoroselaps dorsalis*) is a rare nocturnal snake which appears to consist of a number of disjunct populations in Gauteng and North-West Provinces. A small brightly coloured snake which has mostly been recorded inhabiting moribund termite mounds.

The most current Red Data book for South African reptiles, Branch (1988) lists *Homoroselaps dorsalis* as **Rare**, though this assessment was performed under now out-of-date criteria. *H. dorsalis* is currently listed as **Near Threatened** by the IUCN (World Conservation Monitoring Centre, 1996), though this assessment is also out-of-date as it was performed under obsolete criteria. The conservation status of *H. dorsalis* will be reviewed in coming months by the South African Reptile Conservation Assessment (SARCA).

Table5. Vegetation types that from which the Striped Harlequin Snake *Homoroselaps dorsalis* has been previously recorded. Vegetation types in bold occur along the alignments.

Vegetation type	**Number of records**
Egoli Granite Grassland	8
Winburg Grassy Shrubland	7
Zululand Lowveld	6
KaNgwane Montane Grassland	4
Polokwane Plateau Bushveld	4
Northern Escarpment Dolomite Grassland	4
Soweto Highveld Grassland	**3**
Paulpietersburg Moist Grassland	3
Aliwal North Dry Grassland	3
Carletonville Dolomite Grassland	2
Marikana Thornveld	**2**
Income Sandy Grassland	2
KwaZulu-Natal Highland Thornveld	2
Andesite Mountain Bushveld	**2**
Eastern Free State Clay Grassland	2
Norite Koppies Bushveld	**2**
Scarp Forest	2
Western Maputaland Clay Bushveld	1
Swaziland Sour Bushveld	1
Granite Lowveld	1
Mamabolo Mountain Bushveld	1
Gold Reef Mountain Bushveld	**1**
Northern Zululand Sourveld	1
Makhado Sweet Bushveld	1
Ngongoni Veld	1
KwaZulu-Natal Coastal Belt	1
Gauteng Shale Mountain Bushveld	**1**
Eastern Temperate Freshwater Wetlands	1
Northern Mistbelt Forest	1
Central Free State Grassland	1
Western Free State Clay Grassland	1
Rand Highveld Grassland	1
Barberton Montane Grassland	1
Lydenburg Montane Grassland	1
Lydenburg Thornveld	1
Tsakane Clay Grassland	1
Northern KwaZulu-Natal Moist Grassland	1
Midlands Mistbelt Grassland	1
Total	**79**

Figure14. Several abandoned or moribund termite mounds (*Trinervitermes habelandii*) were observed along the proposed alignments. The majority occurred on the foothills and lower slopes of the Magaliesburg as well as plains between Magaliesburg and Brits to the north. Moribund termite mounds offer favourable habitat for several reptile species including the rare Striped Harlequin Snake.

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 along the alignment as well as loosely embedded rocks on the mid to lower slopes on the Magaliesburg for the Striped Harlequin Snake. All large and especially moribund or abandoned termite mounds and any major rocky outcrops should ideally be conserved. This is especially pertinent during the construction phase. The towers should ideally be erected away from any rocky outcrops or moribund termite mounds. If however any moribund termite mounds have to be destroyed; a rescue and relocation project should be implemented for any termite mounds and loosely embedded rocky material in the areas proposed for the towers or access roads. This is especially pertinent for the towers on the grassy hills where termite mounds and rock outcrops remain. Specimens discovered can be relocated away from the disturbances as well as increasing the information basis of what reptile species are utilising the moribund termite mounds along the alignment.

Blunt-tailed Worm Lizard (*Dalophium pistillum*)

By far the largest local worm lizard with a broad horizontal 'spade' that is covered by a single horny shield. Only known for a few localities in South Africa near Vryheid in the Northern Cape Province and between Vaalwater and the Waterberg in Limpopo Province (Branch 1988). A fossorial species occurring in varied habitats from Kalahari Sand to coastal alluvium. As minimal soil disturbances should occur mainly around the pylons no significant impact is expected on any Blunt-tailed Worm Lizard populations.

Nile Crocodile (*Crocodylus niloticus*)

Although Nile Crocodiles (*Crocodylus niloticus*) historically (in the early 19th century) occurred in abundance in the rivers around Magaliesburg; none remain today. Crocodile farms are however growing in popularity (Carruthers 1990).

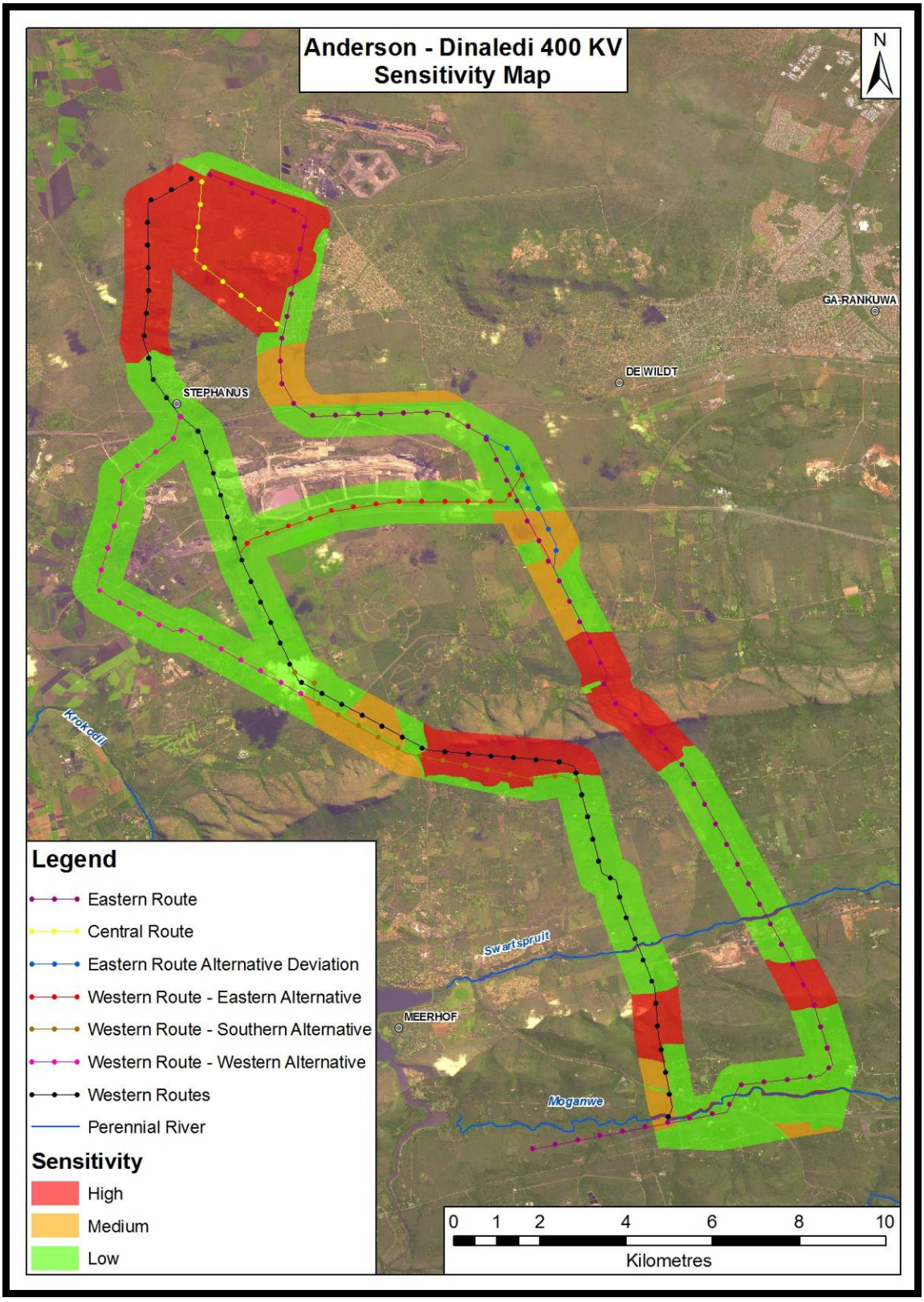

Figure15. Preliminary sensitivity map for the proposed Anderson-Dinaledi transmission line

5. SENSITIVE ENVIRONMENTS OR HABITATS ALONG PROPOSED ALIGNMENTS

5.1 MAGALIESBERG PROTECTED NATURAL ENVIRONMENT (MPNE).

Figure15. The Magaliesburg Protected Natural Environment must be considered as a sensitive habitat for herpetofauna species.

A ridge includes hills, koppies, mountains, kloofs and gorges and/or a landscape type or topographic feature that is characterized by two or more of the following features - a crest, plateau, cliff or footslope. In addition, ridges are characterized by slopes of 5° or more (that is equivalent to slopes of > 8.8% or > 1: 11 gradient) when modelled in a Geographic Information System digital elevation model that is based on 20m contour intervals at a scale of 1:50 000.

Ridges as biodiversity hotspots and future refuges

Varied topography is recognized as one of the most powerful influences contributing to the high biodiversity of southern Africa. The interplay between topography and climate over a long period of time has led to the evolution of a rich biodiversity (Samways & Hatton, 2000). Landscapes composed of spatially heterogeneous abiotic conditions provide a greater diversity of potential niches for plants and animals than do homogeneous landscapes. The richness and diversity of flora has been found to be significantly higher in sites with high geomorphological heterogeneity and it can reasonably be assumed that associated fauna communities will also be significantly more diverse in spatially heterogeneous environments (Burnett *et al*., 1998).

Ridges are characterized by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and variations thereof), slopes and altitudes that give rise to differing soil (for example 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) has been found to be especially important predictors of biodiversity. It follows that ridges will be characterized by a particularly high biodiversity and, as such, their protection will contribute significantly to the conservation of biodiversity in Gauteng and North-west Provinces.

Biotic communities differ between the tops and bottoms of koppies (Samways & Hatton, 2000). Associated faunal communities are similarly diverse. 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 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).

Some taxonomic groups, for example the poorly known and undercollected bryophytes, are found predominantly on ridges, hills, koppies and in kloofs. In this regard, the Magaliesberg is a recognized centre of moss species diversity (van Rooy, 2000). Relatively pristine examples of highveld grassland, nationally poorly conserved and highly transformed vegetation types, are found on ridges. Most grassland in Gauteng has been converted to

crops at some time, excepting on ridges due to their steep rocky slopes. As such, the conservation of ridges in Gauteng and North-west Provinces will provide habitat for significantly high numbers of species allowing for their continued survival in a rapidly urbanizing province, a desirable long-term conservation goal. Ridges are particularly suitable for providing a future refuge for biodiversity in an urbanized landscape as they function as islands even within a natural landscape due to their structural and environmental isolation from the landscape (Samways & Hatton, 2000). Furthermore, according to climate change modelling, level topography will be particularly sensitive to future climate change and major extinction in these areas can be expected (Rutherford *et al.*, 2001). As such, in a landscape affected by climate change, chances of species survival will be higher on ridges.

The entire range of the Magaliesberg must be considered as sensitive habitats providing important habitat to several rare or threatened animal species including the red listed South African Python (*Python natalensis*). Which utilizes moist, rocky, well wooded habitats such as those associated with ridges in Gauteng (Branch1988).The Magaliesburg provides vital habitats for numerous rupicolous (living on or amongst rocks) reptile species including snakes, agamids, skinks and geckos Impacts in the Magaliesberg Protected Natural Environment (MPNE must be kept to a minimum in order to prevent any major environmental degradation. The proposed transmission line should ideally be directed away from certain sensitive habitats including open woodland, forest and kloofs, cliffs, rivers, streams (perennial and seasonal). The proposed transmission alignment should be directed along previously impacted or transformed habitats such as residential plots, road servitudes, Eskom power line servitudes, agricultural fields etc.

5.2 CROCODILE RIVER AND THE SWARTSPRUIT AND ASSOCIATED RIPARIAN ZONES

Figure16. The Crocodile River and its' associated wooded riparian zone must be considered as a sensitive habitat for remaining herpetofauna species.

The riparian zones associated with the Crocodile River and Swartspruit 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 and Savanna Biomes, are in danger of being completely replaced by alien invasive species (Henderson & Musil 1997, Rutherford & Westfall 1994). Any remaining areas of indigenous riparian vegetation within Gauteng and North-West Provinces must therefore be regarded as of conservation importance.
- Rivers 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 transmission alignment is therefore also likely to impact on upstream and downstream areas.
- Indigenous riverine (riparian) vegetation such as that found along the Crocodile River and Swartspruit, 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 closed woodland and thicket, and indigenous forest areas along the Crocodile River provided habitat for a fairly large diversity of animals, and especially birds, within the study area.

RECOMMENDED ALIGNMNET

Preferred Alignment

During the preliminary herpetological habitat assessment or sensitivity scan the majority of habitats and vegetation along the proposed western alignment; except for the Magaliesburg Natural Protected Environment (MNE) and a few scattered granitic hills and outcrops; has been transformed through agriculture, formal settlements and other forms of infrastructure development, such as powerlines, roads (R511) and Telkom lines. The Eastern route is regarded as the route alternative that would pose the great threat to the overall biodiversity of the area during construction of the proposed transmission line as it traverses through the sensitive areas (rocky cliffs) of the Magaliesburg Natural Protected Environment, Wonderboom Municipal Nature reserve and the number of Orange Listed plant species recorded on this route were higher than the other route alternatives (Phamphe 2012).

It is recommended that the transmission line follow the western route. The southern, eastern or western deviations will not ameliorate any potential impacts on the hepetofuana. The main reason for the recommendation of the western alignment is that there are existing powerlines along the majority of the proposed alignment and higher levels of anthropogenic disturbances along this route. The establishment of new transmission line servitudes along a formerly undisturbed area will have greater impact on herpetofauna diversity than if following adjacent to existing servitudes. From an ecological perspective the western route is considerably more degraded than the eastern route. The western route also traverses less natural Marikana Thornveld, the most threatened vegetation type transverse than the alternative alignments.

6. STANDARD FAUNAL MITIGATION MEASURES

The proposed 400kV overhead Anderson to Dinaledi transmission western alignment occurs mainly along degraded as well as transformed grasslands with relatively few moribund termite mounds and limited rock material. Certain sections of the alignment bisect the mid-slopes of the Magaliesberg Protected Natural Environment (MPNE) and precautionary measures should be implemented in this sensitive environment (see attached preliminary sensitivity map). If tower/pylon excavations and vegetation clearance is kept to a minimal foot print the proposed transmission line should not significantly impact on any threatened reptile or amphibian species if the following mitigatory measures are implemented throughout all stages of the proposed project. The temporary alteration of vegetation and soil structure in the effected areas of the proposed Rustenburg pipeline will impact on the fauna and flora directly within the proposed route and potentially in the immediate surrounding area. It is imperative that minimal vegetation clearance and disturbances should occur along the proposed pipeline route. Vegetation clearance should be restricted to the actual transmission line servitude (55m) and not into surrounding grassland or bushveld areas. As certain sections of the proposed transmission line is situated on a sloping gradient; erosion/siltation preventative measures must be implemented throughout all phases of the project. In addition, the increased human density, heavy construction machinery and vehicles will most likely directly and indirectly result in the short-long term alteration of the faunal composition on the site and surrounding areas. Loss of habitat for foraging, reproduction and shelter will most severely impact on the smaller sedentary species (insects, arachnids, reptiles, amphibians and mammals).

6.1 HERPETOFAUNA MANAGEMENT RECOMMENDATIONS

The construction of the proposed Ande4rson-Dinaledi 400kV Transmission line will most-likely 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 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). Prior to construction and vegetation clearance a suitably qualified zoologist (herpetologist) should undertake a walk-through of the preferred alignment and closely examine the proposed tower/pylon construction areas (concrete supports) for the presence of any animal burrows (including spiders and scorpions), rocky outcrops, logs, stumps and other debris and

relocate any affected animals to appropriate habitat away from the servitude or tower.

AMPHIBIAN MANAGEMENT RECOMMENDATIONS

- Construction activities of the Anderson-Dinaledi transmission line should be restricted to daylight hours reducing the potential impact on the nocturnal breeding activities of the majority of amphibian species.
- Ideally the installation of the new towers/pylons should be undertaken during the dry winter months (May-September) when the majority of amphibian species are dormant.
- All pylons should be positioned 32m from the edge of the riparian zone of the Crocodile River and Swartspruit.
- Activities around the Crocodile River and Swartspruit must be strictly limited to the proposed servitude.
- No Giant Bullfrogs must be collected for food or illegal pet trade.
- No activities must be allowed within any adjacent wetland habitat.
- As a precautionary mitigation measure it is recommended that the construction contractor as well as an independent environmental control officer (ECO) should be made aware of the possible presence of certain threatened amphibian species (Giant Bullfrog) prior to the commencement of the construction of the new transmission line.

REPTILE MANAGEMENT RECOMMENDATIONS

- Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons.
- The majority reptile species are sensitive to severe habitat alteration and fragmentation.
- Due to agricultural activities in the area coupled with increased habitat destruction, degradation (alien plant invasion) and disturbances are all causal factors in the alteration of reptile species occurring in these areas.
- Low-lying rock outcrops occurs in certain sections of the transmission line and provide favourable refuges for certain snake and lizard species (rupiculous species).
- Several large termite mounds *Trinervitermes spp.* were observed. Termite mounds offer important refuges for numerous frog, lizard and snake species (Striped Harlequin Snake).
- 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 frogs.
- If any termite mounds have to be destroyed a qualified herpetologist must be present in case any lizard, snake and blind snakes, or the red data Striped Harlequin Snake (Rare) are unearthed.
- Termite mounds are important habitats for numerous animal species. Numerous animal species use holes or abandoned termite mounds as refuge sites and nesting sites. Termites and emerging alates are an important food source for numerous animal species. Wherever possible, large expanses of termite mounds should ideally be avoided wherever possible by the proposed transmission line servitude.
- As a **precautionary measure**; prior to earth-clearing activities a suitably qualified environmental officer/herpetologist must carefully excavate larger termite mounds as well as around the termite mounds or burrow systems, logs, loosely embedded rocks and other surface material and remove affected animal species (reptiles, amphibians, small mammals).
- Any termite mound which must be destroyed should be carefully excavated by hand and pick.
- Any animals rescued or recovered will be relocated in suitable habitat away from the transmission tower and line.
- Trees including stumps; bark and holes in trees are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors).
- The removal of indigenous tree species as well as vegetation clearance must be kept to the minimum area required and be restricted to the servitude.
- Indigenous cleared vegetation should form wood piles and logs and stumps. Dead or decaying wood piles should be created as these will provide valuable refuge areas especially due to the clearance of vegetation cover. Logs and stumps also provide important habitats for several reptile species as well as smaller mammals, amphibians, arachnids and scorpions. With time they will eventually be reduced to valuable compost by several animal species. Dead trees and stumps will also be used for nesting purposes by barbets, hoopoes, owls, hornbills as well as perching or hunting platforms for birds like the kingfisher.
- Any lizards, geckoes, agamids, monitors or snakes encountered should be allowed to escape to suitable habitat away from the disturbance. No reptile should be intentionally killed, caught or collected during any phase of the project.
- Vegetation clearance on the Magaliesburg ridge crossing of the powerline servitude must be limited to the minimum requirements. Activities should be restricted to the current and proposed servitude especially in these sensitive environments.
- Disturbance of topsoil on tower sites with severe slopes shall be minimised at all costs.

- At any tower sites where conventional foundations are installed, the Contractor shall remove the topsoil separately and store it for later use during rehabilitation of such tower sites.
- During backfilling operations, the Contractor shall take care not to dump the topsoil in the bottom of the foundation and then place spoil on top of that.
- In sensitive areas, foundations for tower constructions must be excavated by hand.
- Should any threatened animal species (Striped Harlequin Snake, Blunt-tailed Worm Lizard) be exposed during excavation, the construction in the vicinity of the finding must be stopped. A suitably qualified herpetologist must be called to the site to inspect and determine the significance of the discovery. The relevant conservation authorities must be informed within 24hours of the discovery.

6.2 VEGETATION CLEARING

Management objective

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

Measurable targets

- No damage to vegetation outside the 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 indigenous trees (*Sclerocarya birrea, Acacia caffra, Acacia nilotica*) and vegetation necessary for the safe mechanical construction and electrical operation of the transmission line. Vegetation clearing on tower sites must be kept to a minimum and the alignment shifted away from open and closed *Acacia* woodland areas. Large exotic 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. 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. 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. All alien vegetation in the total servitude and densifiers creating a fire hazard shall be cleared and treated with herbicides.

6.3 REVEGETATION

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 as well as GDARD. 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.

- In accordance with the Conservation of Agricultural Resources Act, No 43 of 1983, slopes in excess of 2% must be contoured and slopes in excess of 12% must be terraced.
- Other methods of rehabilitation of tower sites may also be used at the discretion of the Environmental Control Officer, e.g. stone pitching, logging, etc.
- Contour banks shall be spaced according to the slope on tower sites. The type of soil shall also be taken into consideration.

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 species
- No litigation due to removal of vegetation without the necessary permits

6.4 FIRES

The frequent burning of the vegetation will have a high impact on remaining reptile and amphibian 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.

Fire Prevention

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.

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

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