AN ASSESSMENT OF VERTEBRATES TO INFORM THE ENVIRONMENTAL AUTHORIZATION OF THE CONSTRUCTION OF A NEW 400 KV LINE FROM BRAVO POWER STATION TO LULAMISA (KYALAMI) SUBSTATION (Bravo 3)
DEA Ref No - 12/12/20/1094

by

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Declaration of Professional Standing and Independence:

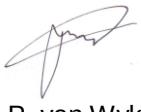
We,

Ignatius Lourens Rautenbach (SACNASP # 400300/05),
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 or unduly benefit them;
- are subcontracted as specialist consultants for the project “An Assessment of Vertebrates to Inform the Environmental Authorization of the Construction of a New 400 KV Line From Bravo Power Station to Lulamisa (Kyalami) Substation (Bravo 3) DEA Ref No - 12/12/20/1094” 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 the consultant 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;
- reserve the right to only transfer our intellectual property contained in this report to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, we recognise that written consent from the client will be required for any of us to release of any part of this report to third parties.
- In addition, remuneration for services provided by us is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.

I.L. Rautenbach



J.C.P. van Wyk

Disclaimer:

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 animal migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. The vertebrate 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. Although the authors exercised due care and diligence in rendering services and preparing documents, they accept no liability, and the client, by receiving this document, indemnifies the authors against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the authors and by the use of this document. This report should therefore be viewed and acted upon with these limitations in mind.

ABSTRACT

The ca. 120km long Bravo 3 Powerline will traverse the Highveld grassland biome in an east – west axis between the Kusile Power Station to the Lulumisa Substation. The line will traverse through six vegetation units as defined by Mucina and Rutherford (2006) (Figure 4). All four major terrestrial and wetland habitats are present, although arboreal is largely non-functional. Land-use to the east is largely grazing. The grasslands represent terrestrial habitat that have conservation status (and concomitant habitat utility) ranging from overgrazed to a fairly well preserved condition. Towards the west land-use is more urban in character with some industries (cf. the Diepsloot WWTF [Figure 42] and quarries [Figures 34 and 40]), but large patches of grassland remain.

All streams and wetlands are red-flagged as sensitive, as per statutory prerequisites.

The line will not impact on its immediate environment since most of the terrain has already been disturbed (or even transformed) and since powerlines themselves are rather benign in spite of their formidable appearance. Mammals (bats excluded), reptiles and frogs are terrestrial and thus not exposed to the risk of collisions with the wires or be electrocuted. It should also be kept in mind that the Bravo 4 line will be within or along the servitude of existing lines and environmental damage (as it may be) is too a large extent factored in by the existing servitude.

The servitude has both a slight positive and negative impact. The natural vegetation along the servitude will be manipulated towards rampant grassland by the removal of woody plants to reduce the risk of 'hot' fires. Generally the grassland in the servitude comprises prime terrestrial habitat by providing refuge and nourishment for herbivorous vertebrates, even though it may be grazed by domestic stock. Grasslands along such a grassy servitude also serve as seedbeds and, when mowed (to further reduce fire risks) the cut grass is left and still functions as habitat and furthermore adds to the organic litter layer.

It is predicted that the powerline and its servitude will not impact on species richness and no Red Data will be displaced

The conservation status of the linear site is rated as **Medium-low** i.e. *Land on which small sections could be considered for conservation but where the area in general has little conservation value* (See Section 5.5 – Assessment Criteria to express conservation status).

The impact of the Bravo 4 Powerline and its servitude is calculated to be 'Moderate'. This ranking is boosted by the high Duration and Regional values and in a sense excessively emphasizes the actual impact on terrestrial vertebrates and their habitats.

No reasonable objection can be raised to oppose the construction of the proposed development.

ASSIGNMENT – Eco-Agent Protocol

Eco-Agent CC Ecological Consultants were subcontracted by Limosella Consultants on behalf of Envirolution Consulting to undertake a mammal, reptile, and amphibian diversity scan along the ca. 120km linear site proposed for the finalised Bravo 3 powerline route. An assessment of vegetation and birds are presented in separate reports. The quality of vertebrate habitats were assessed and used as a mechanism to deduce the likelihood of occurrences. This assignment is in accordance with the 2014 EIA Regulations (No.982, Department of Environmental Affairs and Tourism, 18 June 2010) emanating from Chapter 5 of the National Environmental Management Act, 2004 (Act No. 10 of 2004).

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

1.1 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 area.

1.2 Fauna assessment

Compile lists of the vertebrates that can be expected in the area.
Identify the Red Data species that occur (or may occur) on the site.
Assess the quantitative and qualitative condition of suitable habitat for the Red-Listed vertebrates that may occur in the area.
Assess the likelihood of Red-Listed mammal, reptile and amphibian species being present on the study site.

1.3 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.
Calculate a significance rating for the proposed development.

2. 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 life-support products for plants, animals and humans. Environmental degradation ranges from mega-problems such as global warming, demand for power, land-use practices to smaller-scale issues such as 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 and regulations call developers (and by implication consumers), the scientific community and conservation agencies to task to minimise environmental impact. These include:

The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996),
The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983),
The Environmental Conservation Act, 1989 (Act No. 73 of 1989),
The National Environment Management Act, 1998 (Act No. 107 of 1998) as amended in 2010,
The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004),
The National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004), Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009,
The National Environmental Management: Waste Act [NEM:WA] (Act 59 of 2008),
The National Forests Act, 2006 (Act 84 of 1998 as amended in 2006),
The National Heritage Resources Act, 1999 (Act No. 25 of 1999),
The National Environmental Management: Protected Areas Act (Act 57 0f 2003),
The Mineral and Petroleum Resources Development Act 28 of 2002,
The National Water Act, 1998 (Act No. 36 of 1998), and
The Environmental Impact Assessment Regulations Notice 733 of 2014.

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.

3. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the habitat components and current general conservation status along the route;
- Identify and comment on ecologically sensitive areas or ecological services;
- Comments on connectivity with natural vegetation and habitats on adjacent terrain;
- To provide a list of definite and possible occurrences, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the mammals, reptiles and frogs as well as their habitats within the proposed servitude;
- To investigate the possibility of knock-on effects on the district as result of the development, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.
- Calculate a significance rating for the proposed development.

4. STUDY AREA

4.1 General

The proposed 400KV powerline from the Bravo Substation at the Kusile Powerstation to the southwest of Balmoral) in Mpumalanga to the Lulamisa substation in Kyalami (Gauteng) will convey electricity westwards over flat Highveld plains (Figure 1). This route assessed herein

has been identified as the preferred one from amongst three alternatives as previously presented by ESKOM for scrutiny.

The western section of the route runs through formal and informal residential areas at Diepsloot, Olievenhoutbosch, Blue Valley and Midstream. From there the line will cross primarily agricultural land, small holdings and some mining areas. Pockets of untransformed land are interspersed between the other land uses, particularly in the vicinity of Bronkhorstpruit towards the eastern portion of the line. The proposed Bravo 3line will run along a section of the border of the Diepsloot Nature Reserve and crosses the Rietvlei Nature Reserve, and this adds meaningfully to the species richness presented for the site (Table 1). The Gauteng Conservation Plan (C-Plan v 3.3, GDARD 2014) and the Mpumalanga Biodiversity Sector Plan (Lotter et al, 2015) show the powerline crossing primarily areas with intermediate to low sensitivity although areas classified as Important/Highly Significant, Ecological Support Areas and Important and Necessary are relevant (Figure 2).

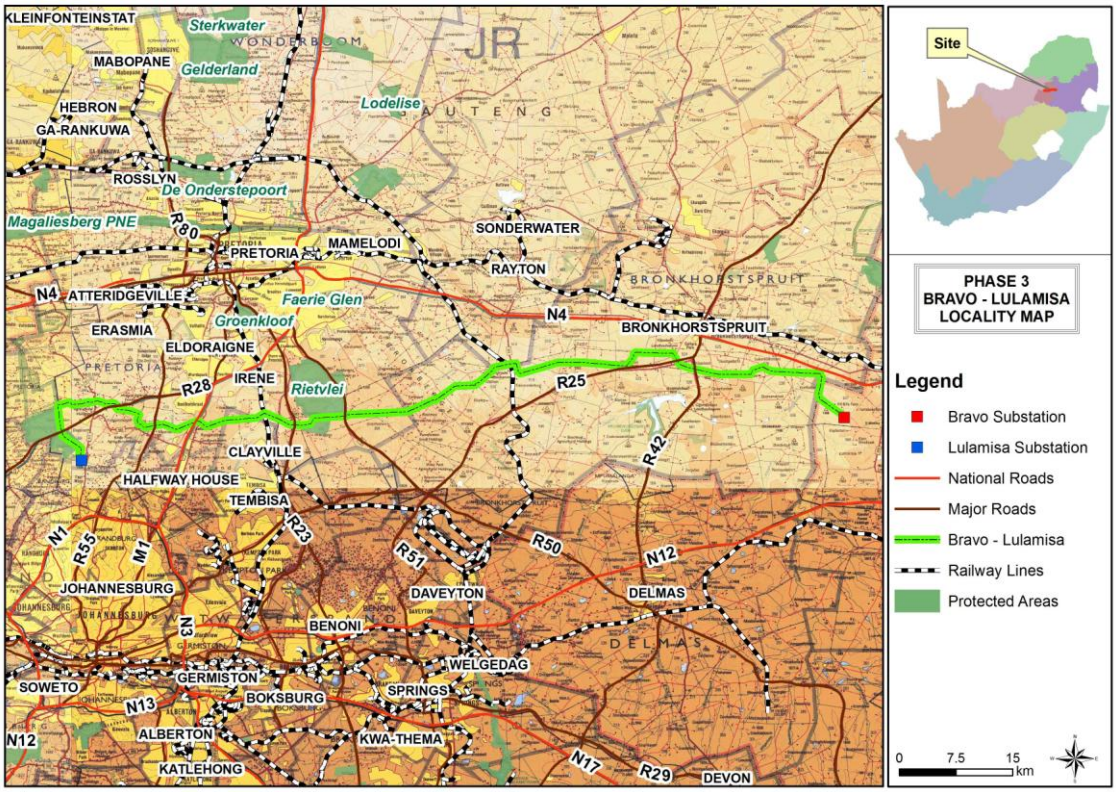


Figure 1: The location of the Bravo 3 powerline.

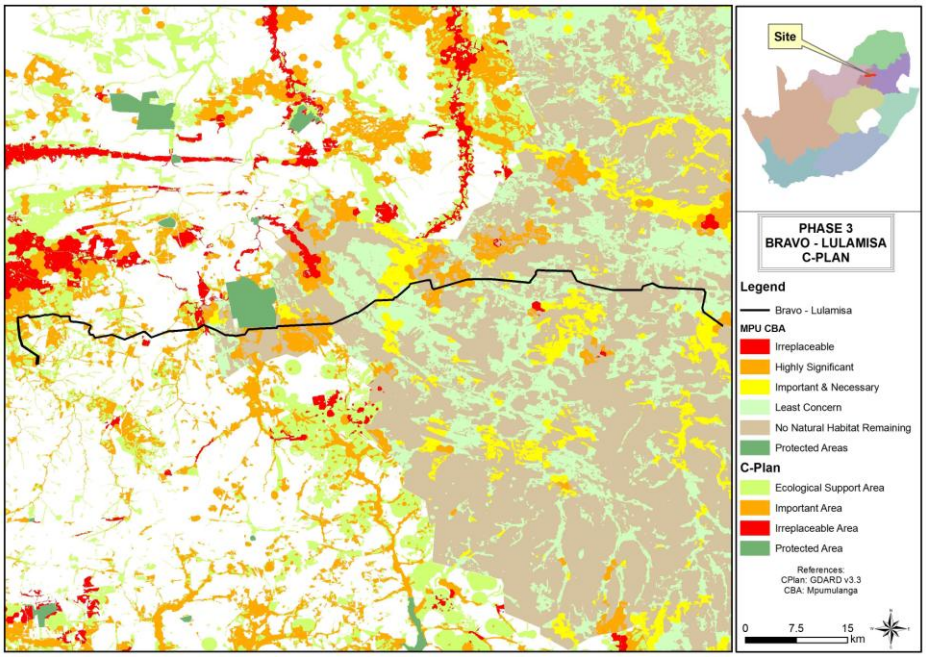


Figure 2: Conservation status of areas traversed by the proposed powerline as classified in Gauteng and Mpumalanga regional datasets.

4.2 Conservation Status

Conservation status as indicated by the National Biodiversity Assessment (2011) shows the line crossing an Endangered area to the west of the line and a Critically Endangered area in the central portion (Figure 3). This, however, was not glaringly obvious during our observations.

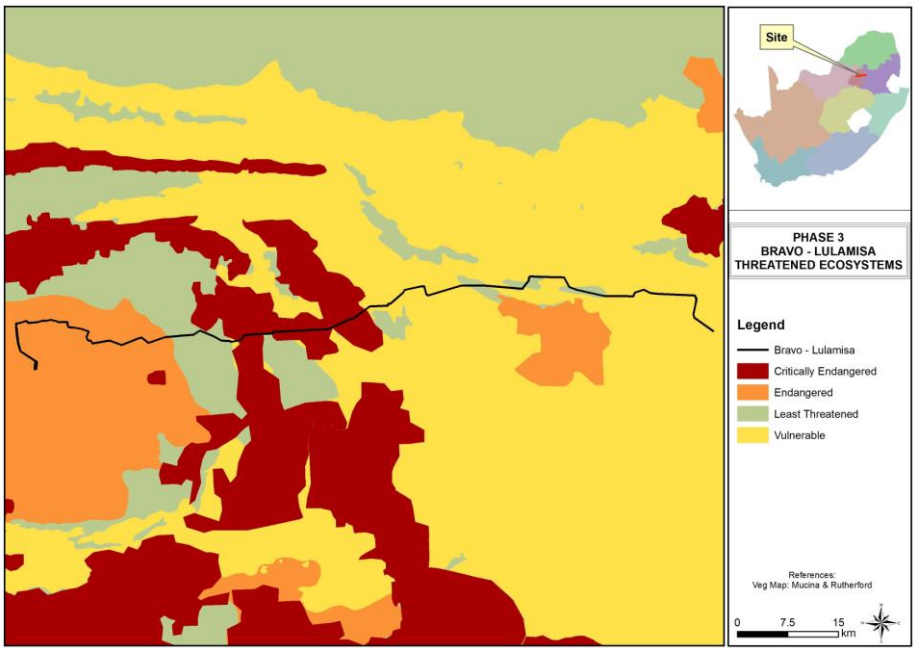


Figure 3: Threatened ecosystems as classified by the 2011 SANBI National Biodiversity Assessment.

4.3 Vegetation Types

The vegetation classification of South Africa (Mucina & Rutherford, 2006) lists the vegetation units crossed by the proposed powerline (Figure 4). These include (from east to west):

- Eastern Highveld Grasland
- Gold Reef Mountain Bushveld
- Andesite Mountain Bushveld,
- Rand Highveld Grassland,
- Carletonville Dolomite Grassland and
- Egoli Granite Grassland,

The accompanying floral report presents a more comprehensive overview of floral units along the site, incorporating all the elements underpinning the above-mentioned vegetation units as well as their conservation status.

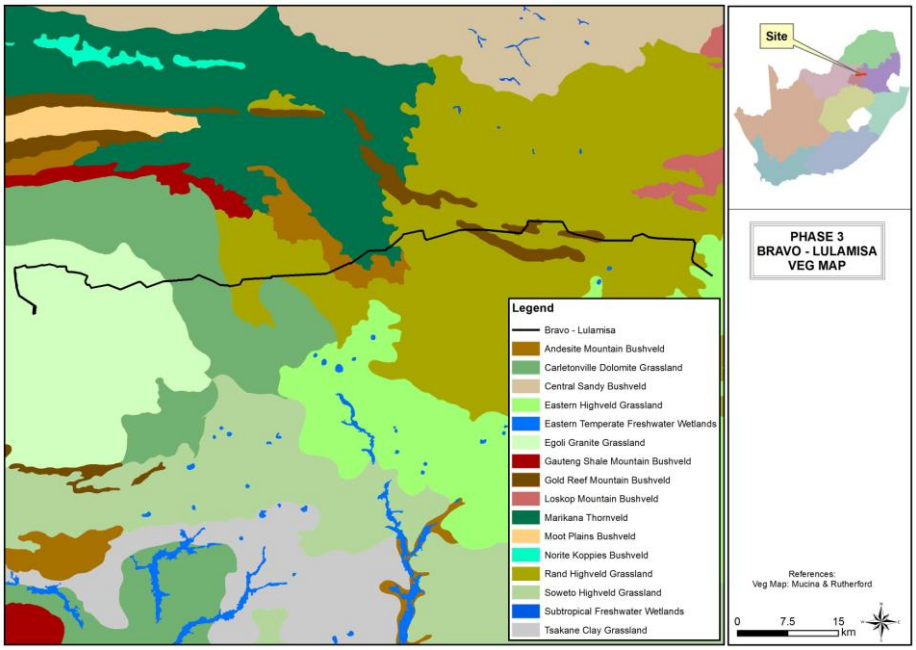


Figure 4: The vegetation classification for the proposed powerline as per the definitions by Mucina and Rutherford (2006).

4.3 Regional Hydrology

Wetland and river systems possibly affected by the proposed powerline are discussed in detail in the accompanying wetland assessment report. In general, the powerline crosses 6 Quarternary Catchments (A21C, A21B, A21A, A23A, B20D and B20F). Several perennial and non-perennial watercourses are crossed by the proposed powerline (Figure 5). Where the Bravo 3 route runs alongside existing lines, it was glaringly obvious that pylons on either side of a stream / wetland are located some distance from this habitat type and that the line does not impinge in any way with riparian and buffer zones.

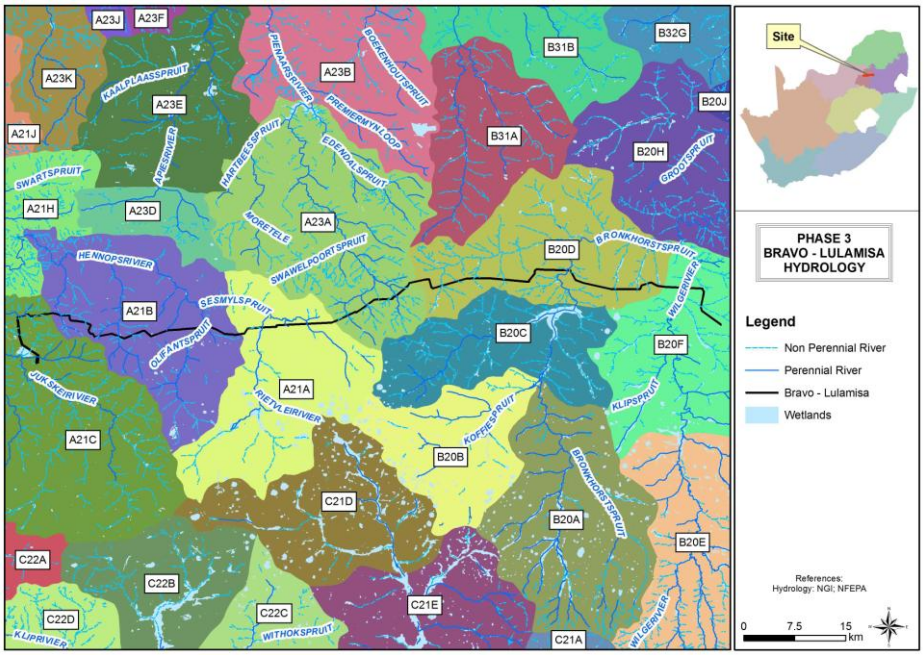


Figure 5: A hydrology map of the site and water features in the proximity of the powerline route.

4.4 Habitat Description

The east to west alignment of the development traverses predominantly through Highveld grassland biome. Even bushveld vegetation units defined by Mucina and Rutherford (2006) (Figure 4) function chiefly as grassland biome (and thus terrestrial habitat) with little (or no) arboreal opportunities for tree-living mammals and reptiles. The route of the new powerline was followed as much as roads allowed, and a global impression was formulated during the three day exercise to allow us to define a conservation ranking for the linear site (See Section 5.6: Significance (Consequence) Rankings). Thirty-nine sampling points were selected where images were taken, specific coordinates were recorded from a Garmin Montana 650, and habitat notes were recorded. These were reworked into images 6 to 44 with the coordinates imbedded in the image and legends describing the salient habitat and spatial characteristics. Collectively Figures 6 to 44 describe the variation in habitat conditions along the Bravo 3 route. Along more than 95% of the entire route the new line will be constructed within or adjacent to the servitude for existing line.

Figure 6: A southerly view of the Kusile Power Plant from the R686. The Bravo 3 transmission line will originate here to convey 400kVa to the Lulamisa Substation ca. 120km to the west. In the foreground grazed grassland with invader Khakibos (*Tagetes minuta*), but nevertheless good refuge for most small terrestrial vertebrates.

Figure 7: A southerly view of Kusile directly on the position of the Bravo 3 line, parallel and in-between existing lines. The plain between this position and Kusile supports primary grassland managed for sustainable grazing by cattle.

Figure 8: The Bravo 3 line will pass overhead at this locality and beyond the spruit will veer south-westerly to Lulamisa. At this position the new line is to be flanked by two lines to the south-west and another to the north-east. Streams crossed by the Bravo 3 supports wetland vegetation which in turn allow the occurrence of moisture-reliant mammals and frogs.

Figure 9: The northern-most of four completed towers for the new line. Here it is bordered by two lines to the north-west and another to the south-east. The intervening land between here and Kusile is grassland well managed for sustainable grazing, and consequently also the conservation of terrestrial habitat. In fact, the grazing quality of the grassland has been strengthened by sowing Smuts Finger seed within the normal stand of *Hyparrhenia hirta* grass.

Figure 10: An easterly view over the mowed servitude for the twin lines. The new line will be constructed to the north (left) of the matching lines. The grazing capacity of the grassy servitude has been increased by manipulating sprouting of Smuts Finger grass; this translates into good terrestrial habitat before cutting.

Figure 11: Here the Bravo 3 line will be along its own servitude some distance from the existing twins. The well-managed grassy plain is grazed by cattle and occupied by typical Highveld grassland mammals and herps.

Figure 12: An easterly view over the grassy servitude for the two exiting lines. The servitude will be broadened to the north to accommodate the Bravo 3 line. Here the pylons are on a slight plateau and the slopes are rocky (the latter not providing suitable habitat for rupiculous vertebrates).

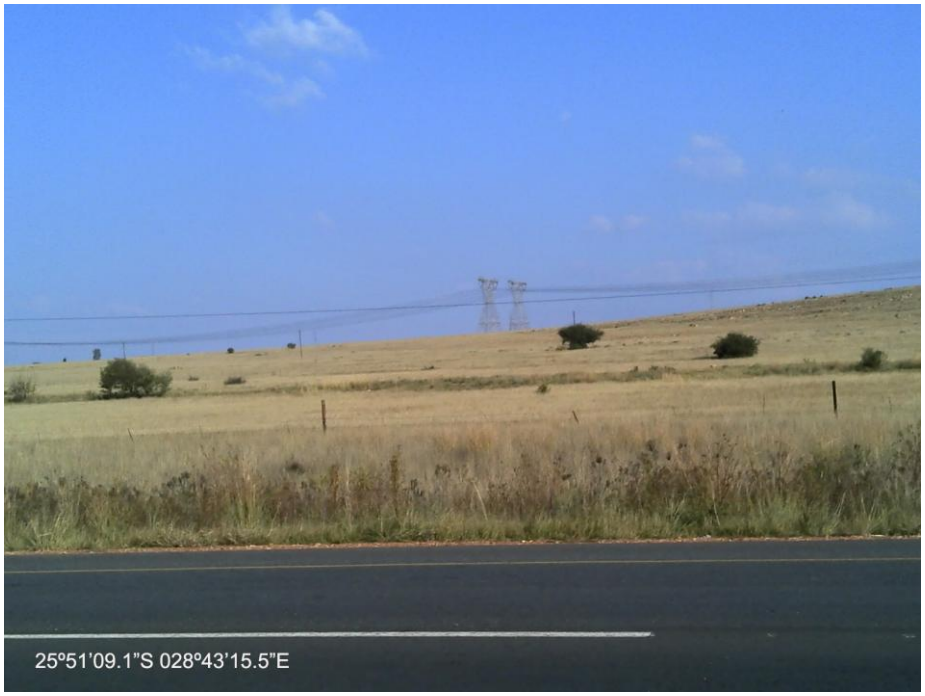


Figure 13: Easterly view where the new line will cross the R25. Rocky grassland with a dense stand of wattles to the south and both irrigated and dry fields to the north.

Figure 14: A view where the line within its own servitude will cross Cathie Street to again join the servitude of the twin lines visible on the horizon to the south. There are irrigated fields to the east, grazing to the west; both offering terrestrial habitat.

Figure 15: Bravo 3 will cross the R513 here, just south of Bronkhorstspruit and will detour away from the servitude of the existing single line to rejoin the servitude of the twin lines visible on the horizon south of the R25. The servitude will pass through lightly-wooded grazing.

Figure 16: View from the same position than Figure 15. Easterly view where the line will cross the R513. Here the servitude Bravo 3 will detour for a short distance from the twin lines to a single line situated to its north. Arboreal habitat is judged suboptimal.

Figure 17: The line will here cross the Vaalbank Road, and will be constructed east (left) of the existing twin lines. The powerline cluster crosses low rocky ridges (rupiculous habitat) located to the south of the point where the photograph was taken. Grazing natural grassland is the predominant land use.

Figure 18: At this location the line will cross the R515 near the T-junction of the R631 with the R515. Planted grazing is the predominant land-use practice in the vicinity. The line detours back to the servitude with twin lines.

Figure 19: The new line will cross the R613 and traverse farmland and grazed grassland. All the trees are all aliens and termitaria in the gravelly substrate abound.

Figure 20: The servitude traverses undeveloped grassland with protruding rocks and subsurface shale. The new line will cross the R964 and R631 at their T-junction. The new line here detours from the existing twin lines to join a single line portrayed in 27.

Figure 21: The new line and the servitude for the twin lines cross the M6 (Graham Road) here, with a southerly view over the Tierpoortrand (Bronberg) with its well-developed rupiculous habitat. The district consists mostly of smallholdings where the environment has mostly been sacrificed for mixed farming and environmental meddling. As elsewhere, the servitude is kept clear of trees and shrubs and tall grass is cut.

Figure 22: The new line will cross the Garsfontein Road (M30) within the servitude of two existing power lines. To either side of the M30 the servitude crosses smallholdings that are responsible for environmental transformation, mostly mixed faming with grazing predominating. Within the servitude woody elements are removed to protect the lines against hot fires.

Figure 23: The new line will cross the R50 at this latitude and longitude with five existing lines. The land crossed on either side of the R50 is devoted to farming, mostly grazing. The basal cover within the servitude is managed to favour grassland.

Figure 24: The new line will be within an existing servitude for five lines that crosses a portion of the Rietvlei Nature Reserve to connect with the Apollo Substation. In the foreground is the feeder-stream for the Marais Dam just inside the reserve.

Figure 25: View east over the R21 where the to-be-constructed Kusile-Lulamisa line, together with the four existing lines, crosses the R21. Trees along the servitude are predominantly wattles. Note the servitude managed towards a rank grassland

Figure 26: On M57 (Goede Hoop Avenue); view easterly over fairly good grassland on undulating Highveld plains within the servitude for four existing high tension powerlines.

Figure 27: Here the new line will cross the M18 (Glen Avenue) between Midstream and Irene. The new line will be within the (?widened) servitude for four existing lines.

Figure 28: Easterly view from the eastern perimeter of Midstream. The new line will here be constructed along a wide servitude for four lines in grassland visible through the blue gum (alien) trees beyond the security fence.

Figure 29: In Midstream suburbia. The new line will run parallel to five existing lines.

Figure 30: The new line running parallel to three existing lines will cross the M37 (Rooihuiskraal Road) at the indicated coordinates, that is between the quarry (to the west) and the Samrand Business Park, with an easterly view over the distant N1. Grassy plains are systematically transformed by construction projects.

Figure 31: The Bravo 3 line will link with the Minerva Substation east of the Olienvenhoutbosch X 26 suburb. A grassland west and north of Minerva consists predominantly of fallow fields with regenerating secondary grasslands, as such regenerating terrestrial habitat.

Figure 32: The new line crosses the N14 and will run parallel and west to the twin lines in a south-westerly direction. The general area has environmentally been disturbed / transformed by industrial developments and smallholding farming. Note the good conservation status of the grassland along the servitude

Figure 33: Along existing twin powerlines in undeveloped grassland.

Figure 34: The new powerline to be constructed south to the existing twin lines will peripherally cross the quarry and its infrastructure in an east-west direction. Apart from disturbance by the quarry, the surrounding area consists of disturbed grassveld.

Figure 35: Northerly view from the R114 over mature grassland, i.e. good terrestrial habitat. The N14 is in the distance. The new line will run parallel to existing lines, in this instance two.

Figure 36: Photographed from 100 meters west the R511 (William Nicol Road) where the new line and the existing twin lines will crisscross in an east-west direction through the Laezonia smallholdings. The smallholdings displaced natural grassveld components.

Figure 37: Traversing Laezonia smallholdings. This type of land-use normally entails environmental meddling and subsequent environmental degradation.

Figure 38: Termitaria are important ecological agents in the major terrestrial habitat type. Photograph made within the wide servitude for the extant twin lines. The new line will be constructed to the north of the twin lines.

Figure 39: Photographed from Pretorius Street where the new line will be built north of the existing twin lines in the Laezonia A.H. Between this location and the westerly crushers the slightly disturbed grassveld is undeveloped within the wide servitude, where passive conservation allowed considerable natural rehabilitation.

Figure 40: The servitude for the two existing lines and the new line make a slight detour to pass the crushers infrastructure, sludge dam, dump and natural drainage depression. Landscape consists of a mosaic of development clusters interspersed with grassland.

Figure 41: In Koedoe Street at the indicated coordinates the new line veers due south along the westerly Diepsloot Waste Water Treatment Facility (WWTF) property. A view over the WWTF's manipulated grassland and irrigated planted pastures, as such presenting habitat only for terrestrial vertebrate species with high ecological tolerances.

Figure 42: Taken just before the new and the existing line veer slightly westwards and then cross the N14 and thereafter the R114 before entering Diepsloot. Photograph made from Falkirk Street.

Figure 43: The new line will be constructed in environmentally highly transformed area along the prominent bridge for a large sewage pipe to the Diepsloot WWTF. Photograph was taken on 18 May 2016 from School Road.

Figure 44: Northerly view from School Road over agricultural developments and disturbed veld with the Lulamisa Substation at 25º 57' 54.46"S 28º 00' 37.68"E in the distance.

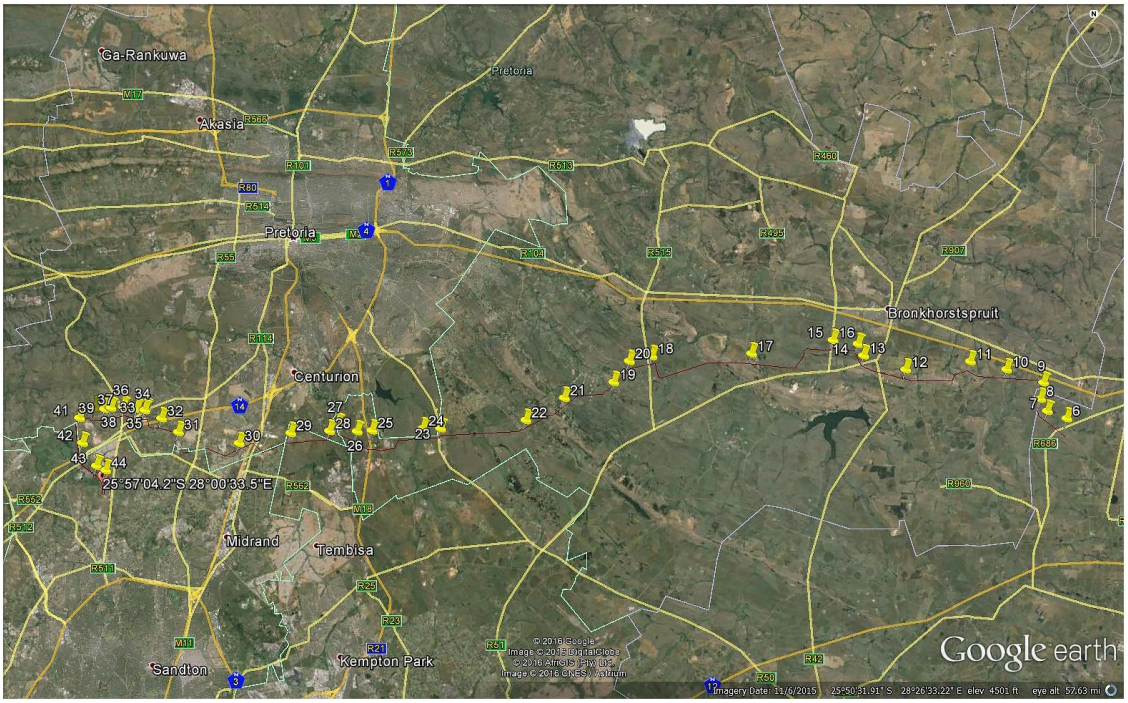


Figure 45: An overview route map superimposed on a Google Earth image of the ca. 120km distance between Kusile and Lulamisa. The numbered yellow pins indicate sampling locations and the numbers refer to the Figures 6 – 44 that describe the environment of that sampling point.

5. METHODS

5.1 Vertebrate Survey

The proposed route of the Bravo 3 route was followed as far as road accessibility allowed. Over a three-day survey (18, 19 and 23 May 2016) 38 localities were selected to note extant habitat and conservation conditions within a radius of 500 meters. A relevant view was photographed, coordinates were noted and later superimposed on the images as presented in Figures 6 – 44.

The presence of mammals, reptiles and amphibians associated with the recognized habitat types of the sampling plot was 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.

5.2 Field Survey

During the site visit mammals, reptiles and amphibians were identified by visual sightings through random transect walks and patrolling with a vehicle. No trapping 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. Locals were interviewed to confirm occurrences or absences of species.

Three criteria were used to gauge the probability of occurrence of vertebrate species on the study site. These include known distribution range, habitat preference and the qualitative and quantitative presence of suitable habitat.

5.3 Desktop Survey

As many vertebrates are either secretive, nocturnal, hibernators, migrators and/or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and data bases. This can be done with a high level of confidence irrespective of season. During the field work phase of the project, this derived list of occurrences is audited.

The probability of occurrences of mammal and herps 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 mammal 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 mammals categorized as low are generally deemed to be rare.

During the analytical phase of the project, locality coordinates were used to dial up Google Earth satellite images of each of the 42 localities. A specific bird's eye view in conjunction with an e-photograph and field notes were used to describe habitat and conservation impressions.

5.4 Specific Requirements

Mammals: During the visit the site was surveyed and assessed for the potential occurrence of such Red Data and/or wetland-associated species 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 member 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.

Herpetofauna: During the visit, the site was surveyed and assessed for the potential occurrence of South African Red Data species in Gauteng and Mpumalanga Provinces (Minter, *et al*, 2004; Alexander & Marais, 2007; Du Preez & Carruthers, 2009 and Bates, *et al*, 2014), such as: Nile Crocodile (*Crocodylus niloticus*); Giant Bullfrog (*Pyxicephalus adspersus*); Plain Stream Frog (*Strongylopus wageri*); Spotted Shovel-Nosed Frog (*Hemisus guttatus*); Whistling Rain Frog (*Breviceps sopranus*); Coppery Grass Lizard (*Chamaeasaura aenea*); Large-Scaled Grass Lizard (*Chamaeasaura macrolepis);* Giant Dragon Lizard (*Smaug giganteus*); Fitzsimons' Flat Lizard (*Platysaurus orientalis fitzimonsi*); Breyer's Long-Tailed Seps (*Tetradactylus breyeri*); Striped Harlequin Snake (*Homoroselaps dorsalis*); and Southern African Python (*Python natalensis*).

5.5 Assessment criteria

A collective conservation status of all habitats along the study site is subjectively assigned to one of five levels of sensitivity, i.e.

High: Ecologically sensitive and valuable land, with high species richness, sensitive ecosystems or Red Data species, that should be conserved and no development allowed.

Medium-high: Land where sections are disturbed but that is still ecologically sensitive to development/disturbance.

Medium: Land on which low-impact development with limited impact on the ecosystem could be considered, but where it is still recommended that certain portions of the natural habitat be maintained as open spaces.

Medium-low: Land on which small sections could be considered for conservation but where the area in general has little conservation value.

Low: Land that has little conservation value and that could be considered for developed with little to no impact on the habitats or fauna.

In some instances the Medium-high, Medium and Medium-high categories are lumped as of Medium Conservation sensitivity. This approach correlates highly with the empirical Significance ratings as defined below.

These correlate with the significance ratings for the development as discussed in Section 5.6, and are tabulated as follows:

RANKING	65-100	64-36	35-16	15-5	1-4
SIGNIFICANCE	Very High	High	Moderate	Low	Minor
CONSERVATION STATUS	High	Medium-high	Medium	Medium-low	Low

5.6 Significance (Consequence) Rankings

The methods and format of the impact tables used in this report are in accordance to the requirements of the 2014 NEMA Regulations. This approach is more empirical and yields quantitative values ideal for comparative purposes. In this instance the total impact of the entire proposed developments is simultaneously calculated. The derived numerical value of the environmental impact will be interpreted in relationship to other conditions and influences (viz. historical events).

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **probability (P)** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The **duration (D)**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **extent (E)**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **magnitude (M)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- the **significance (S)**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;

- the significance rating is calculated by the following formula:

S (significance) = (D + E + M) x (P)

» the **status**, which will be described as either positive, negative or neutral.
» the degree to which the impact can be reversed.
» the degree to which the impact may cause irreplaceable loss of resources.
» the *degree* to which the impact can be *mitigated.*

The numerical value of the calculation is assigned to a significance category.

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

Impacts should be identified for the construction and operational phases of the proposed development. Proposed mitigation measures should be practical and feasible such that they can be realistically implemented by the applicant.

6. RESULTS

A site visit by a mammalogist and a botanist was conducted on 18, 19 and 23 May 2016 from 09:00 - 16:30 hours. The days were warm and sunny with a light wind. A herpetologist made a desktop assessment based on the site visit results that forms part of this report, that ideally should be considered together with the floral report.

6.1 MAMMALS

Acocks (1988), Mucina and Rutherford (2006), Low & Rebelo (1996), Knobel and Bredenkamp (2006) and 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 mammalian distribution.

The local occurrences of mammals are, on the other hand, closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (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.

6.1.1 Mammal Habitat Assessment

All four habitat types are to a greater or lesser extent represented. Terrestrial habitat is by far the most dominant. Rupiculous and wetland habitats are present and judged to support

discerning species narrowly adapted to these habitats. However, arboreal habitat in the form of isolated indigenous trees is present, this is so under-developed that arboreal small mammals are deemed absent (although bushbabies are listed as probably present, but more than likely in garden-variety trees.

6.1.2 Observed and Expected Mammal Species Richness

Species adapted to an arboreal habitat were *a priori* deleted from the list (Table 1) since these were never available. But recently the SA galago managed to expand its distributional range westwards to lush gardens in Gauteng.

It is concluded that 86 species of mammals still manage to persist in rural areas along the 120km to be traversed by the Bravo 3 line. This is a high number for any site, but is an artefact of the extensive area, and particularly the fact that the route passes through the well-stocked Rietvlei game reserve where species like white pangolins, cheetahs, lions, aardwolves, brown hyenas, both species of otters, white rhinos, hippos, buffaloes, zebras, and black wildebeests are protected. There is also ample opportunities for the proven occurrences of Red Data species listed, such as Juliana's golden mole in the Bronberg where the Bravo 3 will cross.

Some of the species of the resident diversity (Table 1) are common and widespread (viz. scrub hares, multimammate mice, pygmy mice, genets, mongooses and others). Many of the species listed in Table 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 [r-selected]), and to a lesser extent their reticent and cryptic nature (scrub hares, genets and mongooses).

The listed vespertilionid bats showed remarkable adaptability by expanding their distributional ranges and population numbers significantly by capitalizing on the roosting opportunities offered by manmade structures; in this instance in the houses and structures in the vicinity. Vesper bats are more tolerant towards roost opportunities and it is more than likely that small colonies found roosting opportunities in the roofs of buildings near the study site. It is not known whether the study site offers caves or suitable structures answering to the exacting roosting requirements of cave-dwelling bats (Hipposideridae, Rhinolophidae, Nycteridae), but it is likely that these have roosts closeby and at times commute to wetlands along the route to hawk for aerial invertebrates and feeding patches formed by insect swarms rising over water during summer sunsets.

Table 1: Mammal diversity. The species observed or deduced to occupy the site. (Systematics and taxonomy as proposed by Bronner et.al [2003], Skinner & Chimimba [2005], Apps [2012] and Stuart & Stuart [2015]).

	SCIENTIFIC NAME	ENGLISH NAME
	Order Afrosoricida	
	Family Chrysochloridae	
CE√	*Neamblysomus julianae*	Juliana's golden mole
	Order Macroscelididae	
	Family Macroscelididae	

√	*Elephantulus myurus*	Eastern rock elephant shrew
	Order Tubulidentata	
	Family Orycteropodidae	
√	*Orycteropus afer*	Aardvark
	Order Hyracoidea	
	Family Procaviidae	
*	*Procavia capensis*	Rock dassie
	Order Lagomorpha	
	Family Leporidae	
√	*Lepus saxatilis*	Scrub hare
√	*Pronolagus randensis*	Jameson's red rock rabbit
	Order Rodentia	
	Family Bathyergidae	
√	*Cryptomys hottentotus*	African mole rat
	Family Hystricidae	
√	*Hystrix africaeaustralis*	Cape porcupine
	Family Tryonomyidae	
√	*Thryonomys swinderianus*	Greater cane rat
	Family Pedetidae	
√	*Pedetes capensis*	Springhare
	Family Sciuridae	
√	*Xerus inaurus*	South African ground squirrel
	Family Myoxidae	
DD*	*Graphiurus platyops*	Rock dormouse
?	*Graphiurus murinus*	Woodland dormouse
	Family Muridae	
√	*Rhabdomys pumilio*	Four-striped grass mouse
NT*	*Dasymys incomtus*	African marsh rat
√	*Mus minutoides*	Pygmy mouse
√	*Mastomys natalensis*	Natal multimammate mouse
√	*Mastomys coucha*	Southern multimammate mouse
√	*Aethomys ineptus*	Tete veld rat
√	*Aethomys namaquensis*	Namaqua rock mouse
√	*Otomys angoniensis*	Angoni vlei rat
√	*Otomys irroratus*	Vlei rat
√	*Gerbilliscus brantsii*	Highveld gerbil
√	*Saccostomus campestris*	Pouched mouse
√	*Dendromus melanotis*	Grey pygmy climbing mouse
√	*Dendromus mesomelas*	Brants' climbing mouse
√	*Dendromus mystacalis*	Chestnut climbing mouse
	Order Primates	
	Family Galagidae	
*	*Galago moholi*	South African galago
	Family Cercopithecidae	
?	*Papio hamadryas*	Chacma baboon
*	*Cercopithecus pygerythrus*	Vervet monkey
	Order Eulipotypha	
	Family Soricidae	
DD√	*Myosorex varius*	Forest shrew
DD√	*Suncus lixus*	Greater dwarf shrew
DD√	*Suncus infinitesimus*	Least dwarf shrew
DD√	*Crocidura cyanea*	Reddish-grey musk shrew

DD√	*Crocidura hirta*	Lesser red musk shrew
	Family Erinaceidae	
NT√	*Atelerix frontalis*	Southern African hedgehog
	Order Chiroptera	
	Family Pteropidae	
√	*Epomophorus wahlbergi*	Wahlberg's epauletted fruit bat
	Family Embalonuridae	
*	*Taphozous mauritianus*	Mauritian tomb bat
	Family Molossidae	
*	*Sauromys petrophilus*	Flat-headed free-tailed bat
√	*Tadarida aegyptiaca*	Egyptian free-tailed bat
	Family Vespertilionidae	
NT?	*Miniopterus schreibersii*	Schreibers' long-fingered bat
NT?	*Myotis welwitchii*	Welwitsch's hairy bat
NT?	*Myotis tricolor*	Temminck's hairy bat
√	*Neoromicia capensis*	Cape serotine bat
√	*Scotophilus dinganii*	African yellow house bat
√	*Scotophilus viridis*	Greenish yellow house bat
	Family Nycteridae	
?	*Nycteris thebaica*	Egyptian slit-faced bat
	Family Rhinolophidae	
NT?	*Rhinolophus clivosus*	Geoffroy's horseshoe bat
	Family Hipposideridae	
DD?	*Hipposideros caffer*	Sundevall's roundleaf bat
	Order Pholidota	
	Family Manidae	
V*	*Manis temminckii*	Ground pangolin
	Order Carnivora	
	Family Hyaenidae	
√	*Proteles cristatus*	Aardwolf
NT*	*Parahyaena brunnea*	Brown hyena
	Family Felidae	
Vu*	*Acinonyx jubatus*	Cheetah
*	*Panthera pardus*	Leopard
√	*Panthera leo*	Lion
?	*Caracal caracal*	Caracal
√	*Felis silvestris*	African wild cat
	Family Viverridae	
√	*Civettictis civetta*	African civet
√	*Genetta genetta*	Small-spotted genet
√	*Genetta tigrina*	SA large-spotted genet
	Family Herpestidae	
√	*Cynictis penicillata*	Yellow mongoose
√	*Galerella sanguinea*	Slender mongoose
√	*Ichneumia albicauda*	White-tailed mongoose
√	*Atilax paludinosus*	Marsh mongoose
	Family Canidae	
√	*Canis mesomelas*	Black-backed jackal
	Family Mustelidae	
√	*Aonyx capensis*	African clawless otter
NT√	*Lutra maculicollis*	Spotted-necked otter
DD*	*Poecilogale albinucha*	African weasel

√	*Ictonyx striatus*	Striped polecat
	Order Perissodactyla	
	Family Rhinocerotidae	
√	*Ceratotherium simum*	White rhinoceros
	Family Equidae	
√	*Equus quagga*	Plains zebra
	Order Suiformes	
	Family Suidae	
√	*Potamochoerus larvatus*	Bushpig
√	*Phacochoerus africanus*	Common warthog
	Order Whippomorpha	
	Family Hippopotamidae	
√	*Hippopotamus amphibious*	Hippopotamus
	Order Ruminanta	
	Family Bovidae	
√	*Syncerus caffer*	African buffalo
√	*Tragelaphus strepsiceros*	Kudu
√	*Tragelaphus oryx*	Eland
√	*Connochaetes gnou*	Black wildebeest
√	*Alcelaphus buselaphus*	Red hartebeest
√	*Damaliscus pygargus phillipsi*	Blesbok
√	*Sylvicapra grimmia*	Common duiker
√	*Redunca fulvorufula*	Mountain reedbuck
√	*Kobus ellipsiprymnus*	Waterbuck
√	*Pelea capreolus*	Grey rhebuck
√	*Antidorcas marsupialis*	Springbok
√	*Raphicerus campestris*	Steenbok

√ 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.

6.1.3 Red Listed Mammal Species Identified:

-By the Scientific Community

The African marsh rat is narrowly dependent on rank semi-aquatic vegetation in riparian zones. This type of floral assemblage is almost always heavily grazed by cattle and thus reduced in effectiveness. However, it is contended that along the 120km trajectory some marsh rats survived, particularly in the Rietvlei Nature Reserve.

The two musk shrew species (*Crocidura* spp.) the two dwarf shrews (*Suncus* spp.) as well as the African weasel (*Poecilogale*) cited as 'DD' in Table 1 are not necessarily endangered. These have not been adequately studied to provide quantitative field data for accurately

assigning a conservation ranking. As a precaution, they are thus considered as 'Data Deficient'. Shrews and the weasel exist 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 smaller prey species. Because of the diet of these ferocious little insectivores / carnivores, they are furthermore not readily trapped with conventional bait or traps which may mean that their numbers are under-estimated. Good capture results for shrews obtained with drift fences and pitfalls support the latter statement.

Hedgehogs are 'Near Threatened' as result of interference by humans and their pets. Under natural conditions the passive defence mechanisms of these rather docile insectivores are sufficient to maintain breeding populations in a healthy condition. Considering the size of the district and connectivity in all directions it is reported that a small population of hedgehogs persist.

It is unclear why the two hairy bat species (*Myotis*) are regarded to be 'Near Threatened'. Cave-dwelling bats (*Miniopterus*, *Rhinolophus*, *Nycteris* and *Hipposideros* spp.) are obligatory hibernators. In order to survive harsh Highveld winters in cold and moist overwintering caves, fat reserves are accumulated and used as 'fuel' when surviving at much-reduced physiological processes (one heart-beat per minute). Should hibernating bats be disturbed, they use fat reserves at an accelerated physiological rate in order to flee. It follows that should they are often disturbed while hibernating (such as by cave explorers), bats run out of fuel before the advent of summer and abundant invertebrate prey, and succumb from lack of 'fuel'.

Cheetah numbers decline for a number of reasons, but chiefly this gangly Red Data status relates to overhunting and poor reproduction capacity. Recent breakthrough in captive breeding and high restocking prices will undoubtedly slow (or even reverse) the falling numbers of cheetahs. Pangolins are sought-after prey to make traditional medicines and thus carry a high cash premium. The Red Data ranking for the piscivorous spotted-necked otters most likely relates to a general drop in water quality and concomitantly declining fish populations.

Brown hyenas have been prosecuted to the point that they are deemed as "Near Threatened". It is amazing how the fallacy of brown hyenas is 'sheep killers' persist. Brown hyenas are known to range far and wide, and it must therefore be accepted that vagrants from the extensive district occasionally visit the study site. It is a recorded occupant of the Rietvlei Nature Reserve, as is the cheetah.

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).

-By the Biodiversity Act No 10 of 2004

Vulnerable species: Cheetah
Pangolin
Juliana's golden mole
Lion

Protected species: Cape clawless otter
South African hedgehog
White rhinoceros
Black wildebeest
Brown hyena
Spotted-necked otter

By the Regulations of the Provincial Authority
GDARD closely follows the findings of a panel of mammalogists (Friedman and Day (Eds.) 2004) that follow the CITES terminology and definitions of conservation rankings.

-By the Mpumalanga Nature Conservation Act no. 10 of 1998

Schedule 2: Protected Game

Hedgehog - Atelerix frontalis
Pangolin - *Manis temminckii*
Lesser bushbaby - *Galago moholi*
Aardwolf - *Proteles cristatus*
Brown hyena - *Parahyaena brunnea*
Antbear - *Orycteropus afer*
Hippopotamus – *Hippopotamus amphibeus*
Antbear - *Orycteropus afer*
Black wildebeest – *Connochaetes gnu*
Eland - *Tragelaphus oryx*
Waterbuck - *Kobus ellipsiprymnus*
Steenbok - *Raphicerus campestris*
Cape clawless otter – *Aonyx capensis*
Spotted-necked otter – *Lutra macullicollis*

Schedule 3: Ordinary Game

Scrub hare - *Lepus saxatilis*
Grey duiker - *Sylvicapra grimmia*
Burchell's zebra – *Equus burchelli*
Kudu – *Tragelaphus strepsiceros*
Blesbok- *Damaliscus pygargus phillipsi*
Springbok – *Antidorcas marsupialis*

Schedule 4: Protected Wild Animals

Cheetah – *Acinonyx jubatus*
Lion – *Panthera leo*
African buffalo – *Syncerus caffer*

Schedule 5: Wild Animals to Which the Provisions of Section 33 Apply

Baboon – *Papio ursinus*
Vervet monkey – *Cercopithecus mitis*
Rock dassie – *Procavia capensis*
Warthog – *Phacochoerus aethiopicus*
Yellow mongoose - *Cynictis penicillata*
Slender mongoose - *Galerella sanguinea*
White-tailed mongoose - *Ichneumia albicauda*
Marsh mongoose - Atilax paludinosus
Civet - Civettictis civetta

Small-spotted genet - *Genetta genetta*
Large-spotted genet - *Genetta tigrina*
African wild cat - *Felis silvestris*

Schedule 8: Problem Animals

Black-backed jackal - *Canis mesomelas*
Caracal – *Felis caracal*
Bushpig – *Potamochoerus porcus*

-Endemism:

None of the species purported to be residents of the study site and surrounding areas are endemic to Gauteng or Mpumalanga.

6.2 HERPETOFAUNA

The local occurrences of reptiles and amphibians are closely related to broadly defined habitat types, namely terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of global distribution ranges of species.

6.2.1. Herpetofauna Habitat Assessment

All four major habitats are present along the study site.

Most of the study site consists of grassland transformed to maize fields. The natural grassland was first transformed for agricultural purposes and later by anthropogenic influences such as buildings, roads, fences and invasive plants. The study site is thus ecologically disturbed in many parts. Moribund termitaria were recorded on the study site. These structures are good indicators of the occurrence of small herpetofauna. Accordingly, it is estimated that the reptile and amphibian population density for the study site is higher. At the time of the site visit the basal cover was generally good and would provide adequate cover for small terrestrial herpetofauna. Where grasslands have been disturbed, prey is proportionately sparsely distributed and foraging grounds for insectivorous herpetofauna need to be fairly extensive to support specific populations.

There are some areas of natural rupiculous habitat on the study site. Due to the presence of natural rupiculous habitat, some species like common girdled lizard and rock agama were added to the species list. However, there are plenty of artificial surrogates for rupiculous habitat, such as buildings, concrete fences and rubble dumps. Only common reptiles like the speckled rock skink will benefit from these structures.

There are rivers, drainage lines, pans and manmade dams along or near the study site. Some of the dams are temporary and others are permanent. These water sources would provide habitat for common water-dependent herpetofauna. All wetlands are protected in Gauteng and Mpumalanga Provinces and are herein regarded as sensitive.

At a few places isolated indigenous trees occur but In general arboreal habitat is functionally absent. Due to the absence of large areas with natural arboreal habitat, some species such

as tree agamas were omitted from the species list. Most of the trees on the study site are exotics. There are almost no dead logs which could have provided shelter and food for a number of herpetofaunal species.

6.2.2. Observed and Expected Herpetofauna Species Richness

Seventy-three reptile species may occur along the Bravo 3 servitude (Table 2) and a possibility of 19 amphibians (Table 2).

The total of 92 herpetofauna species is recorded as potential occupants. Most of these are robust generalists with the ability to capitalise (or at least persist) on disturbed environments. It should be noted that potential occurrence is interpreted as being possible over a period of time as a result of expansions and contractions of population densities and ranges which stimulate migration.

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

The species assemblage is typical of what can be expected in extensive natural areas with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 2) are fairly common and widespread (viz. brown house snake, mole snake, common egg eater, rinkhals, speckled rock skink, common platanna, common river frog, Boettger's caco, bubbling kassina, guttural toad and red toad).

Table 2: Reptile and Amphibian diversity. The species observed or deduced to occupy the site. Systematic arrangement and nomenclature according to Branch (1998), Minter, *et.al* (2004), Alexander & Marais (2007), Du Preez & Carruthers (2009) and Bates *et.al* (2014)

	SCIENTIFIC NAME	ENGLISH NAME
	CLASS: REPTILIA	REPTILES
	Order: TESTUDINES	TORTOISES & TERRAPINS
	Family: Pelomedusidae	Side-necked Terrapins
√	*Pelomedusa subrufa*	Marsh Terrapin
	Family: Testuninidae	Tortoises
√	*Kinixys lobatsiana*	Lobatse Hinged-Back Tortoise
*	*Kinixys spekii*	Speke's Hinged- Back Tortoise
?	*Stigmochelys pardalis*	Leopard Tortoise
	Order:Crcodylia	
	Family: Crcodylidae	Crocodiles
*?**Vu***	*Crocodylus niloticus*	Nile Crocodile
	Order: SQUAMATA	SCALE-BEARING REPTILES
	Suborder:LACERTILIA	LIZARDS
	Family: Gekkonidae	Geckos
?	*Chondrodactylus turneri*	Turner's Gecko
?	*Hemidactylus mabouia*	Common Tropical House Gecko

	SCIENTIFIC NAME	ENGLISH NAME
√	*Lygodactylus capensis capensis*	Common Dwarf Gecko
?	*Lygodactylus nigropunctatus*	Black-Spotted Dwarf Gecko
√	*Pachydactylus affinis*	Transvaal Gecko
*	*Pachydactylus capensis*	Cape Gecko
	Family: Amphisbaenidae	Amphisbeanians
?	*Monopeltis infuscata*	Dusky Worm Lizard
	Family: Lacertidae	Old World Lizards or Lacertids
*	*Ichnotropis capensis*	Ornate Rough-Scaled Lizard
*	*Nucras holubi*	Holub's Sandveld Lizard
*	*Nucras intertexta*	Spotted Sandveld Lizard
*	*Nucras ornata*	Ornate Sandveld Lizard
*	*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard
	Family: Cordylidae	
√***NT***	*Chamaesaura aenea*	Coppery Grass Lizard
?	*Chamaesaura anguina*	Cape Grass Lizard
?***NT***	*Chamaesaura macrolepis*	Large-Scaled Grass Lizard
?	*Cordylus jonesii*	Jones' Girdled Lizard
√	*Cordylus vittifer*	Common Girdled Lizard
?	*Smaug vandami*	Van Dam's Dragon Lizard
	Family: Gerrhosauridae	Plated Lizards
√	*Gerhosaurus flavigularis*	Yellow-Throated Plated Lizard
	Family: Scincidae	Skinks
?	*Acontias gracilicauda*	Thin-Tailed Legless Skink
?	*Acontias occidentalis*	Savanna Legless Skink
√	*Trachylepis capensis*	Cape Skink
√	*Trachylepis punctatissima*	Speckled Rock Skink
?	*Trachylepis varia*	Variable Skink
*	*Afroablepharus wahlbergii*	Wahlberg's Snake-Eyed Skink
?	*Mochlus sundevallii sundevallii*	Sundevall's Writhing Skink
	Family: Chamaeleonidae	Chameleons
?	*Chamaeleo dilepis dilepis*	Common Flap-Neck Chameleon
	Family: Agamidae	Agamas
√	*Agama aculeata distanti*	Eastern Ground Agama
*	*Agama atra*	Southern Rock Agama
	Family: Varanidae	Monitors
?	*Varanus albigularis albigularis*	Southern Rock Monitor
√	*Varanus niloticus*	Water Monitor
	Suborder: SERPENTES	SNAKES
	Family: Typhlopidae	Blind Snakes
√	*Afrotyphlops bibronii*	Bibron's Blind Snake
*	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake
	Family: Leptotyphlopidae	Thread Snakes
*	*Leptotyphlops distanti*	Distant's Thread Snake
?	*Leptotyphlops incognitus*	Incognito Thread Snake
√	*Leptotyphlops scutifrons*	Peter's Thread Snake
	Family: Viperidae	Adders
√	*Bitis arietans arietans*	Puff Adder
√	*Causus rhombeatus*	Rhombic Night Adder
	Family: Lamprophiidae	
?	*Amblyodipsas polylepis polylepis*	Common Purple-Glossed Snake
√	*Aparallactus capensis*	Black-headed Centipede Eater

	SCIENTIFIC NAME	ENGLISH NAME
*	*Atractaspis bibronii*	Bibron's Stiletto Snake
?**NT**	*Homoroselaps dorsalis*	Striped Harlequin Snake
?	*Homoroselaps lacteus*	Spotted Harlequin Snake
?	*Gonionotophis capensis capensis*	Common File Snake
√	*Boaedon capensis*	Common House Snake
*	*Lamprophis aurora*	Aurora Snake
?	*Lycodonomorphus inornatus*	Olive Ground Snake
√	*Lycodonomorphus rufulus*	Brown Water Snake
*	*Lycophidion capense capense*	Cape Wolf Snake
√	*Psammophis brevirostris*	Short-snouted Grass Snake
√	*Psammophis crucifer*	Cross-Marked Grass Snake
?	*Psammophis subtaeniatus*	Western Yellow-Bellied Sand Snake
?	*Psammophis trinasalis*	Fork-Marked Sand Snake
*	*Psammophylax rhombeatus*	Spotted Grass Snake
?	*Psammophylax tritaeniatus*	Striped Grass Snake
?	*Duberria lutrix lutrix*	South African Slug-Eater
√	*Prosymna sundevallii*	Sundevall's Shovel-Snout
√	*Pseudaspis cana*	Mole Snake
	Family: Elapidae	Cobras, Mambas and Others
√	*Hemachatus haemachatus*	Rinkhals
?	*Naja annulifera*	Snouted Cobra
*	*Elapsoidea sundevallii*	Sundevall's Garter Snake
?	*Naja mossambica*	Mozambique Spitting Cobra
	Family: Colubridae	
√	*Crotaphopeltis hotamboeia*	Red-Lipped Snake
√	*Dasypeltis scabra*	Rhombic Egg Eater
?	*Dispholidus typus*	Boomslang
?	*Philothamnus hoplogaster*	Southeastern Green Snake
?	*Philothamnus semivariegatus*	Spotted Bush Snake
?	*Telescopus semiannulatus semiannulatus*	Eastern Tiger Snake
	CLASS: AMPHIBIA	AMPHIBIANS
	Order: ANURA	FROGS
	Family: Pipidae	Clawed Frogs
√	*Xenopus laevis*	Common Platanna
	Family: Bufonidae	Toads
*	*Poyntonophrynus fenoulheti*	Northern Pygmy Toad
√	*Amietophrynus gutturalis*	Guttural Toad
?	*Amietophrynus poweri*	Western Olive Toad
*	*Amietophrynus rangeri*	Raucous Toad
√	*Schismaderma carens*	Red Toad
	Family: Hyperoliidae	Reed Frogs
√	*Kassina senegalesis*	Bubbling Kassina
	Family: Microhylidae	Rubber Frogs
?	*Phrynomantis bifasciatus*	Banded Rubber Frog
	Family: Ptychadenidae	Grass Frogs
?	*Ptychadena anchietae*	Plain Grass Frog
*	*Ptychadena porosissima*	Striped Grass Frog
	Family: Phrynobatrachidae	Puddle Frog
√	*Phrynobatrachus natalensis*	Snoring Puddle Frog
	Family: Pyxicephalidae	

	SCIENTIFIC NAME	ENGLISH NAME
√	*Amietia angolensis*	Common River Frog
*	*Amietia fuscigula*	Cape 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

√ 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.

6.2.3. Red Data Listed Herpetofauna identified
-By the Scientific Community

The study site falls outside the recorded range of the plain stream frog, spotted shovel-nosed frog, whistling rain frog; giant dragon lizard, Fitzsimons' flat lizard, Breyer's long-tailed seps and Southern African python. These species should, however, occur along the linear study site.

The study site falls also outside the natural range of the Nile crocodile, but a few specimens, presumed released captive individuals, are documented in the Rietvlei Dam and Six Mile Spruit.

The striped harlequin snake has been recorded in some of the quarter degree squares of the study site (Transvaal or Ditsong Museum of Natural History records), and moribund termitaria, where this species is most likely to be found, are present on the study site. It is very difficult to confirm whether this cryptic snake is present on any study site but there is a small possibility that it may occur somewhere along the study site.

The coppery grass lizard has also been recorded in this several quarter degree squares (Transvaal or Ditsong Museum of Natural History records) and there are parts of the study site which consist of fairly pristine grassveld. Therefore there is a possibility that this lizard may occur on the study site.

The large-scaled grass lizard has been recorded near a small part of the study site. Therefore there is a very small possibility that this species may occur along the study site.

Temporary pans occur on or near the study site and are near some of the best known areas in an urban setting in South Africa to observe giant bullfrogs.

Giant Bullfrogs require four types of habitat in order to survive under natural conditions: 1) breeding sites, 2) burrowing soils, 3) foraging grounds and 4) dispersal corridors (Carruthers, 2009). To a greater or lesser degree the study site provides all four of these habitats. Requirement 4 (dispersal corridors) play an important part on the study site. Potential breeding sites for the giant bullfrog are present on or near the study site. These breeding sites are temporary, which bullfrogs prefer in order to avoid predation from fish. They also need water bodies with at least one side having a gentle slope. This prerequisite allows for shallow water (less than 10cm deep) which enables the female bullfrog to stand when she lays her eggs outside the water for the male to fertilise. Bullfrog tadpoles swim in schools and stay in the warm, shallow water during the day for rapid development (Van Wyk *et al*., 1992).

Some parts of the study site consist of sandy soil and are suitable as dispersal area for bullfrogs, which combines 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.

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

A species of which Mpumalanga Province has concern and has a *Near Threatened* status, but has no national status or Red Data status in Gauteng Province , like the striped harlequin snake has been recorded on the Gauteng Province side of the study site, but not the Mpumalanga side of the study site (Transvaal or Ditsong Museum of Natural History records).

-By the Regulations of the Provincial Authority
GDARD closely follows the findings of a panel of herpetologists that follow the CITES terminology and definitions of conservation rankings.

-By the Mpumalanga Nature Conservation Act no. 10 of 1998

Schedule 2: Protected Game

Nil.

Bullfrog

All species of reptiles excluding the water leguan, rock leguan and all species of snakes

Schedule 3: Ordinary Game

Nil.

Schedule 4: Protected Wild Animals

Nil.

Schedule 5: Wild Animals to Which the Provisions of Section 33 Apply

Water leguan

Rock leguan

Schedule 6: Problem Animals

All species of exotic tortoises, turtles and terrapins

-Endemism:
None of the species purported to be residents of the study site and surrounding areas are endemic to Gauteng or Mpumalanga.

7. FINDINGS AND POTENTIAL IMPLICATIONS

7.1 Impact Impressions

Towards the west the character of the Bravo 3 line leans towards an urban and smallholdings land-use with some industrial sites; that translates into disturbed and even transformed environments and concomitant depauperate species richness. Wherever fields have been established species richness has been reduced to zero as result of a total habitat transformation into a barren setting. Towards the eastern sector of the line the emphasis is on cattle grazing and environmental disturbance of grasslands varies from high to minimal and the extensive Highveld grassy plains support a higher number of terrestrial vertebrate residents.

The Bravo 4 line will not result in a further loss of ecological sensitive and important habitat units, ecosystem function (e.g. reduction in water quality, soil pollution), loss of mammal habitat, nor of loss/displacement of threatened or protected species. No sensitive ecological system or function is present.

All streams and wetlands are red-flagged as sensitive, as per statutory prerequisites.

Species richness: The *status quo* will not be altered during the construction or especially the operational phases.
Endangered species: Ditto above.
Sensitive species and/or areas (Conservation ranking): Nil. The reality is that the footprint and/or impact of an imposing powerline are in fact ecologically remarkably light, particularly during the operational phase. It should also be kept in mind that the Bravo 4 line will be along the servitude of exiting lines and environmental damage (as it may be) is too a large extent factored in by the existing servitude.
Habitat(s) quality and extent: Natural habitat may be affected during construction (especially compaction by vehicles), but can easily be rehabilitated, or can recover naturally over time.
Impact on species richness and conservation: Nil.
Connectivity: The Bravo 4 development will have no effect on connectivity during the operational stage, and very temporarily and very local during the construction phase.
Management recommendation: Nil.
General: Nil.

7.2 Assessment criteria

The conservation impact on natural biota of the construction and operation of the Bravo 4 Powerline is rated to be **Medium-low** i.e. *Land on which small sections could be considered for conservation but where the area in general has little conservation value* (See Section 5.5 – Assessment Criteria to express conservation status). This definition takes into account

the varied disturbed state of the natural environment along the 120km length of the line, and the virtually benign affect an operational powerline has on the environment.

7.3 Impacts on mammals and herpetofauna

See Section 5.6 (Significance (Consequence) Rankings) for the procedure to calculate ranking values.

Table 3: Direct impact on terrestrial vertebrate communities

Nature: An ESKOM powerline is an imposing structure. However, its effect on terrestrial vertebrate species is limited to the collective surface area of four feet and anchor points typical of the more common towers (see the image on the cover page). This impact is no more than that of rocks or termitaria that may be present in the vicinity. The majority of mammals and all herpetofauna are terrestrial, and as such they are NOT prone to collisions or electrocution. Bats are indeed volant but they seldom hawk for prey at the average height of a powerline (30 meters) and have highly echolocation capabilities to navigate and avoid obstacles. The development can be reversed with human intervention, and recovered materials can be recycled. No irreplaceable loss or even reduction of ecological resources is anticipated. Mitigation the impacts is standard procedure for ESKOM developments.				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Most likely	4	Most likely	4
Duration	Short duration	2	Short duration	2
Extent	Regional	3	Regional	3
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**28**	**Moderate**	**28**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Most likely	4	Most likely	4
Duration	Long term	4	Long term	4
Extent	Regional	3	Regional	3
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**36**	**Moderate**	**36**
Status (positive or negative)	**Negative**		**Negative**	
Reversibility	High		High	
Irreplaceable loss of resources?	Low		Low	
Can impacts be mitigated?	Yes			

Mitigation:

- A powerline *per se* is deemed harmless to terrestrial vertebrates, but the servitude will have an effect.
- It must be noted that an ESKOM servitude act as a valuable conservation asset, such as *inter alia* a seedbank and often as prime terrestrial habitat.
- A powerline is normally served by way of an access dirt tract along the servitude. It is important that this asset is managed to not cause erosion.
- Woody plants are generally removed to reduce the impact of 'hot' fires. Since fires represent a catastrophic event for terrestrial vertebrates, this *modus operandus* is concluded to be positive.
- Mature stands of grass develop along servitudes and serve as excellent refuge and nourishment. However mature stands of grass are mowed to reduce the impact of accidental fires and this deprive most terrestrial vertebrates of refuge and nourishment. This cannot realistically be mitigated and must thus be left to the devices of ecological processes.

Cumulative impacts: Submitted to be initially minimal and thereafter stabilized, as the development will be relatively light and most fauna species have relatively high mobility or adaptivity. Impact to connectivity and ecological services will be insignificant, especially since mammals and herps adapt fast to low-key and consistent disturbances such as noise.

Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.

Table 4: Loss of faunal habitat and ecological structure

Nature: The physical structure of the development will not detract from optimizing habitat maintenance. The management of the servitude of the Bravo 3 Powerline may, however, result in negligible loss of pristine mammal, reptile and amphibian habitats, but this is counterbalanced by seasonal lush grass cover that are irregularly mowed to reduce the intensity of fires. It would appear that cut grass are left *in situ*, which will enhance the build-up of the surface detritus layer. Preservation of vegetation generally affects nutrient cycles, built-up of the organic litter layer and mostly results in habitat refuges.

The minimal loss of habitat due to development can be reversed with human intervention. However, leaving ecological succession to its own devices will mostly result to lush basal cover.

No irreplaceable loss of resources is anticipated.

Mitigation the impacts is standard procedure for ESKOM developments.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Most likely	4	Most likely	4
Duration	Short duration	2	Short duration	2
Extent	Regional	3	Regional	3
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**28**	**Moderate**	**28**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Most likely	4	Most likely	4
Duration	Long term	4	Long term	4
Extent	Regional	3	Regional	3
Magnitude	Minor	2	Minor	2
Significance	**Moderate**	**36**	**Moderate**	**36**
Status (positive or negative)	Negative		Negative	
Reversibility	High		High	
Irreplaceable loss of resources?	Negligible		Negligible	

Can impacts be mitigated?	Yes
Mitigation: • None other than the standard precautionary measures incorporated in ESKOM best-practice development protocol along a servitude. • It is strongly recommend that alien weeds are actively removed / destroyed. • It is suggested to leave cut grass in situ. This will ameliorate the habitat alteration by cutting a high stand of grass, will not detract from the maintenance of a seed bank, and will combat erosion. • ESKOM *modus operandus* for storm water management will suffice.	
Cumulative impacts: Expected to be minimal.	
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly and rehabilitation of the site is undertaken.	

8. LIMITATIONS, ASSUMPTIONS AND GAPS IN INFORMATION

The vertebrate team has sufficient experience and ample access to information sources to confidently compile lists of biota (or in this instance detail the loss of species) to support conclusions and suggested mitigation measures based on a site visit. In instances where doubt exists, a species is assumed to be a possible occupant (viz. *Suncus* species); -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 that an intensive survey will augment this site visit will add significantly to the data base, and the additional costs are unlikely to warrant the effort.

10. CONCLUSIONS

The ca. 120km long Bravo 3 Powerline will traverse the Highveld grassland biome in an east – west axis between the Kusile Power Station to the Lulumisa Substation. The line will traverse through six vegetation units as defined by Mucina and Rutherford (2006) (Figure 4). All four major terrestrial and wetland habitats are present, although arboreal is largely non-functional. Land-use to the east is largely grazing. The grasslands represent terrestrial habitat that have conservation status (and concomitant habitat utility) ranging from overgrazed to a fairly well preserved condition. Towards the west land-use is more urban in character with some industries (cf. the Diepsloot WWTF [Figure 42] and quarries [Figures 34 and 40]), but large patches of grassland remain.

All streams and wetlands are red-flagged as sensitive, as per statutory prerequisites.

The line will not impact on its immediate environment since most of the terrain has already been disturbed (or even transformed) and since powerlines themselves are rather benign in spite of their formidable appearance. Mammals (bats excluded), reptiles and frogs are terrestrial and thus not exposed to the risk of collisions with the wires or be electrocuted. It should also be kept in mind that the Bravo 4 line will be within or along the servitude of

existing lines and environmental damage (as it may be) is too a large extent factored in by the existing servitude.

The servitude has both a slight positive and negative impact. The natural vegetation along the servitude will be manipulated towards rampant grassland by the removal of woody plants to reduce the risk of 'hot' fires. Generally the grassland in the servitude comprises prime terrestrial habitat by providing refuge and nourishment for herbivorous vertebrates, even though it may be grazed by domestic stock. Grasslands along such a grassy servitude also serve as seedbeds and, when mowed (to further reduce fire risks) the cut grass is left and still functions as habitat and furthermore adds to the organic litter layer.

It is predicted that the powerline and its servitude will not impact on species richness and no Red Data will be displaced

The conservation status of the linear site is rated as **Medium-low** i.e. *Land on which small sections could be considered for conservation but where the area in general has little conservation value* (See Section 5.5 – Assessment Criteria to express conservation status).

The impact of the Bravo 4 Powerline and its servitude is calculated to be 'Moderate'. This ranking is boosted by the high Duration and Regional values and in a sense excessively emphasizes the actual impact on terrestrial vertebrates and their habitats.

No reasonable objection can be raised to oppose the construction of the proposed development.

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APPENDIX A:

RÉSUMÉ

IGNATIUS LOURENS RAUTENBACH Ph.D., Prof. Nat. Sci.
Independent Environmental Consultant – MAMMALOGY.

Identity Number	421201 5012 00 5
Gender	Male
Date of Birth	1 December 1942
Nationality	South African
Home Languages	Bilingual (English & Afrikaans)
Postal Address	45 Helgaard Street, Kilner Park, Pretoria, RSA 0186. Tel no +27 12 3334112, Cell +27 082 3351288. E-mail naasrauten@mweb.co.za
Former Position	Retired Director: Planning, Northern Flagship Institute
Present Position	Consultant – Specialist, Environmental Impact Assessments (Applied research), Photographing microstock for four agencies
Qualifications	**B.Sc**. (UP), **T.H.E.D** (Pta TTC), **M.Sc.** (UP), **Ph.D**. (Un. Natal)
Professional Honours	1. Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400300/05 2. Fellow of the Photographic Society of South Africa 3. Master photographer at club level 4. Honorary life member of the S.A. Wildlife Management Association.
Notable Research Contribution	In-depth survey of the Mammals of the Transvaal. 1982. 211pp. Ecoplan Monograph 1.
Notable Literary Contribution	Rautenbach, Naas & Annalene Rautenbach. 2008. *Photography for Focused Beginners.* 302pp with 250 images. Green Door Studio, Pretoria.
Formal Courses Attended	Computer Literacy, Project Management, Contract Design, Senior Management

Employment history

May 2001 - Present Self-employed, collaborator with Eco-Agent CC Ecological Consultants as well as Galago Environmental [environmental impact assessments], 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 Principal 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 collectively partaking in 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

1991 - 2002 Founder member and non-executive director of the Board of Trustees of

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

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

Professional Achievements

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 the 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 1983 – 1995.

Students: Additional to museum manager duties, **c**o-supervised 5 B.Sc. (Hons.), 2 M.Sc. and 2 Ph.D. students.

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.

Personal Evaluation

I am goal-orientated, expecting fellow workers and associates to share this trait. I am an extrovert, sensitive to amicable interpersonal relations. I have a wide interest span ranging from zoological consulting, photography, cooking, sport, news, gardening and out of necessity, DIY. To compensate for my less than perfect memory, I lead a structured and organised life to deal with the detail of a variety of interests. Often to the chagrin to people close to me, I have an inclination to “Think Out of the Box”.

ABRIDGED CURRIVULUM VITAE VAN WYK:

JACOBUS CASPARUS PETRUS (JACO)

Identity number 680804 5041 08 4
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Present position Co-Department Head, Environmental Education & Life Sciences, Hoërskool Waterkloof
Consultant Specialist Environmental Assessments, EIAs, writing, photo-recording
Qualifications **B.Sc**. (U.F.S.) **B.Sc. (Hon.)** (U.F.S.), **H.E.D** (U.F.S.), **M.Sc.** (U.F.S.)
Honours Foundation of Research Development bursary holder
Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400062/09
Notable Research Contribution In-depth field study of the giant bullfrog

Formal Courses Attended Outcomes Based Education, University of the South Africa (2002)
Introductory Evolution, University of the Witwatersrand (2008)
OBE, GET & FET training, 2002-2008, Education Department

Employment history
2000 – Present Co-Department Head for Environmental Education & Life Sciences, Hoërskool Waterkloof, Pretoria.
1995 - 1999 Teaching Biology (Grades 8 – 12) and Physics / Chemistry (Grades 8 – 9) at the Wilgerivier High School, Free State. Duties included 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 (University of Pretoria) 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 Achievement **Research:** Author and co-author of 52 scientific publications in peer-reviewed and popular subject journals, and >60 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.