MARCH 2015

AN ECOLOGICAL REPORT ON THE FLORA AND FAUNA

Eskom Kimberley Strengthening Phase 4 Project : Boundary-Ulco

(Double circuit 400kV powerline from Boundary to Ulco, including a new Ulco TX Substation adjacent to the existing Ulco DX Substation)

A report commissioned by

LANDSCAPE DYNAMICS

ENVIROGUARD ECOLOGICAL SERVICES CC

PO Box 703
Heidelberg
1438

Cell: 082 4641021
envguard@telkomsa.net

CONTENTS

TERMS OF REFERENCE

Project Description:

ESKOM is planning the construction of an approximately 94km powerline from Boundary to Ulco, including a new Ulco TX Substation adjacent to the existing Ulco DX Substation. The powerline route and locality of the substation will be determined during the Scoping and EIA process.

Project Locality:

The project area is located directly west of Kimberley, Northern Cape

Aim of this assessment:

The aim of the impact assessment is to present floristic descriptions of the different vegetation units encountered within the study area and to highlight sensitive attributes and areas within the environment that might be adversely affected by the proposed development. The impacts are to be evaluated and pertinent mitigating actions recommended

ASSIGNMENT

Enviroguard Ecological Services cc. was commissioned by **Landscape Dynamics Environmental Consultants** to conduct an ecological assessment (Flora & Fauna) of the proposed routes identified for the construction of the new Eskom powerlines.

The proposed project contains two proposed routes with an alternative corridor section on one route that stretch from Boundary Power Station outside Kimberley towards the Ulco Substation west of Kimberley.

The aims of the study are to:

- conduct a vegetation survey for the proposed routes
- conduct a faunal assessment for the proposed routes
- identify ecologically sensitive area/s if they are found to be present

The objectives of this study were to:

- Identify the different vegetation units present along the proposed routes
- Describe and map the different vegetation units
- Provide a description of the fauna occurring within the study area.
- Identify species (mammals, reptiles, amphibians) of conservation importance that could possibly occur on the study site.
- Determine potential impacts of the proposed development on the proposed site on the associated fauna.
- To provide a sensitive map of the study

CONDITIONS RELATING TO THIS REPORT

Factors limiting the quality of this study

Flora: A once off survey was conducted on 28 January 2014 followed by surveys from 6-7 January 2015. Thus only those flowering plants that flowered at the time of the visit could be identified with high levels of confidence. Some of the more rare and cryptic species may have been overlooked due to their inconspicuous growth forms. Many of the rare and endangered succulent species can only be distinguished (in the veld) from their very similar relatives on the basis of their reproductive parts. These plants flower during different times of the year. Multiple visits to any site during the different seasons of the year could therefore increase the chances to record a larger portion of the total species complex associated with the area. The survey of the study site is however considered as successful with a correct identification of the different vegetation units.

Fauna: An initial site investigation was undertaken on the 12th February 2014 with additional surveys conducted from the 24-26th of March 2015. The majority of threatened species are extremely secretive and difficult to observe even during intensive field surveys conducted over several years. The presence of threatened species on site is assessed mainly on habitat availability and suitability observed during the field surveys as well as desk-top research (literature, personal records and previous surveys conducted on the site and similar habitats within the area).

Approach

Conclusions reached and recommendations made are based not only on occurrence of individual species, but more appropriately on habitats and ecosystem pattern and processes. Planning must therefore allow for the maintenance of species, habitats and ecosystem processes, even if Red Data or endemic plant species are absent.

Declaration of interest

Enviroguard Ecological Services cc has no vested interest in the property studied nor is it affiliated with any other person/body involved with the property and/or proposed development. Enviroguard Ecological Services cc is not a subsidiary, legally or financially of the proponent.

The study was undertaken by Prof LR Brown (PhD Plant Ecology - UP), Dr H Bezuidenhout (PhD Botany - UP) and Mr CL Cook (MSc Zoology - UP). They are registered as a Professional Natural Scientists with the following details:

Prof LR Brown:	Reg. No. 400075/98 (Botanical Science and Ecological Science).
Dr H Bezuidenhout:	Reg. No. 400148/07 (Ecological Science)
Mr C Cook:	Reg. No. 400084/08 (Zoological Science)

Indemnity

Although Enviroguard Ecological Services cc exercises due care and diligence in rendering services and preparing documents, the client takes full responsibility for this assessment in terms of the National Environmental Management Act of 1998, and exempt Enviroguard Ecological Services cc and its associates and their sub-contractors from any legal responsibility based on the timing of the assessment, the result and the duration thereof, which has an influence on the credibility and accuracy of the assessment. .Enviroguard Ecological Services cc accepts no liability, and the client, by receiving this document, indemnifies Enviroguard Ecological Services cc and its directors, managers, agents and employees against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Enviroguard Ecological Services cc and by the use of the information contained in this document.

Copyright

Copyright on the intellectual property of this document (e.g. figures, tables, analyses & formulas) vests with Enviroguard Ecological Services cc. The Client, on acceptance and payment of this report shall be entitled to use for its own benefit:

- The results of the project;
- The technology described in any report;
- Recommendations delivered to the Client.

INTRODUCTION

The natural resources of South Africa, with its highly complex and diversified society, are continually under threat from development especially in and close to areas richly endowed with natural resources. The natural environment and assets such as soil, water, indigenous vegetation, biodiversity, endemic and rare species and indigenous wildlife should be part of planning any new developments. New development plans should be based on scientific, ecological principles to prevent destruction or the deterioration of the environment and consequently the loss of valuable natural assets - also the loss of plant and animal species (biodiversity) and natural open spaces within the urban environment. This does not only have economic consequences, but from a conservation viewpoint, may have enormous advantages to the natural ecosystems. Development should, therefore, be planned to make the best possible use of natural resources and to avoid degradation, and therefore attention must be paid to environmental factors to make informed decisions. During the last years development became complicated and sophisticated, scientifically based, enterprises where environmental and nature systems are (or should be) accounted for in the planning stages. Modern development planning is intended to improve the way in which South African environmental resources are utilised. This provides a cost-effective procedure for ensuring that environmental concerns are carefully considered in the project development process. This procedure aims at guiding and facilitating the development process of a project. **An ecological evaluation of any area to be developed is presently considered a necessity.**

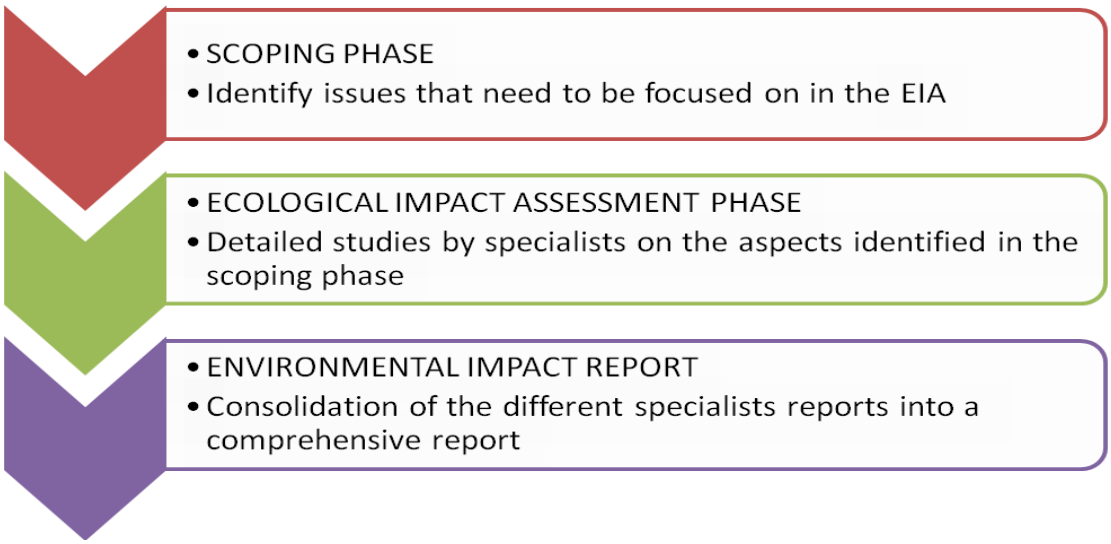
Eskom Transmission is responsible for providing a high quality supply of electricity to meet the ever increasing needs of its end users in South Africa. As a result, its infrastructure of power lines and substations are continuingly being established and expanded upon to support annual load growth.

Eskom endeavors to provide sustainable and affordable energy through the integration and consideration of economic development, environmental quality and social equity. Environmental performance is fundamental to Eskom and they strive to lessen their impact on the natural environment as far as possible. "*Eskom continues to operate as a responsible corporate citizen in South Africa – the goal being to be*

recognised as a world-class utility in terms of environmental management practices and environmental duty of care." (Eskom website 2014).

Active participation of affected and interested parties in the different Eskom projects early in the environmental impact assessment process ensures that the environmental is taken into account before any further plans are made.

In terms of the Environment Conservation Act (Act no. 73 of 1989) an Environmental Impact Assessment (EIA) must be undertaken before any development on land can begin. Such a process will ensure that all aspects and possible consequences to the environment, stakeholders and affected parties are considered during the project. The initial phase of the EIA is the scoping exercise. That is followed by a formal and detailed EIA from where the findings of all specialists are condensed in an Environmental Management Plan (see diagram below).



The overarching purpose of an EIA on the environment is to determine the different consequences of a proposed development on the local and regional environment and to assess and evaluate them (positive and negative). The EIA will also recommend strategies to minimise or even avoid negative impacts. It is also important that consideration is given to the probable significance or "acceptability" of the effects or consequences. According to the National Environmental Management Act (Act 107 of 1998) an environmental impact refers to any impacts on land, water, the atmosphere or living organisms, or on the inter-relationships between them, and impacts on their physical, chemical, aesthetic and cultural properties and conditions

that influence human health and well-being (National Environmental Management Act, 1998 (ACT N0.107 OF 1998).

This vegetation and faunal assessment was undertaken to assist with final decisions regarding the preferred route for the Eskom power line to be constructed between Boundary Power Station and the Ulco Power Station.

Plant communities are regarded as fundamental units of an ecosystem and therefore form the base for environmental planning and the compilation of environmental management plans. Vegetation is the most physical representation of the environment and any changes in the environment is first detected in changes in vegetation. Vegetation also provides habitat for various animal species. Some animal species may use various habitats for various purposes such as feeding, sleeping and reproduction. Thus plant species assemblages reflect habitat and ecosystem health and rarity, and are therefore imperative for an Environmental Impact Assessment.

This report provides information on:

- Broad ecological characteristics of the proposed routes
- Main vegetation types that occur along the proposed routes
- Vegetation units present along the proposed routes
- Faunal species present along the proposed routes
- Likelihood that red data plant and animal species could occur along the different proposed routes
- Sensitive ecosystems that could be affected by the proposed routes

STUDY AREA

The study area is located west of the town of Kimberley in the Northern Cape Province. Kimberley is located close to the centre of South Africa at 28°44'S 24°46'E. Kimberley lies at an elevation of approximately to 1 230m above sea level. The proposed routes for this report stretches from the Boundary substation just east of Kimberley looping around the town of Barkley West ending at the Ulco Substation approximately 94km west of Kimberley (Figure 1).

Climate

The area is known for its hot summers (November-February) and mild to cold winters (June-August). The average midday temperatures for Barkley West range from 18°C in June to 32°C in January and can be below 0°C in winter (July). The erratic rainfall occurs mainly during the summer months. The average annual rainfall for the area is 274mm with the lowest (0mm) in June and the highest (60mm) in February. (Figure 2).

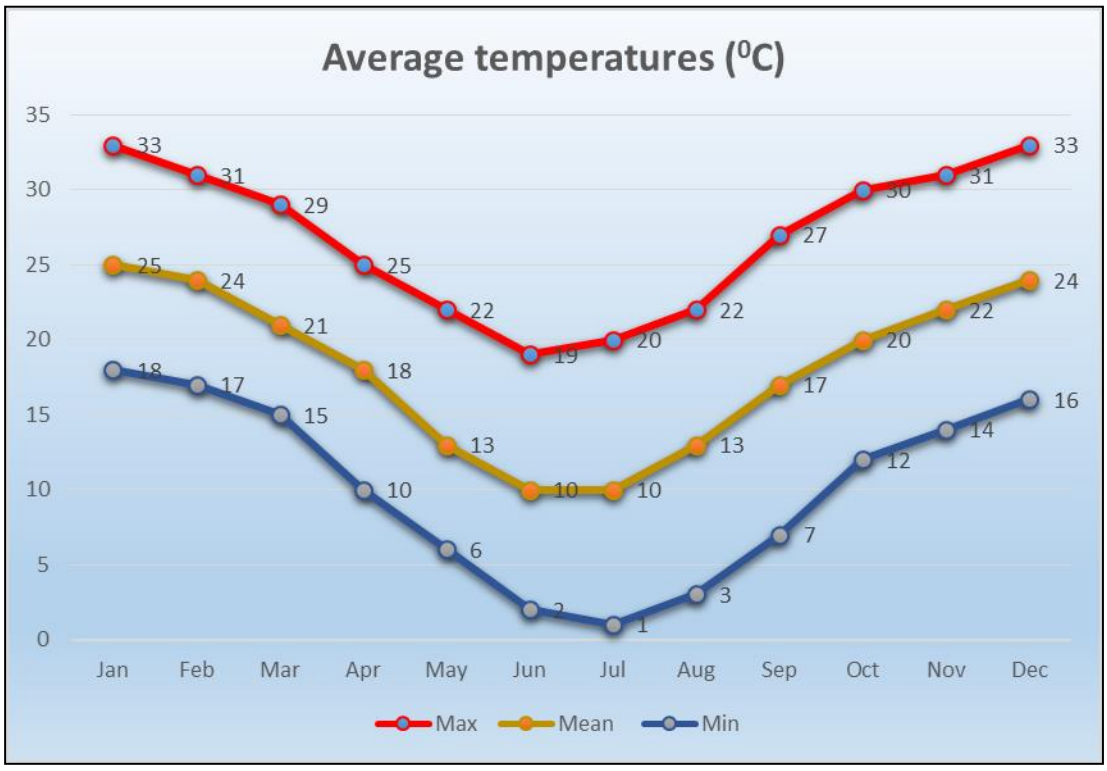


Figure 1. Average temperatures for the study area.

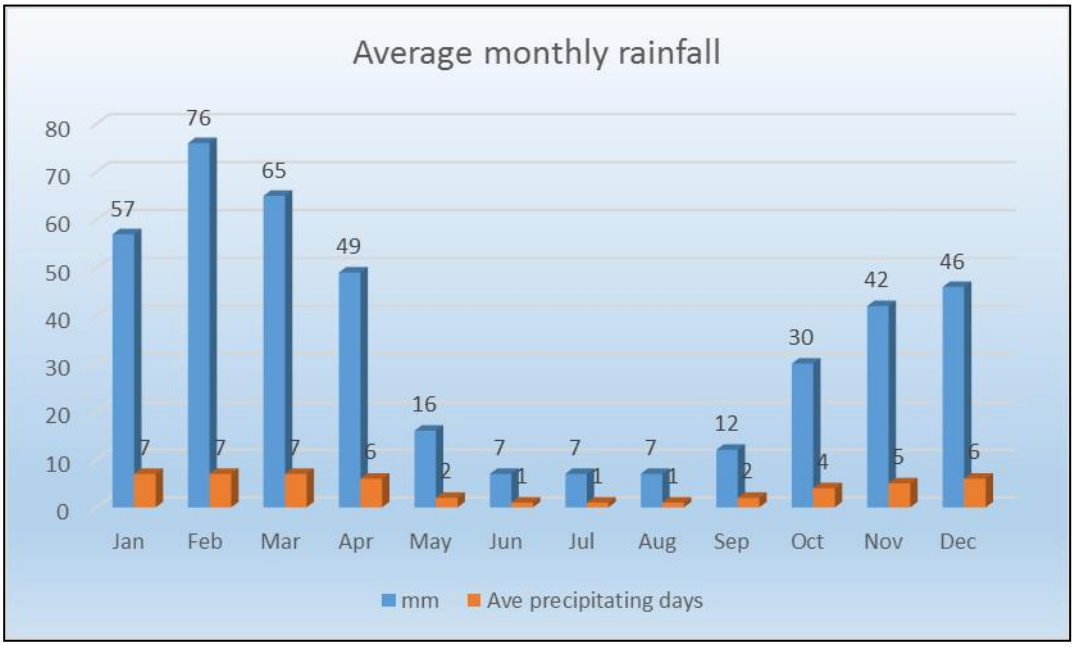


Figure 2. Precipitation for the study area for the study area.

Topography & geology

The landscape varies from flat to gently undulating plains. Both the Vaal River and Harts River flows through the proposed route areas. The following topographical positions are distinguished in the study area: lower-lying areas, midslopes, and pans. Small isolated patches of rocky outcrops are present in some localities. The soil varies from deep red and yellow apedal sandy (Hutton- and Clovelly soil forms) to shallow and stony (Mispah-, Glenrosa- and Kimberley soil forms).

The following geological types occur in the area: Outcrops of the andesitic lavas of the Ventersdorp Supergroup (Allenridge Formation), which is mostly overlain by calcrete; Outcrops of tillite of the Dwyka Formation and shale of the Prince Albert Formation (Karoo Sequence) are found in the study area. Dolerite sills sometimes form ridges or small hills (koppies)(Ib land type). In the elbow of the Vaal River an atypical deep aeolian sandy section (Ah land type) occurs. Closely associated with the Harts- and Vaal rivers are alluvial gravels of Tertiary to Recent age covering Dwyka tillite.

METHODS

Two alternative routes and one alternative connection corridor were visited and surveyed and are indicated on Figure 3.

VEGETATION

The vegetation of the proposed routes was surveyed and data analysed. Prior to the field survey, available literature, and database information pertaining to the vegetation and threatened species of the study area was obtained and reviewed. The literature review included scientific and popular publications on related aspects for the area. Internet searches for ecological issues in the area and red data plant and animal species were done. The Google search engine was used for information pertaining to Red Data flora and fauna and their habitat preferences.

During the first field trip the proposed routes were covered using both vehicle and helicopter transport. During the second visit in 2015 the routes were covered by vehicle and on foot to survey the vegetation in the field.

The Braun-Blanquet survey technique to describe plant communities as ecological units was used for this study (Brown *et al.* 2013; Kent & Coker 1992; Mueller-Dombois & Ellenberg 1974). It allows for the mapping of vegetation and the comparison of the data with similar studies in the area. The vegetation survey was conducted by Prof. LR Brown and Dr H Bezuidenhout.

By using aerial photographs, the study area was stratified into physiognomic - physiographic units. Sample plots were placed on a randomly stratified manner to represent each vegetation unit identified. Plot sizes were fixed at approximately 400 m^2 according to Brown (1997).

Data recorded included:

Data pertaining to the vegetation physiognomy and floristic composition (species richness and canopy cover of each species) was gathered. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were

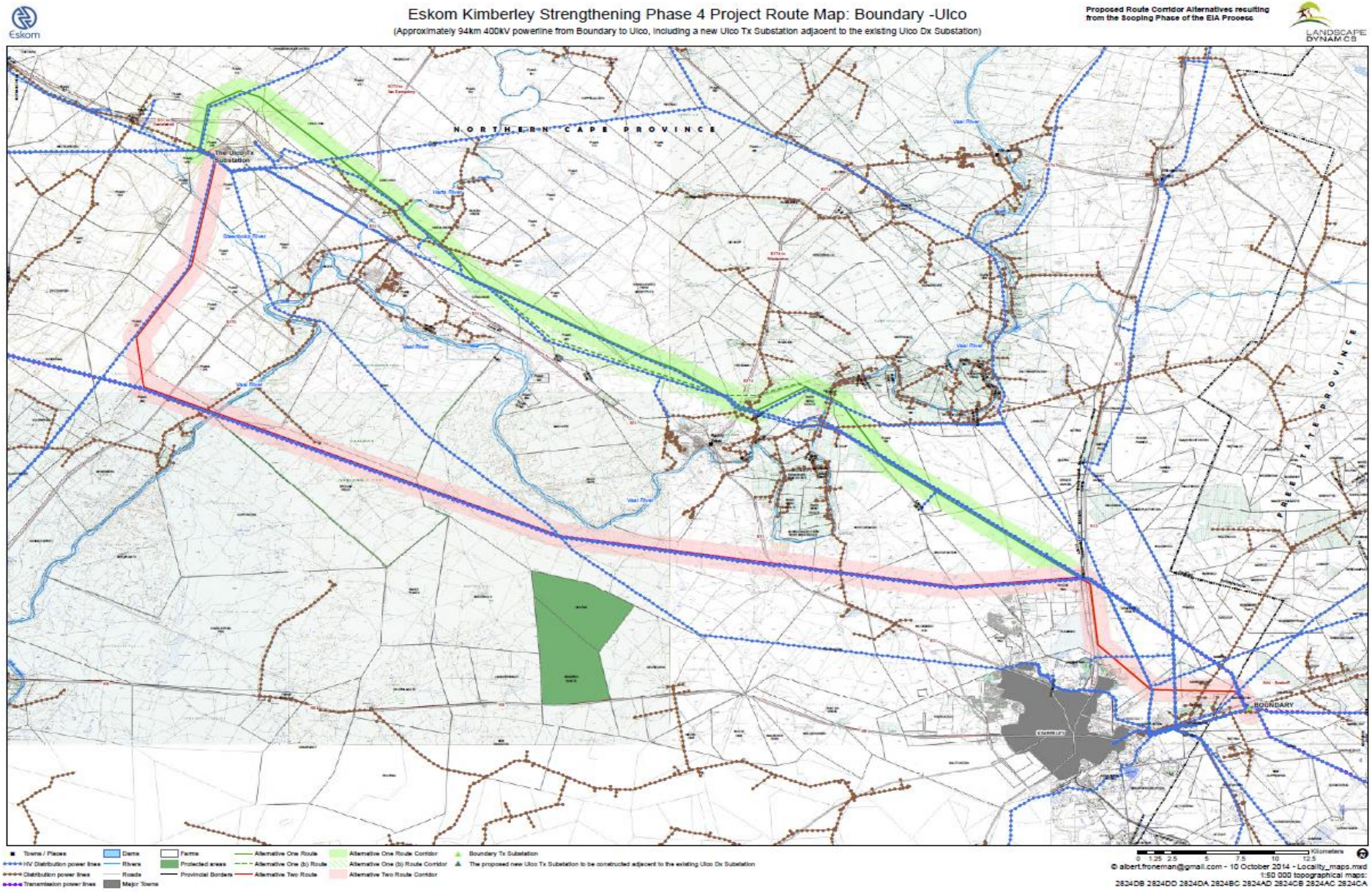


Figure 3: Location of the study area and proposed routes.

Red data species

An investigation was also carried out on rare and protected plants that might possibly occur in the region. For this investigation the National Red List of Threatened Plants of South Africa, Lesotho & Swaziland, compiled by the Threatened Species Programme, South African National Biodiversity Institute (SANBI) as well as information provided by the Northern Cape Nature Conservation office were used. Internet sources were also consulted on the distribution of these species in the area. Other information used included:

- Publication of lists of species that are threatened or protected, activities that are prohibited and exemption from restriction from the National Environmental Management: Biodiversity Act, 2004 (ACT NO. 10 OF 2004).
- List of protected tree species under the National Forests Act, 1998 (ACT NO 84 OF 1998)

The presence of rare and protected species or suitable habitat was recorded during the field visit.

Data processing

A classification of vegetation data was done based on the plant species groupings and occurrence to identify, describe and map vegetation units. The descriptions of the vegetation units include the tree, shrub and herbaceous layers.

The **conservation priority** of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Gauteng area, and the Grassland and Savanna Biomes of South Africa.

The following four **conservation priority** categories were used for each vegetation unit:

High:	Area with high species richness and habitat diversity; presence of viable populations of red data plant species OR suitable habitat for such species; presence of unique habitats; less than 5% pioneer/alien plant species present. These areas are ecologically valuable and important for ecosystem functioning. This land should be conserved and managed and is not suitable for development purposes.
Medium-high:	An area with a natural species composition; not a threatened or unique ecosystem; moderate-high species diversity; between 5-10%

pioneer/alien plant species present, and has connectivity with other natural ecosystems. Although natural it is not a sensitive habitat and commonly occur in the region. Low density development/impacts could be allowed with areas to be left in its natural composition so as to lessen the impact on the natural ecosystem.

Medium: An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species and habitat diversity; between 10-20% pioneer/alien plant species present; that would need moderate input to rehabilitate to an improved condition; and where low density development would have a limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation are maintained**.**

Low-medium: A common vegetation type; moderate to low species and habitat diversity; previously or currently degraded or with large sections in a secondary successional phase; between 20-40% pioneer and/or alien plant species; low ecosystem functioning; low rehabilitation potential. Development could be supported with little impact on the natural environment.

Low: A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants; >40% pioneer and/or alien plant species present; very low habitat uniqueness; whose recovery potential is extremely low; and on which development could be supported with little to no impact on the natural vegetation / ecosystem.

A **sensitivity analysis** was done for the vegetation units identified. This was achieved by evaluating the different vegetation units against a set of habitat criteria. For impact assessment the **potential impacts** on the vegetation was assessed by using the NEMA 2006 guidelines and criteria. To further quantify the severity of each impact, values were assigned to criteria ratings (Table 1).

Table 1: Criteria, criteria ratings and values (in brackets) used in this study to assess possible impacts on vegetation during the proposed development

Criteria	Rating (value)
Extent of impact	Site (1), Region (2), National (3), International (4)
Duration of impact	Short term (1), Medium term (2), Long term (3), Permanent (4)
Intensity of impact	Low (1), Medium (2), High (3)
Probability of impact	Improbable (1), Probable (2), Highly probable (3), Definite (4)

FAUNA

Predictive methods

Satellite imagery of the area was obtained from Google Earth was studied in order to get a three dimensional impression of the topography and current land use. Aerial photographs were utilised for the sensitivity mapping using Arcview 9.2

Literature Survey

A detailed literature search was undertaken to assess the current status of threatened plants well as faunal species that have been historically known to occur in the Kimberly (Boundary)-Barkley West- Delportshoop (Ulco) 2824CD, 2824CC, 2824CB, and 2824BA quarter degree grid cells (QDGC). The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description as well as *National Red List of Threatened Plants of South Africa* (Raimondo *et al,* 2009) as well as internet using POSA (http://posa.sanbi.org). *The Mammals of the Southern African Subregion* (Skinner & Chimimba 2005) and *The Red Data Book of the Mammals of South Africa: A Conservation Assessment* (Friedmann and Daly (editors) 2004) as well as ADU's MammalMap (http://vmus.adu.org.za/vm) accessed on the 20th of March 2015) for mammals. The *Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter *et al.* 2004) for amphibians as well as SAFAP FrogMap (http://vmus.adu.org.za) The *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001) and *South African Red Data Book-Reptiles and Amphibians* (Branch 1988) as well as SARCA (http://sarca.adu.org.za) accessed on the 20th of March 2015) for reptiles.

Site Investigation Methodology

A preliminary assessment of the status, spatial requirements and habitat preferences of all priority species likely to occur on the site was done. For certain species, an estimate of the expected or historical distribution for the area could be extrapolated from published information and unpublished reports, while habitat and spatial requirements were generally derived from the literature

A survey of the proposed development areas was carried out by driving around the site by car and closer inspection of any sensitive or specialised habitats carried out on foot during daylight hours. A single night nocturnal survey (18h00-22h00) was undertaken on the 25th of March 2015.

RESULTS

VEGETATION UNITS

Seven distinct vegetation units could be identified and are indicated in Figure 4 namely:

1. *Vachellia erioloba - Vachellia tortilis* woodland
2. *Vachellia tortilis - Senegalia mellifera* shrubland
3. *Cynodon dactylon-Vachellia karroo* woodland
4. *Senegalia mellifera-Vachellia tortilis* shrubland
5 *Grewia flava – Vachellia erioloba* woodland
6 *Combretum erythrophyllum - Vachellia karroo* woodland
7 *Vachellia species open woodland*

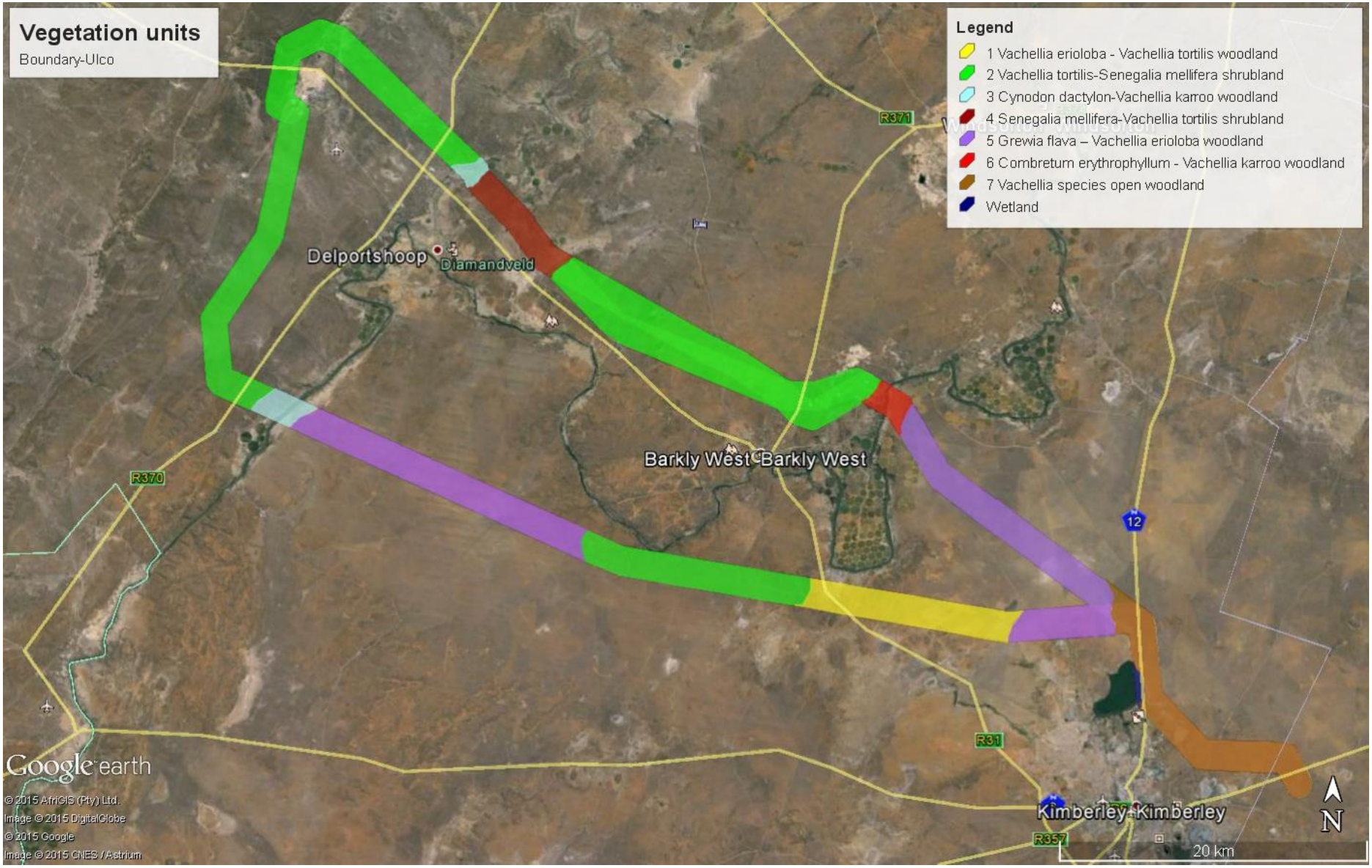


Figure 4. Vegetation units of the proposed study routes (Source: Google earth 2015)

1. The *Vachellia erioloba - Vachellia tortilis* woodland

Soil	Red-yellow apedal soil, clay content of 6 to 25%.	**Tree cover**	10%
Topography	Floodplain	**Shrub cover**	35%
Land use	Livestock and free moving game	**Herb cover**	15%
Unit status	Natural to degraded	**Grass cover**	55%
Faunal spp.	Birds, insects	**Rock cover**	2%
		Erosion	0%

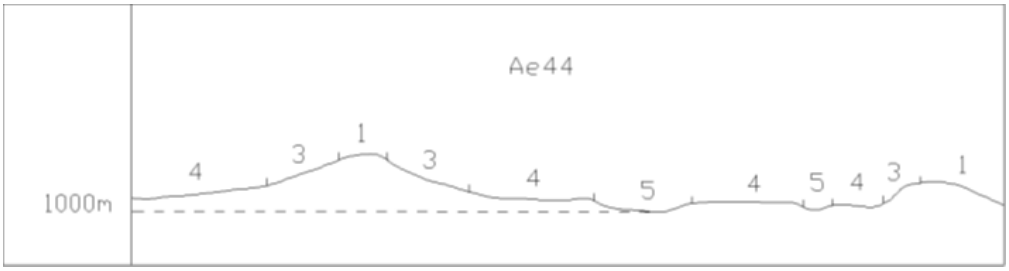
Dominant spp.	Trees *Vachellia erioloba, V. tortilis* and the grasses *Heteropogon contortus* and *Aristida meridionalis*

Conservation value	**Low-medium**	**Ecosystem functioning**	**Low-medium**

The *Vachellia erioloba - Vachellia tortilis* open woodland is strongly associated with the ancient gravel filled old River and associated floodplains of the Vaal River. The dominant and prominent woody plant species consist of shrub and tree *Vachellia tortilis*, tree *Vachellia erioloba* and shrub *Senegalia mellifera*. The most common land –uses are game and goat farming, which have resulted in some areas overgrazed.

The topography varies from flat to slightly undulating floodplains (4) associated with the ancient gravel water course of the Vaal River. The well-drained, stony soil (clay-content <25%) of this community varies in depth from shallow to moderately deep

(0.45 – 0.9 m). The debris of old diamond diggings are mostly found on the crests of the landscape. The dominant rock-soil complex of this Ae 44 land type woodland are the Hutton and Mispah soil forms.



Ae 44 land type terrain form sketch (Land Type Survey Staff 1987)

Geology: Andesitic to basaltic lavas of the Ventersdorp Supergroup sometimes overlain by calcrete. Dwyka tillite occurs in places.

Dominant terrain unit: Floodplain (4) with Hutton and Mispah soil forms dominant. Soil texture fine / medium sand with clay content between 6 to 25%. The red apedal B21 horison is well drained and the soil depth is between 0.45 to 0.9 m.

In summary the important features for this vegetation unit are as follows:

The dominant woody component is well developed with the tree and shrub strata canopy cover respectively 10% and 35%. The conspicuous woody species which are present in this woodland are the dominant trees *Vachellia erioloba, V. tortilis, Boscia albitrunca* and *Ziziphus mucronata* as well as the shrubs *Senegalia mellifera, Searsia ciliata, Tarchonanthus camphoratus, Diospyros lycioides, Grewia flava* and *Protasparagus suaveolens*. The herbaceous layer with a canopy cover of 55% is under grazing pressure. The common grasses of this woodland are *Heteropogon contortus, Panicum coloratum, Aristida meridionalis, Urochloa panicoides, Schmidtia pappophoroides* and *Cynodon dactylon*. The prominent forbs are *Pentzia globosa, Gazania krebsiana, Walafrida densiflora, Salvia species, Nidorella hottentottica, Geigeria ornitiva, Elephanthorrhiza elephantina, Lippia javanica* and *Felicia muricata*.

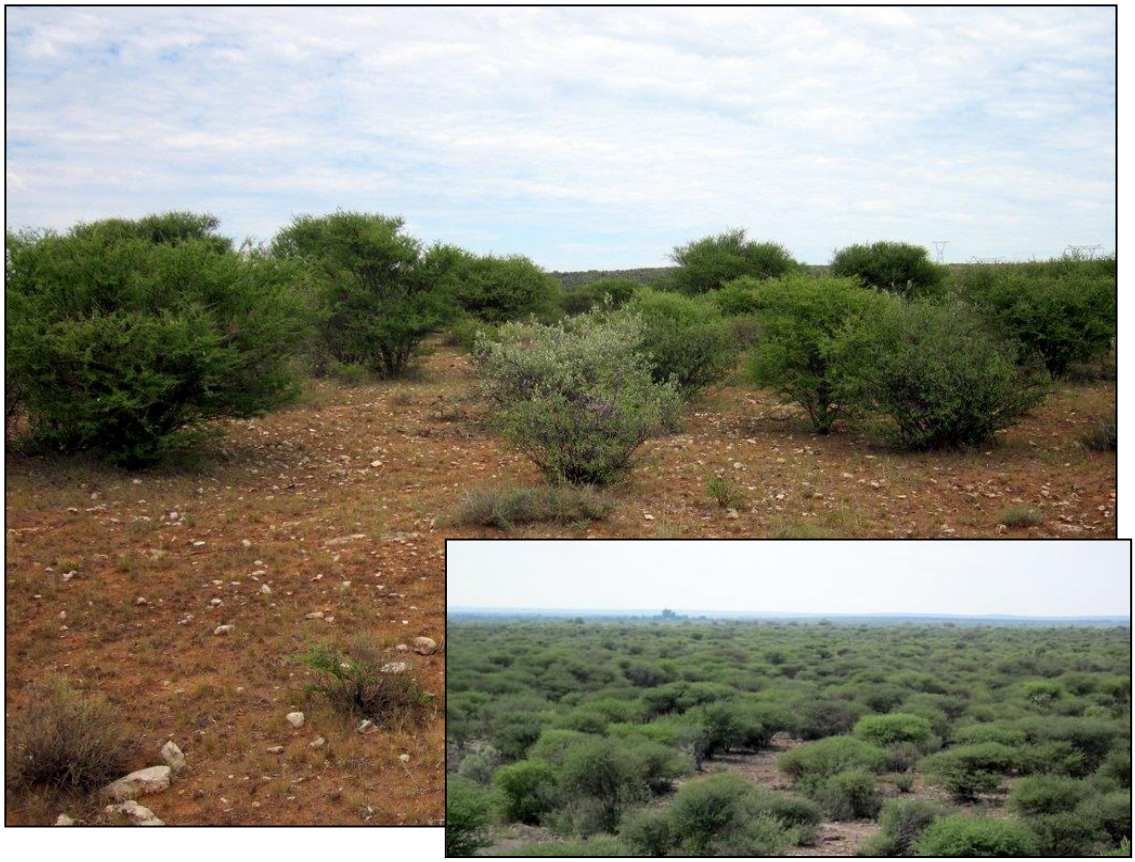
Some areas are recorded where the woodland is invaded by the declared invader *Prosopis glandulosa* and *Agave americana*. These areas are mostly degraded and transformed with little to no natural vegetation left and only bare soil patches visible on the ground in-between the trees and shrubs.

Red data species

Two protected tree plant species namely *Boscia albitrunca* and *Vachellia erioloba* were found within this woodland.

In the broader context of the landscape the proposed power line will impact on the Kimberley Thornveld (Savanna Biome) (SVk 4). The conservation value is less threatened and only 2% is statutorily conserved (Mucina & Rutherford 2006). The rainfall in this area occurs mainly in the summer; it is erratic and can be as high as 682 mm per year. Rain mostly occurs as thunderstorms. This is the same for the rest of the plant communities.

2. *Vachellia tortilis - Senegalia mellifera* shrubland



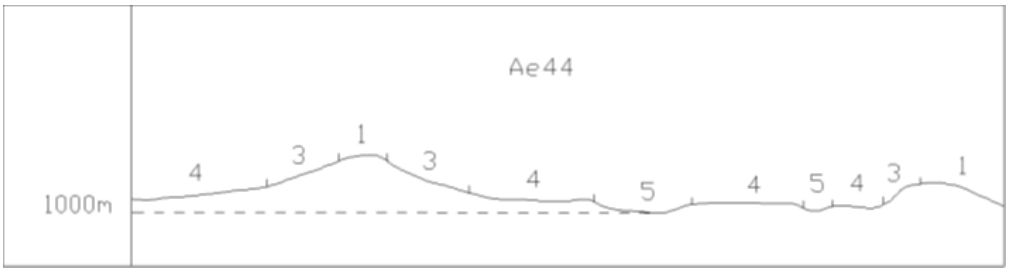
Soil	Rock and shallow stony soil, A horison 6 to 12%.	**Tree cover**	5%
Topography	Crest (1) and Midslope (3)	**Shrub cover**	25%
Land use	Livestock and free moving game	**Herb cover**	2%
Unit status	Natural to degraded	**Grass cover**	30%
Faunal spp.	Birds, insects	**Rock cover**	80%
		Erosion	5%

Dominant spp.	*Vachellia tortilis*, *Senegalia mellifera* and *Tarchonanthus camphoratus* and the grasses *Eragrostis lehmanniana* and *E. superba*.

Conservation value	**Low-medium**	**Ecosystem functioning**	**Low-medium**

The *Vachellia tortilis - Senegalia mellifera* shrubland which is strongly associated with the crest (1) and midslopes (3) of the Ae 44 land type in the study area. The dominant and prominent woody plant species consist of shrub and tree individuals of *Vachellia tortilis* and shrub *Senegalia mellifera*. This closed shrubland occurs along both proposed corridors. The most common land–uses are game and goat farming and agriculture which have resulted in some areas overgrazed. Existing powerline at the Ghaap plateau also noted.

The slightly undulating shrubland is closely associated with the crest (1) and midslopes (3) of the proposed powerline. The habitat of this shrubland consists of well-drained, shallow (< 0.3m), stony soil with large angular, andesitic lava rocks (more than 30%) on the soil surface. This shrubland is situated in the Ae 44 land type. The rock-soil complex of this shrubland consist of rock and Mispah soil form. Small isolated pans (5) have been recorded.



Ae 44 land type terrain form sketch (Land Type Survey Staff 1987)

Geology: Andesitic to basaltic lavas of the Ventersdorp Supergroup sometimes overlain by calcrete. Dwyka tillite occurs in places.

Dominant terrain unit: Crest (1) and midslope (3) with the soil/rock complex dominated by rock and Hutton soil form. Soil texture fine / medium sand with clay content between 6 to 12%. The A horison is well drained and the soil depth is shallower than 0.3 m.

In summary the important features for this shrubland are as follows:

The poorly developed tree stratum has a canopy cover of 5%. The only two trees that are prominent in this shrubland are *Vachellia tortilis* and *Ziziphus mucronata* as well as the protected sparsely distributed *Vachellia erioloba*. The well-developed shrub stratum, with dominant shrub species *Senegalia mellifera*, *Vachellia tortilis*, *Tarchonanthus camphoratus* and *Grewia flava* has a canopy cover of 25%. The herbaceous layer is poorly developed with a canopy cover of 32%. The prominent grasses *Oropetium capensis*, *Sporobolus africanus*, *Fingerhutia africana*, *Aristida meridionalis*, *Eragrostis lehmanniana*, *E. echinochloidea, Cymbopogon plurinodis* and *E. superba* with no forbs that are prominent in this shrubland. The physiognomic structure of this shrubland sometimes changes from open to impenetrable *Senegalia mellifera-Vachellia tortilis* thickets.

Red data species

One protected plant species was recorded namely the sparsely distributed *Vachellia erioloba*.

In the broader context of the landscape the proposed power line will impact on the Kimberley Thornveld (Savanna Biome) (SVk 4). The conservation value of this vegetation type is less threatened and only 2% is statutorily conserved (Mucina & Rutherford 2006).

3. *Cynodon dactylon-Vachellia karroo* woodland

Soil	Soil deeper than 1.2 m with clay content 15 to 35%.	**Tree cover**	2%
Topography	River (5)	**Shrub cover**	2%
Land use	Mining, irrigation, agriculture, livestock and free moving game	**Herb cover**	5%
Unit status	Natural to degraded	**Grass cover**	80%
Faunal spp	Various birds & insects, livestock and game	**Rock cover**	10%
		Erosion	10%

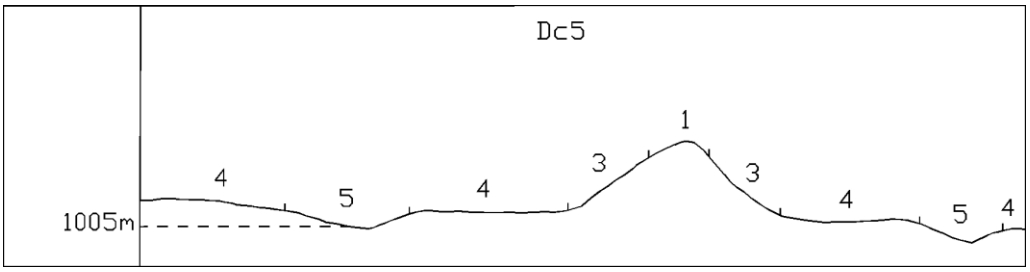
Dominant spp	*Vachellia karroo* and *Searsia lancea* trees and the shrub *Diospyros lycioides* and the grass *Cynodon dactylon* and the *reed Phragmites australis*.

Conservation value	**Medium-high**	**Ecosystem functioning**	**Medium-high**

The *Cynodon dactylon-Vachellia karroo* woodland is strongly associated with the Harts River (5). The dominant and prominent woody plant species consist of the trees *Vachellia karroo* and *Searsia lancea*. The most common land –uses are agriculture, game and goat farming, which have resulted in some areas overgrazed.

The relatively flat terrain is closely associated with the Harts River (5) where the proposed powerline cross the perennial River. The habitat of this open woodland

consists of poorly drained, deep (> 1.2m), silt-clayey, alluvial soil (clay-content between 15 - 35%) of the Harts River. The woodland is situated in the Dc 5 land type with the Katspruit and Mispah soil forms dominant. In some places in the River rocky outcrops were noted but otherwise no rocks or stones recorded.



Dc 5 land type terrain form sketch (Land Type Survey Staff 1987)

Geology: Tillite of the Dwyka Formation and shale of the Prince Albert Formation

Dominant terrain unit: River (5) with the rock-soil complex dominated by Katspruit and Mispah soil forms. Soil texture fine / medium sand with clay content between 15 to 35%. The B horison is poorly drained and the soil depth is deeper than 1.2 m.

In summary the important features for this vegetation unit are as follows:

The tree stratum is poorly developed and has a canopy cover of 2% while the shrub stratum has a canopy cover of 2%. The woody species are the trees *Acacia karroo*, *Searsia lancea*, *S. pendulina*, *Salix mucronata* and the exotic trees *Melia azedarach* and *Prosopis glandulosa*. Other woody species present in this woodland are the trees *Ziziphus mucronata* and the shrub *Diospyros lycioides* and the dwarf shrub *Lycium cinereum*. The herbaceous layer, which is well developed but degraded has a canopy cover of 80%. The prominent grasses are *Cynodon dactylon*, *Cenchrus ciliaris*, *Urochloa panicoides* and the reeds *Typha capensis* and *Phragmites australis* and the sedge *Schoenoplectus corymbosus*. The prominent forbs are the exotics *Argemone ochroleuca*, *Datura stramonium*, *Persicaria lapathifolia, Nicotiana longiflora*, *Flaveria bidentis* and *Verbena bonariensis*.

Red data species

No protected or rare plant species was recorded.

In the broader context of the landscape the proposed powerline impacts on a degraded Upper Gariep Alluvial Vegetation (AZa 4). The conservation value of this vegetation type is vulnerable and only 3% is statutorily conserved (Mucina & Rutherford 2006).

4. *Senegalia mellifera-Vachellia tortilis* shrubland

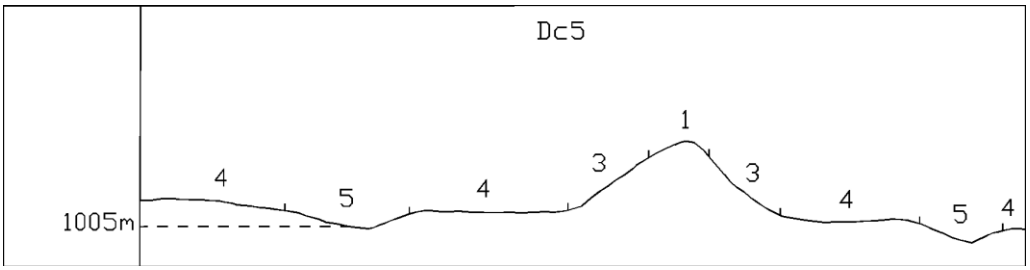
Soil	Rocky outcrop with shallow soil (< 0.25) with clay content 10 to 25%.	**Tree cover**	0%
Topography	Midslope (3)	**Shrub cover**	20%
Land use	Livestock and free moving game	**Herb cover**	55%
Unit status	Natural to degraded	**Grass cover**	3%
Faunal spp	Various birds & insects	**Rock cover**	30%
		Erosion	50%

Dominant spp	*Senegalia mellifera, Vachellia tortilis*, *Ziziphus mucronata* and *Searsia lancea* trees and the shrub *Grewia flava* and the grasses *Stipagrostis uniplumis* and *Enneapogon cenchroides* and the forbs *Aptosimum albomarginatum*, *Felicia muricata* and *Pentzia globosa*.

Conservation value	**Medium**	**Ecosystem functioning**	**Medium**

The *Senegalia mellifera-Vachellia tortilis* shrubland is associated with the undulating midslopes (3) on the eastern side of the Harts River. The dominant and prominent woody plant species consist of the shrubs *Senegalia mellifera* and *Vachellia tortilis*. The most common land–uses are game and goat farming, which have resulted in some areas being overgrazed.

The shrubland is closely associated with shallow (< 0.1 m depth) soil with calcrete stones on the soil surface and in some isolated places windblown (aeolian) sand with soil depth less than 0.25 m. Also in this shrubland are calcrete outcrops which are characteristic of this shrubland. The habitat of this shrubland consists of well drained rocky soil (clay-content between 10 - 25%). The shrubland is situated in the Dc 5 land type with the rock-soil complex being dominated by rock and Mispah soil form. Some termite activity were noted.



Dc 5 land type terrain form sketch (Land Type Survey Staff 1987)

Geology: Tillite of the Dwyka Formation and shale of the Prince Albert Formation

Dominant terrain unit: Midslope (3) with the rock-soil complex dominated by rock and Mispah soil form. Soil texture fine / medium sand with clay content between 10 to 25%. The soil is well drained and the soil depth is less than 0.25 m.

In summary the important features for this vegetation unit are as follows:

No tree species has been recorded, but the well-developed shrub stratum has a canopy cover of 20%. The woody plant species are the shrubs *Senegalia mellifera*, *Vachellia tortilis*, *Grewia flava*, *Ziziphus mucronata*, *Searsia lancea*, *Tarchonanthus camphoratus* and the dwarf shrub *Lycium cinereum*. The herbaceous layer is dominated by the karoo forbs *Pentzia globosa* and *Felicia muricata* and other forbs such as *Aptosimum albomarginatum*, *Chrysocoma ciliata*, *and Pupalia lappacea*. The herbaceous layer has a canopy cover of 55%. The grass species are the annual grasses *Stipagrostis uniplumis*, *Fingerhutia africana*, *Enneapogon cenchroides* and *Aristida meriodinalis* conspicuous with perennial grass species *Schmidtia pappophoroides* and also *Eragrostis lehmanniana* were also recorded.

Red data species

No rare or endangered plant species were recorded, however the calcrete outcrops is a sensitive plant community with sometimes rare and endangered plant species.

In the broader context of the landscape the proposed power line impacts on the Schmidsdrif Thornveld (SVk 6). The conservation value of this vegetation type is least threatened and only 0.2% is statutorily conserved (Mucina & Rutherford 2006).

5. *Grewia flava – Vachellia erioloba* woodland

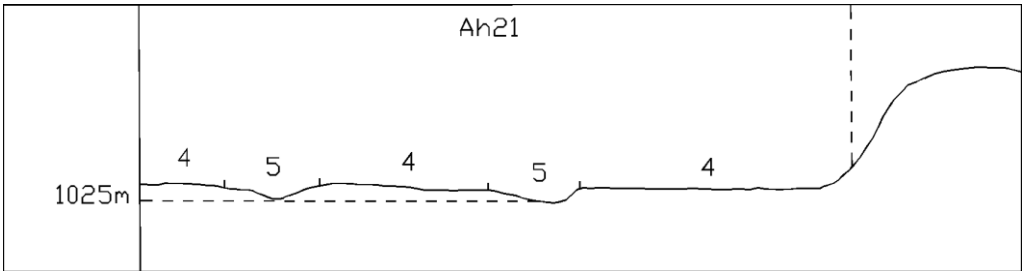
Soil	Deep (> 1.2 m) alluvial and aeolian sand with clay content 6 to 15%.	**Tree cover**	10%
Topography	Midslope (3)	**Shrub cover**	15%
Land use	Livestock and free moving game	**Herb cover**	15%
Unit status	Natural to degraded	**Grass cover**	60%
Faunal spp	Various birds, insects, cattle & game	**Rock cover**	0%
		Erosion	0%

Dominant spp	Prominent tree *Vachellia erioloba*. The prominent shrub species are *Grewia flava*, *Senegalia mellifera*. Prominent grasses are *Eragrostis lehmanniana*, *Schmidtia pappophoroides and Stipagrostis uniplumis*

Conservation value	**Medium**	**Ecosystem functioning**	**Medium**

The *Grewia flava* - *Vachellia erioloba* woodland is associated with the flat midslopes (3), which is overlain by aeolian (windblown sand) and alluvial sandy soil covering the Dwyka tillite. The conspicuous iconic *Vachellia erioloba* is the prominent woody plant species. The open woodland occurs along both proposed powerlines. The most common land-uses are game and goat farming, which have resulted in some areas in being overgrazed and browsed.

The woodland is closely associated with the relatively flat midslopes with deep (> 1.2m) well-drained red-brown and yellow-brown sandy (clay content 6 – 15%) alluvial and aeolian soil. No rocks or stones were noted on the soil surface, which is associated with the Ah 21 land type. The dominant soil form is Hutton soil form, while Shortlands, Clovelly and Mispah soil forms are also found in this woodland.



Ah 21 land type terrain form sketch (Land Type Survey Staff 1987)

Geology: Aeolian sand of Tertiary to Recent age covering Dwyka tillite. Surface limestone occurs sporadically.

Dominant terrain unit: Midslope (3) with the rock-soil complex dominated by the Hutton and Clovelly soil forms. Soil texture fine / medium sand with clay content between 6 to 15%. The soil is well drained and deeper than 1.2 m.

In summary the important features for this vegetation unit are as follows:

The tree stratum, with a canopy cover of 10% is represented by the prominent tree *Vachellia erioloba*. The prominent shrub species are *Grewia flava*, *Senegalia mellifera*, *S. hebeclada*, *Tarchonanthus camphoratus* and *Protasparagus suaveolens*. The shrub layer has a canopy cover of 15%. These prominent woody species, along with the trees *Vachellia tortilis* and *Ziziphus mucronata*, are widely distributed in this woodland. The herbaceous layer has a canopy cover of 75%. Prominent grasses are *Eragrostis pallens*, *E. lehmanniana*, *Pogonarthria squarrosa*, *Schmidtia pappophoroides*, *E. trichophora*, *Aristida congesta* and *Stipagrostis uniplumis*. Forbs that are constantly present are *Hirpicium echinus*, *Dicoma schinzii*, *Hermannia tomentosa*, *Ipomoea obscura*, *Merremia tridentata*, *Solanum nigrum* and *Indigofera daleoides*.

Red data species

One protected plant species was recorded namely the sparsely distributed *Vachellia erioloba*.

In the broader context of the landscape the proposed power line will impact on the Kimberley Thornveld (Savanna Biome) (SVk 4). The conservation value of this vegetation type is less threatened and only 2% is statutorily conserved (Mucina & Rutherford 2006).

6. *Combretum erythrophyllum - Vachellia karroo* woodland

Soil	Deep (> 1.2 m) poorly drained alluvial soil with clay content 15 to 35%.	**Tree cover**	35%
Topography	River floodplain and bank (5)	**Shrub cover**	10%
Land use	Mining and agriculture irrigation	**Herb cover**	15%
Unit status	Natural to degraded	**Grass cover**	25%
Faunal spp	Various birds & insects	**Rock cover**	Nona
		Erosion	None

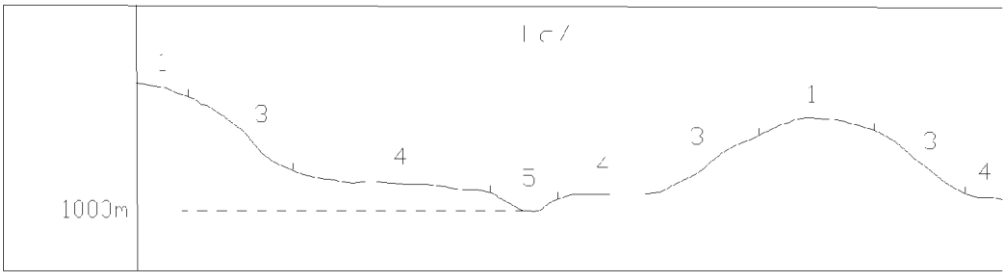
Dominant spp	Woody species *Vachellia karroo, Combretum erythrophyllum, Searsia pendulina, Salix mucronata.* The prominent grasses are *Setaria verticillata* and *Cynodon dactylon*. Unfortunately a large number of exotics

Conservation value	**High**	**Ecosystem functioning**	**Medium-high**

The *Combretum erythrophyllum - Vachellia karroo* woodland is strongly associated with the river bank and floodplain of the Vaal River. The dominant and conspicuous plant species are the trees *Ziziphus mucronata*, *Vachellia karroo* and *Combretum erythrophyllum*, the shrub *Diospyros lycioides* and in the herbaceous layer, the grass species, *Cynodon dactylon*. The closed woodland occurs along both proposed

corridors. The most common land-uses are mining activities and irrigation farming, which have resulted in some areas in being degraded.

The woodland is closely associated with deep (> 1.2 m depth) poorly drained alluvial soil of the Vaal River floodplain and bank (5), where the proposed powerlines cross the River. The clay-content of the soil varies between 15 - 35%. The woodland is situated in the Fc 7 land type with the Dundee and Oakleaf soil forms dominant. In some places in the River rocky outcrops were noted but otherwise no rocks or stones recorded.



Fc 7 land type terrain form sketch (Land Type Survey Staff 1987)

Geology: Oolitic, stromatolitic and algal limestone with interbedded siltstone (Schmidtsdrif Formation, Campbell Group), shale, quartzite, grit and conglomerate (Vryburg Formation, Campbell Group) and surface limestone of Tertiary to Recent age.

Dominant terrain unit: Floodplain and Vaal River bank (5) with the rock-soil complex dominated by the Dundee and Oakleaf soil forms. Soil texture fine / medium sand with clay content between 15 to 35%. The soil is poorly drained and deeper than 1.2 m.

In summary the important features for this vegetation unit are as follows:

The tree stratum is very well-developed and has a canopy cover of 35% while the shrub stratum has a canopy cover of 15%. The woody species are the trees *Vachellia karroo*, *Combretum erythrophyllum*, *Searsia pendulina*, *Salix mucronata* and the exotic shrub/tree *Nicotiana glauca*. Other woody species present in this

woodland are the trees *Ziziphus mucronata*, *Searsia lancea* and the shrub *Diospyros lycioides*. The herbaceous layer, which is very disturbed and is poorly developed, has a canopy cover of 35%. The prominent grasses are *Setaria verticillata* and *Cynodon dactylon*. The prominent forbs are the exotics *Argemone ochroleuca*, *Salsola kali, Opuntia ficus-indica, Cirsium vulgare*, *Tagetes minuta*, *Xanthium spinosum*, *Datura stramonium*, *Nicotiana longiflora* and *Verbena bonariensis*. The common reed *Phragmites australis* is also fairly abundant.

The declared invader tree *Eucalyptus camaldulensis* was also noted downstream.

Red data species

No protected or rare and endangered plant species were recorded but the woodland is under pressure because of a number of activities along the river and should be conserved.

In the broader context of the landscape the proposed powerline impacts on a degraded Upper Gariep Alluvial Vegetation (AZa 4). The conservation value of this vegetation type is vulnerable and only 3% is statutorily conserved (Mucina & Rutherford 2006).

7. *Vachellia* species open woodland

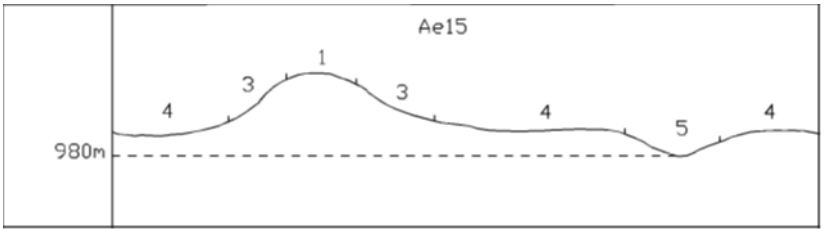
Soil	Red-yellow sand/clay	**Tree cover**	0%
Topography	Midslope (0-3^0)	**Shrub cover**	25%
Land use	Livestock and free moving game	**Herb cover**	15%
Unit status	Natural to degraded	**Grass cover**	55%
Faunal spp.	Birds, insects	**Rock cover**	2%
		Erosion	0%

Dominant spp.	*Vachellia erioloba, V. tortilis* and the grasses *Heteropogon contortus* and *Aristida meridionalis*.

Conservation value	**Low-medium**	**Ecosystem functioning**	**Low-medium**

The *Vachellia* species open woodland that consist of the two conspicuous trees *Vachellia erioloba* and *Vachellia tortilis* is strongly associated with the plains in and around Kimberley city. The dominant woody plant species is the *Vachellia tortilis* shrubs and trees. This open woodland occurs along the red line of the proposed powerline coming into Kimberley from Boshoff. The most common land-uses are game / hunting farms and then also cattle / sheep farming, which in some areas have led to severe grazing.

The topography varies from flat to slightly undulating plain areas with red-yellow well-drained soil varying from sandy to sandy clay (clay content 6 – 15 %). The dominant terrain unit where the proposed line will impact is the midslopes (3) (see figure below). The soil depth varies from 0.7 to deeper than 1.2 m with low rock cover estimated at 2%. In certain areas debris of old diamond diggings are found along the route and there the rock cover increase, with more than 30% well rounded rocks or stones on the soil surface is noted. The rest of the area rocks are mostly present as small scattered stones. No erosion was observed while bare patches of soil comprising between 15 and 40% occur between the vegetation. The dominant land type is the Ae 15 land type.



Ae 15 land type terrain form sketch (Land Type Survey Staff 1987)

Geology: Red to flesh-coloured wind-blown sand of Tertiary to Recent age, with dolerite outcrops.

Dominant terrain unit: Plains (3) with Hutton soil form dominant. Soil texture fine / medium sand with clay content between 6 to 15%. The red apedal B21 horison is well drained and the soil depth is between 0.7 to >1.2 m.

In summary the important features for this vegetation unit are as follows:

The dominant woody component is well developed with the tree stratum >6m tall with a canopy cover of 15%. The shrub stratum is 3m tall with a canopy cover of 25%. The conspicuous woody species which are present in this Woodland are the dominant trees *Vachellia erioloba* and *V. tortilis* as well as the shrubs *Senegalia mellifera*, *Searsia ciliata*, *Tarchonanthus camphoratus*, *Grewia flava* and *Protasparagus suaveolens*. The herbaceous layer is 0.8m tall with a canopy cover of 55%. The common grasses of plant community are *Heteropogon contortus* and *Aristida meridionalis*. The prominent forbs are *Gazania krebsiana*, *Elephanthorrhiza elephantina*, *Lippia javanica* and *Felicia muricata*.

Some areas are recorded where the plant community is invaded by the category 2 declared invader tree and shrub *Prosopis glandulosa* especially where overgrazing by livestock took place in the past. These areas are mostly degraded and transformed with little to no natural vegetation left and only bare soil patches visible on the ground in-between the trees.

Red data species

Two protected tree plant species namely *Boscia albitrunca* and *Vachellia erioloba* were found within this plant community.

In the broader context of the landscape the proposed power line will impact on the Kimberley Thornveld (Savanna Biome) (SVk 4). The conservation value is less threatened and only 2% is statutorily conserved (Mucina & Rutherford 2006). The rainfall in this area occurs mainly in the summer; it is erratic and can be as high as 682 mm per year. Rain mostly occurs as thunderstorms.

FAUNA

The Nama-Karoo and Succulent Karoo, now almost devoid of large wild ungulates, holds some 10 million Sheep (*Ovis aries*) and Goats (*Capra hircus*). The once plentiful and diverse set of nomadic herbivores has been replaced by large encamped herds of small livestock with specialist feeding habits. Nearly 200 years of this treatment has had a devastating effect on the Karoo soils and vegetation. Prolonged heavy grazing is considered to suppress shoot/root formation and flowering in the Nama-Karoo and Succulent-Karoo flora, which leads to compositional changes and depletion and thinning out of the vegetation, particularly those components that the sheep find palatable (Milton *et al.* 1994). Changes in the structure and composition of the vegetation affect the associated fauna. Thinning of the already sparse vegetation layer has greatly accelerated rates of soil erosion. Although conditions have improved since the 1950's, vegetation changes in the Nama-Karoo and Succulent-Karoo are now difficult or even impossible to reverse. The changed herbivore community and the resultant impacts on the vegetation has led to lower productivity of karroid vegetation. This, in turn, is thought to have affected the food chain and ultimately reduced the density of tertiary predators, particularly mammals as well as large eagles. High livestock densities also pose considerable threat to wildlife, since high numbers of domesticated animals generally cause a displacement of game, as there is less suitable habitat available. Furthermore, wild predators and scavengers such as the Black-backed Jackal, Caracal, Leopard and the Cape vulture have been eradicated by livestock farmers who see these animals as a threat to their livelihoods. Poisoned carcasses are often used for this purpose; this method is indiscriminate and therefore poses considerable threat to all predators and scavengers; especially the threatened White-backed and Lappet-faced Vultures. Poaching and illegal hunting (dogs) are further reducing the remnant faunal populations.

No comprehensive faunal surveys were conducted and species lists provided in the Appendix are of species most likely to occur on the site compiled from species observed during the brief field survey and supplemented from previous surveys conducted in the area as well as published literature.

Three general habitat sensitivity scans were carried out from the 24th-26th of March 2015. These site visits did not entail intensive surveying or utilisation of any sampling methods and can rather be viewed as being an opportunity to identify sensitive faunal habitats along the proposed Boundary-Ulco power line alignments.

All animals (mammals (larger), reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as animal tracks (footprints, droppings) to identify animals. The data was supplemented by previous surveys conducted in similar habitats, literature investigations, personal records and historic data. Different habitats were explored to identify any sensitive or specialized species. Habitats explored included the mixed *Vachelia* species open woodland and open shrubland in various forms of transformation and degradation (overgrazing, frequent fires, alien vegetation invasion), loosely embedded rock material of calcrete and dwyka tillite rocky hills/outcroips, wetlands including artificially created dams, Rivers (Vaal and Harts) and associated riparian zones, stumps, moribund termite mounds, abandoned animal burrows, trees and under lose bark material.

MAMMALS

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

mammal species such as rabbits and mongooses. Secondary access roads and vehicles (motor cars, motor cycles, quad bikes) which transverse the area and bisect the valley bottom wetlands increase access to the site as well as potential road fatalities. Major road networks (R31) with high vehicular traffic increase the risk of road fatalities (hedgehogs, hares) of mammals. Smaller mammal species including the South African Hedgehog are extremely vulnerable to feral cats and dogs.

The Yellow and Slender Mongooses and Meerkat/Suricates were observed on the site and prey on the smaller rodents, birds, reptiles and amphibians on the site. Animal burrows (Yellow Mongooses, Suricate, Highveld Gerbil, Multimmamate Mouse and African Molerat) were observed around the sandy sections of the grasslands. Several active Antbear burrow systems were observed within the foothills. Small isolated patches of rocky outcrops are present in some localities and offer suitable habitat for rupicolous mammal species such as Rock Hyrax, Smith's Elephant Shrew, Bushveld Elephant Shrew, Dassie Rat, Smith's Rock Rabbit and Rock Dormouse.

Several Greater Kudu (*Tragelphagus strepsiceros*) and Common Duikers (*Sylvicarpa grimmia*) were observed in the open and closed *Vachelia* (*Acacia*) woodland vegetation units along the alternative alignments. Several Springbok (*Antidorcas marsupialis*) were observed in the open woodland vegetation units. Vervet Monkeys (*Ceropithecus aethiops*) were observed foraging in a Camel-Thorn (*Vachelia erioloba*). Several Chacma Baboons (*Papio ursinus*) were observed drinking along the Vaal River. Several rodent burrows (most likely Bushveld Gerbils) were observed within the sandy sections of the alignments.

Evidence of Cape Clawless Otters (*Aonyx capensis*) in the form of faeces or spraints as well as quills of Cape Porcupine (*Hystrix africaeustralis*) where also observed along the riparian zone of the Harts River.

Figure 5. Several recently scraped and active Aardvark burrows were observed adjacent to the Boundary-Ulco alignments.

Several Aardvark (*Orycteropus afer)* burrow systems where observed during the field survey. Several recently excavated burrows were found in open woodland, scrub and grassland, especially where these are associated with sandy ground. Nevertheless, they are capable of utilizing heavy soils and are found in areas of *Vachelia* woodland and other types of hard ground, and on heavy red soils of parts of the Subregion. They are associated particularly with heavy utilized grassland where there are termite populations (Skinner and Smithers, 1991).

Apart from small exploratory scratchings, which show clearly the impression of the broad front claws, aardvarks appear to make three types of excavations. The first are shallow diggings, often in flat ground or penetrating termitaria, which are only sufficiently deep to give access to the food. Some of these burrows may penetrate a termitarium to a depth sufficient to cover the head and shoulders of the animal, or allow it to disappear altogether. These excavations are not used as refuges and normally are not revisited. The second type of burrow, dug overnight, is a temporary refuge and may penetrate several metres shallowly underground. These may be re-used over a period of a day or two or may be returned to sporadically. They usually have a chamber at the end to allow the individual to turn around. The third type of burrow is the most permanent and is used as a shelter where the young are born.

These permanent shelters may extend deeply into the ground, have an extensive burrow system with numerous chambers, and several entrances. Burrows, when unoccupied, provide both shelter and safe refuge for a wide range of mammals, birds, reptiles and insects (Skinner and Smithers, 1991).

The proposed Boundary-Ulco alignments 1 and 2 bisect portions of the de-proclaimed Vaalbos Nature Reserve. The reserve was de-proclaimed due to land claims in the area. The Vaalbos Nature Reserve was replaced by the Mokalo National Park to the south of Kimberly. The name is derived from the Setswana name for a Camel Thorn tree (*Vachelia Acacia erioloba*), and this Park is dominated by these beautiful trees that can reach up to 16m tall and have a distinctive wide, spreading crown. The park, proclaimed as recently as June 2007, is tucked between the hills, Mokala's landscape varies between koppieveld (hills) and large open plains. The isolated dolerite hills give the place a calming feeling of seclusion and offer a lovely contrast to the large open sandy plains towards the north and west of the Park. Drainage lines from the hills form little tributaries that run into the plains and drain into the Riet River. The Park is currently 19 611ha in size and the following species occur in the park: Black Rhino, White Rhino, disease-free Buffalo, Tsessebe, Roan Antelope, Mountain Reedbuck, Giraffe, Gemsbok, Eland, Zebra, Red Hartebeest, Blue Wildebeest, Black Wildebeest, Kudu, Steenbok, Duiker and Springbok.

Threatened Mammal Species

Various mammal species are likely to occur within the study area. A probable mammal species list of mammals that are likely to occur in study area according to Skinner & (Chimimba 2006) with the assigned level of threat facing each particular species is included as APPENDIX 1. A map was used to correlate the occurrence of the Red Data species with their approximate occurrence within the study area. According to Friedman & Daly (2004) and Skinner & Chimimba (2006), the majority of species within the study area are common and widespread and listed as species of least concern.

Table 2. Mammal species of conservation importance possibly occurring on within the proposed alternative alignments (using habitat availability and distribution as an indicator of presence).

Family	Genus	Species	Common name	Red list category	Atlas region endemic
Felidae	*Leptailurus*	*serval*	Serval	Near-Threatened	0
Manidae	*Smutsia*	*temminckii*	Ground Pangolin	Vulnerable	0

Several mammal species have been downgraded since the conservation assessment undertaken by Friedman & Daly, (2004). Species downgraded to Least Concern including Black-footed Cat (*Felix nigriceps*), Dassie Rat (*Petromus typicus*) and Honey Badger (*Mellivora* capensis) which were previously listed as 'Near Threatened'.

Serval (*Leptailurus serval*)

In sub-Saharan Africa, servals are found in well-watered savanna long-grass environments and are particularly associated with reedbeds and other riparian vegetation types. The major threat to serval is wetland habitat loss and degradation. Wetlands harbour comparatively high rodent densities compared with other habitat types, and form the core areas of serval home ranges. Of secondary importance is degradation of grasslands through annual burning followed by over-grazing by domestic livestock, leading to reduced abundance of small mammals

Ground Pangolins *Smutsia (Manis) temminckii*

Figure 6. Ground Pangolin is a rare solitary species which has been recorded from the Kimberly-Ulco area (Photo taken in KNP).

Ground Pangolins *Smutsia temminckii* are uncommon throughout its known range, which extends from south of the Sahara to the east of Africa and to the northern parts of South Africa. Ground Pangolins are savanna species and don't occur in swamps, grassland, forests and desert. This species is Within this broad category, however, they are catholic in their habitat requirements, occurring in scrub in areas of low rainfall (250mm per year), as well as various types of savanna woodland, floodplain grassland, bushveld, rocky hills, and on sandveld with a much higher rainfall (up to 1 500mm per year). Pangolins move between many different burrow sites with a well-defined home range. In Limpopo Province the area of the home range was 1.3-7.9 km^2 (Skinner & Chimimba 2005).

The Ground Pangolin seems to favour areas with moderate temperatures not dropping below 0°C. The ground pangolin is a savanna species and does not occur in the swamps, grasslands, forest or desert. Within this broad category they are catholic in their habitat requirements, occurring in scrub in areas of low rainfall (250mm per year), and various types of savanna woodland, floodplain grassland, bushveld, rocky hills, and on sandveld with a much higher rainfall (up to 1 400mm per annum). Swart *et al.* (1999) have hypothesized that their absence from parts of southern Africa may be due tio the effects of temperature on certain ant activity and the nest characteristics, especially *Anoplolepis custodiens* (primary food source), which escape the cold winter nights by hibernating deep below the soil surface (Skinner & Chimimba 2005).

This solitary species occurs in low numbers, and occupies large home ranges and move between different burrow sites. The Ground pangolin uses the burrow system of Aarvarks, Springhares and Warthogs. The males in the Sabi Sand nature reserve have home ranges of up to 2000 ha whereas the female move in areas of 500ha. Their major threat seems to be the muti trade as there is a high demand for their scales. Only one young is born per year, seemingly in the drier months). They are also vulnerable to agricultural developments and seem to be susceptible to insecticides. It is highly unlikely that the proposed Boundary-Ulco powerline alignments provide critical habitat for any of the above-mentioned threatened mammal species.

MAMMAL MANAGEMENT RECOMMENDATION*S*

- Due habitat transformation and destruction as well as the high level of human activity within the proposed it is however unlikely that the study area comprises significant habitat for any larger threatened mammal species. These are restricted to the private game parks in the area.
- All large indigenous tree species should be conserved wherever possible as they form important habitat for arboreal mammal species.
- Activities should be restricted away from any rocky hills and outcrops as well as riparian habitats along the non-perennial drainage lines.
- The conservation and correct management of the Vaal and Harts Rivers riparian habitats along the proposed servitudes should ensure the conservation of all remaining suitable habitat for wetland/riverine associated mammals on the site (Cape Clawless Otter).
- No hunting or poaching activities must be allowed along the servitudes during all phase of the project.

REPTILES

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Due to current agricultural activities in the area coupled with increased habitat degradation (overgrazing, soil erosion) and disturbances are all causal factors in the alteration of reptile species occurring in

these areas. Limited low-lying quartzite and dolerite rock outcrops occur around the proposed alignments and provide favourable refuges for certain snake and lizard species (rupicolous species). Reptile species recorded from the scatterd rocky hills and rupicolous outcrops along the alignments included Yellow-Throated Plated Lizard (*Gerrhosaurus flavigularis*), Montane Speckled Skink (*Trachylepis* (*Mabuya*) *punctatissima*), Western Rock Skink (*Trachylepis sulcata sulcata*), Cape Skink (*Trachylepis* (*Mabuya*) *capensis*) Ground Agama (*Agama aculeata*), Cape Thick-toed Gecko (*Pachydactylus capensis)* and Southern Rock Agama (*Agama atra*). The removal of rock material for commericial activities from the de-proclaimed Vaalbos Nature Reserve will have a high negative impact on remaining rupicolous reptile species.

Figure 7. A Western Rock Skink (*Trachylepis sulcata sulcata*) was observed within the calcrete outcrops as well as rocky hills adjacent to the alignments.

The indiscriminate killing of all snake species as well as the illegal collecting of certain species for private and the commercial pet industry reduces reptile populations especially snake populations drastically. Three snake species were recorded including a Mole Snake (*Pseudaspis cana*), Striped Grass Snake (*Psammophylax tritaeniatus*) and a road fatality of a Puff Adder (*Bitis arietans*). The frequent burning of the grassland vegetation on the site will have a high impact on remaining reptiles. Fires during the winter months will severely impact on the

hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks. Trees including stumps; bark and holes in trees are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors). Reptile species recorded in the woodland areas of the sites included Common Dwarf Gecko (*Lygodactylus capensis*), Flap-neck Chameleon (*Chamaeleo dilepis*) and Striped Skink (*Trachylepis punctatissima*) as well as White-throated or Rock Monitor (*Varanus albigularis*)**.**

Moribund (old abandoned or dead mounds) termite mounds offer important refuges for numerous frog, lizard and snake species (Striped Harlequin Snake). Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). These mass emergences coincide with the first heavy summer rains and the emergence of the majority of herpetofauna. Termite mounds also provide nesting site for numerous snakes, lizards (varanids) and frogs. Favourable habitat exists throughout most of the study area for various snake species. Indiscriminate killing of all snake species is likely to have resulted in the disappearance of the larger and the more sluggish snake species within the study area. The frequent burning of the site will have a high impact on remaining reptiles. Fires during the winter months will severely impact on reptiles under brumation which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

A probable reptile species lists according to habitat and distribution records of Branch (1998a) is presented in APPENDIX 2.

Figure 8. Several burrows of the Common Barking Gecko (*Ptenopus garrulus*) were observed in the sandy soils at the base of the Camel Thorns (*Vachelia erioloba*).

Table 3. Reptiles species recorded during the South African Reptile Conservation Assessment (SARCA) from the combined locus = 2824DD, 2825CC, 2825DA, 2825DB, 2825DD

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Agamidae	**Agama*	*aculeata*	*aculeata*	Common Ground Agama	Least Concern (SARCA 2014)	
Agamidae	**Agama*	*aculeata*	*distanti*	Distant's Ground Agama	Least Concern (SARCA 2014)	Yes
Agamidae	**Agama*	*atra*		Southern Rock Agama	Least Concern (SARCA 2014)	
Amphisbaenidae	*Monopeltis*	*capensis*		Cape Worm Lizard	Least Concern (SARCA 2014)	
Atractaspididae	**Aparallactus*	*capensis*		Black-headed Centipede-eater	Least Concern (SARCA 2014)	

Atractaspididae	*Xenocalamus*	*bicolor*	*bicolor*	Bicoloured Quill-snouted Snake	Least Concern (SARCA 2014)	
Chamaeleonidae	**Chamaeleo*	*dilepis*	*dilepis*	Common Flap-neck Chameleon	Least Concern (SARCA 2014)	
Colubridae	*Boaedon*	*capensis*		Brown House Snake	Least Concern (SARCA 2014)	
Colubridae	**Crotaphopeltis*	*hotamboeia*		Red-lipped Snake	Least Concern (SARCA 2014)	
Colubridae	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Least Concern (SARCA 2014)	
Colubridae	*Lycodonomorphus*	*rufulus*		Brown Water Snake	Least Concern (SARCA 2014)	
Colubridae	*Lycophidion*	*capense*	*capense*	Cape Wolf Snake	Least Concern (SARCA 2014)	
Colubridae	*Psammophis*	*trinasalis*		Fork-marked Sand Snake	Least Concern (SARCA 2014)	
Colubridae	**Psammophylax*	*tritaeniatus*		Striped Grass Snake	Least Concern (SARCA 2014)	
Colubridae	**Pseudaspis*	*cana*		Mole Snake	Least Concern (SARCA 2014)	
Cordylidae	*Karusasaurus*	*polyzonus*		Karoo Girdled Lizard	Least Concern (SARCA 2014)	
Elapidae	*Elapsoidea*	*sundevallii*	*media*	Highveld Garter Snake	Not listed	
Elapidae	*Naja*	*nivea*		Cape Cobra	Least Concern (SARCA 2014)	
Gekkonidae	**Chondrodactylus*	*bibronii*		Bibron's Gecko	Least Concern (SARCA 2014)	
Gekkonidae	**Lygodactylus*	*capensis*	*capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)	
Gekkonidae	**Pachydactylus*	*capensis*		Cape Gecko	Least	

					Concern (SARCA 2014)	
Gekkonidae	**Ptenopus*	*garrulus*	*garrulus*	Common Barking Gecko	Least Concern (SARCA 2014)	Yes
Lacertidae	*Nucras*	*holubi*		Holub's Sandveld Lizard	Least Concern (SARCA 2014)	
Lacertidae	**Pedioplanis*	*lineoocellata*	*lineoocellata*	Spotted Sand Lizard	Least Concern (SARCA 2014)	
Pelomedusidae	*Pelomedusa*	*subrufa*		Marsh Terrapin	Least Concern (SARCA 2014)	
Scincidae	*Acontias*	*gracilicauda*		Thin-tailed Legless Skink	Least Concern (SARCA 2014)	Yes
Scincidae	*Afroablepharus*	*wahlbergii*		Wahlberg's Snake-eyed Skink	Least Concern (SARCA 2014)	
Scincidae	**Trachylepis*	*capensis*		Cape Skink	Least Concern (SARCA 2014)	
Scincidae	**Trachylepis*	*punctatissima*		Speckled Rock Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*punctulata*		Speckled Sand Skink	Least Concern (SARCA 2014)	
Scincidae	**Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Least Concern (SARCA 2014)	
Testudinidae	*Homopus*	*femoralis*		Greater Padloper	Least Concern (SARCA 2014)	Yes
Testudinidae	*Psammobates*	*oculifer*		Serrated Tent Tortoise	Least Concern (SARCA 2014)	
Testudinidae	**Stigmochelys*	*pardalis*		Leopard Tortoise	Least Concern (SARCA 2014)	
Typhlopidae	*Rhinotyphlops*	*lalandei*		Delalande's Beaked Blind Snake	Least Concern (SARCA 2014)	

Varanidae	**Varanus*	*albigularis*	*albigularis*	Rock Monitor	Least Concern (SARCA 2014)	
Varanidae	*Varanus*	*niloticus*		Water Monitor	Least Concern (SARCA 2014)	
Viperidae	**Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern (SARCA 2014)	

* reptile species recorded during brief field survey and supplemented with previous surveys conducted in the area.

Threatened Species

No threatened reptile species have been recorded from the combined locus = 2824 CD, 2824 CC, 2824 BB and 2824 BA. Four endemic reptile species namely Distant's Ground Agama (*Agama aculeate distanti*), the Marico Gecko (*Pachydactylus mariquensis*), Thin-tailed Legless Skink (*Acontias gracilicauda*) and Greater Padloper (*Homopus femoralis*) have been recorded in the adjacent grid squares. The Southern African Python (*Python natalensis*), Water Monitor (*Varanus niloticus*) and Rock or White-throated Monitors (*Varanus albigularis*) are protected species.

REPTILE MANAGEMENT RECOMMENDATIONS

- No rock removal should occur adjacent to the proposed towers. No termite mounds should be intentionally destroyed. If any moribund termite mounds have to be destroyed due to tower position it should be carefully excavated by hand and pick.
- Any animals rescued or recovered will be relocated in suitable habitat away from the transmission tower and line.
- Trees including stumps; bark and holes in trees are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors).
- The removal of indigenous tree species (*Vachelia erioloba*) as well as clearance of the riparian vegetation along the Vaal and Harts Rivers must be kept to the minimum area required wherever possible.
- Exotic cleared vegetation should form wood piles and logs and stumps. Dead or decaying wood piles should be created as these will provide valuable refuge areas especially due to the clearance of vegetation cover. Logs and stumps also provide important habitats for several reptile species as well as smaller mammals, amphibians, arachnids and scorpions. With time they will eventually be reduced to valuable compost by several animal species. Dead trees and stumps

will also be used for nesting purposes by barbets, hoopoes, owls, hornbills as well as perching or hunting platforms for birds like the kingfisher.

- Any lizards, gecko's, agamids, monitors or snakes encountered should be allowed to escape to suitable habitat away from the disturbance. No reptile should be intentionally killed, caught or collected during any phase of the project.
- Several venomous snake species occur along the proposed lines including Cape Cobra (*Naja nivea*) and Puff Adder (*Bitis arietans*).
- General avoidance of snakes if the best policy if encountered. Snakes should not be intentionally harmed or killed and allowed free movement away from the area.
- Appropriate foot wear (sturdy leather boots) should be worn in the field.

AMPHIBIANS

Conservation efforts to protect the planet's vertebrate diversity have been disproportionate for the various groups and have tended to favour mammals and birds. The so-called 'lower vertebrates' such as fish, amphibians and reptiles; generally have a lower public appeal and are typically neglected in conservation programmes, yet these groups are of fundamental importance at an ecosystem level.

Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried 1989) and are such worthy of both research and conservation effort. This is made additionally relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but as yet is poorly understood (Wyman 1990; Wake 1991). Amphibians have declined dramatically in many areas of the world. These declines seem to have worsened over the past 25 years and amphibians are now more threatened than either mammals or birds, though comparisons with other taxa are confounded by a shortage of reliable data.

Most frogs have a biphasic life cycle, where eggs laid in water develop into tadpoles and these live in the water until they metamorphose into juvenile fogs living on the land. This fact, coupled with being covered by a semi-permeable skin makes frogs particularly vulnerable to pollutants and other environmental stresses. Consequently frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment.

The biogeographical distribution of amphibians in the greater Kimberly area falls under the Central District. The Central District covers most of Lesotho, Free State

and North West Province, together with northern parts of Northern Cape Province. In the west, the southern boundary follows the course of the Gariep River. In the east, the southern boundary lies in the ecotonal Grassy Karoo. In the northwest, the district ends where subtropical woodlands begin, and in the east the boundary follows the interface between sweet grasslands in the west and sour grasslands in the east. Amphibian species richness is generally low in the Central District and tends to decrease toward the west. Species counts just exceed 10 species per grid cell in the eastern extremes and are mostly <6 in the west. Species richness of endemics is <4 species per grid cell over the entire district, and no range-restricted species are present. This district is subdivided into two assemblages namely the Sweet Grasslands and Kalahari assemblages (Alexander *et al.* 2004).

Seven frog species were recorded from the seasonal and permanent (farm dams) wetland habitats around the proposed alignments including Raucous Toad (*Amietophrynus rangeri*), Drakensberg River Frog (*Amietia quecketii*), Cape River Frog (*Amietia fuscgicula*), Bubbling Kassina (*Kassina senegalensis*), Tremelo Sand Frog (Tomopterna cryptotis), Natal Sand Frog (*Tomopterna natalensis*) and Common Platanna (*Xenopus laevis*). All frog species recorded are common and widespread.

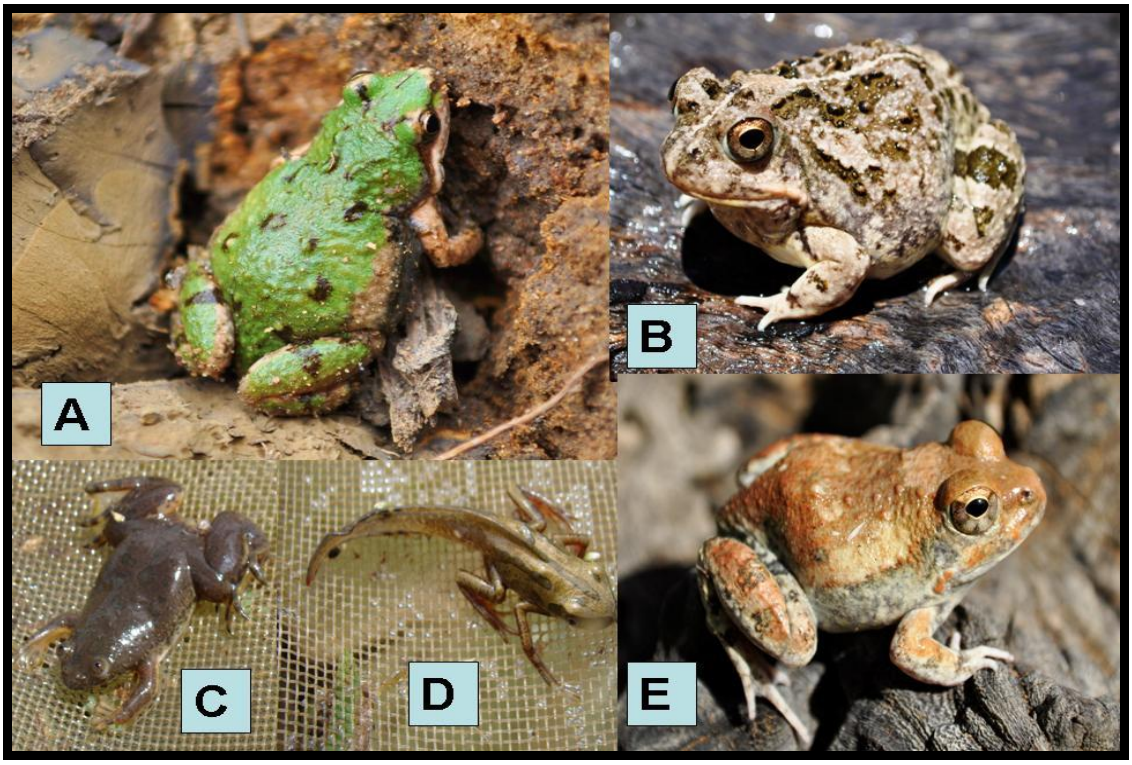


Figure 9. **A conglomerate of photographs displaying the frog species recorded during the current survey. A:** Common or Boettger's Caco (*Cacosternum boettgeri*); **B:** Tremelo Sand Frog (*Tomopterna cryptotis*); **C:** Common

Platanna (*Xenopus laevis*); **D:** Bubbling Kassina (*Kassina senegalensis*) and **E:** Natal Sand Frog (*Tomopterna cryptotis*).

Habitat available for sensitive or endangered species

Figure 10: **A collage of photographs displaying the reproductive cycle of the Giant Bullfrog: A:** Amplectant pairs lay eggs in shallow water between 2-5cm deep; **B:** Tadpoles form characteristic aggregates or schools in the shallow water and **C:** develop rapidly in the warm, nutrient rich water. **D:** The tadpoles reach Gosner stage 42 between 20 and 28 days; **E:** The tail is fully absorbed (Gosner stage 46) at approximately 30-32 days. **F:** The emerging juveniles disperse up to several kilometres (up to 6km) away from the breeding localities.

Giant Bullfrog *(Pyxicephalus adspersus)*

The Giant Bullfrog is currently assigned as a near-threatened species (IUCN Red List category). Giant Bullfrogs have been recorded from the Kimberly area and adjacent grid squares during previous surveys as well as during the South African Frog Atlas Project (SAFAP). Specimens recorded were of road fatalities, migrating adult males as well as potential breeding localities in the Kimberly area. Bullfrog density commonly varies within certain habitats (open grassland and woodland habitat). High densities are often associated with specific microhabitats or patches (hygrophytic or aquatic ephemerophytic grass and sedge dominated temporary pans) that can be identified and randomly sampled. The open *Themeda triandra, Eragrostis lehmanniana* and *Aristida adscensionis* open grassland and Vachelia open woodland habitats are important migratory/dispersal and foraging areas as well as the adjacent seasonal wetlands (pans, drainage and marshland vegetation) surrounding the alternative alignments offer suitable breeding habitats. The seasonal

wetland habitats comprising shallow seasonally inundated depressions offer the most suitable breeding habitat for Giant Bullfrogs in the area. The Highveld Salt Pans may offer suitable breeding habitat for Giant Bullfrogs depending on the salinity of the water. More intensive surveys conducted over extended periods are required in order to ascertain the current conservation status of Giant Bullfrogs in the area.. It is highly unlikely that the proposed alternative Boundary-Ulco powerline alignments will have a significant impact on remaining bullfrog populations if the proposed tower positions are placed away from the any seasonal wetland habitats (especially seasonally inundated pans/grassland). No Giant Bullfrogs must be captured on disturbed during the construction phase of the project.

AMPHIBIAN MANAGEMENT RECOMMENDATIONS

- Construction activities of the Beta-Boundary powerline should be restricted to daylight hours reducing the potential impact on the nocturnal breeding activities of the majority of amphibian species.
- Ideally the installation of the new towers should be undertaken during the dry winter months (May-September) when the majority of amphibian species are dormant.
- The towers must not be placed in any seasonal wetland habitats and should be positioned outside the temporary wet areas.
- No Giant Bullfrogs must be collected for food or illegal pet trade.

As a precautionary mitigation measure it is recommended that the developer and construction contractor as well as an independent environmental control officer (ECO) should be made aware of the possible presence of certain threatened amphibian species (Giant Bullfrog) prior to the commencement of construction of the new line.

DISCUSSION

i. *ENVIRONMENT*

Threatened ecosystems & Protected areas

No protected protected area or and threatened ecosystem occurs within the proposed corridors. The proposed routes do however cross two river systems (Harts river & Vaal River = corridor 1; Harts river = corridor 2) (Figures 11 & 12).

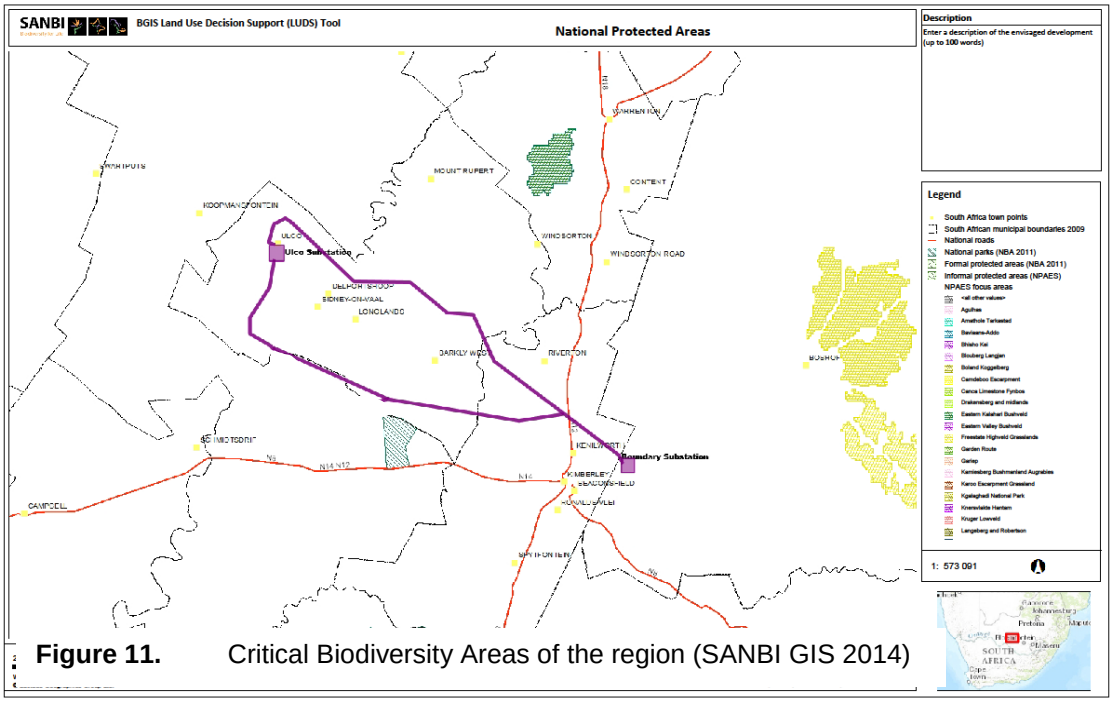


Figure 11. Critical Biodiversity Areas of the region (SANBI GIS 2014)

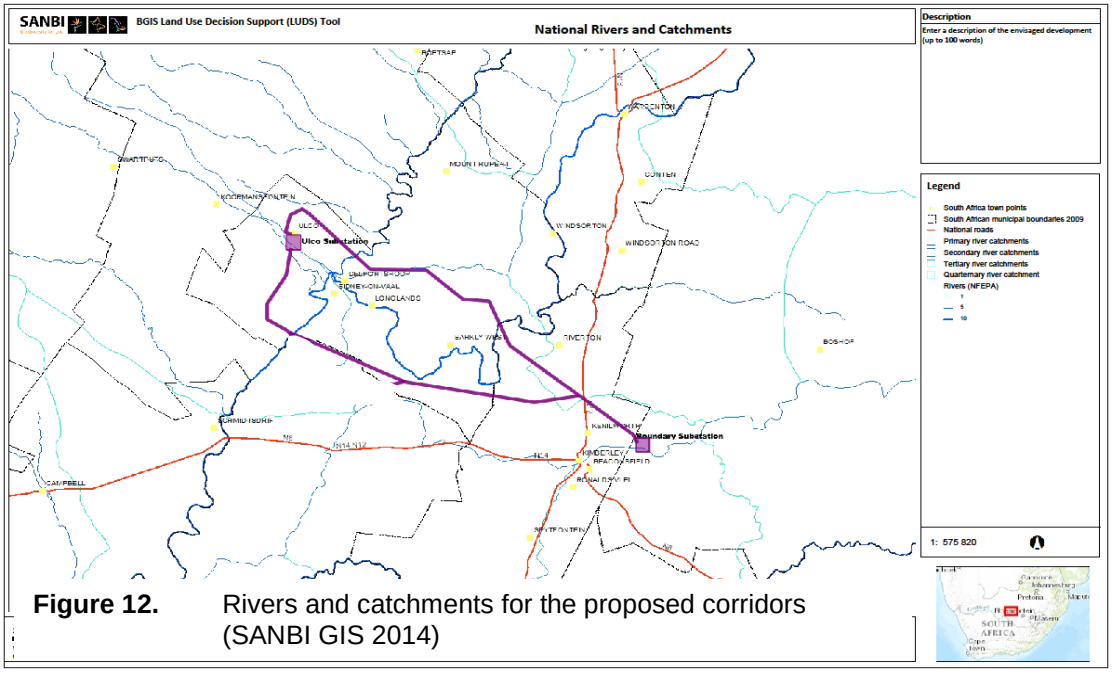


Figure 12. Rivers and catchments for the proposed corridors (SANBI GIS 2014)

ii FLORA

Vegetation types

On a small scale the proposed routes fall within the savanna biome and within a larger regional scale the proposed routes are according to Mucina & Rutherford (2006) located within the Eastern Kalahari Bushveld Bioregion (Svk) (Figure 13).

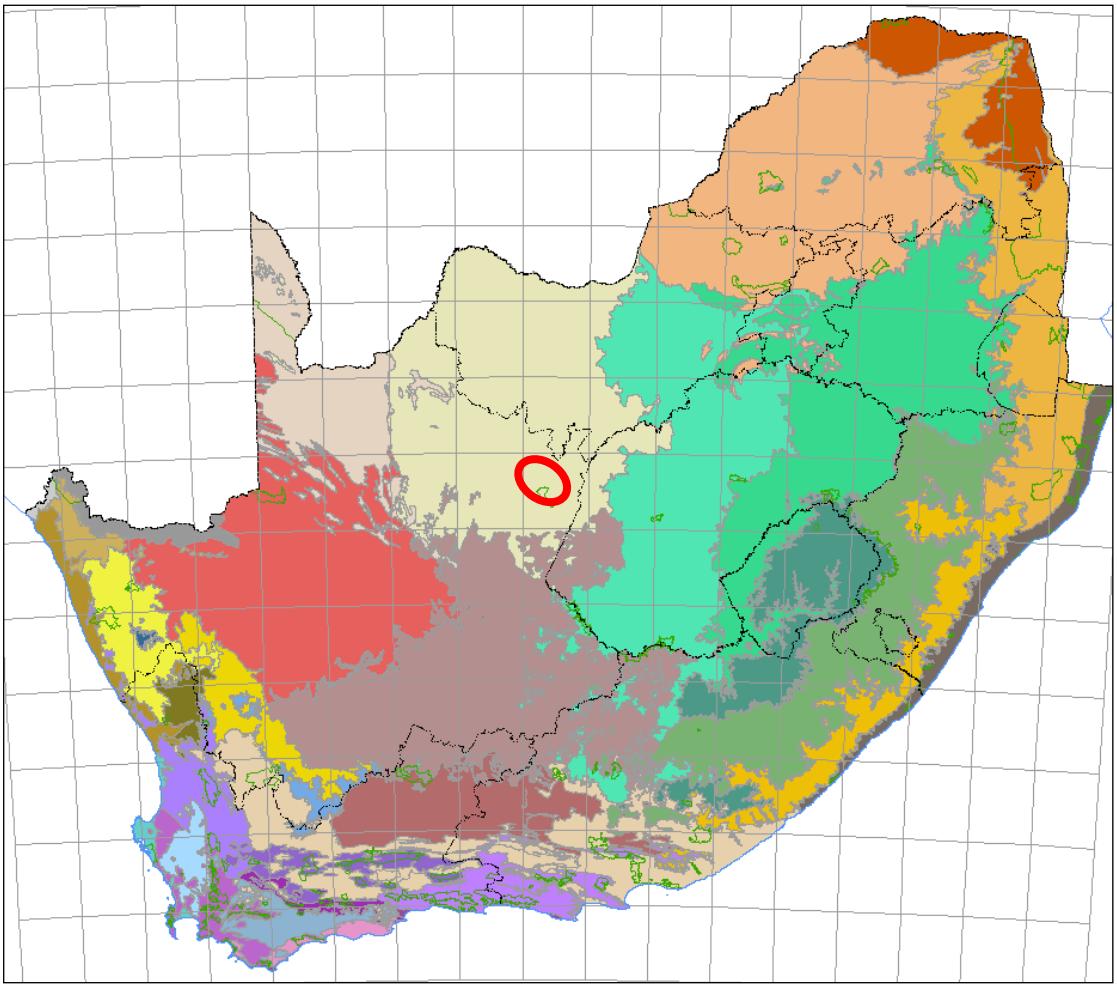


Figure 13. Different Bioregions of South Africa with red circle indicating the proposed routes located within the Eastern Kalahari Bushveld Bioregion (beige).

A Bioregion represents an intermediate level between a biome and a vegetation unit with each bioregion having specific biotic and physical features at a regional scale (Mucina & Rutherford 2006). Each Bioregion has a distinct climatic character that differs from other bioregions.

In terms of vegetation types the proposed routes include the Kimberley Thornveld (SVk4), Schmidtsdrif Thornveld (SVk6) and one small section of the Upper Gariep Alluvial Vegetation (AZa4) (Mucina & Rutherford 2006).

Kimberley Thornveld (SVk4)

The Kimberley thornveld occurs on sandy to loamy texture soil on flat to undulating plains on andesitic lava and sediments of the Karoo Supergroup. In the elbow of the Vaal River just before the confluence with the Harts River, deep aeolian sandy texture soil of the Clovelly and Hutton soil forms occur.

The vegetation comprises a mixture of trees and shrubs and is characterised by the dominance of trees *Vachellia erioloba, V. tortilis, V. karroo* and *Boscia albitrunca.* Other species include *Acacia mellifera, Searsia lancea, Tarchonanthus camphoratus, Ehretia rigida, Acacia hebeclada, Wahlenbergia nodosa, Lycium cinerium, Eragrostis lehmanniana, Aristida canescens, Digitaria eriantha, Heteropogon contortus, Harpagophytum procumbens, Osteospermum muricatum* and *Lippia scaberrima.*

Important taxa: *Blepharis marginata, Euphorbia bergii.*

From a conservation point of view it is regarded as being a least threatened vegetation type, though large areas are already transformed due to agricultural practices.

Schmidtsdrif Thornveld (SVk6)

This vegetation type occurs on slightly undulating plains with a well-developed woody layer with *Acacia mellifera, Acacia tortilis, Boscia albitrunca, Searsia lancea* and *Tarchonanthus camphoratus.* It occurs on andesitic lava of the Allanridge Formation. It has shallow, stony soil with sparsely distributed rocky outcrops also occurring.

The vegetation is dominated by the woody *Acacia mellifera, Searsia lancea, Acacia tortilis and Tarchonanthus camphoratus.* The herbaceous layer is not well developed with various open patches in-between the different herbaceous species. Prominent grasses include *Eragrostis lehmanniana, Aristida canescens, Aristida congesta, Heteropogon contortus, Digitaria eriantha* and *Eragrostis rigidior.* Forbs species include *Hermbstaedtia odorata, Anthospermum rigidum* subsp. *pumilum Harpagophytum procumbens, Lippia scaberrima, Osteospermum muricatum* and *Aloe grandidentata*.

Important taxa: *Blepharis marginata, Euphorbia bergii, Panicum kalahariense, Lithops aucampiae* subsp. *aucampiae*.

From a conservation point of view it is regarded as being a least threatened vegetation type, although only 2% is statutorily conserved. The vegetation is mostly used for cattle and game (hunting) farming.

Highveld Alluvial Vegetation (AZa 5).

This vegetation type occurs along alluvial drainage lines and floodplains along rivers in the Grassland and Savanna Biomes. Altitude ranges between 1000 – 1500 meters above sea level. The topography is mostly level with some erosion present due to frequent flooding. The vegetation consists mostly of *Acacia karroo* thickets, flooded grassland and, due to the disturbance caused by floods, various weeds and alien invasive plants are present. The soil is deep sandy to clayey that have been deposited over the Quaternary alluvial sediments. Bezuidenhout (1994) has identified a number of soil forms such as Oakleaf, Dundee, Glenrosa and Mispah in the floodplain areas of the Vaal River.

The vegetation is dominated by the woody species *Acacia karroo, Salix mucronata, Ziziphus mucronata, Celtis africana, Searsia lancea, Searsia pyroides, Diospyros lycioides,* the red *Phragmites australis* and the grasses *Imperata cylindrica, Cynodon dactylon, Eragrostis plana* and *Miscanthus junceus.* (Mucina & Rutherford 2006).

These areas are regarded as being Least threatened with close to 10% being formally conserved. Unfortunately many of these areas are heavily grazed due to the palatable grass species occurring there.

Vegetation units

The study area comprises natural vegetation used mainly for domestic stock grazing as well as free moving game species. The area comprises three different vegetation units all mostly natural in species composition and their conservation status is indicated on Figure 14.

The ***Vachellia erioloba - Vachellia tortilis*** **woodland (vegetation unit 1)** is characterised by a well-developed woody layer. Two protected of which one is also a

declining red data species were found within this unit. The area has a moderate species richness and provided valuable grazing to farmers in the area. Large sections have however been overgrazed and have become degraded. In some areas alien plant species have displaced the natural vegetation. This vegetation is relatively common in the area and is regarded as having a **low-medium conservation value.**

The ***Vachellia tortilis-Senegalia mellifera*** **shrubland (vegetation unit 2)** comprises the largest part of the proposed corridors. The vegetation is dominated by *Vachellia tortilis* and *Senegalia mellifera* shrubs that for a closed to open shrubland. The grass layer is sparse and has in many cases been caused by overgrazing by cattle. In some areas the land has been ploughed for agricultural purposes. The vegetation unit has a low to moderate species composition with the declining red data species *Vachellia erioloba* present in low numbers. From a plant ecological and ecosystem functioning point of view regarded as having a **low-medium conservation value.**

Vegetation unit 3 (*Cynodon dactylon-Vachellia karroo* woodland) is associated with the Harts River and its associated floodplains. The clayey soil and water makes these areas ideal for agriculture and grazing. As a result many areas have become degraded. The vegetation is typical of riverine and floodplain areas with a moderate species richness. The vegetation is mostly natural and the area is important from an ecosystem functioning point of view. This area has a **medium-high conservation value.**

Vegetation unit 4 (*Senegalia mellifera-Vachellia tortilis* shrubland) is a small section in proposed corridor 1. The vegetation is characterised by shrubs and dwarf shrubs dominating the area. Various grass and forb species are present, while calcrete outcrops have been recorded within this vegetation type by other researchers. None have however been observed during this survey in the proposed corridor. These calcrete outcrops in many cases represent micro habitats and scarce species. The scattered low-lying rocky outcrops and hills form important habitat for rupicolous faunal species such as Elephant Shrews, Rock Hyrax, Southern Pygmy

Toad as well as several reptile species and are considered as sensitive. The proposed towers should be positioned away from any major rocky outcrop. Thus from a plant ecological and ecosystem functioning point of view this area has a **medium conservation value.**

The ***Grewia flava – Vachellia erioloba*** **woodland (vegetation unit 5)** is located in both corridors west of Kimberley. The vegetation is typical of open savannah and mostly used for livestock and game farming purposes. The vegetation consist of a large number of climax species although some areas are overgrazed and dominated by pioneer weedy grasses and forbs. The declining red data tree *Vachellia erioloba* is prominent within this unit. From a plant ecological and ecosystem functioning point of view this unit has a **medium conservation value.**

Riverine areas are considered as important ecosystems due to their water channelling and storing capacity. **Vegetation unit 6 (*Combretum erythrophyllum - Vachellia karroo* woodland)** is representative of such a system. Unfortunately these systems are also subject to human induced influences such as grazing, mining and agriculture. This has also lead to large sections of these systems becoming invaded with alien plant species. This vegetation unit is however, dominated by indigenous species typical of these ecosystems and representative of the natural vegetation of these riparian areas. Only a few alien plant species were observed. From a plant ecological and ecosystem functioning point of view this unit has a **high conservation value.**

Vegetation unit 7 (*Vachellia* species open woodland) occurs over vast areas within the region and belongs to the larger Kimberley Thornveld (SVk 4) vegetation type. The vegetation is more h some alien tree invaders are present in some localities. Large areas of this savannah vegetation are protected in game farms. Two protected tree plant species namely *Boscia albitrunca* and *Vachellia erioloba* were found within this plant community with individuals of various sizes present. The vegetation supports a variety of animal species but is not currently threatened. From a plant ecological and ecosystem functioning point of view this vegetation unit has a **low-medium conservation value.** It is however important that none of the two protected tree species are removed or trimmed down without a permit obtained from the local Nature Conservation bodies. It is also recommended that pylons are placed so as to avoid the removal of these species.

Sensitivity analysis

A sensitivity analysis was done for the seven vegetation units identified. This was achieved by evaluating the different vegetation units against a set of habitat criteria (Table 4). The results indicate that units 1, 2 and 7 have low-medium sensitivity, units 3, 4 and 5 have medium sensitivity (mostly due to the threatened species present) and unit 6 has a high sensitivity to disturbance.

Table 4. Sensitivity analysis for the seven vegetation units identified along the proposed power line routes (Single scores range between 1 and 10 (the higher the score the more important the criterion) (red = high; orange = medium; yellow = low-medium; light yellow = low/none).

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**	**Unit 6**	**Unit 7**
Criteria	*Vachellia erioloba - Vachellia tortilis* woodland	*Vachellia tortilis - Senegalia mellifera* shrubland	*Cynodon dactylon- Vachellia karroo* woodland	*Senegalia mellifera- Vachellia tortilis* shrubland	*Grewia flava – Vachellia erioloba* woodland	*Combretum erythrophyllum - Vachellia karroo* woodland	*Vachellia* species open woodland
Presence of protected / red data species	9	9	5	6	9	5	9
Species richness and composition	5	4	6	5	5	7	5
Dominant/prominent species ecological status	7	5	7	7	7	9	5
Sensitivity to disturbance	3	3	7	5	6	9	3
Conservation status and ecological functioning	3	3	7	6	6	10	3
Area fragmentation	5	7	6	6	7	8	6
Medicinal plants	5	5	5	5	6	7	5
Important topographical features (steep slopes, cliffs etc.)	1	1	9	8	2	9	1
TOTAL SCORE	**48**	**46**	**65**	**60**	**60**	**80**	**49**
Sensitivity rating	**Low-medium**	**Low-medium**	**Medium**	**Medium**	**Medium**	**High**	**Low-medium**

Based on the conservation status and sensitivity analysis a sensitivity map for the proposed corridors were compiles and is indicated in Figure 14

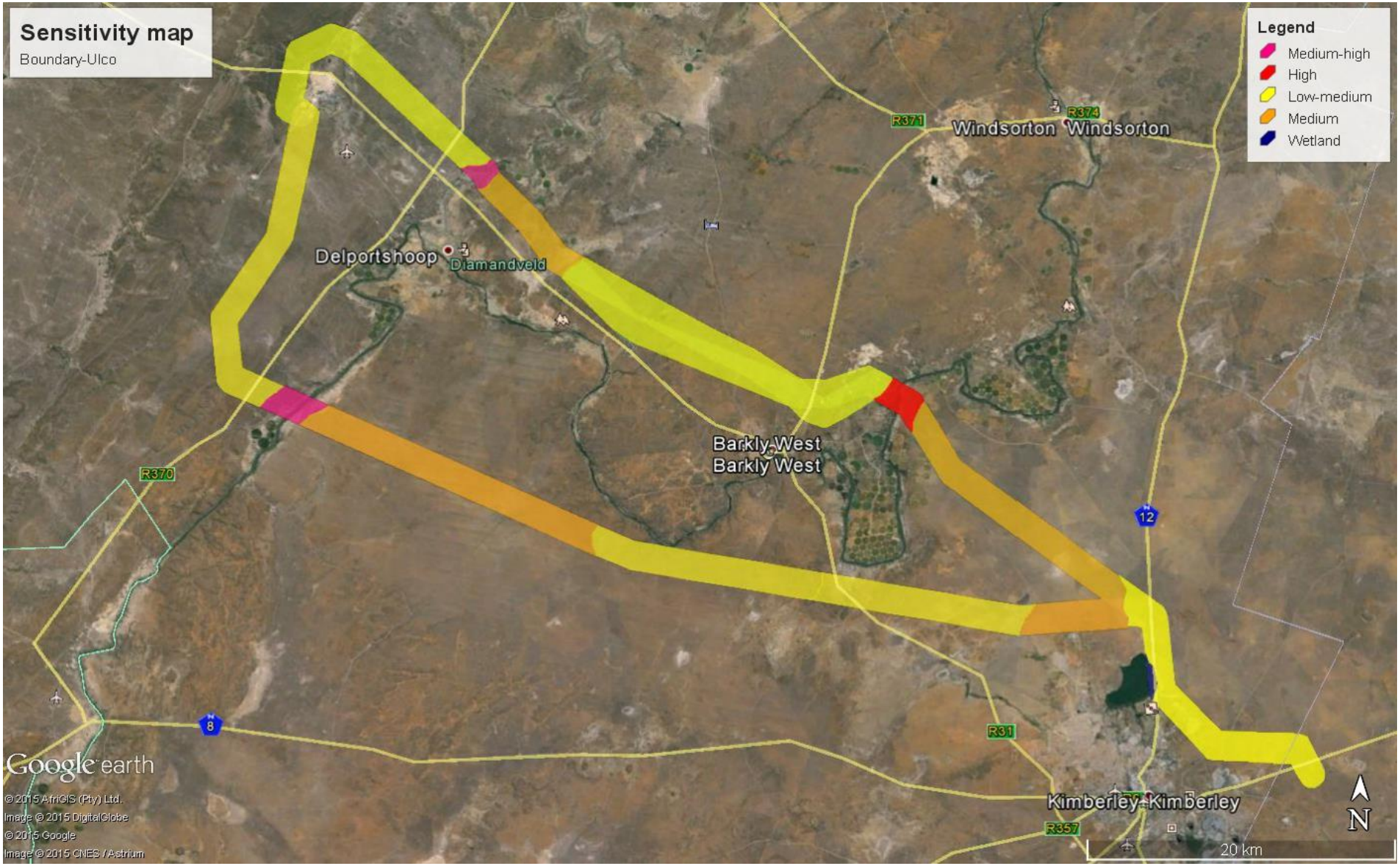


Figure 14. Ecological sensitivity of the different vegetation units along the proposed corridors (source: Google Earth 2015).

Red data species

Only one red data species which is also a protected species namely *Vachellia erioloba* was found to be present in the study area (Table 5). This species has a conservation status of "declining" due to its removal for fire wood and other agricultural activities.

Table 5. Red data species previously recorded in the quarter degree grid of the study area (Raimondo *et al.* 2009).

Genus	Species	National Status	Habitat	Recorded in study area
Vachellia	*erioloba*	Declining	Savanna, semi-desert and desert areas, deep sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops	Units 1, 2 & 5
Antimima	*lawsonii*	Rare	Limestone soils.	Not found (unit 4 possible)
Drimia	*sanguinea*	NT	Open veld and scrubby woodland in a variety of soil types.	Not found
Chasmatophyllum	*rouxii*	DD	Unknown.	Not found
Eucomis	*autumnalis*	Declining	Damp, open grassland and sheltered places from coast to 2450m.	No suitable habitat
Euphorbia	*albertensis*	Rare	Unknown, Germishuizen & Retief 20 (PRE) was collected at the edge of a pan.	No suitable habitat
Harpagophyton	*procumbens*	Declining	savanna biome and is associated mainly with dry sandveld on deep Kalahari sand. It usually occupies plains, dune bases and interdunes. Soils are usually sandy but can be rocky. They are generally nutrient poor, often with lime	Not found (unit 4 possible)
Hoodia	*gordonii*	Declining	Occurs in a wide variety of arid habitats from coastal to mountainous, also on gentle to steep shale ridges, found from dry, rocky places to sandy spots in riverbeds.	Not recorded
Hoodia	*officinalis*	NT	Always found growing inside bushes in flattish or gently sloping areas.	Not recorded
Lithops	*lesliei*	NT	Calcareous, well drained soil in areas that receive 250-400 mm rainfall per year.	Not recorded

Protected species

The Department of Water Affairs and Forestry (now Department of Forestry and Fisheries) developed a list of protected tree species. In terms of Section 15(1) of the National Forests Act, 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization. The Department of Agriculture, Forestry and Fisheries (DAFF) will have to be approached to obtain the required permits for the removal of any protected tree species.

Two protected species have been recorded during the survey and are listed below in the table below:

Protected species of the study area (ACT 10 of 2004).

Species name	Recorded in study area	Unit/s	National tree number
Vachellia erioloba (Camel thorn)	✓	1;2,5	168
Boscia albitrunca (Shepherd's tree)	✓	1	122

Vachellia erioloba (Camel thorn) grows well in poor soils and in harsh environmental conditions. The camel thorn ranges from a 2 m spiny shrub to a 16 m robust tree. The camel thorn is a competitive species that can displace preferred vegetation. They start flowering in late winter to early spring. *Boscia albitrunca* grows in various habitats in arid areas and in the bushveld. It can grow up to 10m tall and is characterised by its white trunk. It is often browsed by animals.

Medicinal species

Four medicinal plant species, have been identified within the study area. These plants occur throughout the southern African region on various soil types and areas none are threatened species.

Plant name	Plant part used	Medicinal use	Vegetation unit
Vachellia karroo	Leaves, bark and gum	Diarrhoea & dysentery Gum: colds, oral thrush & haemorrhage.	3, 6
Lippia javanica	Leaves & twigs	Coughs, cold, stomach problems, bronchitis, headaches	1
Tarchonanthus camphoratus	Leaves & twigs	Stomach trouble, headache, toothache, inflammation	1, 2, 3, 4, 5
Ziziphus mucronata	Roots, bark or leaves	Cough & chest problems; diarrhea; pain relief	1, 2, 3, 4, 5

Alien plant species

A total of four different declared alien invasive species, the tree *Prosopis glandulosa* (units 1 & 3), *Agave americana* (unit 1), *Melia azedarach* (unit 3) and *Eucalyptus camaldulensis* (unit 6) were found within the study area.

Prosopis glandulosa is a small to medium-sized tree that originates in the southwestern parts of the United States. The plant can grow well in semi-arid areas and produced fodder of high nutritive value. As a result the plant was brought into South Africa as a fodder production plant, but has unfortunately become invasive and has displaced the natural vegetation of large areas in the semi-arid regions of the country.

Agave Americana is a large succulent with spear-like leaves in a basal rosette on a short unelongated stem. The plant can grow up to 2 tall. The plant originates from Mexico in Central America and was brought into the country as an ornamental and security hedge plant. It has since escaped into natural areas and reproduce via seeds. It forms impenetrable thickets and can injure humans and animals.

Melia azedarach is a large tree that can grow up to 20m tall. The tree originates from Asia and India and was brought into the country as an ornamental species. It has since escaped into the natural environment and establishes via seeds. They invade

all areas especially riverine areas. Their seeds are mostly dispersed via water and animals.

Eucalyptus camaldulensis originates from Australia and can grow up to 40m tall. It spreads naturally via seeds and competes and displaces with the natural vegetation of an area. It forms extensive stands next to riverine areas. This tree also changes the soil water content and nutrient status of its surrounding habitat assisting in preventing the natural species from growing. It was brought into the country to be used for shelter, timber, firewood and ornamental purposes.

Prosopis glandulosa and *Eucalyptus camaldulenssis* are a declared category 2 (CARA) and 1b (NEMBA) invader trees, while *Agave Americana* and *Melia azedarach* a category 3 (CARA) and NEMBA category 3 invaders. This means that these may not be grown or planted on one's property unless a permit is obtained from nature conservation. **It is recommended that these plants are removed from the different vegetation units and that a programme is implemented on a long-term basis to control the spread of these plants.**

Indigenous invader plant species

One indigenous invader species namely *Acacia mellifera* was found to be present in the study area. This species is part of the natural ecosystem and do not pose a threat to the environment under natural conditions. Where vegetation is disturbed due to overgrazing, agricultural activities, general mismanagement etc., these species can quickly spread, forming dense stands that replace other indigenous species.

ii. *FAUNA*

GENERIC DESCRIPTION OF POTENTIAL IMPACTS OF POWER LINES ON ASSOCIATED FAUNA AS WELL AS RECOMMENDED MITIGATORY MEASURES

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

Habitat destruction and disturbance

During the construction phase and maintenance of powerlines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. As the majority of the alignment occurs within succulent-karroid vegetation dominated by dwarf shrubs and grasses limited vegetation clearance will be required during the operational phase of the project. These activities have an impact on fauna breeding, foraging and roosting in or in close proximity of the servitude, both through modification of habitat and disturbance caused by human activity. The proposed impact will be of **medium-low; short-long term impact** on remaining faunal species.

Mitigation and Recommendations

The following general recommendations are made to minimise the impacts of proposed powerline construction on the immediate environment and remaining **fauna**:

- The proposed alignments should be routed along the existing informal access road as well as degraded and transformed habitats or vegetation units.
- Close site supervision must be maintained during construction.
- During the **CONSTRUCTION** phase workers must be limited to areas under construction within the 22m reserve and access to the undeveloped areas, especially the riparian zones of the Vaal and Harts River and surrounding

open areas must be strictly regulated ("no-go" areas during construction activities).

- All large indigenous tree species especially the protected *Vachelia erioloba* and *Boscia albitrunca* should be conserved wherever possible.
- Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) water in the area. Mobile toilets must be provided in order to minimise unauthorised traffic of construction workers outside of the designated areas.
- All temporary stockpile areas including litter and dumped material and rubble must be removed on completion of construction. All alien invasive plant should be removed from the site to prevent further invasion.
- Firearms or any other hunting weapons must be prohibited on site.
- Contract employees must be educated about the value of wild animals and the importance of their conservation.
- Educational programmes for the contractor's staff must be implemented to ensure that project workers are alerted to the possibility of snakes being found during vegetation clearance. The construction team must be briefed about the management of snakes in such instances. In particular, construction workers are to go through ongoing refresher courses to ensure that protected snakes, such as Southern African Python, are not killed or persecuted when found.
- Severe contractual fines must be imposed and immediate dismissal on any contract employee who is found attempting to snare or otherwise harm remaining faunal species.
- No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site.

VEGETATION/FLORA

All vegetation not interfering with the operation of the line shall be left undisturbed and this included all the smaller shrubs and herbs which don't interfere with the lines. Collection of firewood and traditional medicinal plants is strictly prohibited. No area should be cleared of trees, bushes and other vegetation for the purpose of a camping site.

Management objective

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

Measurable targets

- Adequate protection of remaining indigenous plant species
- No litigation due to removal of vegetation without the necessary permits (*Vachelia erioloba, Boscia albitrunca*).

Mitigation and recommendation

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

All alien vegetation should be eradicated along the servitude. Invasive species (*Prosopis glandulosa; Nicotiana* spp.) should be given the highest priority. No dumping of any materials in undeveloped open areas and neighbouring properties. Activities in the surrounding open undeveloped areas (especially the rocky hills and koppies must be strictly regulated and managed. It is imperative that the construction activities as well as vegetation clearance are restricted to the powerline servitude. The limitation of the disturbance of vegetation cover within the servitude will ameliorate this impact. Impact will be short-long term depending on the amount of vegetation to be cleared. Excessive habitat destruction during construction could reduce the amount of habitat available. This impact is anticipated to be localised, of a long-term nature and of low significance, provided that appropriate mitigation measures are implemented (e.g. the limitation of vegetation clearance within sensitive areas).

REHABILITATION

A suitably qualified rehab specialist should be appointed for the commencement of rehabilitation activities. The specialist should identify areas requiring rehabilitation as well as appropriate seed mixes which are required. Photographic records of the

servitude and access roads prior to construction activities and after the construction phase will be taken to assess the level of rehabilitation and re-vegetation.

Surrounding Farming Activities

Domestic Livestock

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

Management objective

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

Measurable targets

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

ACCESS ROADS

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

The Contractor shall properly mark all access roads. Markers shall show the direction of travel as well as tower numbers to which the road leads. Unnecessary traversing of adjacent open areas is discouraged especially within the Vachelia open woodlands, *Themeda triandra* grasslands, non-perennial drainage lines as well asHighveld Salt Pans. Where required, speed limits shall be indicated on the roads (30km). All speed limits shall be strictly adhered to at all time.

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

VEGETATION CLEARANCE

Management objective

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

Measurable targets

- No damage to vegetation outside the powerline servitude as well as around towers
- No loss of topsoil
- No visible erosion three months after completion of the contract
- All disturbed areas successfully rehabilitated three months after completion of the contract

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

Vegetation clearing on tower sites must be kept to a minimum. Any alien invasive trees with large root systems shall be cut manually and removed, as the use of a bulldozer will cause major damage to the soil when the root systems are removed. Stumps shall be treated with herbicide. Smaller vegetation can be flattened with a machine, but the blade should be kept above ground level to prevent scalping. Any

vegetation cleared on a tower site shall be removed or flattened and not be pushed to form an embankment around the tower.

Disturbed areas of natural vegetation as well as cut and fills must be rehabilitated immediately to prevent soil erosion as well as alien invasive vegetation invasion. This is especially relevant adjacent to the non-perennial drainage lines and seasonally inundated depressions. e allowed after a proper investigation into the necessity, the type to be used, the long-term effects and the effectiveness of the agent. The use of herbicides shall only be allowed after a proper investigation into the necessity, the type to be used, Eskom's approval for the use of herbicides is mandatory. Application shall be under the direct supervision of a qualified technician. All surplus herbicide shall be disposed of in accordance with the supplier's specifications. All alien vegetation in the total servitude and densifiers creating a fire hazard shall be cleared and treated with herbicides.

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

- The contractor must have the necessary knowledge to be able to identify protected species Camel Thorn (Vachelia (*Acacia*) *erioloba*; Shepherd's Tree (*Boscia albitrunca*) as well indigenous species not interfering with the operation of the line due to their height and growth rate.
- The contractor must also be able to identify declared weeds and alien species (*Prosopis glandulosa*, Nicotiana* spp.) that can be totally eradicated.
- The contractor must be in possession of a valid herbicide applicators license.

Fire Prevention

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

Management objective

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

Measurable targets

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

Mitigation and recommendations

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

Threatened animals

At a local scale the study site and surrounding areas comprises limited suitable habitat for any threatened animal species.

Mitigation and recommendations

As a precautionary mitigation measure it is recommended that the developer and construction contractor as well as an environmental control officer should be made aware of the possible presence of certain threatened animal species (Giant Bullfrog, South African Hedgehog, Black-footed Cat) prior to the commencement of construction activities. In the event that any of the above-mentioned species are discovered the animal should not be interfered with and allowed to move away from the construction activities

iii. *IMPACT EVALUATION*

Impact analysis

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and humans. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and disturbance and habitat destruction during construction and maintenance activities. The construction of pylons for the power lines will inevitably have an impact on the surrounding ecosystem. The severity of the impact, however, varies, depending on the nature of the activity and mitigation measures followed. Different impacts on the vegetation will be experienced during construction and operational phase. These impacts on the total ecosystem are listed below and analysed below according to their extent, duration, intensity and probability.

- ***Impact 1 – Loss of natural vegetation***

The construction of pylons will lead to the destruction and loss of vegetation. Vegetation loss can result in degradation of the environment, loss of vegetation cover and resultant erosion and loss of topsoil, increase in water runoff and less water infiltration, loss of habitat for sensitive or secondary species, reduction of species richness and system diversity and eventual loss of ecosystem functioning and species composition. These activities have an impact on fauna breeding, foraging and roosting in or in close proximity of the servitude, both through modification of habitat and disturbance caused by human activity. Thus it is important that no unnecessary destruction of the habitat takes place during any development/construction phase.

- ***Impact 2 – Habitat fragmentation (loss of landscape connectivity)***

Habitat fragmentation refers to destruction of the habitat leading to a discontinuity in a species/populations' the environment. The remaining habitat therefore becomes smaller. The implications of habitat fragmentation is that edge effects along the fragments can cause a further reduction in the habitat while plants and sessile organisms are not able to reproduce anymore that will eventually lead to them dying out. Thus these isolated habitats will become unsuitable to many of the original

species occurring in the area. Species populations can only remain viable if large enough habitat remains or if sizeable corridors exist between the fragments.

- ***Impact 3 – Impacts on vulnerable species***

For the purpose of this report the term “vulnerable species” to threatened, protected, medicinal and red data species. Natural populations of species not regarded as “vulnerable” usually occur in large numbers within various suitable habitats. Vulnerable species are normally species whose habitats have become smaller, usually as a result of human actions, but also as a result of natural disasters (e.g. floods, droughts, fire etc.). The result is that these species are already under stress and any further reduction in their habitat could cause their extinction. Not only will the loss of such a species cause further degradation of the environment and the conservation status of the ecosystem, but it will alter also the functioning of adjacent ecosystems and their species compositions. It is therefore recommended that buffer zones varying from 5m to a 1000m are placed around such species/ecosystems to protect their integrity and survival.

- ***Impact 4 – Establishment of invasive plants and declared weeds***

Weeds, alien invasive and indigenous invasive plants are normally aggressive growers that can out-compete other natural species growing in the environment. These species have superior reproduction and/or vegetative growth mechanisms that enable them to grow and increase faster than other species in the same habitat. Under normal conditions in a stable ecosystem they will not become dominant. However, if a disturbance in the environment takes place whether human induced or natural, these species will normally invade these disturbed areas, displace the few natural species remaining and form a homogeneous stand of vegetation. This could then lead to an uncontrollable spread of these species into the ecosystem as well as adjacent systems. The consequences of alien plant invasions is a loss of soil water, change in nutrient status of the soil, loss of indigenous and climax vegetation, species diversity, change in plant community composition and structure and eventually loss in ecosystem functioning as well as adjacent ecosystems.

Mitigation and recommendations

The following general recommendations are made to minimise the impacts of proposed powerline construction on the **flora** and **fauna**:

- Close site supervision must be maintained during construction.

- During the **construction** phase workers must be limited to areas under construction within the corridor and access to the undeveloped areas, especially the surrounding open areas must be strictly regulated ("no-go" areas during construction activities).
- Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) water in the area.
- All temporary stockpile areas including litter and dumped material and rubble must be removed on completion of construction. All alien invasive plant should be removed from the site to prevent further invasion.
- Contract employees must be educated about the value of wild animals and the importance of their conservation.
- Educational programmes for the contractor's staff must be implemented to ensure that project workers are alerted to the possibility of snakes being found during vegetation clearance. The construction team must be briefed about the management of snakes in such instances. In particular, construction workers are to go through ongoing refresher courses to ensure that threatened snakes, such as Southern African Python, are not killed or persecuted when found.
- Severe contractual fines must be imposed and immediate dismissal on any contract employee who is found attempting to snare or otherwise harm remaining faunal species.
- All vegetation not interfering with the operation of the line shall be left undisturbed this is especially pertinent to the protected Shepherds Tree (*Boscia albitrunca*) as well as Camel Thorn (*Acacia erioloba*). None of these species may be removed without permission from the DAFF & Nature Conservation.
- Collection of firewood and traditional medicinal plants is strictly prohibited.
- All alien vegetation should be eradicated along the corridor.
- In areas where degradation has taken place as a result of the construction, a suitably qualified ecologist or rehabilitation specialist should be appointed for the commencement of rehabilitation activities. The specialist should identify areas requiring rehabilitation as well as appropriate seed mixes which are required.
- No pylons should be placed within the riverine vegetation and their associated floodplains.

The construction of pylons for the power lines will inevitably have an impact on the surrounding ecosystem. The severity of the impact, however, varies, depending on the nature of the activity and mitigation measures followed. Different impacts on the vegetation could be experienced during construction and operational phase. These impacts on the total ecosystem are analysed below according to their extent, duration, intensity and probability. Each of these criteria is given a rating in order to quantify the severity of the impact. For impact assessment the potential impacts on the vegetation was assessed by using the NEMA 2006 guidelines and criteria (Table 1) as described under the methods section of this report. The results are presented below:

Vachellia erioloba - Vachellia tortilis woodland – Unit 1

Impact	Extent	Duration	Intensity	Probability	Score	%
Loss of flora, fauna & habitat	1	2	1	1	**5**	**33**
With mitigation	1	2	1	1	**5**	**33**
Habitat fragmentation	1	2	1	1	**5**	**33**
With mitigation	1	2	1	1	**5**	**33**
Loss of vulnerable species	2	2	2	2	**8**	**53**
With mitigation	1	1	1	1	**4**	**27**
Invasion of invader plants	2	3	2	2	**7**	**47**
With mitigation	1	1	1	1	**4**	**27**
		Average score without mitigation			Low/med	**42**
		Average score with mitigation			Low	**30**

Vachellia tortilis - Senegalia mellifera shrubland – Unit 2

Impact	Extent	Duration	Intensity	Probability	Score	%
Loss of flora, fauna & habitat	1	2	1	1	**5**	**33**
With mitigation	1	2	1	1	**5**	**33**
Habitat fragmentation	1	2	1	1	**5**	**33**
With mitigation	1	2	1	1	**5**	**33**
Loss of vulnerable species	1	1	1	1	**4**	**27**
With mitigation	1	1	1	1	**4**	**27**
Invasion of invader plants	2	3	2	2	**7**	**47**
With mitigation	1	1	1	1	**4**	**27**
		Average score without mitigation			Low	**35**
		Average score with mitigation			Low	**30**

Cynodon dactylon-Vachellia karroo woodland – Unit 3

Impact	Extent	Duration	Intensity	Probability	Score	%
Loss of flora, fauna & habitat	1	1	2	2	6	40
With mitigation	1	1	2	1	5	33
Habitat fragmentation	2	2	2	2	8	53
With mitigation	2	2	2	1	7	47
Loss of vulnerable species	1	2	2	2	7	47
With mitigation	1	1	1	1	4	27
Invasion of invader plants	2	3	2	3	10	67
With mitigation	1	1	1	1	4	27
		Average score without mitigation			Medium	**52**
		Average score with mitigation			Low	**33**

Senegalia mellifera-Vachellia tortilis shrubland – Unit 4

Impact	Extent	Duration	Intensity	Probability	Score	%
Loss of flora, fauna & habitat	1	3	1	2	**7**	**47**
With mitigation	1	2	1	2	**6**	**40**
Habitat fragmentation	1	3	2	1	**7**	**47**
With mitigation	1	2	1	1	**5**	**33**
Loss of vulnerable species	1	2	1	1	**5**	**33**
With mitigation	1	1	1	1	**4**	**27**
Invasion of invader plants	2	3	2	2	**7**	**47**
With mitigation	1	1	1	1	**4**	**27**
		Average score without mitigation			Low/med	**44**
		Average score with mitigation			Low	**32**

Grewia flava – Vachellia erioloba woodland – Unit 5

Impact	Extent	Duration	Intensity	Probability	Score	%
Loss of flora, fauna & habitat	1	3	1	2	**7**	**47**
With mitigation	1	2	1	2	**6**	**40**
Habitat fragmentation	1	3	2	1	**7**	**47**
With mitigation	1	2	1	1	**5**	**33**
Loss of vulnerable species	1	2	1	1	**5**	**33**
With mitigation	1	1	1	1	**4**	**27**
Invasion of invader plants	2	3	2	2	**7**	**47**
With mitigation	1	1	1	1	**4**	**27**
		Average score without mitigation			Low/med	**44**
		Average score with mitigation			Low	**32**

Combretum erythrophyllum - Vachellia karroo woodland – Unit 6

Impact	Extent	Duration	Intensity	Probability	Score	%
Loss of flora, fauna & habitat	1	2	2	2	7	47
With mitigation	1	1	2	1	5	33
Habitat fragmentation	2	3	2	2	9	60
With mitigation	2	2	2	1	7	47
Loss of vulnerable species	1	2	2	2	7	47
With mitigation	1	1	1	1	4	27
Invasion of invader plants	2	3	2	3	10	67
With mitigation	1	1	1	1	4	27
		Average score without mitigation			Medium	**55**
		Average score with mitigation			Low	**33**

Vachellia species open woodland – Unit 7

Impact	Extent	Duration	Intensity	Probability	Score	%
Loss of flora, fauna & habitat	1	3	1	1	**6**	**40**
With mitigation	1	1	1	1	**4**	**27**
Habitat fragmentation	1	3	2	1	**7**	**47**
With mitigation	1	3	2	1	**7**	**47**
Loss of vulnerable species	1	4	1	1	**7**	**47**
With mitigation	1	1	1	1	**4**	**27**
Invasion of invader plants	2	3	2	2	**7**	**47**
With mitigation	1	1	1	1	**4**	**27**
		Average score without mitigation			Low/med	**45**
		Average score with mitigation			Low	**32**

The results of the above **impact evaluations** show that the proposed power lines should have no severe (**high**) impacts on the different units with **medium and medium-low** impacts over the **short-long term** that will be experienced in the different vegetation units (fauna & flora).

The impacts on the loss of flora and habitat will be low to the areas that have a low-medium conservation value due to some areas being overgrazed with some degraded areas present. In the riverine areas the loss of flora and habitat can be

prevented with the placement of pylons outside these areas. The expected impacts in the other units could however be further mitigated by restricting the clearing of natural vegetation to as small an area as needed for the construction of the pylons.

The fragmentation of the habitat is not expected to be of any significance with normal connectivity between ecosystems still intact. Any fragmentation will also be mitigated by clearing as small an area as possible when constructing the pylons and by placing pylons outside the riverine areas.

Only one-two red data/protected species (the trees *Acacia erioloba* & *Boscia albitrunca*) were observed in vegetation units 1, 2, and 5 that could be negatively affected if large numbers are removed or damaged. This will have a local effect on their populations and could be long-term. This could however be mitigated by placing the pylons and powerlines such that as little as possible of these species are affected. Sensitive habitats could also occur within unit 4 (although not observed during the surveys). It is therefore recommended that a qualified plant ecologist/botanist should participate in a walk-down exercise after the final route has been decided upon and the placement of the pylons have been marked in the field.

Four declared alien invader species were found to be present in some units. Thus the clearing of vegetation around the proposed pylon sites could create an opening for these species to invade these sites. This influence will however be site specific and could be mitigated by implementing a long-term monitoring plan whereby any growth of this species are eradicated with immediate effect. The areas affected by the construction activities should also be rehabilitated as soon as the construction is completed. That would also assist in preventing these species establishing. The landowner should also be contacted and requested to implement an eradication programme.

CONCLUSION

Any development will have a negative effect on the natural ecosystem in particular the vegetation thereof. The vegetation of areas where development and building of structures will take place will destroy all vegetation present on the specific area where a structure is planned to be erected. Due to the effect of soil tillage and the complete removal of indigenous vegetation these areas will be totally transformed or destroyed. The effect on the ecosystem and surrounding areas will depend on the planned development activity.

The purpose of any ecological assessment is to determine areas of high sensitivity and to provide guidelines to ensure that the proposed development is ecologically sensitive and to prevent unnecessary destruction of natural ecosystems. It is mostly unavoidable to prevent all development especially power lines to cross and affect sensitive areas. It is therefore important that all possibilities for such power lines are investigated in order to provide ecologically sound recommendations on routes to be followed.

The proposed corridors are located within three different vegetation types of which none are regarded as threatened types.. The landscape is mostly low flat to undulating areas with sandy plains, while rocky hills and outcrops are present in some areas.

This study investigated the vegetation found along the proposed corridors for the proposed powerline from Boundary to Ulco. The two alternative corridors and one alternative section within corridor 1 were investigated from a plant and faunal ecological point of view.

Most of the land is used for agriculture and grazing by domestic stock with free roaming game. All of the units have been evaluated in terms of the indigenous, alien and threatened (protected, red date etc.) plant species present as well as the total ecosystem and its vegetation ecological functioning. Units 1, 2 and 7 were found to have low-medium conservation values and sensitivity to disturbance. Units 3, 4 and 5 were found to have medium conservation value due to threatened plant species present as well as the ecosystem functioning of the riverine unit 11. Unit 6 was found to have a high conservation value and a medium sensitivity to disturbance. It is recommended that no pylons are placed within the riverine areas and associated

floodplains of units 3 and 6. In all other units it is important that the trees *Vachellia erioloba* and *Boscia albitrunca* (where present) are not removed unnecessarily. The impact on habitat fragmentation would be low and could be mitigated. All other impacts were found to be acceptable after mitigation.

One does however have to ensure that no unnecessary disturbance of the natural vegetation occurs so as to eliminate an edge effect. None of the impacts assessed for the different vegetation units will have a high negative effect on the environment and no unit was found to be highly sensitive to development.

One red data/protected species and one protected species were found to be present in units 1, 2 & 5 namely the trees *Vachellia erioloba* and *Boscia albitrunca* respectively. Both the trees *Boscia albitrunca* and *Vachellia erioloba* are regarded as being keystone species in the arid areas of South Africa. They play important roles in the ecosystem by providing food, shelter and shade to various animal and bird species. It is therefore important that these species are not removed from the ecosystem and that the placement of the pylons should be done in such a way as to avoid damaging these species. If single individuals of these species have to be removed, a permit from the Department of Agriculture, Fisheries and Forestry (Forestry Branch) and Nature Conservation will have to be obtained for this purpose. It is recommended that once the final powerline route and pylon positions have been decided on and pegged that a walk down by a qualified plant ecologist is done to determine if any of these protected species must be removed.

Four medicinal plant species were recorded but none are threatened species and are in many areas regarded as bush encroachers of degraded and disturbed areas.

Based on an ecological perspective corridor 1 would be the preferred route. However, the recent de-proclamation of the previous Vaalbos National Park through which a large section of corridor 2 passes, has led to the decimation of large areas of unit 5 with large individuals of the declining *Vachellia erioloba* trees present (see photo right) as a result of mining activities by local and other prospectors. The wood of these trees as well as rocks

mined from the area (photo right) are also sold along the road. It is therefore concluded that both of these corridors could now be considered for the erecting of the power lines from a plant and faunal ecological point of view. The powerlines should be restricted to the transformed and disturbed areas within this area wherever possible.

REFERENCES

BREDENKAMP, G.J. & BROWN, L.R. 2006. Vegetation type and dynamics in African savannas. Ber. d. Reinh.-Tüxen-Ges. 18, 69-82. Hannover 2006.

BROWN 2013

BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS, J., ALEXANDER, G.J., & DE VILLIERS, S. (EDS) 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. SANBI, Pretoria.

BRANCH, W.R. (1988). Field Guide to the Snakes and other Reptiles of Southern Africa. Struik Publishers, Cape Town.

BROWN, L.R. 1997. A plant ecological and wildlife management plan of the Borakalalo Nature Reserve, North-west Province. Ph.D. dissertation. University of Pretoria, Pretoria.

BROWN, L.R., BREDENKAMP, G.J. & VAN ROOYEN, N. 1997. Phytosociological synthesis of the vegetation of the Borakalalo Nature Reserve, North-West province. South African Journal of Botany 63: 242-253.

BROMILOW, C. (2001). Problem Plants of South Africa. Briza Publications, Pretoria South Africa.

CARRUTHERS, V.C. (2001). Frogs and Frogging in South Africa. Struik Publishers, Cape Town.

DE GRAAF, G. (1981). The rodents of southern Africa. Butterworth Press, Pretoria.

ERIKSSON, P.G., NIXON, N. SNYMAN, C.P. & BOTHMA, J. DU P. 1989. Ellipsoidal parabolic dune patches in the southern Kalahari Desert. Journal of Arid Environments, 16: 111–124.

KENT, M. & COKER, P. 1992. Vegetation description and analysis. Belhaven Press, London.

LOW, A.B. AND REBELO, A.G. (EDS) 1998. Vegetation of South Africa, Lesotho and Swaziland. Published by the Department of Environmental Affairs and Tourism. Pretoria.

MINTER, L.R., BURGER, M., HARRISON, J.A., BRAAK, H.H, BISHOP, P.J, AND KLOEPFER, D. 2004. Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland. SI/MAB Series 9. Smithsonian Institution, Washington, DC.

MUCINA, L. & RUTHERFORD, M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African Biodiversity Institute, Pretoria.

MUELLER-DOMBOIS, D. & H. ELLENBERG. 1974. Aims and methods of vegetation ecology. New York: Wiley.

PARRIS, R. 1970. Important role of the Kalahari pans. African Wildlife, 24: 234–237.

PASSMORE, N.I. and CARRUTHERS, V.C. (1995). Frogs of South Africa. A Complete Guide. Wits University Press, Witwatersrand.

ROBERTS, A. (1951). The mammals of South Africa. Central News Agency, Cape Town.

POSA, 2007. Plants of Southern Africa, an online checklist. South African National Biodiversity Institute. Accessed from http://www.sanbi.org/frames/posafram.htm.

RAIMONDO et a.l, 2009. National Red List of Threatened Plants of South Africa. Strelitzia, in press.

SIEGFIED, W.R. (1989). Preservation of species in southern African nature reserves. In: Huntley, B.J. (Ed). Biotic Diversity in Southern Africa, 186-201. Cape Town: Oxford University Press.

SKINNER, J.D. and SMITHERS, R.H.N. (1990). The Mammals of the Southern African Subregion. University of Pretoria, Pretoria.

SKINNER, J.D., and CHIMIMBA, C.T. (2005). The Mammals of the Southern African Subregion 3rd ed. Cambridge University Press.

SKINNER, J.D. and SMITHERS, R.H.N. (1990). The Mammals of the Southern African Subregion. University of Pretoria, Pretoria.

SMITHERS, R.H.N. (1986). South African Red Data Book-Terrestrial Mammals. South African National Scientific Programmes Report No.125: 1-214.

South African National Biodiversity Institute (SANBI) & Department of Environmental Affairs and Tourism (DEAT). 2009 Threatened Ecosystems in South Africa: Descriptions and Maps. Draft Reprt May 2009.

VAN ROOYEN, MW, VAN ROOYEN, N, BOTHMA, J DU P & VAN DEN BERG, H. 2008. Landscapes in the Kalahari Gemsbok National Park. Koedoe (5):1: 99-112.

http://creativearticle.com/featured/brits-average-weather-temperatures-climate-soundbites/

ANNEXURE 1

Mammal species historically recorded in the area according to Skinner & Chimimba (2005). Actual species lists will most likely contain far fewer species due to high levels of habitat transformation and degradation as well as high levels of human disturbances (hunting and poaching activities). This is especially pertinent to the larger mammal species including predatory species which are considered problem animals to adjacent livestock farmers.

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS (Skinner & Chimimba 2005)
Cape Serotine Bat	*Neoromicia capensis*	Least Concern
Lesueur's Hairy Bat	***Cistugo lesueuri***	**Vulnerable D2**
Egyptian Slit-faced Bat	*Nycteris thebiaca*	Least Concern
Geoffrey's Horseshoe Bat	*Rhinolophus clivosus*	Least Concern
Egyptian Free-tailed Bat	*Tadarida aegyptiaca*	Least Concern
Reddish-grey Musk Shrew	*Crocidura cyanea*	Data Deficient
Cape Hare	*Lepus capensis*	Least Concern
Scrub Hare	*Lepus saxatilis*	Least Concern
Namaqua Rock Mouse	*Aethomys namaquensis*	Least Concern
Short-tailed Gerbil	*Desmodillus auricularis*	Least Concern
Hairy-footed Gerbil	*Gerbillurus paeba*	Least Concern
Spectacled Dormouse	*Graphiurus ocularis*	Least Concern
Large-eared Mouse	*Malacothrix typica*	Least Concern
Multimammate Mouse	*Mastomys coucha*	Least Concern
Karoo Bush Rat	*Otomys unisulcatus*	Least Concern
Brant's Whistling Rat	*Parotys bransii*	Least Concern
Littledale's Whistling Rat	*Parotomys littledalei*	Least Concern
Pygmy Rock Mouse	*Pteromyscus collinus*	Least Concern
Striped Mouse	*Rhabdomys pumillio*	Least Concern
Round-eared Elephant-Shrew	*Marcoscelides proboscideus*	Least Concern
Cape Ground Squirrel	*Xerus inauris*	Least Concern
Springhare	*Pedetes capensis*	Least Concern
Porcupine	*Hystrix africaeaustralis*	Least Concern
Rock Hyrax	*Procavia capensis*	Least Concern
Suricate	*Suricata suricatta*	Least Concern
Small Grey mongoose	*Galerella pulverulenta*	Least Concern
Yellow Mongoose	*Cynictis penicillata*	Least Concern
Striped Polecat	*Ictonyx striatus*	Least Concern
Small-spotted Genet	*Genetta genetta*	Least Concern
Serval	***Leptailurus serval***	**Near-Threatened**
Black-footed Cat	*Felis nigripes*	Least Concern
Black-Backed Jackal	*Canis mesomelas*	Least Concern

Caracal	*Caracal caracal*	Least Concern
Honey Badger	*Mellivora capensis*	Lower Risk/ Least Concern
Bat-eared Fox	*Otocyon megalotis*	Least Concern
Leopard	*Panthera pardus*	Least Concern
Cape Fox	*Vulpes chama*	Least Concern
Aardwolf	*Proteles critatus*	Least Concern
Common Duiker	*Sylvicapra grimmia*	Least Concern
Steenbok	*Raphicerus campestris*	Least Concern
Klipspringer	*Oreotragus oreotragus*	Least Concern
Springbok	*Antidorcas marsupialis*	Least Concern
Blesbok	*Damaliscus pygargus phillipsi*	Least Concern
Gemsbok	*Oryx gazella*	Least Concern
Aardvark	*Orycteropus afer*	Least Concern
Ground Pangolin	***Smutsia temminckii***	**Vulnerable C2a(i)**

ANNEXURE 2

List of reptiles recorded according to the Reptile Atlas of Southern Africa; 18 species found for the combined locus = 2821DD, 2922AA, 2922BA.

Family	Genus	Species	Subspecies	Common name	Red list category
Agamidae	*Agama*	*atra*		Southern Rock Agama	Least Concern (SARCA 2014)
Atractaspididae	*Atractaspis*	*bibronii*		Bibron's Stiletto Snake	Least Concern (SARCA 2014)
Colubridae	*Boaedon*	*capensis*		Brown House Snake	Least Concern (SARCA 2014)
Colubridae	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Least Concern (SARCA 2014)
Colubridae	*Psammophis*	*notostictus*		Karoo Sand Snake	Least Concern (SARCA 2014)
Elapidae	*Naja*	*nigricincta*	*woodi*	Black Spitting Cobra	Least Concern (SARCA 2014)
Gekkonidae	*Chondrodactylus*	*angulifer*	*angulifer*	Common Giant Ground Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Chondrodactylus*	*bibronii*		Bibron's Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus*	*capensis*		Cape Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus*	*latirostris*		Quartz Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus*	*purcelli*		Purcell's Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Ptenopus*	*garrulus*	*maculatus*	Spotted Barking Gecko	Least Concern (SARCA 2014)
Lacertidae	*Pedioplanis*	*inornata*		Plain Sand	Least

				Lizard	Concern (SARCA 2014)
Lacertidae	*Pedioplanis*	*lineoocellata*	*pulchella*	Common Sand Lizard	Least Concern (SARCA 2014)
Scincidae	*Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Least Concern (SARCA 2014)
Varanidae	*Varanus*	*albigularis*	*albigularis*	Rock Monitor	Least Concern (SARCA 2014)
Varanidae	*Varanus*	*niloticus*		Water Monitor	Least Concern (SARCA 2014)
Viperidae	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern (SARCA 2014)

ANNEXURE 3

List of frog species recorded during the South African Frog Atlas Project (SAFAP) and of species likely to occur on the site according to Minter et al. 2004. Actual species lists will most likely contain far fewer species due to extensive habitat transformation as well as habitat degradation due to high levels of overgrazing and soil erosion and wetland degradation.

Common Name	Species	Breeding Requirements
Common River Frog	*Amietia (Afrana) quecketii*	Rivers and permanent water (springs, ponds and farm dams).
Cape River Frog	*Amietia (Afrana) fuscigula*	Permanent waterbodies including springs, farm dams and rivers
Giant Bullfrog	***Pyxicephalus adspersus***	**Temporary pools, pans and vleis, permanent bodies of water such as shallow seasonally inundated margins of farm dams**
Bushveld Rain Frog	*Breviceps adspersus*	Terrestrial breeder eggs deposited in an underground chamber.
Tremelo Sand Frog	*Tomopterna cryptotis*	Shallow permanent streams or vleis in grassland
Tandy's Sand Frog	*Tomopterna tandyi*	Small streams, pans, temporary rainpools and is commonly associated with farm dams.
Bubbling Kassina	*Kassina senegalensis*	Open vleis, pans, dams in grassland
Boettger's Caco	*Cacosternum boettgeri*	Marsh, vleis, inundated grassland
Karoo Toad	*Vandijkophrynus (Bufo)gariepinus*	Permanent and temporary waterbodies such as streams, dams. Roadside rainpools, quarries, pans, seepages and spongy bogs.
Guttural Toad	*Amietophrynus* (*Bufo*) *gutturalis*	Open vleis, pans, ponds, dams, slow streams
Common Platanna	*Xenopus laevis*	Open vleis, pans, ponds, dams, slow streams