VERTEBRATE ASSESSMENT OF THE PROPOSED EXPANDED ESKOM SERVICE FACILITIES TO STEELPOORT MINES, LIMPOPO PROVINCE

by

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Declaration of Professional Standing and Independence:

We,
Ignatius Lourens Rautenbach (SACNASP # 400300/05)
Alan Charles Kemp (SACNASP # 400059/09)
and Jacobus Casparus Petrus van Wyk (SACNASP # 400062/09),
declare that we:

- hold higher degrees in the biological sciences, which allowed registration by S.A. Council for National Scientific Professions (SACNASP) as Professional Zoologists that sanction us to function independently as specialist scientific consultants;
- declare that as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003 this project was our own work from inception and reflects exclusively our observations and unbiased scientific interpretations, and executed to the best of our abilities;
- abide by the Code of Ethics of the SACNASP;
- are committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas we appreciate opportunities to learn through constructive criticism and debate, we reserve the right to form and hold our own opinions within the constraints of our training, experience and results and therefore will not submit willingly to the interests of other parties or change our statements to appease them;
- are subcontracted as specialist consultants by Nsovo Consulting CC for the project "Vertebrate Assessment of the Proposed Expanded Eskom Service Facilities to Steelpoort Mines, Limpopo Province ", as described in this report;
- have no financial interest in the proposed development other than remuneration for the work performed;
- do not have, and will not have in the future, any vested or conflicting interests in the proposed development;
- undertake to disclose to Nsovo Consulting CC and its client(s) as well as to the competent authority any material information that may have the potential to influence any decisions by the competent authority, as required in terms of the Environmental Impact Assessment Regulations 2006;
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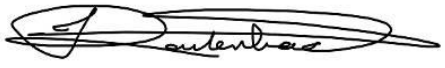

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ABSTRACT

No ecologically sensitive areas or systems that warrant special conservation attention were identified on substation sites 1, 2 or 3, or notionally along the proposed routes of the power lines connecting them. Consequently, with the present level of understanding there is no reason to redirect the proposed routes. It is furthermore not foreseen that any Red Data species in the area will ultimately be displaced or even unduly affected by the intended development.

Of the three sites proposed for the construction of the new substation, Alternative Site 1 is recommended, since it is ecologically already the most transformed. However, no ecological objection will be raised should Sites 2 or 3 be selected. It is anticipated that the floral composition of the power line servitudes will be altered towards one dominated by grass as result of regular bush clearing. It is further foreseen that, for practical reasons, fires will be avoided, resulting in rank grass cover that will support higher population densities of more common pioneering terrestrial species.

It would appear that the proposed routes for the new power lines were as far as possible carefully plotted to avoid sensitive areas (Fig. 13). Within the level of insight in the current phase in the decision-making process, no new sites or routes are offered that will improve on the ESKOM proposals herein evaluated. However, it is suggested that, once ESKOM has made a final decision on a preferred substation site and associated route(s) for power lines, these are subjected to a 'walk-though' scrutiny by floral and vertebrate specialists to finalize the decision-making process.

According to ESKOM's Impact Assessment Criteria, the Significance Ranking is 44, which equates to a ranking of "High". We are of the opinion that this Ranking / Significance over-estimate the projected project's consequences to vertebrate species diversity and population densities.

1. INTRODUCTION

We were engaged by Dimela-Eco CC on behalf of Nsovo Consulting to assess the mammal, bird, reptile, and amphibian species richness of proposed alternative terrains for the new Senakangwedi B substation and associated power lines. These will be part of expansions and additions to ESKOM's energy provision for the present and future chromium, vanadium and aluminium mines in the Steelpoort area. The quality of vertebrate habitats were assessed and used as a mechanism to deduce the likelihood of species occurrences.

During the 22/23 January 2014 site visits arranged for specialists to scrutinize proposed sites, respective personnel from ESKOM's Transmission and Distribution Divisions disagreed on the suitability of the proposed sites for the Senakangwedi B

substation. Although the specialists visited and inspected these sites, it was decided that ESKOM will arrange inter-corporate meetings between the respective divisions to define proposed development sites acceptable to both disciplines.

Another site visit was conducted on 27 March 2014, under the guidance of an ESKOM project manager and other officials. Initially five new prospective sites were introduced, but during this visit it was decided to withdraw two sites as development candidates, thus narrowing specialist scrutiny to three potential development sites. The primary consideration in selecting these was their proximity to future clients. ESKOM officials were clear that specialists are free to propose additional development sites, and especially air their opinions regarding prospective route(s) of incoming power lines.

2. ASSIGNMENT – Protocol

This assignment is in accordance with the 2010 EIA Regulations (No. R. 543-546, Department of Environmental Affairs and Tourism, 18 June 2010) emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

The assignment is interpreted as follows: Compile a scholarly report of the vertebrate fauna of the site, with emphasis on Red Data species that occur or may occur on the alternative sites. In order to compile this, the following had to be done:

2.1 Initial preparations:

- Obtain all relevant maps and information on the natural environment of the concerned area. This includes information on Red Data vertebrate species that may occur in the to-be-affected area.

2.2 Fauna assessment

- Compile lists of the vertebrates that can be expected in the area targeted for development.
- Assess the quantitative and qualitative condition of suitable habitats for the Red Listed vertebrates that may occur in the area.
- Identify the Red Data species that occur (or may occur).
- Express an opinion pertaining to the conservation status of Red Data species habitats.

2.3 General

- Identify and describe particular ecologically sensitive areas.
- Identify problem areas in need of special treatment or management, e.g. bush encroachment, erosion, water pollution, degraded areas, reclamation areas.
- Make recommendations on aspects that should be monitored during development.

3. RATIONALE

Environmental conservation is no longer the prerogative of vocal left-wing 1960s-style green activist NGOs. Instead it is now universally appreciated that a rapidly-growing and more demanding human population is continuing to place exponential stress on the earth's resources with irredeemable costs to ecosystems. It is also recognized that ecosystems are in fact nature's 'engine room' to manufacture fundamental live-support products for plants, animals and humans. Environmental degradation ranges from mega-problems such as global warming, demand for power, land-use practices to indiscriminate use of household chemicals.

The new conservation awareness is settling at all levels ranging from consumers, school curricula, communities to governments. This new consciousness is typified by vigorous debate and empathy, and sometimes by decisiveness (viz. new legislation).

In South Africa, a number of acts (viz. the Environmental Conservation Act [Act 73 of 1989], the National Water Act. [Act No 36 of 1998], The National Heritage Resources Act [No. 25 of 1999], Environmental Conservation Act [Act 73 of 1989], The Constitution of the Republic of South Africa Act [No 108 of 1996], the National Environmental Management Act [NEMA] [Act 107 of 1998 as amended in 2010], the National Heritage Resources Act No. 25 of 1999, the National Environmental Management Biodiversity Act, [Act 10 of 2004], the National Environmental Management: Waste Act [NEM:WA] [Act 59 of 2008], and the Environmental Impact Assessment Regulations: GN R. 543-546 of 18 June 2010, as amended (Gazette No 33306 – Regulation 547)) call developers (and by implication consumers), the scientific community and conservation agencies to task to minimise environmental impact. The conduct of natural scientists is directed by The Natural Scientific Professions Act (Act 27 of 2003). Nowadays a development prerogative is to precede new constructions by a multidisciplinary environmental investigation to assess the conservation costs. This is to ensure that best conservation practices are applied during the planning, construction and operational phases of new developments.

4. SCOPE AND OBJECTIVES OF THE STUDY

- To define vertebrate habitat types present within the collective area of the three proposed developments and the notional connecting power line routes;
- To qualitatively and quantitatively assess the significance of vertebrate habitat components and current general conservation status of the three areas highlighted for the substations and the servitudes for the connecting power lines;
- To identify and comment on ecologically sensitive areas;
- To comment on connectivity with adjacent natural vegetation and habitats;
- To provide a list of mammals, birds, reptiles and frogs that occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the vertebrate species richness of the study site, and

- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.
- To consider and motivate alternative substation locations and power line routes within a zone of < 1 km either side from the proposed routes.

5. STUDY AREA

Mines are substantial consumers of electricity. Presently energy is routed via high-tension 400kV lines to the Senakangwedi Substation just outside Steelpoort on the R555 (24º 48' 46"S; 30º 04' 40"E) (Fig. 4). Here electricity is transformed as per client requirements and distributed to such mines as Tweefontein, Lannex and Tobatse, and the Lion Ferrochrome processing plant. A need for increased power provision has been identified. In order to facilitate the plans to increase service capacity, ESKOM has finalised plans for a new power line from the Senakangwedi Substation westwards along the R555 (Fig. 2), which has already received the prerequisite approval. The new Senakangwedi B substation will be connected to this line for power supply, as well as to a secondary source in case of power interruptions to the first. From the new Senakangwedi B substation, provision lines will be constructed to connect consumers.

Steelpoort is located in the extensive Steelpoort valley (Fig. 4), flanked by the Leole and Steelpoort Mountain ranges, and is halfway between Stofberg and Burgersfort along the R555 road in the Limpopo Province. The valley's summer rainfall environment supports vegetation adapted to its semi-arid conditions (See Section 5 and particularly the sister report dealing with vegetation). All the new ESKOM developments will be on the rather flat savannah plains in the Steelpoort district along the valley of the Steelpoort Basin, with the Steelpoort River to the north-west of the intended developments. Mountainous terrain is avoided (Figs. 1, 3 & 12). The general area targeted for development has for decades been subjected to intense and persistent cattle grazing, which has resulted in widespread encroachment of mostly *Acacia* scrub. As result of the shade effect of the dense scrub, as well as fires and heavy grazing, basal cover is poor in both density and quality. These conditions reflect directly on the conservation status of the terrestrial habitat type. Trees with high and broad canopies are few and far between (if at all), in this instance, having a direct bearing on availability of arboreal (tree-living) mammals and general availability and productivity of insects, fruits and seeds. There are no rupiculous (rock-dwelling) or wetland habitats present on any of the three proposed substation development sites.

At his stage of the planning process, three alternative sites for a new Senakangwedi B substation are under consideration. All three have been selected for their proximity to new consumers. The surface area of such a substation where biota will be replaced is relatively small (*ca*. 600 X 600 meters), which is insignificant relative to that of the district (or that comprised by the six farms to be affected), and modest compared to the sum total of the natural environment to be transformed along the servitudes underneath the new power lines. It thus follows that the environmental impact of the power lines requires more focused consideration.

The new developments will be located on the farms Dwars Rivier 372 KT, Frischgewaagd 359 KT, Kalkfontein 367 KT, Spitskop 333 KT, Steelpoort Park 366

KT and Tweefontein 360 KT. To gain a better understanding of the impact of the developments on the ecological dynamics of the area, these six farms are collectively considered when ascertaining vertebrate species richness and environmental changes.

The region in the vicinity of where the new power installations are envisaged consists of a mosaic of grazing land amongst mixed scrub, compromised woodlands and, to the north-west of the R555, extensive formal and informal urban developments (Fig. 2). Several industrial sites (particular associated with mining) are present in the general area of the envisaged developments. Chromium, vanadium and aluminium mining has progressively taken over some agrarian land for a more economically rewarding but destructive form of land-use.

Nominally, the major portion of the site falls in Mucina and Rutherford's (2006) Sekhukhune Mountain Bushveld vegetation unit, with only the Senakangwedi Substation and a short portion of its connecting power line falling in the Sekhukhune Plains Bushveld. However, the floral composition of these vegetation units has been altered by over-utilization.

Substrates vary between red sandy soils to light clay with some gravel, and are of Gabbro or Norite origins. These soil types are conducive to burrowing. Termitaria have been recorded; moribund termitaria are indicative of certain small mammals, birds and reptiles that are partial to these structures for refuge.

The biotic conservation condition of the area to be subjected to the envisioned development is rated as below average, mostly as result of bush encroachment caused by persistent overgrazing. Authorities normally request an overview of the 500 meters of adjoining properties, which in this instance is similar for the three notional substations and connecting power lines.

Potentially, the construction and operation of the new connecting power lines has a greater potential for causing an ecological imbalance along their servitudes. However, the advice of environmental specialists during the 22/23 January 2014 site meeting was heeded, so that the latest planning phase now avoids invading the fenced conservation area immediately west of Alternative 3 site for the substation, and furthermore, power lines are plotted to avoid hillsides and wherever possible to use existing servitudes for new lines (Fig. 3).

No daytime roosting sites for discerning cave bats have been recorded (viz. deep caves, mine adits, hollow baobab trees). However, whispering bats are likely to find roosting opportunities in the district and commute to hawk *inter alia* over the study site. Vesper bats are certain to find daytime roosting opportunities in structures of civilization.

The physiognomic characters of the three ESKOM identified sites for a new substation are as follows:

ALTERNATIVE 1:

Spatially, this site is defined by the following coordinates measured towards its middle: 24º 55' 06"S' 30º 06' 52"E. The servitude for the powerline for Alternative 1 will cover a distance of 25,935km.

This multi-sided site is roughly 600 X 600 meters in extent, and is situated between the electrical security fence of the mine compound along its western boundary, and the R577 to Kennedy's Vale. To the east of the R577 is a solitary koppie that will not be affected by the intended development. The existing small Uchaba substation is located in an enclave just outside the south-eastern portion of the site (Fig. 5). The site is dominated by a dense stand of tall grass and a sparse stand of scrub, especially towards the north-west (Fig. 6). The typical arid plains woodland of the area has obviously forcibly been removed. The substrate consists of compacted clayish soil hard enough to discourage the construction of tunnels by burrowing animals.

Ecologically, the site is judged to be severely compromised and its conservation rating is therefore considered to be "Very Low".

ALTERNATIVE 2:
Spatially, this site is defined by the following coordinates measured towards its middle: 24º 53' 45"S' 30º 06' 43"E. The powerline servicing this Alternative will be 21,455km in length.

The terrain set aside is less than 600 X 600 meters, and consists of ecologically disturbed and arid plains woodlands that regressed to predominantly isolated *Acacia burkei* trees. In places, dense stands of immature *Aloe castanea* were recorded (Fig. 7). A slight rocky rise fails to offer rupiculous habitat for creatures partial to nooks and crannies amongst rocks. A small portion of the site has been tilled in the past but is now ecologically reclaimed by a dense stand of *Euclea* plants growing on compacted red sandy soil (Fig. 8).

The conservation status of the site is rated as "Low". Although the flora of the site has not been displaced, it has been over-utilized.

ALTERNATIVE 3:
Spatially, this site is defined by the following coordinates measured towards its middle: 24º 52' 51"S' 30º 08' 12"E. The servitude for the powerline for this alternative will be 26,227km.

This site is 750 X 660 meters along it longer sides. It is located immediately east of a protected property that is game-fenced (Fig. 9). The poor basal cover and substandard stand of trees on the proposed site for the new substation (Figs. 10 & 11) is in stark contrast to the well-developed woodland within the protected area (Fig. 12). This proposed development site is heavily grazed by cattle in the traditional manner (Fig. 11); clearly without management considerations.

The conservation status of this site is rated as "Low" and is judged to be in a downward spiral. The terrestrial and arboreal habitats of this site have been over-utilized by cattle grazing and fires.

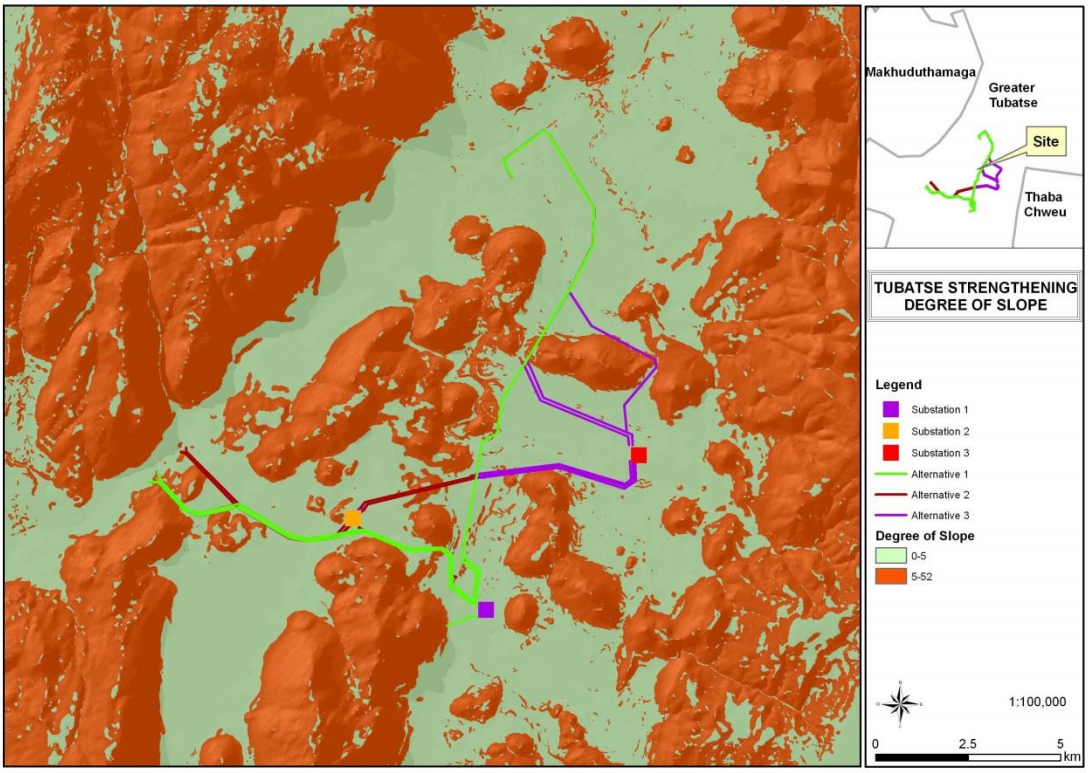

Figure 1: Map of the study area illustrating the fact that ESKOM avoided hillsides by routing the power line along the valley floor with a degree of slope 0 - 5º.

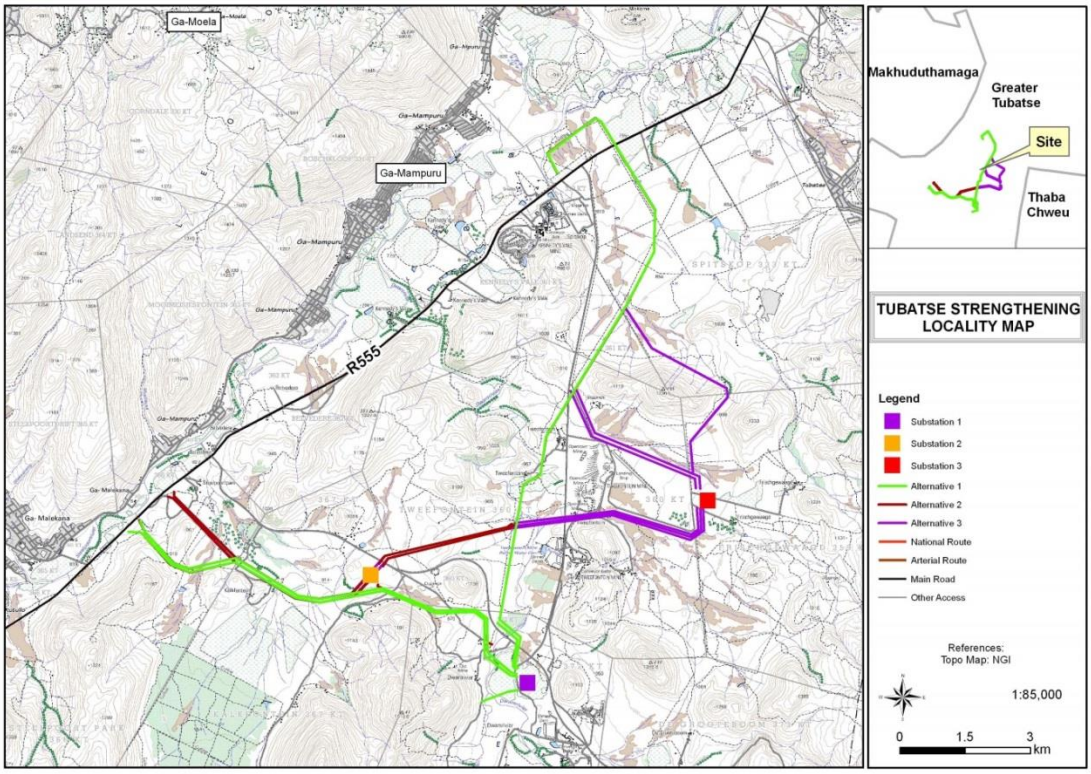

Figure 2: Topocadastral map illustrating the three proposed locations for the new substation, and the associated incoming and outgoing power lines that would connect it to the Senakanwedi Substation and to the end of the new (to be constructed) southwest orientated line parallel to the R555.

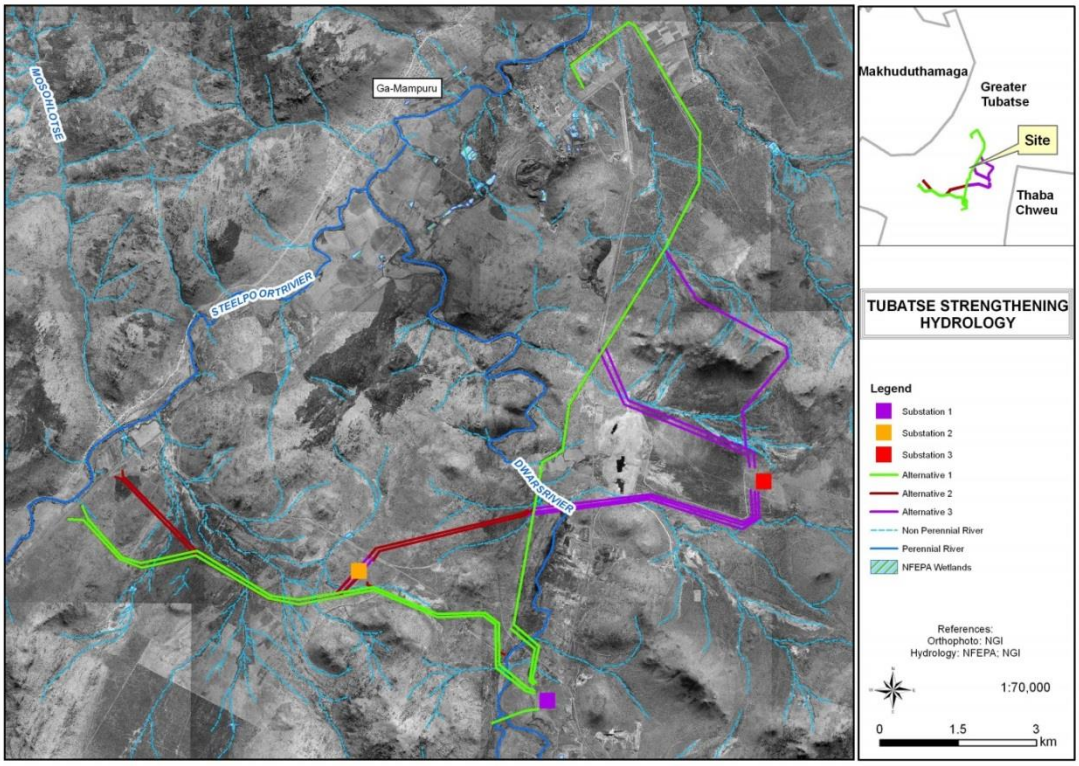

Figure 3: The hydrology of the general area targeted for a new substation on one of three alternative sites, and accompanying high tension power lines. The relief discernable on the map amply illustrate that the power lines are indeed planned to skirt mountains and the conservation area west of the proposed alternative site 3 for the substation.

Figure 4: A westerly view over a part of the existing Senakanwedi Substation where 400kW power is transformed to conform to the desiderata of clients.

Figure 5: The modest Uchuba Substation that is located in the south-eastern corner of the proposed Alternative 1 site for the new substation.

Figure 6: A view southwest over the development area for Alternative 1 site for the new substation. The entire proposed development area has been transformed into tall grassland by deforestation, probably for tilling.

Figure 7: A westerly view over the major portion of the Alternative 2 site for the proposed new substation. Although not transformed by invasive land-use practices, it is concluded that mature trees have been reduced. Dense patches of aloes occur in some areas.

Figure 8: A north-westerly view over the Alternative 2 site. This image portrays a small sector transformed by deforestation of indigenous woodland components and subsequently invaded by low scrub.

Figure 9: A southerly view over the western border of the proposed Alternative 3 site, formed by a game fence and road. The veld within the area protected by the game fence is characterised by good basal cover and taller trees with denser canopies.

Figure 10: A northerly view over the proposed Alternative 3 site. It is clear that the basal cover has been subjected to a recent fire, whereas the stands of trees are not as dense and tall as those within the protected area.

Figure 11: Another northerly view over proposed Alternative 3 development site, reiterating the post-fire condition of the grass cover and the more scattered stands of stunted trees.

Figure 12: A view from the Alternative 3 site over the protected area beyond the game fence, which contrasts its dense and high nature of the more natural woodland, particularly to the south-east, relative to areas impacted by such high-impact land-use practices illustrated in Figs. 8 & 9.

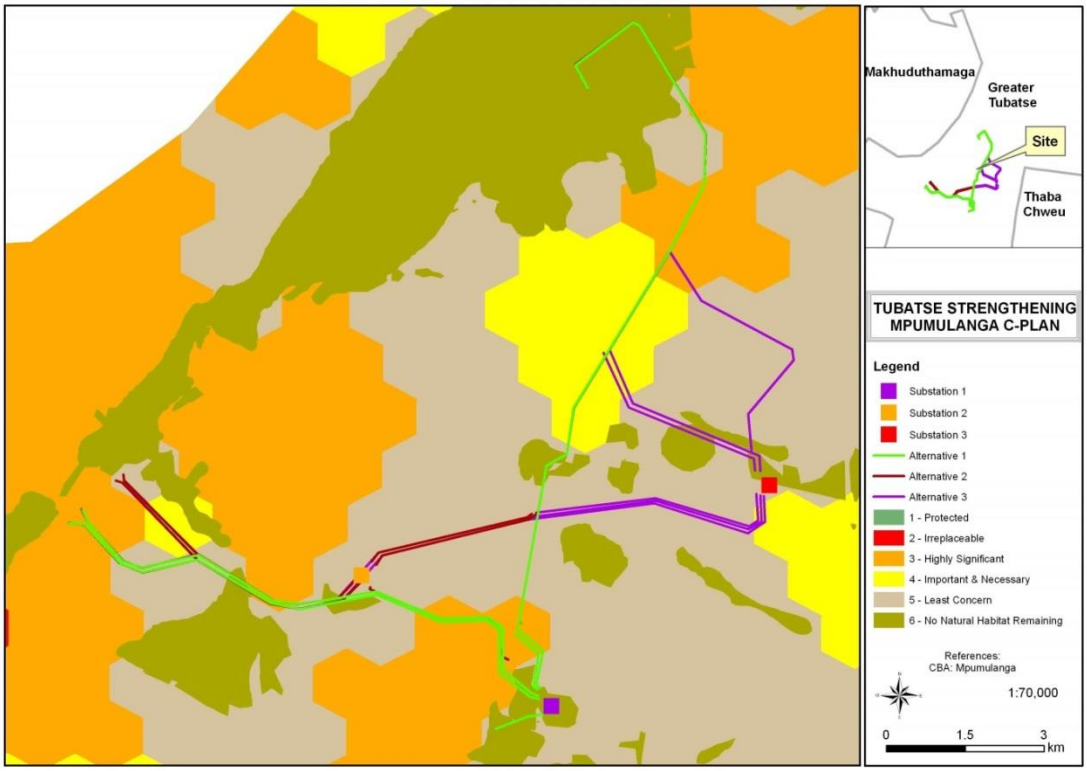

Figure 13: C-Plan of the to-be-affected area overlying the six farms mentioned on page 7, formerly on the Mpumalanga but currently reallocated to the Limpopo Province.

6. METHODS

Site visits were conducted on 22 and 23 January 2014 and again on 27 March 2014. Before and after the field excursions, desk-top studies using Google Earth technology were conducted to gain bird's eye perspectives of the of the topography and the extent of the proposed development on the environment. During the site visits, critical matters pertaining to the assignment were clarified with ESKOM personnel. The three alternative positions for the new substation currently under consideration were eventually investigated. The routes for incoming and outgoing power lines were only released in early April 2014. During the 27 March 2014 site visit the then assumed best-practise routes of the connecting power lines were considered (Figs. 1 & 13).

The species richness of all three higher taxa for the general area south of the R555 on the six farms cited above is derived, and these are then interpreted in view of the planned developments. The study site is hence defined as the three alternative sites proposed for the new substation, as well as the linear terrains to be affected by the power lines serving the selected substation site (Figs. 1, 2 & 3). These overlie the six farms listed on page 7. In order to accommodate migrations, the adjoining areas of the to-be-affected farms were considered when species lists were compiled.

The footprint for the new substation will only be *ca.* 600 X 600 meters but environmental destruction will *in situ* be total. Ecologically, this loss will be insignificant, especially when considered in the context of the extensive rural

character of the surrounding area south of the R555. The impact of incoming and outgoing power lines will be more extensive given their ultimate length. The footprints of pylons will be relatively insignificant. The servitude for the power lines will be linear and although it will not be subject to further development it will be regularly bush-cleared with concomitant collateral ecological damage biased towards a rank grass cover.

Within natural areas the observed and derived presence of vertebrates associated with the recognized habitat types of the study site, were recorded. This was done with due regard to the well recorded global distributions of Southern African vertebrates coupled to the qualitative and quantitative nature of recognized habitats.

One kilometre zones on either side of the proposed power lines were sampled in the field and scrutinized on Google Earth. Should sensitive ecological areas or systems are identified along the proposed routes the lines can be redirected within these zones.

6.1 Field Survey

During the site visit mammals were identified by visual sightings through random transect walks and patrolling with a vehicle. No trapping or mist netting was conducted, as the terms of reference did not require such intensive work. In addition, mammals were also identified by means of spoor, droppings, burrows or roosting sites, and birds from old nests, moulted feathers, food remains, droppings and/or tracks. No field surveys were conducted for avi- or herpetofaunas.

Three criteria were used to gauge the probability of occurrences of vertebrate species on the study site. These include known distribution ranges, habitat preferences and the qualitative and quantitative presences of suitable habitats.

6.2 Desktop Survey

As many mammals and herpetofauna are either secretive, nocturnal, hibernators and/or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of such species based on authoritative tomes, scientific literature, field guides, atlases and data bases. The same approach was used for the desktop study of bird species expected. This can be done with a high level of confidence irrespective of season.

The probability of occurrences of mammal, birds and herpetofauna species was based on their respective geographical distributional ranges and the suitability of on-site habitats. In other words, *high* probability would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common, i.e. normally occurring at high population densities.

Medium probability pertains to a species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable breeding population, as

well as its geographical isolation is also taken into consideration. Species categorized as *medium* normally do not occur at high population numbers, but cannot be deemed as rare.

A *low* probability of occurrence will mean that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some species categorized as *low* are generally deemed to be rare.

6.3 Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of Red Data and/or wetland-associated species such as Juliana's golden mole (*Neamblosomus juliana*), Highveld golden mole (*Amblysomus septentrionalis*), Rough-haired golden mole (*Chrysospalax villosus*), African marsh rat (*Dasymys incomtus*), Angoni vlei rat (*Otomys angoniensis*), Vlei rat (*Otomys irroratus*), White-tailed rat (*Mystromys albicaudatus*), a nember of shrews such as the Forest shrew (*Myosorex varius*), Southern African hedgehog *(Atelerix frontalis), a number of bats such as the* Short-eared trident bat (*Cloeotis percivali*), African clawless otter (*Aonyx capensis*), Spotted-necked otter (*Lutra maculicollis*), Marsh mongoose (*Atilax paludinosus*), Brown hyena (*Parahyaena brunnea*), etc.

Birds: To identify Red Data species likely to occur on the site and to express an opinion regarding their probable occurrence based of specific habitat requirements, based on the latest Red List assessments (BirdLife South Africa 2014, Taylor 2014).

Herpetofauna: The site was assessed for the potential occurrence of Red Data species in Limpopo Province (Alexander and Marais, 2007; Minter, *et al*, 2004, Du Preez & Carruthers, 2009 and Carruthers & Du Preez, 2011), such as: Giant bullfrogs (*Pyxicephalus adspersus*), striped harlequin Snake (*Homoroselaps dorsalis*); Swazi rock snake (*Lamprophis swazicus*); Transvaal quill-snouted snake (*Xenocalamas transvaalensis*); Eastwood's long-tailed seps (*Tetradactylus eastwoodae*); Soutpansberg flat lizard (*Platysaurus relictus*); Woodbush legless skink (*Acontophiops lineatus*); Muller's velvet gecko (*Homopholis mulleri*); Methuen's dwarf gecko (*Lygodactylus methueri*), Natal hinged tortoise (*Kinixys natalensis*) and the Southern African python (*Python natalensis*).

7. RESULTS

7.1 Mammals

Acocks (1988), Mucina and Rutherford (2006), Low & Rebelo (1996), Knobel and Bredenkamp (2006), SANBI & DEAT (2009) discuss the distinguishing plant associations of the study area in broad terms. It should be acknowledged that botanical geographers have made immense strides in defining plant associations (particularly assemblages denoted as vegetation units or veld types), whereas this cannot be said of zoologists. The reason is that vertebrate distributions are not very dependent on the minutiae of plant associations. Rautenbach (1978 & 1982) found that mammal assemblages can at best be correlated with botanically defined biomes, such as those by Low and Rebelo (1996 & 1998), and latterly by Mucina and Rutherford (2006) as well Knobel and Bredenkamp (2006). Hence, although the

former's work has been superseded by the work of the latter two, the definitions of biomes are similar and both remain valid for mammals and are therefore recognized as a reasonable determinant of mammal distribution.

The local occurrences of mammals are, on the other hand, closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of mammal species by evaluating the habitat types within the context of global distribution ranges. Sight records and information from residents or knowledgeable locals audit such deductions.

7.1.1 Mammal Habitat Assessment

Only two major habitat types are present on the study site, i.e. terrestrial and arboreal. Whereas a few weakly-developed seasonal drainage lines are present, these are incapable of sustaining moisture-reliant small mammal species. Here and there slight undulations of the valley floor have rocky protrusions (such as on substation Alternative 2 site), but in this instance these are also too isolated and too modest to provide nooks and crannies for discerning rupiculous mammals.

The terrestrial habitat is by far the most extensive. It is, however, been ecologically over-utilized by grazing and by regular fires and can thus only be rated as in a "Very Low" to "Low" conservation condition.

The arboreal habitat consists of mixed woodland. Trees are generally scattered and tree canopies scant. At places brush encroachment is evident, particularly by sickle bush. This habitat is therefore regarded as sub-optimal and its conservation status cannot be rated higher than "Low".

It is submitted that the poor conservation status of the terrestrial and arboreal habitats of the area in general and the wider study site in particular reflects negatively on both species richness and population densities. Especially endangered species are the first to surrender to environmental disorder.

7.1.2 Observed and Expected Mammal Species Richness

All charismatic mammals (like elephants, buffaloes, rhinos, lions, leopards, hyenas) have long since been extirpated for sport or to favour cattle farming. Mammal species reliant on rupiculous and wetlands / aquatic habitats have *a priori* been omitted from the list of potential occurrences in the district (Table 7.1.4.1).

It is concluded that 58 species of mammals are still part of the present-day mammal species assemblage on the six farms, or within one kilometre either side of the proposed power line route.

The presence of persistent species such as aardvark, porcupines, springhares, baboons, vervet monkeys, warthogs and kudus was not confirmed, but considering the extent of the district and the excellent connectivity, it can be assumed that they are at least occasional vagrants onto the site. Most of the species of the resident diversity (Table 7.1.4.1) are common and widespread (viz. scrub hares,

multimammate mice, pygmy mice, mongooses and others). Many of the species listed in Table 7.1.4.1 are robust (some with strong pioneering capabilities). The reason for their survival success is predominantly seated in their remarkable reproduction potential (viz. multimammate mice species capable of producing ca. 12 pups per litter at intervals of three weeks), and to a lesser extent their reticent and cryptic nature (scrub hares, genets and mongooses). It should, however, be emphasized that the species diversity (species richness super-imposed on population numbers) is low as result of the poor conservation index of the ground cover and the constraining effect of patches of unyielding compacted substrates.

Of note is the failure to record the presence of rodent moles. This ubiquitous rodent is listed as a possible resident, but its low prevalence can probably be related to the compacted nature of the substrate.

It is submitted that kudu, duiker and steenbok still occur at least occasionally on the site since immigration from the district is likely.

The small carnivores (mongooses and genets) are exceptionally reticent in habits, apart from having wide habitat tolerances. As a result they persist in areas in close association of human occupation as long as prey densities remain on sustainable levels.

The listed Vespertilionidae bats showed remarkable adaptivity by expanding their population numbers significantly by capitalizing on the roosting opportunities offered by manmade structures in the vicinity. Versper bats are more tolerate towards roost choice and it is more than likely that small colonies found roosting opportunities in the roofs of building on or near the site. The study site offers no caves or suitable structures answering to the exacting roosting requirements of cave-dwelling bats (Hipposideridae, Rhinolophidae, Nycteridae), but it is likely that they have roosts elsewhere and at times over fly the site.

The species richness is low for such an extensive area. That is ascribed to only two habitats available and a dismal quality of conservation that resulted in limited Red Data species displacements.

7.1.3 Red Listed Mammals

The short-snouted elephant shrew, the single-striped grass mouse, the Bushveld gerbil, the three shrews and the African weasel cited as “DD” in Table 7.1.4.1 are not necessarily endangered. These small mammals have not been adequately studied to provide quantitative field data to accurately assign a conservation ranking, and are thus as a precaution considered as ‘Data Deficient’. Shrews, elephant shrews and weasels function at the apex of the food pyramid, which means that their population numbers are inevitably significantly lower than that of similar-sized herbivorous mammals and especially of their prey species. Because of the diet of these vociferous little insectivores / carnivores, they are furthermore not readily trapped with conventional bait or traps, which may mean that their numbers are under-estimated. Results obtained with drift fences and pitfalls support the latter statement. Bushveld gerbils are inclined to display population explosions during periods of abundant resources and as such serve as a copious layer in the trophic

pyramid of small carnivores and raptors. However, this phenomenon is unlikely on the site discussed here as result of the unyielding nature of the substrate at places, thus unlikely to allow the construction of adequate burrows to house a fast increasing population. Obviously this impairment reflects negatively on the dynamics of the on-site ecological web.

Hedgehogs are 'Near Threatened' as result of interference by humans and their pets. Considering the size of the district it is considered possible that a small population of hedgehogs persist.

It is likely that whispering (or cave-dwelling) bats have found suitable daytime roosts in the district, be that deep caves or manmade structures such as abandoned mine adits. All cave dwelling bats (*Hipposideros*, *Nycteris* and *Rhinolophus* species) enter deep torpor during winter. If they are disturbed in their cave roosts they are forced out of torpor, and during the awakening they burn up accumulated fat serving as fuel for the torpor period. If such an interference is repeated too often these creatures are left without energy sources, either physiological or the absence of prey items for sustenance during winter, resulting is starvation. Hence their precarious conservation status.

It has been shown that brown hyenas roam over extensive areas, quite often close to human habitation. It must hence be accepted that occasional vagrants will roam onto the study site.

The SANBI website for Sekhukhune Mountainlands ecosystem lists Juliana's Golden Mole and Gunning's Golden Mole as regional residents. This claim is fiercely contested, at least on any of the development and adjunct areas *per se*.

No other Red Data or sensitive species are deemed present on the site, either since the site is too disturbed, falls outside the distributional ranges of some species, or does not offer suitable habitat(s).

7.1.4 Mammal Species Richness

Table 7.1.4.1: Mammal diversity. The species observed or deduced to occupy the site. (Systematics and taxonomy as proposed by Bronner et.al. [2003] and Skinner and Chimimba [2005]).

	SCIENTIFIC NAME	ENGLISH NAME
DD*	*Elephantulus brachyrhynchus*	Short-snouted elephant shrew
?	*Orycteropus afer*	Aardvark
√	*Lepus saxatilis*	Scrub hare
√	*Cryptomys hottentotus*	African mole rat
√	*Hystrix africaeaustralis*	Cape porcupine
*	*Pedetes capensis*	Springhare
*	*Paraxerus cepapi*	Tree squirrel
*	*Graphiurus murinus*	Woodland dormouse
*	*Acomys spinosissimus*	Spiny mouse
DD*	*Lemniscomys rosalia*	Single-striped grass mouse

*	*Rhabdomys pumilio*	Four-striped grass mouse
*	*Mus minutoides*	Pygmy mouse
*	*Mastomys natalensis*	Natal multimammate mouse
*	*Mastomys coucha*	Southern multimammate mouse
?	*Thallomys paedulcus*	Acacia rat
?	*Thallomys nigricauda*	Black-tailed tree rat
*	*Aethomys ineptus*	Tete veld rat
DD*	*Gerbilliscus leucogaster*	Bushveld gerbil
*	*Saccostomus campestris*	Pouched mouse
*	*Dendromus melanotis*	Grey pygmy climbing mouse
*	*Dendromus mesomelas*	Brants' climbing mouse
*	*Dendromus mystacalis*	Chestnut climbing mouse
√	*moholi*	South African galago
√	*Papio hamadryas*	Chacma baboon
√	*Cercopithecus pygerythrus*	Vervet monkey
DD*	*Suncus lixus*	Greater dwarf shrew
DD*	*Crocidura cyanea*	Reddish-grey musk shrew
DD*	*Crocidura hirta*	Lesser red musk shrew
NT*	*Atelerix frontalis*	Southern African hedgehog
?	*Epomophorus wahlbergi*	Wahlberg's epauletted fruit bat
*	*Taphozous mauritianus*	Mauritian tomb bat
?	*Sauromys petrophilus*	Flat-headed free-tailed bat
*	*Tadarida aegyptiaca*	Egyptian free-tailed bat
NT?	*Miniopterus schreibersii*	Schreibers' long-fingered bat
*	*Neoromicia capensis*	Cape serotine bat
*	*Scotophilus dinganii*	African yellow house bat
*	*Scotophilus viridis*	Greenish yellow house bat
*	*Nycteris thebaica*	Egyptian slit-faced bat
NT*	*Rhinolophus clivosus*	Geoffroy's horseshoe bat
NT*	*Rhinolophus darlingi*	Darling's horseshoe bat
*	*Rhinolophus simulator*	Bushveld horseshoe bat
DD*	*Hipposideros caffer*	Sundevall's roundleaf bat
?	*Proteles cristatus*	Aardwolf
NT?	*Parahyaena brunnea*	Brown hyena
*	*Felis silvestris*	African wild cat
√	*Genetta genetta*	Small-spotted genet
√	*Genetta tigrina*	SA large-spotted genet
√	*Cynictis penicillata*	Yellow mongoose
√	*Galerella sanguinea*	Slender mongoose
*	*Mungos mungo*	Banded mongoose
√	*Canis mesomelas*	Black-backed jackal
DD?	*Poecilogale albinucha*	African weasel
√	*Ictonyx striatus*	Striped polecat
√	*Phacochoerus africanus*	Common warthog
√	*Tragelaphus strepsiceros*	Kudu
√	*Sylvicapra grimmia*	Common duiker
√	*Raphicerus campestris*	Steenbok
√	*Aepyceros melampus*	Impala

√ ***Definitely there or have a high probability to occur;***
***** *Medium* probability to occur based on ecological and distributional parameters;
? *Low* probability to occur based on ecological and distributional parameters.

Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book/IUCN (World Conservation Union) (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, LR/cd = Lower risk conservation dependent, LR/nt = Lower Risk near threatened, DD = Data Deficient. All other species are deemed of Least Concern.

7.2 Birds

7.2.1 Bird Habitat Assessment

Despite two different vegetation units being identified for the wider study area (Sekhukune Mountain or Plains Bushveld; Mucina & Rutherford 2006), the habitats at all sites considered were on the relatively flat valley floor of the Steelpoort River and had been variously degraded and/or transformed (Figs. 3-11). With vegetation structure rather than composition being predominant in estimating bird species composition, only two broad habitat types were considered, although they are in reality more extremes of a woody-grassy gradient rather than discrete habitat patches. Cognisance was also taken of surrounding, more natural and hillier features that might provide sources of some species (Figs. 3-11).

1. Wooded savanna. The least affected habitats on and around the sites investigated seemed to consist mainly of taller and denser stands of trees and shrubs (Figs. 8,11) than those more affected by burning and livestock grazing (Figs. 9,10) and/or random development (Figs. 3-5, 11). When such habitat was partially degraded, the size and canopy of woody plants decreased and the spacing increased (Figs. 7,9,10), ending up as low scattered shrubs (Figs. 9,10) or, in the more extreme cases, further degradation transforming the habitat to patches of aloes (Fig. 7) or entirely of grassland (Figs. 4,5).
xxxxx
2. Grassland. It seems unlikely that the study area originally supported many areas of exclusively grassland, except maybe along sections of the watercourses, but now patches have appeared where the woody cover has been removed. This seems to have occurred in efforts to encourage grazing (Figs. 9,10), mainly by the use of fire, or maybe where land was cleared for cultivation and has now fallen fallow (Figs. 4,5), in either case the dominance of grasses retained by the burning and grazing pressures where it has not otherwise reverting to more shrubby habitat.

7.2.2 Observed and Expected Bird Species Richness

Out of the 260-268 bird species recorded respectively during the SABAP2 and SABAP1 national bird atlas projects for the 2430CC (Kennedy's Vale) quarter-degree grid cell within which the site occurs, only 197 are expected to occur on and around the study sites(Harrison et al. 1997, www.sabap2.org.za; Table 7.2.2.1). One hundred and seven (54%) species are expected to have a high probability of occurrence, 61 (31%) a medium probability and 29 (15%) a low probability, which indicate the potential of the best habitats but the relatively poor condition of the remainder.

The two different habitat types that I distinguished are expected to support somewhat different species of birds (Table 7.2.2.1). Seventy-four generalist species (38%) are expected to use both habitat types, including the 15 species (7%) classed as aerial feeders and expected to range across all habitats when feeding, while of the remainder 91 species (46%) are expected to prefer the more wooded habitats and 32 species (16%) the more grassy habitats. Based on this total of 273 assessments of predicted habitat preference, wooded bushveld was potentially the richest and most distinctive habitat, predicted to be used by 166 (61%) of the expected species, compared to 107 (39%) for the grassy bushveld. The 15 aerial-feeding species are included within the above analysis, not only for all the habitats they range across when feeding, but also if there are terrestrial habitats that some might use for breeding. Obviously, the wooded habitats are supporting the greater proportion of the expected species.

Table 7.2.2.1: Bird species diversity observed and expected on and around the proposed sites for a substation and connecting power lines for the present and future chromium, vanadium and aluminium mines in the Steelpoort area, Mpulalanga (2430CC). Based on the national list and annotations of Birdlife South Africa (2011), sorted in the order of 'Roberts VII' (Hockey *et al*. 2005), with probability of occurrence and habitat preferences assessed after a site visit on 17 March 2014 and comparison with lists from SABAP 1&2 (Harrison *et al*., 1997; www.sabap2.org).

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence (see 5.4 above)			Preferred Habitats (see 6.2 above)
		RD	S	E	High	Medium	Low	
Coqui Francolin	*Peliperdix coqui*					M		1
Crested Francolin	*Dendroperdix sephaena*				H			1
Shelley's francolin	*Scleroptila shelleyi*						L	2
Natal Spurfowl	*Pternistis natalensis*						L	1
Swainson's Spurfowl	*Pternistis swainsonii*				H			1,2
Common Quail	*Coturnix coturnix*		NBM			M		2
Helmeted Guineafowl	*Numida meleagris*				H			1,2
Kurrichane Buttonquail	*Turnix sylvaticus*					M		2
Greater Honeyguide	*Indicator indicator*					M		1
Lesser Honeyguide	*Indicator minor*					M		1
Brown-backed Honeybird	*Prodotiscus regulus*					M		1
Bennett's Woodpecker	*Campethera bennettii*					M		1
Golden-tailed Woodpecker	*Campethera abingoni*						L	1
Cardinal Woodpecker	*Dendropicos fuscescens*				H			1
Bearded Woodpecker	*Dendropicos namaquus*					M		1
Yellow-fronted Tinkerbird	*Pogoniulus chrysoconus*				H			1
Acacia Pied Barbet	*Tricholaema leucomelas*				H			1
Black-collared Barbet	*Lybius torquatus*					M		1
Crested Barbet	*Trachyphonus vaillantii*					M		1
Southern Yellow-billed Hornbill	*Tockus leucomelas*					M		1,2
African Grey Hornbill	*Tockus nasutus*				H			1
African Hoopoe	*Upupa africana*				H			1,2

Green Wood-hoopoe	*Phoeniculus purpureus*				H			1
Common Scimitarbill	*Rhinopomastus cyanomelas*				H			1
European Roller	*Coracias garrulus*	NT,NT	NBM				L	1,2
Lilac-breasted Roller	*Coracias caudatus*					M		1
Purple Roller	*Coracias naevius*						L	1
Woodland Kingfisher	*Halcyon senegalensis*		BM				L	1
Brown-hooded Kingfisher	*Halcyon albiventris*					M		1
Striped Kingfisher	*Halcyon chelicuti*						L	1
White-fronted Bee-eater	*Merops bullockoides*					M		1,2
Little Bee-eater	*Merops pusillus*				H			1,2
European Bee-eater	*Merops apiaster*		B/NBM			M		2
Speckled Mousebird	*Colius striatus*				H			1
Red-faced Mousebird	*Urocolius indicus*				H			1
Jacobin Cuckoo	*Clamator jacobinus*		BM			M		1
Black Cuckoo	*Cuculus clamosus*		BM		H			1
African Cuckoo	*Cuculus gularis*		BM				L	1
Klaas's Cuckoo	*Chrysococcyx klaas*					M		1
Diderick Cuckoo	*Chrysococcyx caprius*		BM		H			1,2
Burchell's Coucal	*Centropus burchellii*					M		1,2
African Palm-Swift	*Cypsiurus parvus*				H			Aerial
Alpine Swift	*Tachymarptis melba*		BM			M		Aerial
Common Swift	*Apus apus*		NBM			M		Aerial
African Black Swift	*Apus barbatus*				H			Aerial
Little Swift	*Apus affinis*				H			Aerial
White-rumped Swift	*Apus caffer*		BM		H			Aerial
Purple-crested Turaco	*Tauraco porphyreolophus*						L	1
Grey Go-away-bird	*Corythaixoides concolor*				H			1
Barn Owl	*Tyto alba*					M		1,2
African Scops-Owl	*Otus senegalensis*				H			1
Spotted Eagle-Owl	*Bubo africanus*				H			1,2
Pearl-spotted Owlet	*Glaucidium perlatum*				H			1
Fiery-necked Nightjar	*Caprimulgus pectoralis*				H			1,2
Rock Dove	*Columba livia*						L	1
Speckled Pigeon	*Columba guinea*						L	1
Laughing Dove	*Streptopelia senegalensis*				H			1,2
Cape Turtle-Dove	*Streptopelia capicola*				H			1,2
Red-eyed Dove	*Streptopelia semitorquata*					M		1
Emerald-spotted Wood-Dove	*Turtur chalcospilos*				H			1
Namaqua Dove	*Oena capensis*						L	2
African Green-Pigeon	*Treron calvus*					M		1
Spotted Thick-knee	*Burhinus capensis*				H			1,2
Three-banded Plover	*Charadrius tricollaris*					M		2
Blacksmith Lapwing	*Vanellus armatus*						L	2
Crowned Lapwing	*Vanellus coronatus*				H			2
Black-shouldered Kite	*Elanus caeruleus*				H			1,2
Yellow-billed Kite	*Milvus aegyptius*		BM		H			1,2

White-backed Vulture	*Gyps africanus*	EN,EN					L	1,2
Cape Vulture	*Gyps coprotheres*	EN,VU					L	1,2
Black-chested Snake-Eagle	*Circaetus pectoralis*					M		1,2
Brown Snake-Eagle	*Circaetus cinereus*					M		1,2
African Harrier-Hawk	*Polyboroides typus*				H			1
Lizard Buzzard	*Kaupifalco monogrammicus*				H			1
Gabar Goshawk	*Melierax gabar*				H			1,2
Shikra	*Accipiter badius*				H			1
Steppe Buzzard	*Buteo buteo*		NBM		H			1,2
Tawny Eagle	*Aquila rapax*	EN,LC					L	1,2
Wahlberg's Eagle	*Hieraaetus wahlbergi*		BM		H			1,2
Secretarybird	*Sagittarius serpentarius*	VU,VU				M		2
Lesser Kestrel	*Falco naumanni*		NBM				L	2
Rock Kestrel	*Falco rupicolus*					M		1,2
Amur Falcon	*Falco amurensis*		NBM			M		1
Lanner Falcon	*Falco biarmicus*	VU,LC				M		1,2
Black-headed Heron	*Ardea melanocephala*				H			2
Cattle Egret	*Bubulcus ibis*				H			2
Hadeda Ibis	*Bostrychia hagedash*				H			1,2
Abdim's Stork	*Ciconia abdimii*	NT,LC	NBM			M		2
White Stork	*Ciconia ciconia*		NBM				L	2
Black-headed Oriole	*Oriolus larvatus*					M		1
Fork-tailed Drongo	*Dicrurus adsimilis*				H			1
African Paradise-Flycatcher	*Terpsiphone viridis*					M		1
Brubru	*Nilaus afer*				H			1
Black-backed Puffback	*Dryoscopus cubla*				H			1
Black-crowned Tchagra	*Tchagra senegalus*				H			1
Brown-crowned Tchagra	*Tchagra australis*				H			1
Southern Boubou	*Laniarius ferrugineus*					M		1
Crimson-breasted Shrike	*Laniarius atrococcineus*				H			1
Orange-breasted Bush-Shrike	*Chlorophoneus sulfureopectus*				H			1
Grey-headed Bush-Shrike	*Malaconotus blanchoti*				H			1
White-crested Helmet-Shrike	*Prionops plumatus*				H			1
Retz's Helmet-Shrike	*Prionops retzii*						L	1
Chinspot Batis	*Batis molitor*				H			1
Pied crow	*Corvus albus*				H			1,2
White-necked Raven	*Corvus albicollis*						L	2
Red-backed Shrike	*Lanius collurio*		NBM		H			1,2
Lesser Grey Shrike	*Lanius minor*		NBM		H			1,2
Common Fiscal	*Lanius collaris*						L	2
Magpie Shrike	*Corvinella melanoleuca*				H			1
Black Cuckooshrike	*Campephaga flava*					M		1
Grey Penduline-Tit	*Anthoscopus caroli*					M		1
Southern Black Tit	*Parus niger*				H			1
Ashy Tit	*Parus cinerascens*					M		1
Brown-throated Martin	*Riparia paludicola*						L	Aerial

Barn Swallow	*Hirundo rustica*		**NBM**		H			Aerial
Pearl-breasted Swallow	*Hirundo dimidiata*					M		Aerial,1,2
Greater Striped Swallow	*Cecropis cucullata*		**BM**		H			Aerial
Lesser Striped Swallow	*Cecropis abyssinica*		**BM**		H			Aerial
Red-breasted Swallow	*Cecropis semirufa*				H			Aerial
Rock Martin	*Hirundo fuligula*					M		Aerial
Common House-Martin	*Delichon urbicum*		**NBM**			M		Aerial
Black Saw-wing	*Psalidoprocne holomelaena*						L	Aerial
Dark-capped Bulbul	*Pycnonotus tricolor*				H			1
Sombre Greenbul	*Andropadus importunus*					M		1
Long-billed crombec	*Sylvietta rufescens*				H			1
Yellow-bellied Eremomela	*Eremomela icteropygialis*					M		1
Burnt-necked Eremomela	*Eremomela usticollis*				H			1
Broad-tailed Warbler	*Schoenicola brevirostris*						L	2
Olive-tree Warbler	*Hippolais olivetorum*		**NBM**				L	1
Icterine Warbler	*Hippolais icterina*		**NBM**			M		1
Willow Warbler	*Phylloscopus trochilus*		**NBM**		H			1
Arrow-marked Babbler	*Turdoides jardineii*				H			1
Chestnut-vented Tit-Babbler	*Sylvia subcaerulea*				H			1
Garden Warbler	*Sylvia borin*		**NBM**		H			1
Cape White-eye	*Zosterops capensis*			**(*)**	H			1
Rattling Cisticola	*Cisticola chiniana*				H			1,2
Croaking Cisticola	*Cisticola natalensis*						L	2
Neddicky	*Cisticola fulvicapilla*				H			1
Zitting Cisticola	*Cisticola juncidis*					M		2
Tawny-flanked Prinia	*Prinia subflava*				H			1,2
Bar-throated Apalis	*Apalis thoracica*				H			1
Yellow-breasted Apalis	*Apalis flavida*					M		1
Grey-backed Camaroptera	*Camaroptera brevicaudata*				H			1
Rufous-naped Lark	*Mirafra africana*				H			2
Sabota Lark	*Calendulauda sabota*				H			1,2
Groundscraper Thrush	*Psophocichla litsitsirupa*				H			1.2
Kurrichane Thrush	*Turdus libonyanus*				H			1
Marico flycatcher	*Bradornis mariquensis*				H			1,2
Southern Black flycatcher	*Melaenornis pammelaina*				H			1
Fiscal Flycatcher	*Sigelus silens*			**(*)**		M		1,2
Spotted flycatcher	*Muscicapa striata*		**NBM**		H			1
Cape Robin-Chat	*Cossypha caffra*				H			1
White-throated Robin-Chat	*Cossypha humeralis*					M		1
White-browed Scrub-Robin	*Erythropygia leucophrys*				H			1,2
African StoneChat	*Saxicola torquatus*					M		2
Familiar Chat	*Cercomela familiaris*				H			1,2
Mocking cliff-Chat	*Thamnolaea cinnamomeiventris*						L	1
Red-winged Starling	*Onychognathus morio*					M		1,2
Cape Glossy Starling	*Lamprotornis nitens*				H			1,2
Violet-backed Starling	*Cinnyricinclus leucogaster*					M		1

Red-billed Oxpecker	*Buphagus erythrorhynchus*				H			1,2
Amethyst Sunbird	*Chalcomitra amethystina*				H			1,2
White-bellied Sunbird	*Cinnyris talatala*				H			1,2
Marico Sunbird	*Cinnyris mariquensis*					M		1
White-browed Sparrow-Weaver	*Plocepasser mahali*				H			1,2
Lesser Masked-Weaver	*Ploceus intermedius*					M		1
Southern Masked-Weaver	*Ploceus velatus*				H			1,2
Village Weaver	*Ploceus cucullatus*					M		1
Red-billed Quelea	*Quelea quelea*				H			1,2
Southern Red Bishop	*Euplectes orix*					M		2
Fan-tailed Widowbird	*Euplectes axillaris*					M		2
White-winged Widowbird	*Euplectes albonotatus*				H			2
Red-collared Widowbird	*Euplectes ardens*					M		2
Thick-billed Weaver	*Amblyospiza albifrons*					M		1,2
Orange-breasted Waxbill	*Amandava subflava*						L	2
Red-headed Finch	*Amadina erythrocephala*					M		1,2
Cut-throat Finch	*Amadina fasciata*				H			1
Common Waxbill	*Estrilda astrild*				H			2
Violet-eared Waxbill	*Uraeginthus granatinus*					M		1,2
Blue Waxbill	*Uraeginthus angolensis*				H			1,2
Green-winged Pytilia	*Pytilia melba*				H			1
Red-billed Firefinch	*Lagonosticta senegala*					M		1
Jameson's Firefinch	*Lagonosticta rhodopareia*				H			1
Bronze Mannikin	*Spermestes cucullata*				H			1,2
Pin-tailed Whydah	*Vidua macroura*				H			1,2
Long-tailed Paradise-Whydah	*Vidua paradisaea*					M		1,2
Shaft-tailed Whydah	*Vidua regia*						L	1,2
Village Indigobird	*Vidua chalybeata*					M		1
Purple Indigobird	*Vidua purpurascens*						L	1
House Sparrow	*Passer domesticus*		I		H			1,2
Cape Sparrow	*Passer melanurus*				H			1
Southern Grey-headed Sparrow	*Passer diffusus*				H			1
African Pipit	*Anthus cinnamomeus*				H			2
Plain-backed Pipit	*Anthus leucophrys*				H			2
Buffy Pipit	*Anthus vaalensis*					M		2
Yellow-fronted Canary	*Crithagra mozambica*				H			1,2
Black-throated Canary	*Crithagra atrogularis*				H			1,2
Streaky-headed Seedeater	*Crithagra gularis*				H			1,2
Cinnamon-breasted Bunting	*Emberiza tahapisi*				H			2
Cape Bunting	*Emberiza capensis*						L	2
Golden-breasted Bunting	*Emberiza flaviventris*				H			1

Red Status	Status in south Africa (S)	Endemism in South Africa (E)
NA = Not Assessed	BM = breeding migrant	Endemism in South Africa (E) (not southern Africa as in field guides)
LC = Least Concern	NBM = non-breeding migrant	
NT = Near-Threatened	V = vagrant	* = endemic

VU = Vulnerable	I = introduced	
EN = Endangered	R = rare	(*) = near endemic (i.e. ~70% or more of population in RSA)
CR = Critically Endangered	PRB = probable rare breeder	B* = breeding endemic
EX = Extinct Regionally	RB = rare breeder	B(*) = breeding near endemic
NR = Not Recognised	RV = rare visitor	W* = winter endemic
Red Status is from *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland,* Taylor (2014).		

7.2.3 Red Listed Birds

Threatened species are included on the list of expected species if they have been previously recorded and/or are suspected to occur in the study area, regardless of the probability of their occurrence, so that, based on the Precautionary Principle, they are included even if they have a low probability. Based on a preview of the revised Red Data list of South African birds by BirdLife South Africa (BirdLife South Africa 2014, Taylor 2014), only seven species, the Near Threatened **European Roller** and **Abdim's Stork**, the Vulnerable **Secretarybird** and **Lanner Falcon**, and the Endangered **White-backed** and **Cape Vultures**, and **Tawny Eagle**, might make use of the types of habitat on site. The roller, eagle and two vulture species are indeed expected to have a low probability of occurrence, since the quality of the habitat and extent of the site is not in the core of their range or expected to provide important sources of food. The reduced ground cover is expected to be more attractive to the Secretarybird and stork, since they forage on the ground, and the falcon is expected to breed in the surrounding hills and so more likely to visit the area when hunting for its predominantly avian prey, which is why they are expected to have a medium probability of occurrence.

Under the previous listings (Barnes 2000), nine threatened Red Data species were reported for the 2430CC grid cell under SABAP 1, with two additional species more recently reported under SABAP 2. In addition to the species already expected on site above, Half-collared Kingfisher, Black Stork, Lesser Kestrel and Red-billed Oxpecker have been omitted because they are no longer classified as threatened. None of the bird species of special concern listed for the Sekhukune Mountains ecosystem (MP 9) are expected on or around the sites due to unsuitable habitat (Blue Crane, Blue Korhaan, Grey Crowned Crane, Rudd's Lark, Southern Ground Hornbill, Wattled Crane, Yellowbreasted Pipit), except for the Cape Vulture mentioned above.

7.2.4 Bird Species Richness

The habitats on and around these substation and power line sites offer patches of natural bushveld, whose mix of woody and grassy components generally support a high diversity of bird species, probably augmented by others from the different vegetation types nearby on the hiller terrain, and hence the expected list of 197 species. Even the more degraded areas offer more either open or monotonous aspects of the vegetation that attract their own suite of species, but the overall

degraded status of the area is likely to eliminate a number of more specialised species and to only support the existing species at relatively low densities.

Despite the diverse avifauna expected, only seven threatened species are expected, and for none of these is the relatively small footprint of the developments likely to be important in their conservation. Of the proposed developments, the power lines and their servitudes are expected to have the greatest potential impact for birds, providing high perches where none were previously available (which may be used for hunting, roosting or nesting with different ecological effects), and introducing the risk of in-flight collisions (most dangerous for larger species that regular fly lower down, but which can be mitigated). The substation, wherever it is placed, will completely transform any natural habitat but only over a relatively small footprint.

7.3 Herpetofauna

7.3.1 Herpetofauna Habitat Assessment

Occurrences of reptiles and amphibians are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland / aquatic environments. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of specific global distributional ranges.

From a herpetological habitat perspective, it was concluded that two of the four major habitats are present on the three substation sites as well as the routes of the power lines, namely terrestrial and arboreal habitat. Here and there slight undulations of the valley floor have rocky protrusions (such as on substation Alternative 2). Man-made structures simulating a rupiculous habitat are present on alternative 1 of the study site. There are a few weakly-developed seasonal drainage lines present near some of the study sites but these fail to meet the requirements of moisture-reliant reptiles and amphibia.

A few termitaria were recorded. Moribund termitaria normally provide ideal retreats for certain reptiles and amphibians. Accordingly, it is postulated that these are structures are utilized and that reptile and amphibian diversity and population density of the study site is consequently higher. Grasslands on the site were generally burned and heavily grazed in the past and are thus ecologically disturbed (Fig. 11). However, during the time of the site visit the basal cover was lush in some places (Fig. 6, grasslands on Alternative 1 for the substation) due to the good rains earlier and can be expected to provide adequate nourishment and cover for small terrestrial herpetofauna.

The indigenous trees provide ample habitat for arboreal species, while the dead logs provide shelter and food for some herpetofauna. Natural arboreal habitat is comprised of Aloes and indigenous *Acacia* trees in various stages of their development and of sickle bush stands. The larger *Acacia* trees may offer refuge to tree-living reptiles like Tree Agamas and Flap-neck Chameleons.

Except for slight undulations of the valley floor that may have rocky protrusions (such as on substation Alternative 2), no natural rupiculous habitat is present on the three

study sites. Man-made rupiculous habitat exists in the substation at alternative 1. These man-made structures offer nooks and crannies as refuge for common rupiculous herpetofauna.

There are a few weakly-developed seasonal drainage lines westerly to the Steelpoort or Dwars Rivers, but these are outside of the study site (Fig. 3). These drainage lines are incapable of sustaining moisture-reliant herpetofauna with the exception of some frog species. However they may during heavy rains play an important role as distribution corridors from larger permanent water bodies like the Steelpoort River and the Dwars River.

Connectivity with surrounding properties is excellent and good opportunities for migration exist. Some of the surrounding properties are game-fenced, but these do not obstruct herpetofaunal migration.

7.3.2 Observed and Expected Herpetofauna Species Richness

It is concluded that 67 reptile species and 22 frog species occur on the study site (Table 7.3.4.1), but no occurrences were confirmed.

The American red-eared terrapin (*Trachemys scripta elegans*) and the Brahminy blind snake (*Ramphotyphlops braminus*) are the only two feral reptile species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011). Only a few populations are known in South Africa and they are not expected to occur on a site as remote as this.

The species assemblage is typical of what can be expected of an open woodland habitat that is severely disturbed but still with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 7.3.4.1) are fairly common and widespread (viz., Van Son's thick-toed gecko, flap-neck chameleon, brown house snake, mole snake, montane speckled skink, rainbow skink, rock monitor, guttural toad, common caco and red toad).

7.3.3 Red Listed Herpetofauna

The three smaller substation study sites and the servitude routes fall outside the natural range of the striped harlequin snake, Swazi rock snake, Transvaal quill-snouted snake, Eastwood's long-tailed seps, Soutpansberg flat lizard, Woodbush legless skink, Muller's velvet gecko, Methuen's dwarf gecko and Natal hinged tortoise. It is thus concluded that these species are absent on the study site. Eastwood's long-tailed seps is furthermore officially extinct.

The striped harlequin snake has not been recorded on this quarter degree square (TVL Museum records). Few moribund termitaria, where this species is most likely to take refuge, are present on the study site. It is very difficult to confirm whether this cryptic snake is present at any study site, but it is most unlikely to occur on this particular study site.

The study site falls inside the distributional range of the Southern African python. Because of the extensive size and diverse habitats and sub-habitats of the study site

and adjoining areas, the Southern African python can be expected on the study site. According to Bradley (1990), Southern African pythons favour moist, rocky, well-wooded valleys, plantations or bush country and seldom if ever stray far from permanent water (such as the Steelpoort River). The overall study area thus provides suitable habitat for the Southern African python, although the three substation sites are far too small to support a viable population (it is estimated that a single python needs at least a 100ha area to forage). The occasional Southern African Python may thus occasionally venture onto one of the three substation sites or on the ultimately densely vegetated power line servitudes.

No potential breeding site for the giant bullfrog is present on any of the three study sites. The three substation sites consist of sandy soil and are suitable for occurrences when considering feeding and aestivation. It is essential that the soil be suitable for burrowing on a daily basis during the short activity period at the beginning of the rainy season and for deeper retreats during the resting periods. Considering the size of the three smaller substation sites and that no breeding sites for bullfrogs are found on or near any of these or in sample points along the servitude routes, the possibility of giant bullfrogs occurring on the study site is regarded very slim.

It is important to note that in the latest literature (Measey (ed.) 2011 and Carruthers & Du Preez 2011), the giant bullfrog's conservation status in South Africa has officially been upgraded from "Near Threatened" (Minter *et al*, 2004) to "Least Concern".

7.3.4 Herpetofauna Species Richness

Table 7.3.4.1: Reptile and Amphibian diversity. The species observed or deduced to occupy the site. Systematic arrangement and nomenclature according to Branch (1998), Alexander and Marais (2007), Minter, *et.al* (2004) & Du Preez and Carruthers (2009).

	SCIENTIFIC NAME	**ENGLISH NAME**
	CLASS: REPTILIA	**REPTILES**
	Order: TESTUDINES	**TORTOISES & TERRAPINS**
	Family: Pelomedusidae	**Side-necked Terrapins**
?	*Pelomedusa subrufa*	Marsh or Helmeted Terrapin
?	*Pelusios sinuatus*	Serrated Hinged Terrapin
	Family: Testudinidae	**Tortoises**
√	*Stigmochelys pardalis*	Leopard Tortoise
?	*Kinixys lobatsiana*	Lobatse Hinged Tortoise
	Order: SQUAMATA	**SCALE-BEARING REPTILES**
	Suborder:LACERTILIA	**LIZARDS**
	Family: Gekkonidae	**Geckos**
√	*Pachydactylus affinis*	Transvaal Thick-toed or Transvaal Gecko
√	*Pachydactylus vansoni*	Van Son's Thick-toed Gecko
√	*Hemidactylus mabouia*	Moreau's Tropical House Gecko
√	*Lygodactylus capensis*	Cape Dwarf Gecko

	Family: Agamidae	**Agamas**
*	*Agama aculeate*	Ground Agama
?	*Agama atra*	Southern Rock Agama
√	*Acanthocercus atricollis*	Southern Tree Agama
	Family:Chamaeleonidae	**Chameleons**
√	*Chamaeleo dilepis*	Flap-neck Chameleon
	Family:Amphisbaenidae	**Worm Lizards**
?	*Monopeltis infuscate*	Dusky Spade-snouted Worm Lizard
	Family: Scincidae	**Skinks**
√	*Trachylepis capensis*	Cape Skink
√	*Trachylepis punctatissima*	Montane Speckled Skink
√	*Trachylepis varia*	Variable Skink
√	*Trachylepis margaritifer*	Rainbow Skink
√	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink
?	*Acontias gracilicauda*	Thin-tailed Leggless Skink
?	*Scelotes mirus*	Montane Dwarf burrowing Skink
	Family:Lacertidae	**Old World Lizards or Lacertids**
?	*Pedioplanis lineoocellata*	Spotted Sand Lizard
?	*Nucras ornata*	Ornate Sandveld Lizard
?	*Nucras holubi*	Holub's Sandveld Lizard
?	*Ichnotropis squamulosa*	Common Rough-scaled Lizard
	Family: Gerrhosauridae	**Plated Lizards**
?	*Gerhosaurus flavigularis*	Yellow-throated Plated Lizard
	Family: Cordyidae	
?	*Platysaurus orientalis*	Sekukhune Flat Lizard
?	*Cordylus vittifer*	Transvaal Girdled Lizard
	Family: Varanidae	**Monitors**
√	*Varanus albigularis*	Rock Monitor
?	*Varanus niloticus*	Water Monitor
	Suborder: SERPENTES	**SNAKES**
	Family: Typhlopidae	**Blind Snakes**
?	*Typhlops bibronii*	Bibron's Blind Snake
?	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake
	Family: Leptotyphlopidae	**Thread Snakes**
*	*Leptotyphlops conjunctus*	Cape Thread or Worm Snake
*	*Leptotyphlops scutifrons*	Peter's Thread or Worm Snake
	Family: Pythonidae	**Pythons**
Vu√	*Python natalensis*	Southern African Python
	Family: Atractaspididae	**African burrowing Snakes**
?	*Atractapis bibronii*	Southern Stiletto Snake
?	*Aparallactus capensis*	Cape or Black-headed Centipede Eater
*	*Amblyodipsas concolor*	Natal Purple-glossed Snake
?	*Homoroselaps lacteus*	Spotted Harlequin Snake
	Family: Colubridae	**Typical Snakes**
?	*Lycodonomorphus rufulus*	Common Brown Water Snake
√	*Boaedon capensis*	Brown House Snake
	Lamprophis inornatus	Olive House Snake
?	*Lamprophis guttatus*	Spotted House or Rock Snake
?	*Lamprophis aurora*	Aurora House Snake
?	*Lycophidion capense*	Cape or Common Wolf Snake

	Mehelya capensis	Southern or Cape File Snake
?	*Duberria lutrix*	Common Slug Eater
√	*Pseudaspis cana*	Mole Snake
?	*Prosymna sundevallii*	Sundevall's Shovel-snout
√	*Psammophylax rhombeatus*	Spotted Skaapsteker
?	*Psammophylax tritaeniatus*	Striped Skaapsteker
?	*Psammophis angolensis*	Dwarf Whip Snake
√	*Psammophis brevirostris*	Short-snouted Grass or Sand Snake
√	*Psammophis crucifer*	Crossed Whip Snake
?	*Philothamnus natalensis*	Eastern Green Snake
?	*Philothamnus hoplogaster*	Green Water Snake
?	*Philothamnus semivariegatus*	Spotted Bush Snake
√	*Dasypeltis scabra*	Common or Rhombic Egg Eater
*	*Crotaphopeltis hotamboeia*	Herald Snake
*	*Telescopus semiannulatus*	Common Tiger Snake
√	*Dispholidus typus*	Boomslang
	Family: Elapidae	**Cobras, Mambas and Others**
?	*Elapsoidea sunderwallii*	Sundevall's Garter Snake
?	*Aspidelaps sculatus*	Shield Cobra
√	*Naja annulifera*	Snouted Cobra
√	*Naja mossambica*	Mozambique Spitting Cobra
√	*Dendroaspis polylepis*	Black Mamba
	Family: Viperidae	**Adders**
√	*Causus rhombeatus*	Rhombic Night Adder
√	*Brits arietans*	Puff Adder
	CLASS: AMPHIBIA	**AMPHIBIANS**
	Order: ANURA	**FROGS**
	Family: Pipidae	**Clawed Frogs**
?	*Xenopus laevis*	Common Platanna
	Family: Breviceptidae	**Rain Frogs**
*	*Breviceps adspersus*	Bushveld Rain Frog
	Family: Bufonidae	**Toads**
√	*Amietaophrynus gutturalis*	Guttural Toad
?	*Amietaophrynus rangeri*	Raucous Toad
?	*Amietaophrynus maculatus*	Flat-backed Toad
*	*Amietaophrynus garmani*	Eastern Olive Toad
?	*Poyntonophrynus fenoulheti*	Northern Pygmy Toad
√	*Schismaderma carens*	Red Toad
	Family: Hyperoliidae	**Reed Frogs**
?	*Kassina senegalesis*	Bubbling Kassina
?	*Hyperolius mamoratus*	Painted Reed Frog
	Family: Microhylidae	**Rubber Frogs**
?	*Phrynomantis bifasciatus*	Banded Rubber Frog
	Family Phrynobatrachidae	**Puddle Frog**
?	*Phrynobatrachus natalensis*	Snoring Puddle Frog
	Family Ptychadenidae	**Grass Frogs**
?	*Ptychadena porosissima*	Striped Grass Frog
*	*Ptychadena anchietae*	Plain Grass Frog
	Family: Pyxicephalidae	
?	*Amietia angolensis*	Common River Frog

?	*Strongylopus fasciatus*	Striped Stream Frog
?	*Strongylopus grayii*	Clicking Stream Frog
√	*Cocosternum boettgeri*	Boettger's Caco or Common Caco
NT?	*Pyxicephalus adspersus*	Giant Bullfrog
?	*Tomopterna cryptotis*	Tremolo Sand Frog
?	*Tomopterna natalensis*	Natal Sand Frog
?	*Tomopterna tandy*	Tandy's Sand Frog

√ Definitely there or have a *high* probability of occurring;
***** *Medium* probability of occurring based on ecological and distributional parameters;
? *Low* probability of occurring based on ecological and distributional parameters.

Red Data species rankings as defined in Branch, The Conservation Status of South Africa's threatened Reptiles': 89 – 103..In:- G.H.Verdoorn & J. le Roux (editors), 'The State of Southern Africa's Species (2002) and Minter, *et.al*, Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, NT = Near Threatened, DD = Data Deficient. All other species are deemed of Least Concern.

8. FINDINGS AND POTENTIAL IMPLICATIONS

In spite of a rural character interspersed with mining activities, the general area targeted for the construction of a new substation and associated high tension power lines has been ecologically degraded and its conservation status cannot be regarded to be any better than "Low". It is furthermore judged that its ecological health is in a slow downward cycle of disrepair, given the obvious disregard for range management practices. This scenario can be remedied with progressive conservation measures, but that option falls outside the jurisdiction of ESKOM and the expected footprint of its developments. According to the C-plan of Mpumalanga the new substation will be located in an area of "No Concern" or "No Natural Habitat Remaining" (Fig. 13).

From a vertebrate perspective, none of the three substation sites contains ecologically sensitive areas or utilities. Of the three proposed sites for the substation, Site 1 is deemed marginally the best. This opinion is based on the fact that this area has already been transformed into secondary grassland. However, no objection will be raised should Site 2 or 3 is favoured, since the environment on these too has also been compromised. It follows that the lengths of the corridors for the power lines will be of no importance and therefore need not be taken in consideration.

The route(s) of the new power line(s) are planned to be as ecologically benign as possible. Mountain slopes of > 5º are avoided (Fig. 1), no wetlands will be affected and wherever possible servitudes will be shared with other utilities. Figure 13 illustrates that over most of its length the power lines will be in areas of "No Concern" or "No Natural Habitat Remaining", with only small sectors in areas regarded as "Highly Significant" or "Important and Necessary". Of note, however, is our perception that the resolution of the C-plan is very coarse. It is submitted that the new power lines will result in a more noticeable effect on the ecological functioning within the servitude and adjoining areas since deforestation and fire prevention can

be expected to favour rank grasslands that in turn will numerically benefit common terrestrial vertebrates reliant on good cover and nourishment. Although it should be admitted that this scenario would be unnatural it should positively influence the food chain within the home ranges of local raptors and small carnivores.

8.1 Impact Assessment

Species richness: The species richness on the campus of the Senakangwedi B substation will be displaced but that will be no more than a very localized and insignificant event.
Endangered species: Considering the insignificant extent of the substation campus and the relatively narrow and linear servitude co-incidentally transformed towards rank grassland, it is not expected that any extant endangered species' conservation ranking will be put at risk.
Sensitive species and/or areas (Conservation ranking): Other than endangered species, no sensitive species or sensitive areas are flagged.
Habitat(s) quality and extent: Relatively speaking the intended development will not substantially change the reigning ecological character of the general area. The projected swath of grassland in the power line servitudes can be seen as a positive biodiversity development (albeit unnatural).
Impact on species richness and conservation: It is contended that the proposed development will not significantly impact negatively on the species assemblages and conservation of the general area.
Connectivity: Unimpaired by human interference.
Management recommendation: Nil.
General: Nil.

8.2 Potential Impacts

- *Loss of exotic species, declared weeds and invader plants*

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Nil	Nil	Nil	Nil	Nil	Nil

It is an indication of the rural character of the general area targeted for the development that a low incidence of exotic plants is recorded.

- *Loss of ecological sensitive and important vegetation units*

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Nil	Nil	Nil	Nil	Nil	Nil

When expressed as vertebrate habitats, no ecological sensitive or important vegetation units are deemed present on the site. The power lines will be routed as much as possible through environmentally benign areas (Figs. 1 & 13) whereas intrusions into "Important and Necessary" or "Highly Significant" areas are limited and unavoidable.

- Loss of ecosystem function (e.g. reduction in water quality, soil pollution)

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Nil	Nil	Nil	Nil	Nil	Nil

Ecosystem function loss will be limited to the small and subscribed area for the Senakangwedi B substation itself. Ecosystem function along the servitude may become altered but that will not necessary represent a loss.

- Loss of faunal habitat

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Nil	Nil	Nil	Nil	Nil	Nil

Loss of faunal habitat on the substation terrain will be negligible. It is contended that faunal habitat for terrestrial fauna may actually improve once the power lines are operational and servitudes are managed for fires and scrub intrusions.

- Loss/displacement of threatened or protected fauna

Nature of Impact	Extent	Duration	Probability	Intensity	Significance
Nil	Nil	Nil	Nil	Nil	Nil

Potential displacements of Red Data vertebrate species will be limited to the substation terrain and possibly the servitude. That is regarded as insignificant.

8.3 Impact Assessment Criteria

The possible impacts, as described in the next section, were assessed based on the following determination of impact significance:

The Significance of the impact is calculated as follows
Significance = Consequence *(Magnitude+ Duration+ Extent + Reversibility)* **X Probability**
wherein the following meaning applies:

- The *Magnitude* of the impact is quantified as either:
    - Low: Will cause a low impact on the environment;
    - Moderate: Will result in the process continuing but in a controllable manner;
    - High: Will alter processes to the extent that they temporarily cease; and
    - Very High: Will result in complete destruction and permanent cessation of processes.
- *Reversibility/ Replaceability.* This refers to the degree to which the impact can be reversed or the lost resource can be replaced.
- The *Duration* (Exposure) which indicates whether:
    - The impact will be of an immediate nature;
    - The impact will be of a short tem (Between 0-5 years);
    - The impact will be of medium term (between 5-15 years);
    - The impact will be long term (15 and more years); and

- The impact will be permanent.

- The *Probability*: which shall describe the likelihood of impact occurring and will be rated as follows:
  - Extremely remote: Which indicates that the impact will probably not happen;
  - Unusual but Possible: Distinct possibility of occurrence;
  - Can Occur: there is a possibility of occurrence;
  - Almost Certain: Most likely to occur; and
  - Certain/ Inevitable / is currently occurring: Impact will occur despite any preventative measures put in place.

Ranking	Magnitude	Reversibility	Extent	Duration	Probability
5	Very high/ don't know	Irreversible	International	Permanent	Certain/inevitable / already occurring
4	High		National	Long term (impact ceases after operational life of asset	Almost certain
3	Moderate	Reversibility with human intervention	Provincial	Medium term	Can occur
2	Low		Local	Short term	Unusual but possible
1	Minor	Completely reversible	Site bound	Immediate	Extremely remote
0	None		None		None

The Significance (Consequences) of the proposed Steelpoort development on vertebrates is rated as follows:
Impact Significance = *(Magnitude+ Duration+ Extent + Reversibility)* **X Probability**
(2+4+2+3)X4
11X4
44 (=High Significance Ranking – see below)

RANKING	65-100	64-36	35-16	15-5	1-4
SIGNIFICANCE	Very High	High	Moderat	Low	Minor

9. LIMITATIONS, ASSUMPTIONS AND GAPS IN INFORMATION

The vertebrate team has sufficient experience and ample access to information sources to confidently compile lists of biota such as presented herein to support conclusions and suggested mitigation measures based on site visits. In instances where doubt exists, a species is assumed to be a possible occupant (viz. *Suncus* species and pythons); -this approach renders the conclusions to be robust. In instances where the possible occurrence has significant ecological implications, an intensive survey is recommended. In view of the latter, it is highly unlikely whether an intensive survey to augment this site visit will add significantly to the data base, and the additional costs are unlikely to warrant the effort. However, a third investigation phase is recommended, namely a 'walk-through' of the finalized preferred site and finalized power line routes.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bone fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage. The team can thus not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

10. RECOMMENDED MITIGATION MEASURES

Given the fact that no ecologically sensitive area or critical function has been identified, no mitigation measures are offered for the construction phase and immediately after the commissioning of the operational phase. However, it is recommended that personnel involved in bush clearing along the power line servitudes are trained to eradicate alien plants.

11. CONCLUSION

No ecologically sensitive areas or systems that warrant special conservation attention were identified on the Senakangwedi B substation sites 1, 2 or 3, or notionally along the proposed routes of the power lines connecting them. Consequently, with the present level of understanding there is no reason to redirect the proposed routes. It is furthermore not foreseen that any Red Data species in the area will ultimately be displaced or even unduly affected by the intended development.

Of the three sites proposed for the construction of the new substation, Alternative Site 1 is recommended since it is ecologically the most transformed. However, no objection will be raised should Sites 2 or 3 are selected. It is anticipated that the floral composition of the power line servitudes will be altered towards one dominated

by grass as result of regular bush clearing. It is further foreseen that, for practical reasons, fires will be avoided resulting in rank grass cover that will support higher population densities of more common pioneering terrestrial species.

It would appear that the proposed routes for the new power lines were as far as possible carefully plotted to avoid sensitive areas (Figs. 1 & 13). With the level of insight in the current phase in the decision-making process, no new sites or routes are offered that will improve on the ESKOM proposals herein evaluated. However, it is suggested that once ESKOM has made a final decision on a preferred substation site and associated route(s) for power lines, that these are subjected to a 'walk-though' scrutiny by floral and vertebrate specialists to finalize the decision-making process.

According to ESKOM's Impact Assessment Criteria, the Significance Ranking is 44, which equals a ranking of "High". We are of the opinion that this Ranking / Significance over-estimate the projected project's consequences to vertebrate species diversity and population densities.

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13 CURRICULUM VITAE

ABBREVIATED CV

RAUTENBACH, Ignatius Lourens

Identity number	421201 5012 00 5
Gender	Male
Date of birth	1 December 1942
Nationality	South African
Home languages	Afrikaans, fluent in English
Postal address	45 Helgaard Street, Kilner Park, Pretoria, RSA 0186. Tel no +27 12 3334112, Cell 082 3351288 E-mail **naasrauten@mweb.co.za**
Former position	Retired Director: Planning, Northern Flagship Institute
Present position	Consultant – Specialist Environmental Assessments,
Project management	Research –EIAs, writing, woodworking, photo-recording
Qualifications	**B.Sc**. (UP), **T.H.E.D** (Pta TTC), **M.Sc.** (UP), **Ph.D**.(Un. Natal)
Honours	Fellow of the Photographic Society of South Africa Master photographer at club level Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400300/05
Notable Research Contribution	In-depth survey of the Mammals of the Transvaal
Notable Literary Contribution	Rautenbach, Naas & Annalene Rautenbach. 2008. *Photography for Focused Beginners.* 302pp with 250 images. Green Door Studio, Pretoria.
Formal Courses	Computer Literacy, Project Management, Contract Design, Senior Management

Employment history

May 2001 - Present Self-employed, collaborator with du Plessis & Associates [display design and construction], Galago Ventures [environmental impact assessment], technical writing, and photography

April 1999 - August 2001 Director: Planning, Northern Flagship Institution

Jan 1991 - April 1999 Executive Director, Transvaal Museum

July 1967 - Dec 1990 Curator (in charge) of the Division of Mammalogy, Transvaal Museum. Promoted to Specialist Scientist rank as of June 1985

March - June 1967 Research student at the Mammal Research Institute of the Zoology Department, University of Pretoria

July 1966, Nov l966 - Febr 1967 Member of the Smithsonian Institution's field teams as part of the 'African Mammal Project'

1966: Part-time research assistant to Prof. J. Meester, University of Pretoria

1962 - 1965 Temporary assistant during University holidays in the Nematology laboratories, Agricultural Technical Services

1992 - 2001 Founder member and non-executive director of the Board of Trustees of the Museum Park Section 21 Company

1993 - 2001 Founder member and Trustee of the privatised Museums Pension Fund

1997 - 2001 Non-executive director of the Tswaing Section 21 Company

Professional Achievement

Managed a research institute of 125 members of staff. Solicited numerous grants totalling ≥ R1 000 000. Initiated and overseen building programmes of R30 million at Transvaal Museum. Conceptualised and managed 12 display programmes.

Research: Author and co-author of 85 scientific publications re mammalogy in peer reviewed subject journals, 18 Popular articles, 10 Books, and >400 contractual EIA research reports. Extensive field work and laboratory experience in Africa, Europe, USA, Alaska, Brazil and Mexico. B-rated by FRD as scientist of international status

Public Recognition: Public speaking *inter alia* Enrichment Lecturer on board the 6* SS Silver Wind, radio talks, TV appearances

Hobbies

Technical writing, photography, field logistics, biological observations, wood working, cooking, designs.

DETAILS OF SPECIALIST CONSULTANT
Abridged Curriculum Vitae: Alan Charles Kemp

Born: 7 May 1944 in Gweru, Zimbabwe
Citizenship: South African, British
Marital status: Married, 1 daughter, 1 son

Present work address

Naturalists & Nomads, 8 Boekenhout Street, Navors, Pretoria, 0184, South Africa
Tel: (27)(12)804-7637 Fax: (27)(12)804-7637
E-Mail: leadbeateri@gmail.com

or

Naturalists & Nomads, Postnet Suite #38, Private Bag X19, Menlo Park, 0102, South Africa

Qualifications:

1965 B.Sc. Rhodes University, Zoology and Entomology as majors
1966 B.Sc. Hons. Rhodes University, Zoology
1973 Ph.D. Rhodes University, Zoology of Pretoria

Thesis: (Ph.D.) on ecology, behaviour and systematics of hornbills in Kruger National Park

Professional titles:

• Pr.Sci.Nat. South African Council for Natural Scientific Professions (Zoological & Ecological Sciences) **Registration Number 400059/09**

Professional career:

- Field Research Assistant to Prof. Tom J. Cade, Section of Ecology and Systematics, Cornell University, in Kruger National Park, South Africa, Nov 1966 - Apr 1969.
- Department of Birds, Transvaal Museum, Pretoria, June 1969 – August 1999, Head of Department from 1971, rising to Senior Scientist and then Head Curator by 1974.
- Elected Manager, Transvaal Museum, September 1999 – July 2001, until voluntary early retirement.
- Edward Grey Institute of Ornithology, Oxford, December 2001 – April 2002, drafting specialist bird texts for Gale Publishing, USA and Andromeda Press, Oxford, UK.

- Berg ‘n Dal & Pretoria, April 2002 - February 2003, presenting paper and later editorial assistant for book from the Mammal Research Institute, University of Pretoria, *The Kruger Experience: ecology and management of savanna heterogeneity.*
- Bangkok, March – June 2003, drafting research papers for colleague at Mahidol University; touring Laos.
- Pretoria, August-December 2003, editorial assistant for book from the Mammal Research Institute, University of Pretoria, a revision of *The Mammals of Southern Africa.*
- Hala-Bala Wildlife Reserve, January – December 2004, a one-year rainforest study of hornbills, raptors and owls in southern Thailand for their National Center for Genetic Engineering and Biotechnology (BIOTEC).
- Pretoria, January 2005 – July 2007, organizing 4th International Hornbill Conference at Mabula Game Lodge and editing and publishing CD-ROM proceedings, and consulting on ground hornbills to Mabula, University of Cape Town and Endangered Wildlife Trust.
- Bangkok, India, Singapore, Sarawak, September 2006 – April 2008. Assisted colleagues at Mahidol University, Bankok, with compilation of research paper on molecular systematics of hornbills, and travelled to see other Asian habitats and meet with other colleagues.
- Bangkok, December 2011 – April 2012. Assisted colleagues at Mahidol University, Bangkok, with compilation of research papers and co-editing/writing three hornbill books together with colleagues in Singapore.

Academic career:

• Students:

- Completed post graduate students: M.Sc. 14; Ph.D. 5.

• Author of:

- 53 scientific papers or notes in refereed journals
- 48 papers at national and international congresses
- 6 scientific (unpublished) reports on environment and natural resources
- 74 popular scientific papers.
- 18 contributions in books

• Editorial Roles

- Ostrich, African Journal of Ornithology (editor 1973-75).
- Bird Conservation (International (editorial committee 1995-present)

• FRD evaluation category: C2 (Avian Biology and Systematics)

- Associate positions:
  - University of the Witwatersrand, Honourary lecturer, Department of Zoology (1988-2001)
  - Percy FitzPatrick Institute of African Ornithology, University of Cape Town, research associate (2001 – present).
  - Transvaal Museum, Honourary curator (2004-present)
  - Wildlife Conservation Society, New York, wildlife conservation associate (1996-present).

Membership:

- American Ornithologist's Union, Corresponding Fellow (1986- present)
- Birdlife South Africa (previously South African Ornithological Society), Ordinary Member (1969-present), President (1975-1993) of Northern Transvaal (Pretoria) Branch, Honourary Life Member of Pretoria Bird Club (2000 – present).

Special committees:

- International Ornithological Committee of 100, elected member (1989-present).
- Raptor Research Foundation, Grants assessor, Leslie Brown Memorial Fund (1985-present).

Merit awards and research grants:

- 1969-86. Annual research grants from South African Council for Scientific and Industrial Research (CSIR).
- 1974. Chapman Fund Award, American Museum of Natural History, for field research in Borneo and India.
- 1986-98. Annual research award from South African Foundation for Research Development (FRD) as "C"-graded national scientist.
- 1989-95. Team member of FRD Special Programme in Conservation Biology.
- 1989-95. Team member of FRD Special Programme in Molecular Systematics.
- 1991-95. Various private sector sponsorships.
- 1992, 1994. FRD merit award to museum scientists.
- 2000. Special NRF Science Liaison award to attend 10th Pan-African Ornithological Congress, Kampala, Uganda.
- 2001. Special NRF Science Liaison award to attend 3rd International Hornbill Workshop, Phuket, Thailand.
- 2004. One year's support from Thailand's National Center for Genetic Engineering and Biotechnology (BIOTEC) for rainforest survey research.
- 2007-2008. Six month's funding to enable specialist assistance at Department of Microbiology, Mahidol University, Thailand.

Consultant

- Sept-Oct 1994 – Kruger National Park, specialist consultant on ground hornbills to BBC Natural History Unit for filming of Wildife on One programme, 6 weeks.
- Oct-Nov 1996. Kruger National Park, specialist consultant on various birds to David Attenborough for BBC series Life of Birds, 3 weeks.
- Sep-Oct 1998. Kruger National Park, specialist hornbill consultant to National Geographic magazine team, 4 weeks.
- October 2001 – Mala Mala, specialist consulting on ground hornbills for National Geographic film unit, 1 week.
- 2004-present - >15 specialist birding and nature tours as a National South African Tourist Guide, registration number GP0770.
- 2005-present – >30 Biodiversity assessments for a Ramsar wetland proposal, Important Bird Area proposal, and general scoping, G20 and specialist avifaunal EIAs.

ABBREVIATED CV

Van WYK, Jacobus Casparus Petrus (Jaco)

Identity number	680804 5041 08 4
Gender	Male
Date of birth	4 August 1968
Nationality	South African
Home languages	Afrikaans, fluent in English
Postal address	P.O. Box 25085, Monument Park, Pretoria, 0105. Tel +27 12 347 6502, Cell +27 82 410 8871 E-mail **jcpvanwyk@absamail.co.za**
Former position	Biology teacher, Wilgerivier High School, Free State.
Present position	Co-Department Head, Environmental Education & Life Sciences, Waterkloof High School Consultant – Specialist Environmental Assessments, EIAs, writing, photo-recording
Qualifications	**B.Sc**. (U.F.S.) **B.Sc. (Hon.)** (U.F.S.), **H.E.D** (U.O.F.S.), **M.Sc.** (U.F.S.)
Honours	1. Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400062/09 2. Foundation of Research Development bursary holder
Notable Research Contribution	In-depth field study of the giant bullfrog
Notable Activities	Field excursions for learners
Formal Courses Attended	Outcomes Based Education, University of the Witwatersrand (2002) Introductory Evolution (2008) OBE, GET & FET training, 2002-2008, Education Department

Employment history

2000 – Present Co-Department Head for Environmental Education & Life Sciences, Waterkloof High School, Pretoria.

1995 - 1999 Teach biology (Grades 8 – 12) and physics / chemistry (Grades 8 – 9) at the Wilgerivier High School, Free State. Duties include teaching, mid-level management and administration.

July 1994 – Dec 1994 Teaching botany practical tutorials to 1st year students at the Botany & Zoology Department of the Qwa-Qwa campus of the University of Free State, plant collecting, amphibian research

1993 - 1994 Mammal Research Institute research associate on the Prince Edward Islands; topics field biology and population dynamics of invasive alien rodents, three indigenous seals, invertebrate assemblages, censussing king penguin chicks and lesser sheathbills, and marine pollution

1991 - 1993 Laboratory demonstrator for zoological and entomological practical tutorials, and caring for live research material, University of the Free State

1986 - 1990 Wildlife management and eco-guiding, Mt. Everest Game Farm, Harrismith

Professional Achievements Manage the teaching of live sciences at a large high school

	Research: Author and co-author of 40 scientific publications in peer reviewed and popular subject journals, and 5 contractual EIA research reports. Extensive field work and laboratory experience in Africa **Public Recognition:** Public speaking *inter alia* radio talks, TV appearances
Hobbies	Popular writing, travel, marathon running, climbing (viz Kilimanjaro), photography, biological observations, public speaking.