APPENDIX 8 – ECOLOGY REPORT

ZEUS - MERCURY - VREDEFORT DOME

EXTENDED STUDY PROJECT: SOILS, VEGETATION AND MAMMALS

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by
Francois de Wet

E-mail:
sedewet@iafrica.com
Fax: +27 17 811 3388
Cell: +27 82 462 8563

ENVIROPULSE

Postnet Suite 876
Private Bag X 9013
Ermelo 2350
Mpumalanga

Reg.nr: Ck98 / 46100 / 23
Sole member S.F. de Wet

ESKOM ZEUS-MERCURY (VREDEFORT DOME AREA) 400kV TRANSMISSION LINE ENVIRONMENTAL IMPACT ASSESSMENT – ECOLOGICAL REPORT

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1. INTRODUCTION

1.1 LOCALITY

The study area falls within the area between Potchefstroom and Parys, bordering northwest of the Vredefort Dome Crater. It is illustrated in the appended maps. The following also illustrates the size and extent of the study area. It is:

- 8-18 km southeast from Potchefstroom in a direct line towards Vredefort,
- 13 km south and east of Potchefstroom.
- 22-33 km northwest of Parys, in a direct line towards Potchefstroom.

1.2 VELD TYPE

The whole study area falls within the grassland biome, described by Acocks (1988) as the central variation of Bankenveld, Veld Type 61, or described by Bredenkamp and Van Rooyen (1988) as Rocky Highveld Grassland (Veld Type 34).

Most of this veld type, where the soil is deep enough, is ploughed up (Acocks, 1988).

Rocky ridges and outcrops with bushveld vegetation are present as relatively pristine islands of bushveld surrounded by footslopes that consist of a mosaic of ploughed land and undisturbed grassland.

1.3 CLIMATE

The annual rainfall is erratic and varies between 650-750mm per year on long term average (Bredenkamp and Van Rooyen, 1998). At the time field work for this report was conducted (September 2007) a total of 125 mm of early spring rains (the first rain of the wet season) was recorded in only two days, after almost no rain the previous year.

Temperatures of this veld type range between -12˚ C and 39˚ C with an average of 16˚ C (Bredenkamp and Van Rooyen, 1998).

1.4 ALTITUDE

Altitude for the veld type is expected to be between 1500 and 1600 m above sea level.

1.5 GEOLOGY AND SOILS

The geology underlying the Bankenveld is confined to the Pretoria series and is diverse (Van der Merwe, 1962).

The geology at the study area varies between large areas of Andesite, with Shale islands in the central and southwestern parts. Other sedimentary rocks are found southwest in the study area, while Dolerite and Arenite are found northwest and Dolomite and Quartz are found on the southeastern periphery.

Van der Merwe (1962) broadly classified the soils as belonging to the Brown to Reddish-Brown Ferruginous Lateritic Soils. The soils are described as generally a belt that form an intermediate group between the Red Earths of the Mistbelt and the Grey Ferruginous Lateritic Soils of the Bushveld, but is more closely related to the latter soil group.

1.6 TERMS OF REFERENCE

Terms of reference were as follows:

- The necessary site visit had to be undertaken of four alignments as proposed (this number of proposed alternatives increased while the study was underway and two weeks before the report was written there were eight route alternatives)
- The four alignments provided had to be assessed and if necessary, local deviations had to be recommended.
- Levels of significance had to be determined for potential impacts along the routes.
- Significance would be determined by considering and quantifying where possible, the nature, extent, duration, intensity and probability of each potential impact.
- Recommendations had to be made regarding mitigation and/or management measures to address the impacts identified.
- Levels of significance before and after mitigation had to be provided.
- A preferred alignment had to be identified.
- Recommendations for the appropriate mitigation of potential impacts associated with the construction of the 765kV power line had to be formulated.
- The deliverable would be a specialist Biodiversity Report.

Specifically the following input was required:

- The biodiversity status along the proposed alignments had to be assessed;
- The potential mitigation measures had to be assessed that would minimize impacts on the biodiversity along the three alignments
- The location or identification of any areas that would be considered 'no-go' areas from a biodiversity perspective had to be determined.
- Survey The alignments had to be surveyed for floristic diversity (common flora species, Red Data flora species, alien and invasive plant species, etc);
- All relevant aspects had to be mapped
- The presence of Red Data fauna species had to be determined.

2. METHODOLOGY

A desktop study was undertaken to determine Red Data flora and fauna species occurring in the study area.

Stratification of survey sites was based on ecological units represented by the variation shown from the geology, topography, vegetation and the soils on the development area[1]. Landsat images were used and mapping results obtained through IRIS[2]. These maps/photos were used for fieldwork.

Soils were evaluated using a hand soil auger. The soil classification was carried out according to the Taxonomic System for South Africa (Macvicar, 1991).

A list of plant species at the survey site was recorded together with notes on land terrain unit, soil depth, soil texture, soil form, soil sensitivity[3], dominant woody and herbaceous species, alien invaders, biodiversity expectation, as well as veld condition and other notes. Photos of the terrain were taken as well as the GPS position at each survey site. Veld condition was subjectively assessed.

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[1] Basis data serves as reconnaissance purpose, as it was gathered in only two days. The data is therefore not suitable for large scale mapping. Higher resolution data is needed for detail planning. Basis data used in this report is therefore not suitable for large scale mapping.

[2] Hennie van der Berg - IRIS International 20 Boom Street Potchefstroom 2531 South Africa hennievdb@softhome.net Tel: +27 18 2976287 Fax: +27 88 018 2976287 Cell: +27 82 8781760

3 Factors leading to instability and erosion, i.e. high clay content, plinthic material, steep slopes or alluvial soils

A total of 74 survey sites were selected but 29 of these were actually assessed due to time constraints and the heavy rain showers at that time. This data was used and extrapolated to derive at broad soil patterns on an ecological map for the study area. (See with appended site reports). The position of the survey sites were marked on a map of the study area (See appended map).

The data from field work was summarized as an ecological map and this together with the aerial photo for the report was created by GIS Corporation[4].

The distances that each alternative alignment or ESKOM route option transected ecological units illustrated on the ecological map were also calculated by GIS Corporation. The information was used to weigh up the different route options, taking into consideration the length over ecologically sensitive areas. Unploughed Hutton soil would therefore be taken into account when proposing an alternative route, as it may be the habitat of rare reptile species. Similarly the rocky outcrops are considered as very important habitat for a wide diversity of fauna and flora species and therefore also taken into account when proposing an alternative alignment. Clayey soils (ploughed or unploughed) and alluvial soils are also considered with the proposal of ecological alternative routes. Sensitive clays on riverbanks, wetlands and on footslopes would have long term affect on the maintenance and stability of the infrastructure and these are also taken into account when planning the best ecological route.

3. RESULTS

3.1 RED DATA PLANTS AND MAMMALS

3.1.1 RED DATA PLANTS

A total of ten species are listed by SANBI, of which three are considered “Rare” and seven as “Insufficiently known”.

None of these species were observed at the time of the survey.

[4] GIS Corporation – Hester Badenhorst, hesterbaden@mweb.co.za

Table 1: PRECIS Red Data Plant Species near Vredefort, according to quarter degree square grid references:

2627CA
Boscia foetida Schinz subsp. *minima* Toelken (Rare)
Kniphofia typhoides Codd (Insufficiently known)
Scirpus varius C.B.Clarke (Insufficiently known)
Asclepias eminens (Harv.) Schltr. (Rare)
Parapodium costatum E.Mey. (Insufficiently known)
Eucomis autumnalis (Mill.) Chitt subsp. *clavata* (Baker) Reyneke (Insufficiently known)
2627CB
Asclepias eminens (Harv.) Schltr. (Rare)
2627CC
Kniphofia typhoides Codd (Insufficiently known)
2627CD
Panicum volutans J.G.Anderson (Insufficiently known)
Kniphofia typhoides Codd (Insufficiently known)

3.1.2 RED DATA MAMMALS

One small mammal species* is listed by the Transvaal Museum for the study area. It is *Mystromys albicaudatus* of the order Rodentia, family Muridae. This species is endemic and vulnerable. Although this species was not observed at the time when the survey was conducted, its occurrence is still possible at unploughed grassland and relative pristine bushveld near rocky outcrops.

3.2 NON-RED DATA FAUNA

3.2.1 SMALL MAMMALS

This species described above, the rodent *Mystromys albicaudatus* and other small mammal species which are listed by the Transvaal Museum, with their habitat and feeding requirements are as follows:

Crocidura mariquensis
Habitat: Wet areas, along riverbanks and swamps. The occurrence might be patchy as the habitat is specialized.

Rhinolophus clivosus
Habitat: Roosts in rock cavities and old mines.

Tadarida aegyptiaca
Habitat: In all habitat types, roosts in cavities of trees and in man made structures.

*Mystromys albicaudatus**
Habitat: Savanna grassland, Karroo, and Cape macchia.
Feeds on insects, green vegetation.
Nests in soil cracks, and in excavated structures of other animals.
Other: Endemic and vulnerable.

Cryptomys hottentotus
Habitat: Most soils except for compacted soils and heavy soils.
Only one breeding pair in a colony.

Mastomys natalensis
Habitat: Wide spectrum of habitats including buildings. Savanna woodland and grassland regions with rainfall higher than 400 mm.

Rattus rattus
Habitat: Wide spectrum of habitats, including buildings. Favours natural areas with a high vegetation cover.

Rhabdomys pumilio
Habitat: Wide spectrum of habitats, including buildings. Prefer habitat with short and dense grass.

Lepus capensis
Habitat: Open grassland or grassland with sparse shrub component. Water dependant.

Lepus saxatilis
Habitat: Savanna woodland and mixed savanna scrub, avoids open grassland.

Papio cynocephalus ursinus
Habitat: Wide spectrum of habitat, water, shelter, and food must persist.
Other: Cites appendix 2.

Ictonyx striatus
Habitat: Wide spectrum of habitats. Agriculture and development holds conservation threats.

Genetta genetta
Habitat: Woodland, scrub and fynbos.

Although none of these species were observed at the time of the survey, it is possible that some or all of these species are present at the study area.

3.2.2 OTHER FAUNA

Although a reptile survey was not part of the T.o.R. for this study, an unconfirmed report was received that some sort of Cordyla species occurs on one of the farms. The apparent length given as 1 meter made this report even more interesting, yet no time was available for follow-up surveys. The habitat of the species was definitely not on ploughed land and the surrounding dominant soil type is the Hutton soil form.

A recent discovery of a mite species, *Bovidromus roussouwi*, a micro-organism invertebrate by Prof Theron of the University of North-West (Potchefstroom) was very significant and this species require protection. This species is found on higher lying rock plates at rocky outcrops on the farm of Mr Roussouw. The species has a unique way in its feeding and reproduction but is not yet on the Red Dat a list (*Pers. comm.* Prof Theron). This is the only species ever recorded in South Africa, and as far as known in the world. The name of the species describes its two cattle-like horns on its head and is named after the owner of the property, Mr Roussouw.

Mites, along with ticks, belong to the subclass Acarina (also known as Acari) and the class Arachnida. Mites are among the most diverse and successful of all the invertebrate groups. They have exploited an incredible array of habitats, and because of their small size (most are microscopic) most go totally unnoticed. Many live freely in the soil or water, but there are also a large number of species that live as parasites on plants or animals and even some that feed on mold.

There are hundreds of species of mites associated with other bee species, and most are poorly described and understood. Some are thought to be parasites, while others beneficial symbionts.

There are over 45 000 described species of mites. Scientists believe that we have only found 5% of the total diversity of mites.

3.3 SOILS AND VEGETATION

Large areas on footslopes are ploughed, as it was described as typical for this veld type by Acocks (1988). Red sandy clay loams (Hutton form) are mostly ploughed, but other highly textured and structured soils were also ploughed (Shortlands and Arcadia). Unploughed areas consisted of grazing areas near rocky outcrops, which had a higher woody component present than on the grassland plains.

Biodiversity on the rocky outcrops and natural grasslands were therefore expected to be higher than the ploughed lands, where plant species diversity was also relatively low. Even though no Red Data Plants were noted it must be realized that the survey was conducted at the end of the dry season and that a significantly higher number of plant species would be recorded deeper into the wet season. Species with high conservation status could therefore still be present, although it was not observed.

3.4 TABLE RESULTS

Table 2. Soil and vegetation results.

Survey point	Land Terrain Unit	Geology	Soil depth (mm) A–hor.	Soil depth (mm) E/B hor.	Soil texture A-hor.	Soil texture E/B – hor.	Soil Form	Soil Description	Soil Sensitivity ***(1 =Not Sensitive & 5 = Very sensitive)***	Dominant Tree and Shrub Species	Dominant Grass Species	Dominant Alien invader & weed species	Notes , VCA, Biodiversity expectancy ***(BE): 1 = Very Poor & 5 = Very Good***
4	**CREST**	**ANDESITE**	**250**	**450**	**SaClLm**	**SaClLm**	**HUTTON**	**Orthic A on Red Apedal B on Unspecified**	**3**	▪ ***Acacia caffra***	▪ ***Themeda triandra***	▪ ***Tagetes minuta***	▪ **Partially disturbed** ▪ **Ploughed below koppie** ▪ **BE: 3-4**
5	CREST	ANDESITE	250	1200+	SaLm	Not assessed	GLENROSA - MISPAH	Orthic A on Lithocutanic – Orthic A on Hard Rock	1	▪ *Acacia karroo*	▪ *Elionurus muticus*	▪ None observed	▪ Selectively grazed ▪ Natural grazing area ▪ BE: 4-5
8	MIDSLOPE	ANDESITE	200	200+	SaClLm	SaCl	STERKSRUIT	Orthic A on Prismacutanic B	5	▪ *Acacia karroo*	▪ *Themeda triandra*	▪ None observed	▪ Game Farm ▪ Heavily Grazed ▪ BE: 3-4
9	CREST	QUARTZITE	200	400	SaClLm	SaClLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪ *Acacia karroo* ▪ *Rhus lancea*	▪ *Cynodon dactylon*	▪ *Opuntia ficus-indica* ▪ *Melia azedarach*	▪ Old land ▪ Grazing area ▪ BE: 1 (old land) ▪ BE: 4 (grazing area)

Survey point	Land Terrain Unit	Geology	Soil depth (mm) A–hor.	Soil depth (mm) E/B hor.	Soil texture A-hor.	Soil texture E/B – hor.	Soil Form	Soil Description	Soil Sensitivity *(1 =Not Sensitive & 5 = Very sensitive)*	Dominant Tree and Shrub Species	Dominant Grass Species	Dominant Alien invader & weed species	Notes , VCA, Biodiversity expectancy *(BE): 1 = Very Poor & 5 = Very Good*
20	FOOTSLOPE	SEDIMENTARY	300	550 (B1) 550+ (B2)	SaClLm	SaCl	STERKSPRUIT	Orthic A on Prismacutanic B	5	▪ N/a	▪ *Cynodon dactylon*	▪ *Eucalyptus* sp.	▪ Disturbed ▪ Old lands ▪ BE: 1
22	VALLEY BOTTOM	SHALE	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Hydromorphic	5	▪ *Acacia karroo*	▪ *Cynodon dactylon*	▪ *Salix babylonica*	▪ Riverbank ▪ Natural Grazing ▪ BE: 4-5
24	VALLEY BOTTOM	ANDESITE	Not assessed	Not assessed	SaClLm	SaClLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪ *Ziziphus mucronata*	▪ *Hyparrhenia hirta*	▪ None observed	▪ BE: 1-2 = ploughed land ▪ BE: 4 -5 = grazing area
25	VALLEY BOTTOM	ANDESITE	300	1000 (B1) 1000+ (B2)	SaClLm	SaCl	SEPANE	Orthic A on Pedocutanic B on unconsolidated material with signs of wetness	5	▪ *Acacia karroo*	▪ *Cynodon dactylon*	▪ None observed	▪ Overgrazed ▪ River bank ▪ Very sensitive soils ▪ BE: 1-2

Survey point	Land Terrain Unit	Geology	Soil depth (mm) A–hor.	Soil depth (mm) E/B hor.	Soil texture A-hor.	Soil texture E/B – hor.	Soil Form	Soil Description	Soil Sensitivity ***(1 =Not Sensitive & 5 = Very sensitive)***	Dominant Tree and Shrub Species	Dominant Grass Species	Dominant Alien invader & weed species	Notes , VCA, Biodiversity expectancy ***(BE): 1 = Very Poor & 5 = Very Good***
26	FOOTSLOPE – VALLEY BOTTOM	ANDESITE	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Hydromorphic	5	▪ Not assessed	▪ *Eragrostis curvula* ▪ *Imperata cylindrica*	▪ None observed	▪ Near wetland/river ▪ BE: 4-5
27	VALLEY BOTTOM	ANDESITE	300	1000 (B1) 1000+ (B2)	SaClLm	SaCl	SEPANE	Orthic A on Pedocutanic B on unconsolidated material with signs of wetness	5	▪ *Rhus lancea*	▪ *Sorghum bicolor*	▪ *Populus canescens*	▪ Disturbed riverbank ▪ Very sensitive soils ▪ BE: 1-2
29	CREST	ANDESITE	100	100+	SaClLm	SaClLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪ *Acacia karroo*	▪ *Themeda triandra*	▪ None observed	▪ Ploughed (north of road) and grazing area (south of road) ▪ Shallow soils ▪ BE: 1 =N. of rd ▪ BE: 3 = S. of rd
36	CREST (KOPPIE)	ANDESITE	250	1200+	SaClLm	SaClLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪ *Acacia karroo*	▪ *Themeda triandra*	▪ *Cereus peruvianus*	▪ Soil depth decreases closer to the koppie ▪ BE: 4-5

Survey point	Land Terrain Unit	Geology	Soil depth (mm) A–hor.	Soil depth (mm) E/B hor.	Soil texture A-hor.	Soil texture E/B – hor.	Soil Form	Soil Description	Soil Sensitivity ***(1 =Not Sensitive & 5 = Very sensitive)***	Dominant Tree and Shrub Species	Dominant Grass Species	Dominant Alien invader & weed species	Notes , VCA, Biodiversity expectancy ***(BE): 1 = Very Poor & 5 = Very Good***
38	1. Midslope 2. Footslope	DOLERITE	1. 250 2. 250	1. 250+ 2. 400 (B1) 400+ (B2)	SaClLm	SaClLm	DRESDEN	1. Orthic A on Hard plinthic B 2. Orthic A on Yellow-brown apedal B1 on Plinthic B2	4	▪ *Acacia karroo*	▪ *Hyparrhenia hirta*	▪ *Melia azedarach*	▪ BE: = 1 (South-west side of road) and 2 (North east side of road) ▪ Grazing on North-east side of road (midslope) ▪ Ploughed on South-west side of road (footslope)
41	MIDSLOPE	QUARTZITE	200	200+ (Hard rock)	LmSa	Not assessed	MISPAH	Orthic A on Hard Rock	1	▪ *Acacia karroo*	▪ *Cynodon dactylon* ▪ *Hyparrhenia hirta*	▪ None observed	▪ Game Farm ▪ Overgrazed ▪ BE: 4
42	CREST	DOLERITE	250	1500+	SaClLm	SaClLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪	▪ *Eragrostis curvula*	▪ *Prosopis glandulosa*	▪ Old land ▪ BE: 1
44	Not recorded	QUARTZITE	300	300+	LmSa	Not assessed	MISPAH	Orthic A on Hard Rock	1	▪ *Rhus lancea* ▪ *Ziziphus mucronata*	▪ *Themeda triandra*	▪ None observed	▪ Grazing area ▪ Overgrazed ▪ BE: 2-3

Survey point	Land Terrain Unit	Geology	Soil depth (mm) A–hor.	Soil depth (mm) E/B hor.	Soil texture A-hor.	Soil texture E/B – hor.	Soil Form	Soil Description	Soil Sensitivity *(1 =Not Sensitive & 5 = Very sensitive)*	Dominant Tree and Shrub Species	Dominant Grass Species	Dominant Alien invader & weed species	Notes , VCA, Biodiversity expectancy *(BE): 1 = Very Poor & 5 = Very Good*
45		SEDIMENTARY	250	410+	SaClLm	SaClLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪ *Acacia karroo*	▪ *Cynodon dactylon*	▪ *Opuntia ficus-indica*	▪ Grazing area ▪ Disturbed ▪ BE: 2
48	CREST	DOLERITE	250	1500+	SaClLm	SaClLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪ None	▪ *Cynodon dactylon* ▪ *Sorghum bicolor*	▪ None observed	▪ Disturbed area ▪ BE: 1
49	FOOTSLOPE	QUARTZITE	250	800+ (G)	Lm	Cl	KATSPRUIT	Orthic A on G - horizon	5	▪ *Acacia karroo* ▪ *Ziziphus mucronata*	▪ *Cynodon dactylon*	▪ *Eucalyptus* sp. ▪ *Opuntia ficus-indica*	▪ Old land ▪ BE: 1-2
50	FOOTSLOPE	SHALE	300+ (A & B mixed)		Lm	Cl	KATSPRUIT	Orthic A on G - horizon	5	▪ None	▪ N/a**	▪ None	▪ **Ploughed land ▪ Disturbed ▪ BE: 1

Survey point	Land Terrain Unit	Geology	Soil depth (mm) A–hor.	Soil depth (mm) E/B hor.	Soil texture A-hor.	Soil texture E/B – hor.	Soil Form	Soil Description	Soil Sensitivity *(1 =Not Sensitive & 5 = Very sensitive)*	Dominant Tree and Shrub Species	Dominant Grass Species	Dominant Alien invader & weed species	Notes , VCA, Biodiversity expectancy ***(BE): 1 = Very Poor & 5 = Very Good***
53	FOOTSLOPE	SEDIMENTARY	250	250+	SaClLm	ClLm	BAINSVLEI	Orthic A on Red Apedal B on Plinthic B	3-4	▪ *Acacia karroo*	▪ *Eragrostis curvula*	▪ None	▪ Peach Orchard on small holding ▪ BE: 1
54	FOOTSLOPE	SEDIMENTARY	250	800	SaClLm	SaClLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪ *Acacia karroo*	▪ *Themeda triandra*	▪ None observed	▪ Ploughed on southern side of road at small holding ▪ Grazing on northern side of road ▪ BE: 1 (ploughed area) & 3(heavily grazed area)
56	FOOTSLOPE	ARENITE	250	1500	SaClLm	SaCLLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪ *Acacia karroo* (adjacent to unploughed area)	▪ *Cynodon dactylon* (adjacent to unploughed area)	▪ None observed	▪ Ploughed land ▪ BE: 4-5
69	MIDSLOPE	Not recorded	250	1500	LmSa	Not assessed	MISPAH	Orthic A on Hard Rock	1	▪ *Rhus pyroides*	▪ *Digitaria eriantha* ▪ *Melinis repens*	▪ *Opuntia ficus-indica*	▪ Grassland burnt ▪ BE: 5

Survey point	Land Terrain Unit	Geology	Soil depth (mm) A–hor.	Soil depth (mm) E/B hor.	Soil texture A-hor.	Soil texture E/B – hor.	Soil Form	Soil Description	Soil Sensitivity *(1 =Not Sensitive & 5 = Very sensitive)*	Dominant Tree and Shrub Species	Dominant Grass Species	Dominant Alien invader & weed species	Notes , VCA, Biodiversity expectancy *(BE): 1 = Very Poor & 5 = Very Good*
70	CREST		250	400+	SaClLm	SaClLm	HUTTON	Orthic A on Red Apedal B on Unspecified	3	▪ *Acacia karroo*	▪ *Cynodon dactylon*	▪ None observed	▪ Old land ▪ Red data reptile species (*Cordylus* sp.) found in area adjacent to the site ▪ BE: 1
72	FOOTSLOPE		250	600+	SaClLm	SaCl	SHORTLANDS	Orthic A on Red Structured B	5	▪ N/a**	▪ N/a**	▪ None	▪ **Ploughed Maize land ▪ BE: 1
73	FOOTSLOPE	Not recorded	250	450+	LmSa	Not Assessed	WESTLEIGH	Orthic A on Soft Plinthic B	4	▪ N/a**	▪ N/a**	▪ None	▪ **Ploughed Maize land ▪ BE: 1
74	MIDSLOPE	QUARTZITE	250	n/a	LmSa	N/a	MISPAH	Orthic A on Hard Rock	1	▪ *Acacia robusta*	▪ *Cynodon dactylon* ▪ *Hyparrhenia hirta*	▪ *Melia azedarach*	▪ Koppie and farm houses ▪ BE: 4

4. IMPACT ASSESSMENT TABLES

The information gathered during fieldwork is used with the evaluation of the impact envisaged.

4.1 CRITERIA AGAINST WHICH EXPECTED IMPACTS ARE EVALUATED

Nature of the impact	Description of impact
Extent of the impact	Describe whether the impact will be : • local extending only as far as the development site; or limited to the site and immediate surroundings; or • will have an impact on the region, or • will have an impact on o a national scale or o across international borders
Duration of the impact	• Short term (0-5 years) • Medium term (5-15 years) • Long term (16-30 years) • Permanent
Intensity	The specialist should establish whether the impact is destructive or benign and should be qualified as low, medium or high. The specialist study must attempt to quantify the magnitude of the impacts and outline the rationale used.
Probability of occurrence	• Improbable, where the possibility of the impact to materialize is very low • Probable, where there is a distinct possibility that the impact will occur • Highly probable, where it is most likely that the impact will occur • Definite, where the impact will definitely occur
Status of the impact	The specialist should determine whether the impacts are negative, positive or neutral (“cost – benefit” analysis). The impacts are to be assessed in terms of their effect on the project and the environment. For example, an impact that is positive for the proposed development may be negative for the environment. It is important that this distinction is made in the analysis.
Accumulative impact	Consideration must be given to the extent of any accumulative impact that may occur due to the proposed development. Such impacts must be evaluated with an assessment of similar developments already in the environment. Such impacts will be either positive or negative, and will be graded as being of negligible, low, medium or high impact.
Degree of significance / confidence	**No significance**: the impacts do not influence the proposed development and/or environment in any way. **Low significance**: the impacts will have a minor influence on the proposed development and/or environment. These impacts require some attention to modification of the project design where possible, or alternative mitigation. **Moderate or medium significance**: the impacts will have a moderate or medium influence on the proposed development and/or environment. The impact can be ameliorated by a modification in the project design or implementation of effective mitigation measures. **High significance**: the impacts will have a major influence on the proposed development and/or environment. The impacts could have the “no-go” implication on portions of the development regardless of any mitigation measures that could be implemented.

4.2 EVALUATION OF EXPECTED IMPACTS FROM THE ZEUS-MERCURY (VREDEFORT DOME AREA) 400 KV TRANSMISSION LINES ON THE ECOLOGY

The four alignments selected by the client by 26 September 2007 are evaluated. These are the Zeus-Mercury Western Alignment Route 1 (W1), Zeus-Mercury Western Alignment Route 2 (W2), the Central Alignment (ZM) and the Eastern Alignment (Ae):

4.2.1 Zeus-Mercury Western Alignment Route 1 (W1)

Impact Table 1

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on Soils**	
Nature of impact	***The impact of service roads and construction on the topsoil and on sensitive soils that may lead to erosion***	
Legal requirements	Soil Conservation Act of 1946 and of 1969	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Local, but once the site has been constructed there is no or minimal impact
Duration of impact	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction and during operation - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances. However, if rehabilitation was done after construction, no or minimal impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent erosion resulting from construction activities	N/A

Impact Table 1 (continued)

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on Soils**	
Accumulative Impact	Moderate	Negligible
Level of significance	Relatively medium to high compared to other line options, but **medium** significance at direct impact	**Medium**
Mitigation measures	Provision should be made for water drainage away from direct disturbance area. With deeper soils with underlying soft plinthic material the construction should take into account the presence of water that will definitely be hazardous unless provision is made for drainage away from the impact. Rehabilitate topsoil after disturbance. Topsoil should be added if little soil remains after construction and be recovered with indigenous grass.	Maintain service roads, water run-off. Maintenance of service roads necessary. Water run-off diverters and humps along roads at slopes and culverts at drainage line crossings are necessary.
Level of significance after mitigation	**Low to medium significance**	**Low to medium significance**
EMP requirements	Rehabilitate topsoil after construction. Lower parts of the catena will have a higher risk of soil erosion due to the presence of seep areas and a shallow water table in that part of the terrain morphology. The contractor should take this into account when planning water diversions.	Maintain service roads
Discussion The fluctuation of the water table between the wet and dry seasons may cause problems where soils are shallow or where topsoil is disturbed. Erosion will probably result depending on the volume of water and the extent of the disturbance. In the event of high rainfall occurring over a number of years, seeplines will be active and unless sufficient mitigation measures are put in place the disturbance will lead to gully erosion.		

Impact Table 2

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on recently discovered micro-organism species on rocky outcrops (koppies)**	
Nature of impact	***Impact of construction and service roads on survival of micro-organisms (Bovidromus roussouwi) occurring on rocky outcrops***	
Legal requirements	The recently discovered *Bovidromus roussouwi* species are not yet legally protected but construction could affect their survival on islands of rocky outcrops. This species is endemic to this area and internationally significant, does not occur outside a 50 km radius from Potchefstroom and nowhere else on this world (*Pers. comm*., Prof Theron).	
Stage	Construction and Decommissioning	Operation
Extent of impact	Limited to the site and its immediate surroundings, with a higher frequency of occurrence higher up on rocky outcrops	This species in nowhere else discovered so it has **international** implication
Duration of impact	Long term – if immediate habitat is affected by the impact of construction of powerline footprint	Long term – if immediate habitat is affected by the impact of construction of powerline footprint
Intensity	High	Medium
Probability of occurrence	Probable	Probable
Status of the impact	Negative – service roads not allowed through rocky areas	Negative – service roads not allowed through rocky areas
Accumulative Impact	Potentially high, but a relative low accumulative impact is envisaged with this line option compared to other line options	Low to moderate
Level of significance	Relatively **low** compared to other route options when focusing on all aspects including soils, for the impact would be largely due to the service road. Service roads not recommended through rocky areas but around it. However potentially **medium** significance at immediate impact area due to large distance of rocky areas affected.	Potentially **medium**

Impact Table 2 (continued)

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on recently discovered micro-organism species on rocky outcrops (koppies)**	
Mitigation measures	It should be noted that the recently discovered *Bovidromus roussouwi* is legally not yet protected but construction would affect their survival. However, in the event of permission being obtained to proceed with construction of the power line and/or service roads through some rocky areas service roads would need to be constructed on lower parts of the rocky areas on more level ground as these organisms have a preference for higher lying terrain. Rocky outcrop areas should not have service road crossings but rather detours to the opposite point to avoid transecting through sensitive *Bovidromus roussouwi* habitat.	Service roads should not run parallel directly under the power lines, but should detour around the pylons and rocky outcrops if power lines transect these sensitive habitats. Maintenance of culverts and service roads necessary.
Level of significance after mitigation	Relatively **low**	**No significance** on micro-organisms
EMP requirements	Ensure no roads are constructed through rocky outcrops.	None.
Discussion It is important not to ensure the long term survival of *Bovidromus roussouwi* by not interfering with the habitat on rocky outcrops through the construction of footprint areas for pylons or through the construction of service roads through habitat of *Bovidromus roussouwi*. The species *Bovidromus roussouwi* does not yet enjoy protected status but it is unique in the extent of occurrence, with international significance. It performs an important soil forming function and is the only species of its kind (genus) occurring within the Vredefort / Potchefstroom area (within a 50 km radius). Its unique reproductive and feeding behaviour is published in 2007 by Prof Theron from the North West University (Potchefstroom). The rocky areas are also islands of undisturbed natural areas offering important habitat to birds and animals and a diversion away from these rocky areas would avoid the negative impact on the ecology.		

Impact Table 3

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on wetlands**	
Nature of impact	***The impact of construction and of service roads on wetland function and hydrology.***	
Legal requirements	National Water Act No 36 of 1998.	
Stage	Construction and Decommissioning	Operation
Extent of impact	Limited to the site and its immediate surroundings	Local, but once the service roads has been constructed there is no or minimal impact
Duration of impact	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction and during operation - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances. However, if rehabilitation was done after construction, limited impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent erosion resulting from construction activities	Neutral
Accumulative Impact	Moderate	Negligible
Level of significance	**Relatively <u>low</u> compared to other route options. Level of significance potentially <u>low to medium</u> per local impact**	**Potentially <u>low</u>**
Mitigation measures	Culverts needed with service roads at minor drainage line crossings, but wetlands should not have service road crossings but rather detours to the opposite point to avoid transecting through hydromorphic soils. All soil material, i.e. topsoil plus subsoil, should be removed as deep as the weathered rock and be replaced by concrete to provide stability for the pylon structure.	Maintenance of service roads necessary.

Impact Table 3 (continued)

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on wetlands**	
Level of significance after mitigation	**<u>Low significance</u> after mitigation.**	**<u>Low</u> significance**
EMP requirements	Ensure no roads are constructed through wetlands or hydromorphic soils.	N/a
<u>Discussion</u> It is important to maintain the function of the wetlands by not interfering with the hydrology through the construction of roads or by diversion of water. Wetlands have protected status and do not only have an important water catchment function, but it offers important habitat to birds and animals. The impact on bird habitat is fully covered in the ornithological report of Chris van Rooyen.		

Impact Table 4

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on flora**	
Nature of impact	***Impact on the floral biodiversity***	
Legal requirements	Biodiversity Act, No 10 of 2004.	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings*	N/A
Duration of impact	Permanent**. Red Grass is a good indicator within the grassland of herbaceous biodiversity and topsoil disturbance will result in permanent loss of this Decreaser grass species.	Negligible if sound management is in place
Intensity	Low	Negligible if sound management is in place; medium if servitude is mowed and not burned.
Probability of occurrence	Probable to definite (definite long term irreversible change in grass composition expected unless construction is done under controlled supervision.	Negligible if sound management is in place; definite if servitude is mowed and not burned.
Status of the impact	Negative	N/A
Accumulative Impact	Low	Negligible if sound management is in place
Level of significance	**Low to none**	**Low**
Mitigation measures	Inform contractor / manager and staff of this impact (awareness)	N/A
Level of significance after mitigation	**None**	**Medium** due to cutting of trees as part of maintenance
EMP requirements	• Contain the disturbance in Red Grass (*Themeda triandra*) dominated areas to as small possible area.	N/A
Discussion *Although the impact during construction may be limited to the site and immediate surroundings, the disturbance of pristine grassland has national importance. Grasslands offer important habitats to a number of endemic and rare flora and fauna species. **Permanent impact on the grass species composition is definite with grassland areas with heavy clays, which have a dominance of Red Grass. Once the topsoil is ploughed or disturbed valuable grazing is permanently lost and the same Red Grass dominated grass sward will never revert back to its original pristine stage. Red Grass forever lost, also imply a lost of the number of other herbaceous species associated with Decreaser dominated veld.		

Impact Table 5

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on fauna**	
Nature of impact	***The disturbance impact on fauna, mostly indirect impacts, such as poaching on mammals, reptiles and birds***	
Legal requirements	Environmental Conservation Act 1998	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings on unploughed deep red apedal soils (Hutton form).	Local (birds); Negligible (mammals), One reptile species not yet identified (possibly one of the girdled lizards, e.g. the Sungazer, *Cordylus* cf. *giganteus* found on the property of Mr Kobus Delport).
Duration of impact	Short term (mammals, reptile species)	Long term (birds); N/A (mammals) & Long term (reptile species above)
Intensity	Medium (mammals)	Low (birds); N/A (mammals); High (reptile species)
Probability of occurrence	Highly probable on unploughed Hutton soils near koppies	Highly probable
Status of the impact	Negative	Negative
Accumulative Impact	Low	Low (birds); Negligible (mammals) & Low (retile species)
Level of significance	**Low**	Low (birds); No significance (mammals) & Low to medium (reptile species)
Mitigation measures	Environmental education to contractors - implications of poaching	Fit PVC Bird Guards on towers near important bird habitats such as near pans, wetlands or dams and Bird Flight Diverters at grasslands with high biodiversity or where a high incidence of bird collisions is expected. Reptile species mentioned on Mr Delport's farm and occurring in similar habitats elsewhere affected by powerline construction must be moved to suitable areas with the assistance of herpetologists and provincial conservation authorities.
Level of significance after mitigation	**Low**	**Low (birds)**; **Low** significance **(mammals and reptile species)**.
EMP requirements	All the role players involved during construction must be well informed of the negative impact and implications of poaching.	PVC Bird Guards and Bird Flight Diverters at appropriate sections of transmission line. Determine status and distribution of reptile species mentioned above.
Discussion Steenbuck, Grey Duiker, Oribi, Blesbuck, Springbuck and other game or birds or other fauna will be poached unless strict control and monitoring is in place. This will be highly probable especially in rocky outcrop areas where the biodiversity is high, or where power lines transect through undisturbed grassland. Direct impacts of the transmission line include mortalities caused by bird collisions. Wetlands, dams and pan areas and other important bird habitat areas should therefore be taken into account when refining the exact route. The bird collision impact also affect ESKOM negatively through high costs while restoring power supply to end users.		

Impact Table 6

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on Biodiversity**	
Nature of impact	***The impact of service roads and construction on biodiversity***	
Legal requirements	NEMBA of 2004 and Environmental Conservation Act 1998	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Local, but once the site has been constructed there is no or minimal impact
Duration of impact	Short term – if no rehabilitation takes place after construction - affects vegetation with disturbance under uncontrolled circumstances	Short term - If rehabilitation was done after construction, no or minimal impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent permanent habitat and biodiversity loss through erosion resulting from construction activities	N/A
Accumulative Impact	Moderate	Negligible
Level of significance	**Medium**	**Low**
Mitigation measures	The rocky areas should not have roads through them, but around it as far as possible. Management that applies to soil conservation also apply here – if topsoil is lost through disturbance then all the other components of the ecological pyramid is affected.	Maintain service roads, water run-off. Maintenance of service roads necessary. Water run-off diverters and humps along roads at slopes and culverts at drainage line crossings are necessary.
Level of significance after mitigation	**Medium significance**	**Low significance** if roads are diverted around rocky areas as far as possible.
EMP requirements	Rehabilitate topsoil after construction. Lower parts of the catena will have a higher risk of soil erosion due to the presence of seep areas and a shallow water table in that part of the terrain morphology. The contractor should take this into account when planning water diversions.	Maintain service roads
Discussion Biodiversity is threatened mainly at islands of rocky outcrops surrounded by large areas of ploughed land. Unploughed land also has higher biodiversity especially on mineral rich sensitive soils where clay content is higher.		

Impact Table 7

Theme	**Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on fire management**	
Nature of impact	***Using regular fire versus mowing during management of transmission line servitude***	
Legal requirements		
Stage	Construction and Decommissioning	Operation
Extent of impact	N/A	Local
Duration of impact	N/A	Permanent*
Intensity	N/A	Low
Probability of occurrence	N/A	Probable
Status of the impact	N/A	Negative
Accumulative Impact	N/A	Negligible
Level of significance	Low	**Medium**
Mitigation measures	N/A	Use fire under safe environmental conditions (i.e. green fire index) to remove moribund vegetation. Burning is preferred above mowing due to the negative impact of mowing on the grass composition, i.e. changing a decreaser dominated grass sward to a grassland dominated by Thatching Grass (*Hyparrhenia hirta*) with higher fire risk.**
Level of significance after mitigation	N/A	**No significance**

Impact Table 7 (continued)

Theme	Impact of the Zeus-Mercury Western Alignment Route 1 (W1) on fire management	
EMP requirements	N/A	• Burn at least every second year under good climatic conditions, with rainfall from 900 mm p.a. or more and under safe environmental conditions, i.e. green fire index, after 3 pm or before 11 am and with grass fuel load of less than 4 tons/ha. • If mowing is already practised – where such a disturbance already exists, the hay must be removed after the mowing action and the time of mowing should be limited to summer months, if grassland is dominated by Thatching Grass.
Discussion *The compositional change from Decreaser dominated *Themeda triandra* grassland to a grassland with tall grass, such as *Hyparrhenia hirta* is irreversible. After disturbance of the topsoil of pristine grassland where Red Grass is dominant, this species will decline in its abundance and be replaced by more competitive tall grass species, such as Thatching Grass (*H. hirta*). Other pioneer grass species may also increase in their abundance, with the result that Decreaser species will be lost permanently. The mowing action has a definite impact on the quality of grazing and will on the long term lead to the loss of valuable grazing species and biodiversity. Thatching Grass is a tall grass that will out-compete other short grass species taking away the sunshine and moisture requirements needed for survival. ** Mowing and accumulation of hay afterwards will favour tall grass competitive species such as Thatching Grass and be detrimental to short grass species such as Red Grass that need sunlight exposure in order to stimulate tiller growth – Thatching Grass can produce tillers through organic debri.		

4.2.2 Zeus Perseus Western Alignment Route 2 (W2)

Impact Table 8

Theme	**Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on Soils**	
Nature of impact	***The impact of service roads and construction on the topsoil and on sensitive soils that may lead to erosion***	
Legal requirements	**Soil Conservation Act of 1946 and of 1969**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Local, but once the site has been constructed there is no or minimal impact
Duration of impact	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction and during operation - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances. However, if rehabilitation was done after construction, no or minimal impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent erosion resulting from construction activities	N/A
Accumulative Impact	Moderate	Negligible
Level of significance	Relatively low to medium compared to other line options, but **low** significance at direct impact	**Low**

Impact Table 8 (continued)

Theme	Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on Soils	
Mitigation measures	Provision should be made for water drainage away from direct disturbance area. With deeper soils with underlying soft plinthic material the construction should take into account the presence of water that will definitely be hazardous unless provision is made for drainage away from the impact. Rehabilitate topsoil after disturbance. Topsoil should be added if little soil remains after construction and be recovered with indigenous grass.	Maintain service roads, water run-off. Maintenance of service roads necessary. Water run-off diverters and humps along roads at slopes and culverts at drainage line crossings are necessary.
Level of significance after mitigation	**Low significance**	**Low significance**
EMP requirements	Rehabilitate topsoil after construction. Lower parts of the catena will have a higher risk of soil erosion due to the presence of seep areas and a shallow water table in that part of the terrain morphology. The contractor should take this into account when planning water diversions.	Maintain service roads
Discussion The fluctuation of the water table between the wet and dry seasons may cause problems where soils are shallow or where topsoil is disturbed. Erosion will probably result depending on the volume of water and the extent of the disturbance. In the event of high rainfall occurring over a number of years, seeplines will be active and unless sufficient mitigation measures are put in place the disturbance will lead to gully erosion.		

Impact Table 9

Theme	**Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on recently discovered micro-organism species on rocky outcrops (koppies)**	
Nature of impact	***Impact of construction and service roads on survival of micro-organisms (Bovidromus roussouwi) occurring on rocky outcrops***	
Legal requirements	The recently discovered *Bovidromus roussouwi* species are not yet legally protected but construction could affect their survival on islands of rocky outcrops. This species is endemic to this area and internationally significant, does not occur outside a 50 km radius from Potchefstroom and nowhere else on this world (*Pers. comm*., Prof Theron).	
Stage	Construction and Decommissioning	Operation
Extent of impact	Limited to the site and its immediate surroundings, with a higher frequency of occurrence higher up on rocky outcrops	This species in nowhere else discovered so it has **international** implication
Duration of impact	Long term – if immediate habitat is affected by the impact of construction of powerline footprint	Long term – if immediate habitat is affected by the impact of construction of powerline footprint
Intensity	High	Medium
Probability of occurrence	Probable	Probable
Status of the impact	Negative – service roads not allowed through rocky areas	Negative – service roads not allowed through rocky areas
Accumulative Impact	Potentially high, but a relative low accumulative impact is envisaged with this line option compared to other line options	Low to moderate
Level of significance	Relatively **high** compared to other route options (i.e. W1) but potentially **high** significance at immediate impact area	Potentially **medium**
Mitigation measures	It should be noted that the recently discovered Bovidromus roussouwi is legally not yet protected but construction would affect their survival. However, in the event of permission being obtained to proceed with construction of the power line and/or service roads through some rocky areas service roads would need to be constructed on lower parts of the rocky areas on more level ground as these organisms have a preference for higher lying terrain. Rocky outcrop areas should not have service road crossings but rather detours to the opposite point to avoid transecting through sensitive Bovidromus roussouwi habitat.	Service roads should not run parallel directly under the power lines, but should detour around the pylons and rocky outcrops if power lines transect these sensitive habitats. Maintenance of culverts and service roads necessary.

Impact Table 9

Theme	**Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on recently discovered micro-organism species on rocky outcrops (koppies)**	
Level of significance after mitigation	Relatively **low**	**No** significance
EMP requirements	Ensure no roads are constructed through rocky outcrops.	None.
Discussion It is important not to ensure the long term survival of *Bovidromus roussouwi* by not interfering with the habitat on rocky outcrops through the construction of footprint areas for pylons or through the construction of service roads through habitat of *Bovidromus roussouwi*. The species *Bovidromus roussouwi* does not yet enjoy protected status but it is unique in the extent of occurrence, with international significance. It performs an important soil forming function and is the only species of its kind (genus) occurring within the Vredefort / Potchefstroom area (within a 50 km radius). Its unique reproductive and feeding behaviour is published in 2007 by Prof Theron from the North West University (Potchefstroom). The rocky areas are also islands of undisturbed natural areas offering important habitat to birds and animals.		

Impact Table 10

Theme	**Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on Wetlands**	
Nature of impact	***The impact of construction and of service roads on wetland function and hydrology***.	
Legal requirements	National Water Act No 36 of 1998.	
Stage	Construction and Decommissioning	Operation
Extent of impact	Limited to the site and its immediate surroundings	Local, but once the service roads has been constructed there is no or minimal impact
Duration of impact	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction and during operation - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances. However, if rehabilitation was done after construction, limited impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent erosion resulting from construction activities	Neutral
Accumulative Impact	Moderate	Negligible
Level of significance	**Relatively <u>low</u> compared to other route options. Level of significance potentially <u>medium</u> per local impact**	**Potentially <u>low to medium</u>**
Mitigation measures	**Culverts needed with service roads at minor drainage line crossings, but wetlands should not have service road crossings but rather detours to the opposite point to avoid transecting through hydromorphic soils. All soil material, i.e. topsoil plus subsoil, should be removed as deep as the weathered rock and be replaced by concrete to provide stability for the pylon structure.**	**Maintenance of service roads necessary.**

Impact Table 10 (continued)

Theme	**Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on Wetlands**	
Level of significance after mitigation	**Low significance after mitigation.**	**Low significance**
EMP requirements	Ensure no roads are constructed through wetlands or hydromorphic soils.	N/a
Discussion It is important to maintain the function of the wetlands by not interfering with the hydrology through the construction of roads or by diversion of water. Wetlands have protected status and do not only have an important water catchment function, but it offers important habitat to birds and animals. The impact on bird habitat is fully covered in the ornithological report of Chris van Rooyen.		

Impact Table 11.

Theme	**Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on flora**	
Nature of impact	***Impact on the floral biodiversity***	
Legal requirements	**Biodiversity Act, No 10 of 2004.**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings*	N/A
Duration of impact	Permanent**. Red Grass is a good indicator within the grassland of herbaceous biodiversity and topsoil disturbance will result in permanent loss of this Decreaser grass species.	Negligible if sound management is in place
Intensity	Low	Negligible if sound management is in place; medium if servitude is mowed and not burned.
Probability of occurrence	Probable to definite (definite long term irreversible change in grass composition expected unless construction is done under controlled supervision.	Negligible if sound management is in place; definite if servitude is mowed and not burned.
Status of the impact	Negative	N/A
Accumulative Impact	Low	Negligible if sound management is in place
Level of significance	**Low**	**Low**
Mitigation measures	Inform contractor / manager and staff of this impact (awareness)	N/A
Level of significance after mitigation	**Low**	**Low to none**
EMP requirements	Contain the disturbance in Red Grass (*Themeda triandra*) dominated areas to as small possible area.	N/A
Discussion *Although the impact during construction may be limited to the site and immediate surroundings, the disturbance of pristine grassland has national importance. Grasslands offer important habitats to a number of endemic and rare flora and fauna species. **Permanent impact on the grass species composition is definite with grassland areas with heavy clays, which have a dominance of Red Grass. Once the topsoil is ploughed or disturbed valuable grazing is permanently lost and the same Red Grass dominated grass sward will never revert back to its original pristine stage. Red Grass forever lost, also imply a lost of the number of other herbaceous species associated with Decreaser dominated veld.		

Impact Table 12

Theme	**Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on fauna**	
Nature of impact	***The disturbance impact on fauna, mostly indirect impacts, such as poaching on mammals, reptiles and birds***	
Legal requirements	Environmental Conservation Act 1998	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings on unploughed deep red apedal soils (Hutton form).	Local (birds); Negligible (mammals), One reptile species not yet identified (possibly one of the girdled lizards, e.g. the Sungazer, *Cordylus* cf. *giganteus* found on the property of Mr Kobus Delport).
Duration of impact	Short term (mammals, reptile species)	Long term (birds); N/A (mammals) & Long term (reptile species above)
Intensity	Medium (mammals)	Low (birds); N/A (mammals); High (reptile species)
Probability of occurrence	Highly probable on unploughed Hutton soils near koppies	Highly probable
Status of the impact	Negative	Negative
Accumulative Impact	Low	Low (birds); Negligible (mammals) & Low (retile species)
Level of significance	**Medium**	Low (birds); **No** significance (mammals) & **Low to medium** (reptile species)
Mitigation measures	Environmental education to contractors - implications of poaching	Fit PVC Bird Guards on towers near important bird habitats such as near pans, wetlands or dams and Bird Flight Diverters at grasslands with high biodiversity or where a high incidence of bird collisions is expected. Reptile species mentioned on Mr Delport's farm and occurring in similar habitats elsewhere affected by powerline construction must be moved to suitable areas with the assistance of herpetologists and provincial conservation authorities.
Level of significance after mitigation	**None**	Low (birds); **No to low** significance (mammals and reptile species).
EMP requirements	All the role players involved during construction must be well informed of the negative impact and implications of poaching.	PVC Bird Guards and Bird Flight Diverters at appropriate sections of transmission line. Determine status and distribution of reptile species mentioned above.
Discussion Steenbuck, Grey Duiker, Oribi, Blesbuck, Springbuck and other game or birds or other fauna will be poached unless strict control and monitoring is in place. This will be highly probable especially in rocky outcrop areas where the biodiversity is high, or where power lines transect through undisturbed grassland. Direct impacts of the transmission line include mortalities caused by bird collisions. Wetlands, dams and pan areas and other important bird habitat areas should therefore be taken into account when refining the exact route. The bird collision impact also affect ESKOM negatively through high costs while restoring power supply to end users.		

Impact Table 13

Theme	**Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on Biodiversity**	
Nature of impact	***The impact of service roads and construction on biodiversity***	
Legal requirements	**NEMBA of 2004 and Environmental Conservation Act 1998**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Local, but once the site has been constructed there is no or minimal impact
Duration of impact	Short term – if no rehabilitation takes place after construction - affects vegetation with disturbance under uncontrolled circumstances	Short term - If rehabilitation was done after construction, no or minimal impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent permanent habitat and biodiversity loss through erosion resulting from construction activities	N/A
Accumulative Impact	Moderate	Negligible
Level of significance	**Medium to high**	**Low**
Mitigation measures	Management that applies to soil conservation also apply here – if topsoil is lost through disturbance then all the other components of the ecological pyramid is affected.	Maintain service roads, water run-off. Maintenance of service roads necessary. Water run-off diverters and humps along roads at slopes and culverts at drainage line crossings are necessary.
Level of significance after mitigation	**Low significance**	**No significance**
EMP requirements	Rehabilitate topsoil after construction. Lower parts of the catena will have a higher risk of soil erosion due to the presence of seep areas and a shallow water table in that part of the terrain morphology. The contractor should take this into account when planning water diversions.	Maintain service roads
Discussion Biodiversity is threatened mainly at islands of rocky outcrops surrounded by large areas of ploughed land. Unploughed land also has higher biodiversity especially on mineral rich sensitive soils where clay content is higher.		

Impact Table 14.

Theme	**Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on fire management**	
Nature of impact	***Using regular fire versus mowing during management of transmission line servitude***	
Legal requirements		
Stage	Construction and Decommissioning	Operation
Extent of impact	N/A	Local
Duration of impact	N/A	Permanent*
Intensity	N/A	Low
Probability of occurrence	N/A	Probable
Status of the impact	N/A	Negative
Accumulative Impact	N/A	Negligible
Level of significance	N/A	**Medium**
Mitigation measures	N/A	Use fire under safe environmental conditions (i.e. green fire index) to remove moribund vegetation. Burning is preferred above mowing due to the negative impact of mowing on the grass composition, i.e. changing a decreaser dominated grass sward to a grassland dominated by Thatching Grass (*Hyparrhenia hirta*) with higher fire risk.**
Level of significance after mitigation	N/A	**Low significance**

Impact Table 14.

Theme	Impact of the Zeus-Mercury Western Alignment Route 2 (W2) on fire management	
EMP requirements	N/A	• Burn at least every second year under good climatic conditions, with rainfall from 900 mm p.a. or more and under safe environmental conditions, i.e. green fire index, after 3 pm or before 11 am and with grass fuel load of less than 4 tons/ha. • If mowing is already practised – where such a disturbance already exists, the hay must be removed after the mowing action and the time of mowing should be limited to summer months, if grassland is dominated by Thatching Grass.
Discussion *The compositional change from Decreaser dominated *Themeda triandra* grassland to a grassland with tall grass, such as *Hyparrhenia hirta* is irreversible. After disturbance of the topsoil of pristine grassland where Red Grass is dominant, this species will decline in its abundance and be replaced by more competitive tall grass species, such as Thatching Grass (*H. hirta*). Other pioneer grass species may also increase in their abundance, with the result that Decreaser species will be lost permanently. The mowing action has a definite impact on the quality of grazing and will on the long term lead to the loss of valuable grazing species and biodiversity. Thatching Grass is a tall grass that will out-compete other short grass species taking away the sunshine and moisture requirements needed for survival. ** Mowing and accumulation of hay afterwards will favour tall grass competitive species such as Thatching Grass and be detrimental to short grass species such as Red Grass that need sunlight exposure in order to stimulate tiller growth – Thatching Grass can produce tillers through organic debri.		

4.2.3 Central Alignment Route (ZM)

Impact Table 15

Theme	**Impact of the Central Alignment Route (ZM) on Soils**	
Nature of impact	***The impact of service roads and construction on the topsoil and on sensitive soils that may lead to erosion***	
Legal requirements	**Soil Conservation Act of 1946 and of 1969**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Local, but once the site has been constructed there is no or minimal impact
Duration of impact	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction and during operation - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances. However, if rehabilitation was done after construction, no or minimal impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent erosion resulting from construction activities	N/A
Accumulative Impact	Moderate	Negligible
Level of significance	Relatively medium to high compared to other line options, but medium to high significance at direct impact	Medium

Impact Table 15 (continued)

Theme	**Impact of the Central Alignment Route (ZM) on Soils**	
Mitigation measures	Provision should be made for water drainage away from direct disturbance area. With deeper soils with underlying soft plinthic material the construction should take into account the presence of water that will definitely be hazardous unless provision is made for drainage away from the impact. Rehabilitate topsoil after disturbance. Topsoil should be added if little soil remains after construction and be recovered with indigenous grass.	Maintain service roads, water run-off. Maintenance of service roads necessary. Water run-off diverters and humps along roads at slopes and culverts at drainage line crossings are necessary.
Level of significance after mitigation	**Low significance**	**Low significance**
EMP requirements	Less service road construction required due to the fact that there is existing power line with service road.	Maintain service roads
Discussion The fluctuation of the water table between the wet and dry seasons may cause problems where soils are shallow or where topsoil is disturbed. Erosion will probably result depending on the volume of water and the extent of the disturbance. In the event of high rainfall occurring over a number of years, seeplines will be active and unless sufficient mitigation measures are put in place the disturbance will lead to gully erosion.		

Impact Table 16

Theme	**Impact of the Central Alignment Route (ZM) on recently discovered micro-organism species on rocky outcrops (koppies)**	
Nature of impact	***Impact of construction and service roads on survival of micro-organisms (Bovidromus roussouwi) occurring on rocky outcrops***	
Legal requirements	The recently discovered *Bovidromus roussouwi* species are not yet legally protected but construction could affect their survival on islands of rocky outcrops. This species is endemic to this area and internationally significant, does not occur outside a 50 km radius from Potchefstroom and nowhere else on this world (*Pers. comm*., Prof Theron).	
Stage	Construction and Decommissioning	Operation
Extent of impact	Limited to the site and its immediate surroundings, with a higher frequency of occurrence higher up on rocky outcrops	This species in nowhere else discovered so it has **international** implication
Duration of impact	Long term – if immediate habitat is affected by the impact of construction of powerline footprint	Long term – if immediate habitat is affected by the impact of construction of powerline footprint
Intensity	High	Medium
Probability of occurrence	Probable	Probable
Status of the impact	Negative – service roads not allowed through rocky areas	Negative – service roads not allowed through rocky areas
Accumulative Impact	Potentially high, but a relative low accumulative impact is envisaged with this line option compared to other line options	Low to moderate
Level of significance	Relatively **low** compared to other route options (i.e. W1) but potentially **low** significance at immediate impact area due to fact that there is an existing line.	Potentially **low to none**
Mitigation measures	It should be noted that the recently discovered *Bovidromus roussouwi* is legally not yet protected but construction would affect their survival. However, in the event of permission being obtained to proceed with construction of the power line and/or service roads through some rocky areas service roads would need to be constructed on lower parts of the rocky areas on more level ground as these organisms have a preference for higher lying terrain. Rocky outcrop areas should not have service road crossings but rather detours to the opposite point to avoid transecting through sensitive *Bovidromus roussouwi* habitat.	Service roads should not run parallel directly under the power lines, but should detour around the pylons and rocky outcrops if power lines transect these sensitive habitats. Maintenance of culverts and service roads necessary.

Impact Table 16 (continued)

Theme	**Impact of the Central Alignment Route (ZM) on recently discovered micro-organism species on rocky outcrops (koppies)**	
Level of significance after mitigation	Relatively **low**	**No** significance
EMP requirements	Ensure no roads are constructed through rocky outcrops.	None.
Discussion It is important not to ensure the long term survival of *Bovidromus roussouwi* by not interfering with the habitat on rocky outcrops through the construction of footprint areas for pylons or through the construction of service roads through habitat of *Bovidromus roussouwi*. The species *Bovidromus roussouwi* does not yet enjoy protected status but it is unique in the extent of occurrence, with international significance. It performs an important soil forming function and is the only species of its kind (genus) occurring within the Vredefort / Potchefstroom area (within a 50 km radius). Its unique reproductive and feeding behaviour is published in 2007 by Prof Theron from the North West University (Potchefstroom). The rocky areas are also islands of undisturbed natural areas offering important habitat to birds and animals.		

Impact Table 17

Theme	**Impact of the Central Alignment Route (ZM) on wetlands**	
Nature of impact	***The impact of construction and of service roads on wetland function and hydrology.***	
Legal requirements	National Water Act No 36 of 1998.	
Stage	Construction and Decommissioning	Operation
Extent of impact	Limited to the site and its immediate surroundings	Local, but once the service roads has been constructed there is no or minimal impact
Duration of impact	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction and during operation - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances. However, if rehabilitation was done after construction, limited impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent erosion resulting from construction activities	Neutral
Accumulative Impact	Moderate	Negligible
Level of significance	Relatively **low** compared to other route options. Level of significance potentially **low** per local impact	Potentially **low**
Mitigation measures	Culverts needed with service roads at minor drainage line crossings, but wetlands should not have service road crossings but rather detours to the opposite point to avoid transecting through hydromorphic soils. All soil material, i.e. topsoil plus subsoil, should be removed as deep as the weathered rock and be replaced by concrete to provide stability for the pylon structure.	Maintenance of service roads necessary.

Impact Table 17 (continued)

Theme	**Impact of the Central Alignment Route (ZM) on wetlands**	
Level of significance after mitigation	**Low significance after mitigation.**	**Low significance**
EMP requirements	Ensure no roads are constructed through wetlands or hydromorphic soils.	N/a
Discussion It is important to maintain the function of the wetlands by not interfering with the hydrology through the construction of roads or by diversion of water. Wetlands have protected status and do not only have an important water catchment function, but it offers important habitat to birds and animals. The impact on bird habitat is fully covered in the ornithological report of Chris van Rooyen. Due to the fact that there is an existing line with service roads less impact is envisaged than it would have with a new route.		

Impact Table 18

Theme	**Impact of the Central Alignment Route (ZM) on flora**	
Nature of impact	***Impact on the floral biodiversity***	
Legal requirements	**Biodiversity Act, No 10 of 2004.**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings*	N/A
Duration of impact	Permanent**. Red Grass is a good indicator within the grassland of herbaceous biodiversity and topsoil disturbance will result in permanent loss of this Decreaser grass species.	Negligible if sound management is in place
Intensity	Low	Negligible if sound management is in place; medium if servitude is mowed and not burned.
Probability of occurrence	Probable to definite (definite long term irreversible change in grass composition expected unless construction is done under controlled supervision.	Negligible if sound management is in place; definite if servitude is mowed and not burned.
Status of the impact	Negative	N/A
Accumulative Impact	Low	Negligible if sound management is in place
Level of significance	**Low**	**Low**
Mitigation measures	Inform contractor / manager and staff of this impact (awareness)	N/A
Level of significance after mitigation	**medium**	**medium**
EMP requirements	Contain the disturbance in Red Grass (*Themeda triandra*) dominated areas to as small possible area.	N/A

Discussion

*Although the impact during construction may be limited to the site and immediate surroundings, the disturbance of pristine grassland has national importance. Grasslands offer important habitats to a number of endemic and rare flora and fauna species.

**Permanent impact on the grass species composition is definite with grassland areas with heavy clays, which have a dominance of Red Grass. Once the topsoil is ploughed or disturbed valuable grazing is permanently lost and the same Red Grass dominated grass sward will never revert back to its original pristine stage. Red Grass forever lost, also imply a lost of the number of other herbaceous species associated with Decreaser dominated veld. Due to the fact that there is an existing line with service roads less impact is envisaged than it would have with a new route.

Impact Table 19

Theme	**Impact of the Central Alignment Route (ZM) on fauna**	
Nature of impact	***The disturbance impact on fauna, mostly indirect impacts, such as poaching on mammals, reptiles and birds***	
Legal requirements	**Environmental Conservation Act 1998**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings on unploughed deep red apedal soils (Hutton form).	Local (birds); Negligible (mammals), One reptile species not yet identified (possibly one of the girdled lizards, e.g. the Sungazer, *Cordylus* cf. *giganteus* found on the property of Mr Kobus Delport).
Duration of impact	Short term (mammals, reptile species)	Long term (birds); N/A (mammals) & Long term (reptile species above)
Intensity	Medium (mammals)	Low (birds); N/A (mammals); High (reptile species)
Probability of occurrence	Highly probable on unploughed Hutton soils near koppies	Highly probable
Status of the impact	Negative	Negative
Accumulative Impact	Low	Low (birds); Negligible (mammals) & Low (retile species)
Level of significance	**Medium**	Low (birds); **No** significance (mammals) & **Low to medium** (reptile species)
Mitigation measures	Environmental education to contractors - implications of poaching	Fit PVC Bird Guards on towers near important bird habitats such as near pans, wetlands or dams and Bird Flight Diverters at grasslands with high biodiversity or where a high incidence of bird collisions is expected. Reptile species mentioned on Mr Delport's farm and occurring in similar habitats elsewhere affected by powerline construction must be moved to suitable areas with the assistance of herpetologists and provincial conservation authorities.
Level of significance after mitigation	**Low**	Low (birds); **No** significance (mammals and reptile species).
EMP requirements	All the role players involved during construction must be well informed of the negative impact and implications of poaching.	PVC Bird Guards and Bird Flight Diverters at appropriate sections of transmission line. Determine status and distribution of reptile species mentioned above.
Discussion Steenbuck, Grey Duiker, Oribi, Blesbuck, Springbuck and other game or birds or other fauna will be poached unless strict control and monitoring is in place. This will be highly probable especially in rocky outcrop areas where the biodiversity is high, or where power lines transect through undisturbed grassland. Direct impacts of the transmission line include mortalities caused by bird collisions. Wetlands, dams and pan areas and other important bird habitat areas should therefore be taken into account when refining the exact route. The bird collision impact also affect ESKOM negatively through high costs while restoring power supply to end users. Due to the fact that there is an existing line with service roads less impact is envisaged than it would have with a new route.		

Impact Table 20

Theme	**Impact of the Zeus-Mercury Central Alignment Route (ZM) on Biodiversity**	
Nature of impact	***The impact of service roads and construction on biodiversity***	
Legal requirements	**NEMBA of 2004 and Environmental Conservation Act 1998**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Local, but once the site has been constructed there is no or minimal impact
Duration of impact	Short term – if no rehabilitation takes place after construction - affects vegetation with disturbance under uncontrolled circumstances	• Short term - If rehabilitation was done after construction, no or minimal impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent permanent habitat and biodiversity loss through erosion resulting from construction activities	N/A
Accumulative Impact	Moderate	Negligible
Level of significance	**Medium**	**Low**
Mitigation measures	Management that applies to soil conservation also apply here – if topsoil is lost through disturbance then all the other components of the ecological pyramid is affected.	Maintain service roads, water run-off. Maintenance of service roads necessary. Water run-off diverters and humps along roads at slopes and culverts at drainage line crossings are necessary.
Level of significance after mitigation	**Medium significance**	**Low to no significance**
EMP requirements	Rehabilitate topsoil after construction. Lower parts of the catena will have a higher risk of soil erosion due to the presence of seep areas and a shallow water table in that part of the terrain morphology. The contractor should take this into account when planning water diversions.	Maintain service roads
Discussion Biodiversity is threatened mainly at islands of rocky outcrops surrounded by large areas of ploughed land. Unploughed land also has higher biodiversity especially on mineral rich sensitive soils where clay content is higher. Due to the fact that there is an existing line with service roads less impact is envisaged than it would have with a new route.		

Impact Table 21

Theme	**Impact of the Central Alignment Route (ZM) on fire management**	
Nature of impact	***Using regular fire versus mowing during management of transmission line servitude***	
Legal requirements		
Stage	Construction and Decommissioning	Operation
Extent of impact	N/A	Local
Duration of impact	N/A	Permanent*
Intensity	N/A	Low
Probability of occurrence	N/A	Probable
Status of the impact	N/A	Negative
Accumulative Impact	N/A	Negligible
Level of significance	N/A	**Medium**
Mitigation measures	N/A	Use fire under safe environmental conditions (i.e. green fire index) to remove moribund vegetation. Burning is preferred above mowing due to the negative impact of mowing on the grass composition, i.e. changing a decreaser dominated grass sward to a grassland dominated by Thatching Grass (*Hyparrhenia hirta*) with higher fire risk.**
Level of significance after mitigation	N/A	**Low significance**

Impact Table 21 (continued)

Theme	Impact of the Central Alignment Route (ZM) on fire management	
EMP requirements	N/A	• Burn at least every second year under good climatic conditions, with rainfall from 900 mm p.a. or more and under safe environmental conditions, i.e. green fire index, after 3 pm or before 11 am and with grass fuel load of less than 4 tons/ha. • If mowing is already practised – where such a disturbance already exists, the hay must be removed after the mowing action and the time of mowing should be limited to summer months, if grassland is dominated by Thatching Grass.
Discussion *The compositional change from Decreaser dominated *Themeda triandra* grassland to a grassland with tall grass, such as *Hyparrhenia hirta* is irreversible. After disturbance of the topsoil of pristine grassland where Red Grass is dominant, this species will decline in its abundance and be replaced by more competitive tall grass species, such as Thatching Grass (*H. hirta*). Other pioneer grass species may also increase in their abundance, with the result that Decreaser species will be lost permanently. The mowing action has a definite impact on the quality of grazing and will on the long term lead to the loss of valuable grazing species and biodiversity. Thatching Grass is a tall grass that will out-compete other short grass species taking away the sunshine and moisture requirements needed for survival. ** Mowing and accumulation of hay afterwards will favour tall grass competitive species such as Thatching Grass and be detrimental to short grass species such as Red Grass that need sunlight exposure in order to stimulate tiller growth – Thatching Grass can produce tillers through organic debri.		

4.2.4 Eastern Alignment (Ae)

Impact Table 22

Theme	**Impact of the Eastern Alignment (Ae) on Soils**	
Nature of impact	***The impact of service roads and construction on the topsoil and on sensitive soils that may lead to erosion***	
Legal requirements	**Soil Conservation Act of 1946 and of 1969**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Local, but once the site has been constructed there is no or minimal impact
Duration of impact	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction and during operation - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances. However, if rehabilitation was done after construction, no or minimal impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent erosion resulting from construction activities	N/A
Accumulative Impact	Moderate	Negligible
Level of significance	Relatively medium to high compared to other line options, but medium to high significance at direct impact	Medium

Impact Table 22 (continued)

Theme	Impact of the Eastern Alignment (Ae) on Soils	
Mitigation measures	Provision should be made for water drainage away from direct disturbance area. With deeper soils with underlying soft plinthic material the construction should take into account the presence of water that will definitely be hazardous unless provision is made for drainage away from the impact. Rehabilitate topsoil after disturbance. Topsoil should be added if little soil remains after construction and be recovered with indigenous grass.	Maintain service roads, water run-off. Maintenance of service roads necessary. Water run-off diverters and humps along roads at slopes and culverts at drainage line crossings are necessary.
Level of significance after mitigation	**Low to medium significance**	**Low to medium significance**
EMP requirements	Rehabilitate topsoil after construction. Lower parts of the catena will have a higher risk of soil erosion due to the presence of seep areas and a shallow water table in that part of the terrain morphology. The contractor should take this into account when planning water diversions.	Maintain service roads
Discussion The fluctuation of the water table between the wet and dry seasons may cause problems where soils are shallow or where topsoil is disturbed. Erosion will probably result depending on the volume of water and the extent of the disturbance. In the event of high rainfall occurring over a number of years, seeplines will be active and unless sufficient mitigation measures are put in place the disturbance will lead to gully erosion.		

Impact Table 23

Theme	**Impact of the Eastern Alignment (Ae) on recently discovered micro-organism species on rocky outcrops (koppies)**	
Nature of impact	***Impact of construction and service roads on survival of micro-organisms (Bovidromus roussouwi) occurring on rocky outcrops (No outcrops on this route option)***	
Legal requirements	n/a	
Stage	Construction and Decommissioning	Operation
Extent of impact	Limited to the site and its immediate surroundings, with a higher frequency of occurrence higher up on rocky outcrops – there are no rocky areas on this route, so N/A	n/a
Duration of impact	n/a	n/a
Intensity	n/a	n/a
Probability of occurrence	n/a	n/a
Status of the impact	n/a	n/a
Accumulative Impact	n/a	n/a
Level of significance	Potentially **no** significance at immediate impact area	Potentially **none**
Mitigation measures	n/a	n/a
Level of significance after mitigation	**None**	**No** significance
EMP requirements	n/a	None.
Discussion n/a		

Impact Table 24

Theme	**Impact of the Eastern Alignment (Ae) on wetlands**	
Nature of impact	***The impact of construction and of service roads on wetland function and hydrology.***	
Legal requirements	National Water Act No 36 of 1998.	
Stage	Construction and Decommissioning	Operation
Extent of impact	Limited to the site and its immediate surroundings	Local, but once the service roads has been constructed there is no or minimal impact
Duration of impact	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances	• Short term if immediately rehabilitated immediately or soon after construction. • Permanent – if no rehabilitation takes place after construction and during operation - affects permanent soil loss and loss of vegetation with disturbance under uncontrolled circumstances. However, if rehabilitation was done after construction, limited impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent erosion resulting from construction activities	Neutral
Accumulative Impact	Moderate	Negligible
Level of significance	**Relatively <u>medium to high</u> compared to other route options. Level of significance potentially <u>medium</u> per local impact**	**Potentially <u>medium</u>**
Mitigation measures	**Culverts needed with service roads at minor drainage line crossings, but wetlands should not have service road crossings but rather detours to the opposite point to avoid transecting through hydromorphic soils. All soil material, i.e. topsoil plus subsoil, should be removed as deep as the weathered rock and be replaced by concrete to provide stability for the pylon structure.**	**Maintenance of service roads necessary.**

Impact Table 24 (continued)

Theme	**Impact of the Eastern Alignment (Ae) on wetlands**	
Level of significance after mitigation	**Low significance after mitigation.**	**Low significance**
EMP requirements	Ensure no roads are constructed through wetlands or hydromorphic soils.	N/a
Discussion It is important to maintain the function of the wetlands by not interfering with the hydrology through the construction of roads or by diversion of water. Wetlands have protected status and do not only have an important water catchment function, but it offers important habitat to birds and animals. The impact on bird habitat is fully covered in the ornithological report of Chris van Rooyen.		

Impact Table 25

Theme	**Impact of the Eastern Alignment (Ae) on flora**	
Nature of impact	***Impact on the floral biodiversity***	
Legal requirements	**Biodiversity Act, No 10 of 2004.**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings*	N/A
Duration of impact	Permanent**. Red Grass is a good indicator within the grassland of herbaceous biodiversity and topsoil disturbance will result in permanent loss of this Decreaser grass species.	Negligible if sound management is in place
Intensity	Low	Negligible if sound management is in place; medium if servitude is mowed and not burned.
Probability of occurrence	Probable to definite (definite long term irreversible change in grass composition expected unless construction is done under controlled supervision.	Negligible if sound management is in place; definite if servitude is mowed and not burned.
Status of the impact	Negative	N/A
Accumulative Impact	Low	Negligible if sound management is in place
Level of significance	**Low**	**Low**
Mitigation measures	Inform contractor / manager and staff of this impact (awareness)	N/A
Level of significance after mitigation	**high**	**Low to none**
EMP requirements	Contain the disturbance in Red Grass (*Themeda triandra*) dominated areas to as small possible area.	N/A
Discussion *Although the impact during construction may be limited to the site and immediate surroundings, the disturbance of pristine grassland has national importance. Grasslands offer important habitats to a number of endemic and rare flora and fauna species. **Permanent impact on the grass species composition is definite with grassland areas with heavy clays, which have a dominance of Red Grass. Once the topsoil is ploughed or disturbed valuable grazing is permanently lost and the same Red Grass dominated grass sward will never revert back to its original pristine stage. Red Grass forever lost, also imply a lost of the number of other herbaceous species associated with Decreaser dominated veld.		

Impact Table 26

Theme	**Impact of the Eastern Alignment (Ae) on fauna**	
Nature of impact	***The disturbance impact on fauna, mostly indirect impacts, such as poaching on mammals, reptiles and birds***	
Legal requirements	Environmental Conservation Act 1998	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings on unploughed deep red apedal soils (Hutton form).	Local (birds); Negligible (mammals), One reptile species not yet identified (possibly one of the girdled lizards, e.g. the Sungazer, *Cordylus* cf. *giganteus* found on the property of Mr Kobus Delport).
Duration of impact	Short term (mammals, reptile species)	Long term (birds); N/A (mammals) & Long term (reptile species above)
Intensity	Medium (mammals)	Low (birds); N/A (mammals); High (reptile species)
Probability of occurrence	Highly probable on unploughed Hutton soils near koppies	Highly probable
Status of the impact	Negative	Negative
Accumulative Impact	Low	Low (birds); Negligible (mammals) & Low (retile species)
Level of significance	**Low to medium**	Low (birds); **No** significance (mammals) & **Low to medium** (reptile species)
Mitigation measures	Environmental education to contractors - implications of poaching	Fit PVC Bird Guards on towers near important bird habitats such as near pans, wetlands or dams and Bird Flight Diverters at grasslands with high biodiversity or where a high incidence of bird collisions is expected. Reptile species mentioned on Mr Delport's farm and occurring in similar habitats elsewhere affected by powerline construction must be moved to suitable areas with the assistance of herpetologists and provincial conservation authorities.
Level of significance after mitigation	**None**	Low (birds); **No** significance (mammals and reptile species).
EMP requirements	All the role players involved during construction must be well informed of the negative impact and implications of poaching.	PVC Bird Guards and Bird Flight Diverters at appropriate sections of transmission line. Determine status and distribution of reptile species mentioned above.
Discussion Steenbuck, Grey Duiker, Oribi, Blesbuck, Springbuck and other game or birds or other fauna will be poached unless strict control and monitoring is in place. This will be highly probable especially in rocky outcrop areas where the biodiversity is high, or where power lines transect through undisturbed grassland. Direct impacts of the transmission line include mortalities caused by bird collisions. Wetlands, dams and pan areas and other important bird habitat areas should therefore be taken into account when refining the exact route. The bird collision impact also affect ESKOM negatively through high costs while restoring power supply to end users.		

Impact Table 27

Theme	**Impact of the Zeus-Mercury Eastern Alignment Route (Ea) on Biodiversity**	
Nature of impact	***The impact of service roads and construction on biodiversity***	
Legal requirements	**NEMBA of 2004 and Environmental Conservation Act 1998**	
Stage	Construction and Decommissioning	Operation
Extent of impact	Site and immediate surroundings	Local, but once the site has been constructed there is no or minimal impact
Duration of impact	Short term – if no rehabilitation takes place after construction - affects vegetation with disturbance under uncontrolled circumstances	• Short term - If rehabilitation was done after construction, no or minimal impact is expected during operation.
Intensity	Low - provided that construction is done under controlled supervision.	Low
Probability of occurrence	Probable	Improbable during operation, provided that construction was properly managed
Status of the impact	Negative – except if sufficient measures are put in place during or immediately after construction to prevent permanent habitat and biodiversity loss through erosion resulting from construction activities	N/A
Accumulative Impact	Moderate	Negligible
Level of significance	**Medium**	**Medium**
Mitigation measures	Management that applies to soil conservation also apply here – if topsoil is lost through disturbance then all the other components of the ecological pyramid is affected.	Maintain service roads, water run-off. Maintenance of service roads necessary. Water run-off diverters and humps along roads at slopes and culverts at drainage line crossings are necessary.
Level of significance after mitigation	**Medium significance**	**Medium significance**
EMP requirements	Rehabilitate topsoil after construction. Lower parts of the catena will have a higher risk of soil erosion due to the presence of seep areas and a shallow water table in that part of the terrain morphology. The contractor should take this into account when planning water diversions.	Maintain service roads
Discussion Biodiversity is threatened mainly at islands of rocky outcrops surrounded by large areas of ploughed land. Unploughed land also has higher biodiversity especially on mineral rich sensitive soils where clay content is higher.		

Impact Table 28

Theme	**Impact of the Eastern Alignment (Ae) on fire management**	
Nature of impact	***Using regular fire versus mowing during management of transmission line servitude***	
Legal requirements		
Stage	Construction and Decommissioning	Operation
Extent of impact	N/A	Local
Duration of impact	N/A	Permanent*
Intensity	N/A	Low
Probability of occurrence	N/A	Probable
Status of the impact	N/A	Negative
Accumulative Impact	N/A	Negligible
Level of significance	N/A	**Medium**
Mitigation measures	N/A	Use fire under safe environmental conditions (i.e. green fire index) to remove moribund vegetation. Burning is preferred above mowing due to the negative impact of mowing on the grass composition, i.e. changing a decreaser dominated grass sward to a grassland dominated by Thatching Grass (*Hyparrhenia hirta*) with higher fire risk.**
Level of significance after mitigation	N/A	**Low significance**

Impact Table 28 (continued)

Theme	Impact of the Eastern Alignment (Ae) on fire management	
EMP requirements	N/A	• Burn at least every second year under good climatic conditions, with rainfall from 900 mm p.a. or more and under safe environmental conditions, i.e. green fire index, after 3 pm or before 11 am and with grass fuel load of less than 4 tons/ha. • If mowing is already practised – where such a disturbance already exists, the hay must be removed after the mowing action and the time of mowing should be limited to summer months, if grassland is dominated by Thatching Grass.
Discussion *The compositional change from Decreaser dominated *Themeda triandra* grassland to a grassland with tall grass, such as *Hyparrhenia hirta* is irreversible. After disturbance of the topsoil of pristine grassland where Red Grass is dominant, this species will decline in its abundance and be replaced by more competitive tall grass species, such as Thatching Grass (*H. hirta*). Other pioneer grass species may also increase in their abundance, with the result that Decreaser species will be lost permanently. The mowing action has a definite impact on the quality of grazing and will on the long term lead to the loss of valuable grazing species and biodiversity. Thatching Grass is a tall grass that will out-compete other short grass species taking away the sunshine and moisture requirements needed for survival. ** Mowing and accumulation of hay afterwards will favour tall grass competitive species such as Thatching Grass and be detrimental to short grass species such as Red Grass that need sunlight exposure in order to stimulate tiller growth – Thatching Grass can produce tillers through organic debri.		

4.3 TABLE 5: SUMMARY OF IMPACT LEVELS OF CONSTRUCTION AND OPERATION ON EACH ROUTE BEFORE AND AFTER MITIGATION (ROUTE ALTERNATIVES W1, W2, ZM AND EA).

ISSUE	Nature of Impact	Route W 1		Route W 2		Route Zm		Route Ea	
		Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Soils	The impact on the topsoil and on sensitive soils that may lead to erosion	1.Construction – Relatively **medium** compared to other line options (9.5 km sensitive soils), but **medium** significance at impact 2. Operation - **Medium**	1.Construction – **Low** significance 2. Operation – **Low**	1.Construction – Relative **medium to high** **Medium to high** significance (11.4km sensitive soils) 2.Operation – Relatively **low to medium**	1.Construction – **Low to medium** **Low to Medium** significance 2.Operation – **Low**	1.Construction – **Relatively medium to high** significance (12.4km sensitive soils) 2.Operation – Relatively **Medium**	1.Construction – **Low to medium** significance 2.Operation – **Low to medium**	1.Construction – Relatively **Medium to high** significance (13.1km sensitive soils) 2.Operation – **Medium**	1.Construction – Relatively **low to medium** significance 2.Operation – **Low to medium**
***Bovidromus roussouwi* occurrence on rocky outcrops (Koppies)**	The impact on rock surface containing rare and endemic micro-organisms that requires protection (not yet listed as Red Data)	1.Construction – Relatively & potentially **medium** significance (largest proportion, 3.8km rocky areas) 2.Operation – Potentially **medium**	1.Construction –**low** significance 2.Operation - **None**	1.Construction – Relatively low but potentially **high** significance (only 1km rocky areas) 2.Operation – Potentially **low**	1.Construction –**low** significance 2.Operation - **none**	1.Construction – Relatively **medium** but potentially **high** significance (2.8km rocky areas) 2.Operation – **Medium**	1.Construction - **low** significance 2.Operation **- None**	1.Construction – **None** (Rocky outcrops not present) 2.Operation – **None**	1.Construction – **None** (Rocky outcrops not present) 2.Operation - **None**
Wetlands	The impact on wetland function and hydrology.	1.Construction – Relatively **low** to other line options(4.9km alluvial soils), but potentially **medium** significance 2.Operation – **Low to medium**	1.Construction – **Low** 2.Operation **Low**	1.Construction – Relatively **low** to other line options(3.4km alluvial soils), but potentially low to **medium** significance 2.Operation – **Low to medium**	1.Construction – **Low** 2.Operation **Low**	1.Construction – Relatively **low** (2.2km alluvial soils), but potentially medium significance 2.Operation - Potentially **low**	1.Construction – **Low** 2.Operation -**Low**	1.Construction – Relatively **medium to high** compared to other line options (8.5km alluvial soils) but **medium** significance 2.Operation – **medium**	1.Construction – **low** 2.Operation – **low**

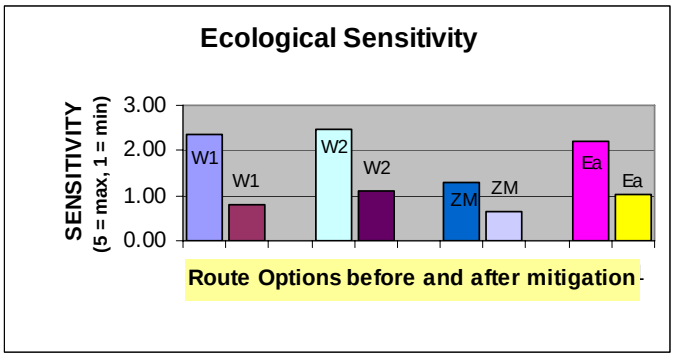
ISSUE	Nature of Impact	Route W 1		Route W 2		Route Zm		Route Ea	
		Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Flora	Impact on the floral diversity	1.Construction – Current knowledge of Red data species – **None** recorded/few Red data species listed, but potentially **none** on general flora (4.9km ploughed Hutton land, second largest proportion) 2.Operation– **Low**	1.Construction – **Low** 2.Operation – **Low to none** for general species, none expected for Red Data species	1.Construction – Current knowledge of Red data species – **None** recorded/few Red data species listed, but potentially **low** on general flora (6.7km ploughed Hutton land, second largest proportion) 2.Operation– **Low**	1.Construction – **none** 2.Operation – **none** for general species, none expected for Red Data species	1.Construction – Low 2. Operation - Current knowledge of Red data species – **None** recorded/few Red data species listed, but potentially **medium** on general flora (3.4km ploughed Hutton land) 2.Operation – **medium** for general species, **none** for Red Data species	1.Construction – **Low** 2.Operation – **Low to None**	1.Construction – **Low** 2. Operation - Current knowledge of Red data species – **None** recorded/few Red data species listed, but potentially **high** on general flora (2.2km ploughed Hutton land) 2.Operation – **high** for general species, **none** expected for Red Data species	1.Construction – **Low** 2.Operation – **Low to none** for general species, none expected for Red Data species

ISSUE	Nature of Impact	Route W 1		Route W 2		Route Zm		Route Ea	
		Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Fauna	Impact on the faunal diversity	1.Construction – Current knowledge of Red data species – Medium**:** One reptile species recorded/few mammals species listed but not recorded, potentially **medium** on general fauna (3.1km conserved grassland on Hutton soils) 2.Operation – **None**	1.Construction – **Low to none** 2.Operation - **None**	1.Construction – Current knowledge of Red data species – Medium to high**:** One reptile species recorded/few mammals species listed but not recorded, potentially **relatively high for Cordyla species** (4.2km conserved grassland on Hutton soils) 2.Operation – **None**	1.Construction – **Low to none** 2.Operation - **None**	1.Construction – Current knowledge of Red data species – **Low:** No species recorded/few mammal species listed but not recorded, potentially **medium** on general fauna (2.4km conserved grassland on Hutton soils) 2.Operation – **None**	1.Construction – **Low to none** 2.Operation – **None**	1.Construction – Current knowledge of Red data species – **Low to medium:** One reptile species recorded/few mammal species listed but not recorded, potentially low on general fauna (1.3km conserved grassland on Hutton soils) 2.Operation – **None**	1.Construction – **None** 2.Operation - **None**
Biodiversity	The impact on overall biodiversity	1.Construction – Potentially **Medium to high** for general species or potential Red Data plant species 2.Operation – **Low**	1.Construction – **Low** 2.Operation - **None**	1.Construction – Potentially **Medium to high** for general species or potential Red Data plant species 2.Operation – **medium**	1.Construction – **Low** 2.Operation - **low**	1.Construction – Potentially **medium** 2.Operation – **Medium -** (sensitive soils)	1.Construction – **Low** 2.Operation – **Low to none**	1.Construction – Potentially **high** on sensitive soils and wetlands, but no rocky areas (koppies) affected, thus potentially **medium** 2.Operation – **Medium** (sensitive soils)	1.Construction – Potentially **medium** 2.Operation – **Medium**

ISSUE	Nature of Impact	Route W 1		Route W 2		Route Zm		Route Ea	
		Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Fire Management	Mowing in stead of using regular fire during management of transmission line servitude	1.Construction - **N/a** 2.Operation – **Medium**	1.Construction -**N/a** 2.Operation – **Low**	1.Construction - **N/a** 2.Operation – **Medium**	1.Construction -**N/a** 2.Operation – **Low**	.Construction - **N/a** 2.Operation – **Medium**	1.Construction -**N/a** 2.Operation – **Low**	1.Construction - **N/a** 2.Operation – **Medium**	1.Construction -**N/a** 2.Operation – **Low**

5. DISCUSSION AND RECOMMENDATIONS

5.1 BEST ECOLOGICAL ALTERNATIVE



W1 = Western alignment 1
W2 = Western alignment 2
ZM = Zeus – Mercury alignment = Central route
Ea = Eastern alignment

Paired data sets for each of the above show the envisaged impact before (left) and after (right) mitigations if all the factors affecting ecological sensitivity are considered. From the figure above the following is noted:

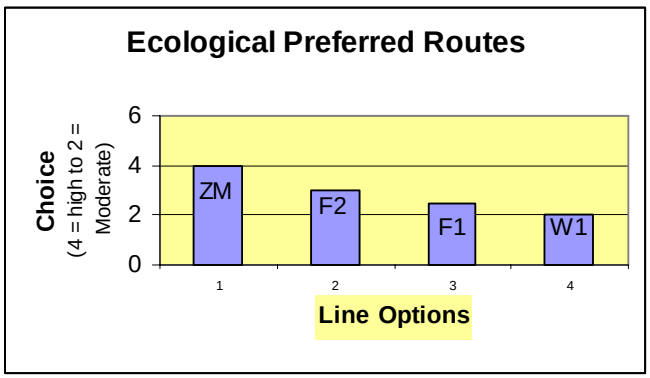
- With all route options similar negative impacts are envisaged if all the ecological impacts could be lumped except for the central alignment due to the presence of existing power line. However, significant reductions in the impacts are envisaged after mitigation.
- W2 is slightly more sensitive of the two western alignment options before mitigation but after mitigation W1 is better.
- The W2 and Ea options are the least desired of the four options if all factors are lumped.

However, from ten line options considered from the ecological map when the existing impact of the Central Alignment is highlighted, the following pattern emerges which includes two ecological alternatives, (see figure below): With this comparison biodiversity expectation and ecological sensitivity (from the extent of rocky outcrops, wetlands/riverbanks and highly textured/structured soils) are taken into account.

The ecologically preferred options would then be:

- First: ZM (Central Alignment)
- Second: F2 (Ecological Alternative alignment 2)
- Third: F1 (Ecological alternative alignment 1)
- Fourth: W1 (Western alignment 1).

(**NB: Note:** If the new route would be chosen with the sole objective to reduce risk of electricity power cuts as result of fire then ZM would not be the preferred route and it would be better to split the new line to prevent both lines to trip as result of one fire).



	Line Options			
	First choice	Second choice	Third choice	Fourth Choice
Biodiversity Expectation (from field work observations and considering existing line at ZM)	ZM	W1	W2	Ea
Ecological sensitivity (from Ecological Map - proportion rocky outcrops, alluvial and other sensitive soils)	F2	A3	A4	F1 & Ea
Rocky Outcrops	A1, A2 & Ea	F2	A3	F1
Sensitive Soils	F2	F1	W1 & W2	ZM
Ploughed land (Largest areas ploughed preferred)	F2	F1	W2	W1
Total Rating (considering just managing existing impact of ZM)	**ZM**	**F2**	**F1**	**W1**
	Line Options			
	First choice	Second choice	Third choice	Fourth Choice

The impact of the development on sensitive soils is envisaged to be medium but with mitigation the long term impact can be reduced. Most of the unploughed red clay areas have high biodiversity potential associated with pristine grassland. These areas are dominated by Red Grass. The shallow soils on rocky outcrops may also be the habitat of threatened plant species and is known to be the habitat of a mite species that requires protection. Rocky outcrops therefore needs protection, as these areas are often associated with Red Data species (including some bird species).

Minimal impact on the ecology can be achieved by taking into consideration the ecological alignment options as illustrated in the appended map if present service roads along the ZM route are properly managed.

As this report reflects vegetation from a winter survey a follow-up survey(s) is/are proposed during the wet seasons (for November/January).

The following recommendations are made for the construction and operational phases of this project.

5.2 CONSTRUCTION AND OPERATIONAL PHASES

5.2.1 CONSTRUCTION PHASE

Construction camp:

The construction camp may be located anywhere on disturbed (ploughed) or previously disturbed (old lands) areas, except within 100m from wetland and rocky outcrop areas. Any permanent structures (if applicable) need to take into account the high clay. A dry toilet system is recommended due to the poor drainage. Green water discharge should be monitored and controlled. The following points should be taken into account in the location of construction camps:

Water bodies in proximity as source for washing.

Existing roads is in proximity of the study area (refrain form making new roads to construction camp).

In the event that new roads would be needed to construction camps on black turf (Vertic soils, Arcadia soils) or Red clays (Shortlands soils):

With the construction of the roads the access roads should fulfill the following criteria.

Sufficient provision should be made for water drainage away from the road.

- Clay should be removed to the depth of saprolite and be replaced with suitable road-filling material.

Rehabilitation of sensitive soils:

Care should be taken not to disturb the topsoil for any disturbance of the topsoil cause permanent loss of the Themeda triandra-dominated grassland character. Preventative measures include the insurance that sunlight always falls directly on the grass layer. Building material should not be allowed to be placed on the grass in such a way as to deprive it from sunlight. Areas that are already disturbed where Coach Grass or Weeping Love Grass or Taaipol dominates should be selected instead. Mowing of the grassland will also cause permanent loss of Red Grass, especially when the mowed material is not immediately removed. Mowing of the grassland under the power lines is not recommended but controlled burning is recommended instead (Chris Austin from Environet can be contacted for a fire management course – Cell 083 459 0504).

In the event where it is inevitable that an area with Red Grass dominating will be disturbed the sod with topsoil should be removed to a depth of 250mm to 300mm and be kept moist (so that the roots are in contact with shallow water) in open areas where sunlight can shine on the Red Grass. Red Grass can also be planted in plug form, which is an expensive exercise, but it should prove to be successful. Grass cover after rehabilitation should be as close as possible (or better) than the norm for this veld type. A realistic target would be to restore grass tuft distance to a minimum of 3cm. Planting of Red Grass plugs are recommended above sowing, but depending on the size of area that would need restoration, sowing can be considered. Coach Grass (Cynodon dactylon) seed is recommended for sowing and not Eragrostis curvula due to the high fire risk that result in the long term if the latter species is chosen.

5.2.2 OPERATIONAL PHASE

Grassland monitoring at areas where it was disturbed (and rehabilitated afterwards) through the construction phase would need to be done yearly for the first three years. Grass cover and composition needs to be evaluated.

Grass fuel load or volume of grass also needs to be monitored on a regular basis. If no grazing occurs the grass would need to be burned at levels exceeding 3000 kg/ha. A disk pasture meter is recommended as a rapid method to establish grass volume. Burning should be preferably at night time to minimize fire risk.

6. CONCLUSION

The best route is simply the one where there is already an existing line with service roads, ZM or Central Alignment. Ecologically the second best route is proposed closer to Potchefstroom, further away from the Vredefort Dome area. Specific route alignments are illustrated in the appended map/aerial photo. By choosing the ZM option or second best, the proposed ecological alignment (F2) the ecological impact will be limited to minimum.

The fact that there is an existing power line route (ZM) with its service road is significant, for not extra significant ecological impact will be created – existing service roads can be used without creating a new one.

The direct ecological impact envisaged on new route alternatives is medium on most parts, at lower lying areas close to the wetlands or river drainage system and also on higher lying koppies and on sensitive clayey areas on the footslopes. The largest impact envisaged is the disturbance of topsoil dominated by Red Grass. This would affect both fauna and flora on the long term. Red Grass is common on undisturbed grassland areas, underlain by clayey soils. Specific recommendations include the removal of topsoil with Red Grass intact and to prevent any cover on Red Grass dominated grassland during construction. Mitigations on midslope or wetland ecotone areas are necessary to allow natural underground seepage towards the drainage lines. If it requires construction to be closer than 100m to the wetlands or drainage lines the ecological impact would be higher.

7. EXECUTIVE SUMMARY

Minimal impact on the ecology can be achieved by taking into consideration the ecological alignment options as illustrated in the appended map

Ecologically the best route is the Central Alignment, second best is proposed closer to Potchefstroom, further away from the Vredefort Dome area. Specific route alignments are illustrated in the appended map/aerial photo.

The ecologically preferred options are therefore:

- 1) ZM (Central Alignment)
- 2) F2 (Ecological Alternative alignment 2)
- 3) F1 (Ecological alternative alignment 1)
- 4) W1 (Western alignment 1).

The impact of the development on biodiversity rich and sensitive soils of alternative routes is envisaged to be medium but with mitigation the long term impact can be reduced significantly. Most of the unploughed red clay areas have high biodiversity potential associated with pristine grassland. These areas are dominated by Red Grass. The shallow soils on rocky outcrops may also be the habitat of threatened plant species and is known to be the habitat of a mite species that requires protection. Rocky outcrops require protection as these areas are often associated with Red Data species. Wetlands and riverine alluvial floodplains are also sensitive and should be avoided when choosing an ecological friendly alternative for the powerline route.

The direct ecological impact envisaged is medium on most parts on the study area and the distribution of ecological sensitive areas is extensive, except at Central alignment where the impact is less. Highest impact envisaged on alternative routes is at the lower lying part of the catena including wetlands or river drainage systems and also on higher lying koppies and on sensitive clayey areas on the footslopes/plains.

The largest impact envisaged is the impact on fauna and flora associated with rocky outcrops and wetlands and the disturbance of topsoil at clayey footslopes that are dominated by Red Grass and the loss of habitat of its associated flora and fauna.

8. REFERENCES

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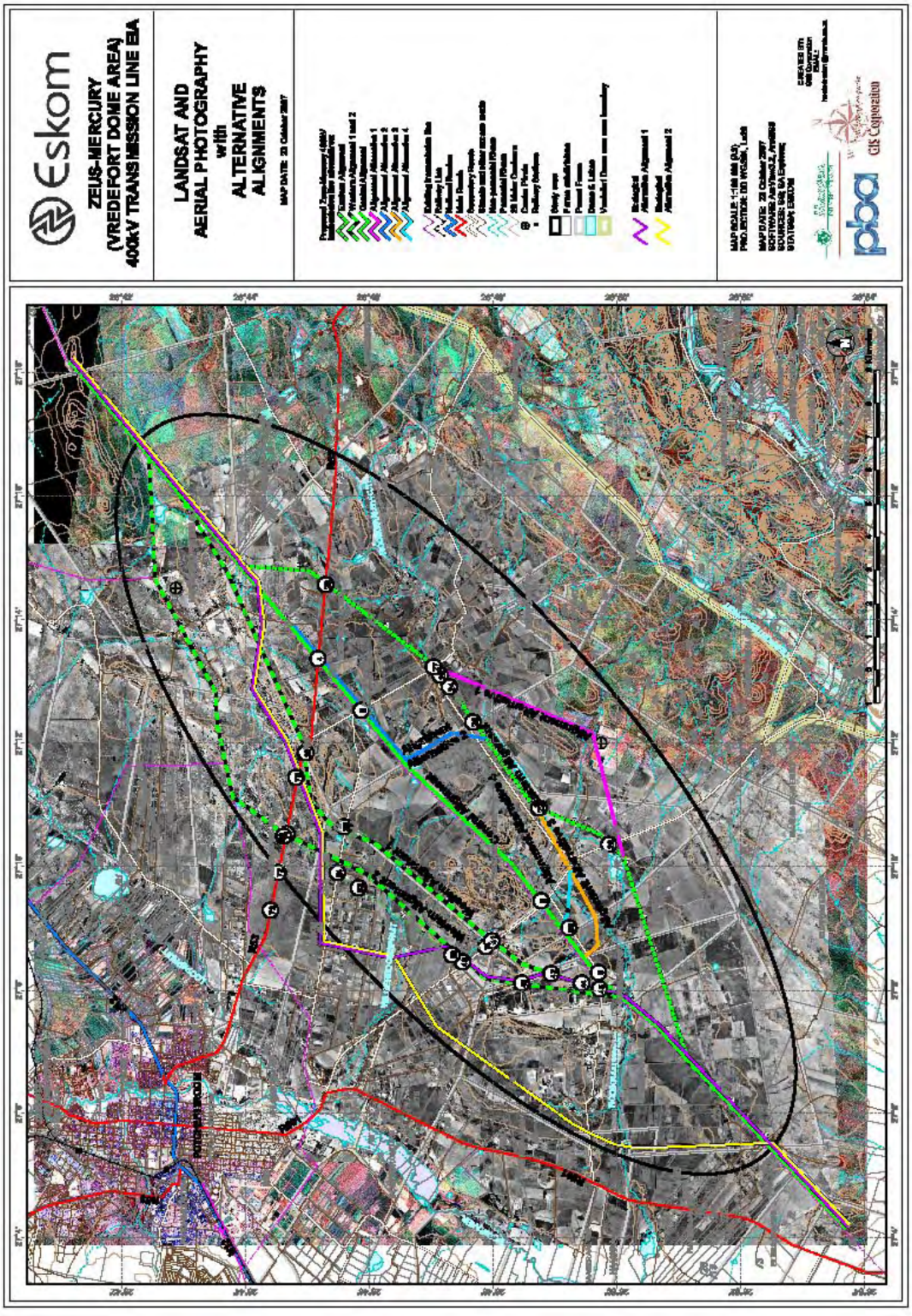
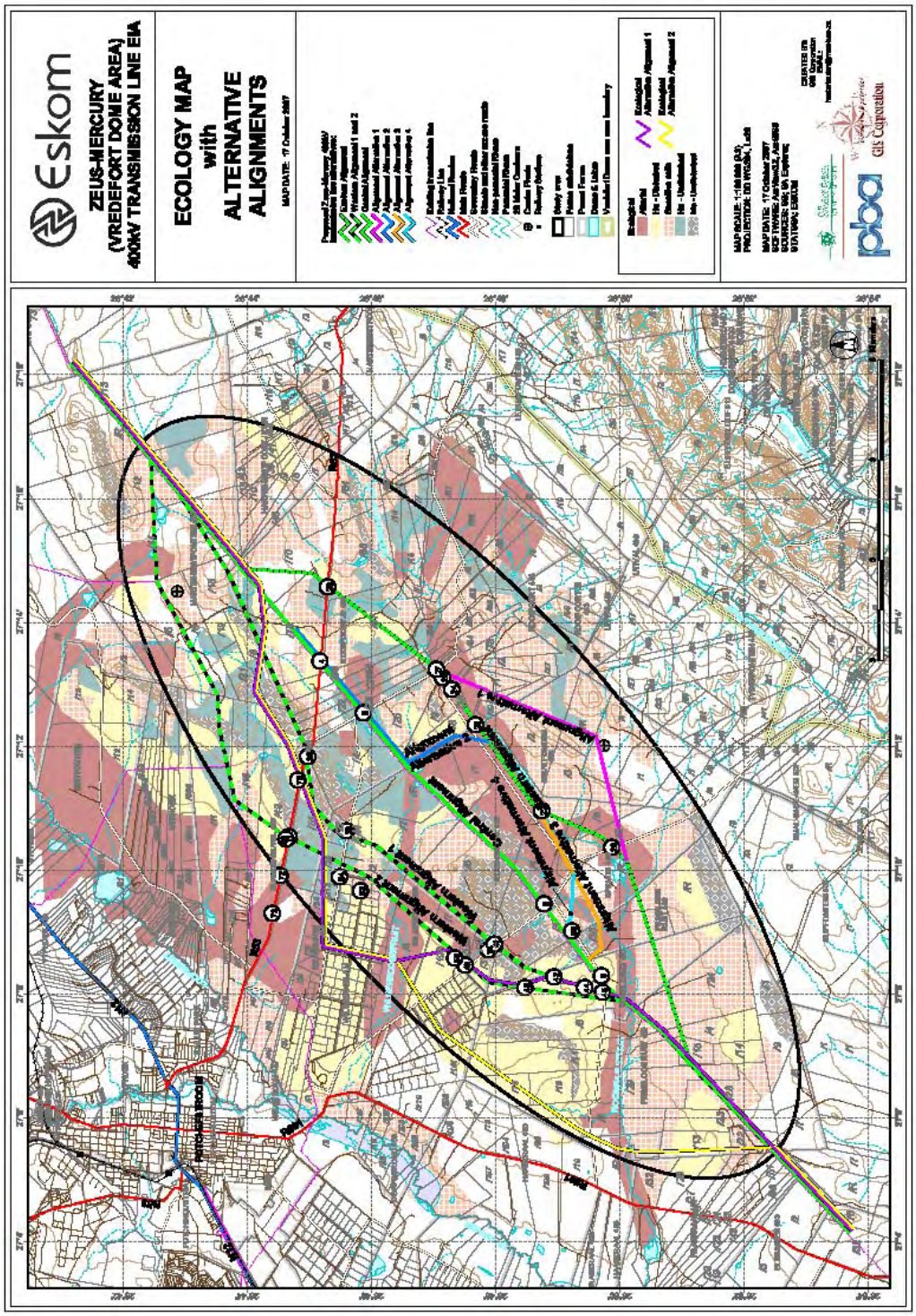
APPENDIX A –

MAP OF ZEUS-MERCURY (VREDEFORT DOME AREA) 400kV TRANSMISSION LINE EIA: LANDSAT AND AERIAL PHOTO WITH ALTERNATIVE ALIGNMENTS SHOWING SURVEY SITES



APPENDIX B –

MAP OF ZEUS-MERCURY (VREDEFORT DOME AREA) 400kV TRANSMISSION LINE EIA: ECOLOGICAL MAP WITH ALTERNATIVE ALIGNMENTS SHOWING SURVEY SITES



APPENDIX C – SITE REPORTS

Site number	**Site 4**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest		
Geology / Soils	Andesite / Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	250 mm		
Subsoil depth	450 mm		
Soil erodability	Moderate	**Veld Condition**	Partially disturbed
Dominant Species	Forbs and woody species = *Acacia caffra* Grasses = *Themeda triandra* Alien invaders and weeds = *Tagetes minuta*		
Notes	• Biodiversity expectation = Moderate to Good • Ploughed below koppie • Site at R53 road crossing		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 5**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest		
Geology / Soils	Andesite / Glenrosa- Mispah		
Soil description	Orthic A on Lithocutanic – Orthic A on Hard Rock		
Soil texture A-horizon	Sandy Loam		
Soil texture B-horizon	Not assessed		
Soil depth A-horizon	100 mm		
Subsoil depth	100+ mm		
Soil erodability	Low	**Veld Condition**	Selectively grazed
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Elionurus muticus*		
Notes	• Biodiversity expectation = Good to Very Good • Natural grazing area • Site at power line		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 8**		
Date visited	27-28/09/2007		
Land terrain Unit	Midslope		
Geology / Soils	Andesite / Sterkspruit		
Soil description	Orthic A on Prismacutanic B		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay		
Soil depth A-horizon	200 mm		
Subsoil depth	200+ mm		
Soil erodability	Very High	**Veld Condition**	Heavily grazed
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Themeda triandra*		
Notes	• Biodiversity expectation = Moderate to Good • Game Farm • Site near power line		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 9**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest		
Geology / Soils	Quartzite (Sedimentary on geological map) / Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	200 mm		
Subsoil depth	400 mm		
Soil erodability	Moderate	**Veld Condition**	Slightly degraded
Dominant Species	Forbs and woody species = *Acacia caffra, Rhus lancea* Grasses = *Cynodon dactylon* Alien invaders and weeds = *Opuntia ficus-indica, Melia azedarach*		
Notes	• Biodiversity expectation = Good • Grazing area • Site near powerline		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 20**		
Date visited	27-28/09/2007		
Land terrain Unit	Footslope		
Geology / Soils	Sedimentary / Sterkspruit		
Soil description	Orthic A on Prismacutanic B		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay		
Soil depth A-horizon	300 mm		
Subsoil depth	550 mm (B1) 550+mm (B2)		
Soil erodability	Very High	**Veld Condition**	Disturbed
Dominant species	Grasses = *Cynodon dactylon* Alien invaders and weeds = *Eucalyptus* sp.		
Notes	• Biodiversity expectation = Very poor • Old lands		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 22**		
Date visited	27-28/09/2007		
Land terrain Unit	Valley bottom		
Geology	Shale		
Soil description	Not assessed (300m from road)		
Soil texture A-horizon	Not assessed		
Soil texture B1-horizon	Not assessed		
Soil texture B2-horizon	Not assessed		
Soil depth A-horizon	Not assessed		
Subsoil depth	Not assessed		
Soil erodability	Very High	**Veld Condition**	Slightly degraded
Dominant Species	Forbs and woody species = *Acacia karroo, Ziziphus mucronata* Grasses = Not assessed Alien invaders and weeds = *Salix babylonica*		
Notes	• Biodiversity expectation = Good to Very Good • Natural grazing • Riverbank		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 24**		
Date visited	27-28/09/2007		
Land terrain Unit	Valley bottom		
Geology / Soils	Andesite / Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	Not assessed		
Subsoil depth	Not assessed		
Soil erodability	Very High	**Veld Condition**	Disturbed/Slightly degraded
Dominant Species	Forbs and woody species = *Ziziphus mucronata* Grasses = *Hyparrhenia hirta*		
Notes	• Biodiversity expectation = Poor to Very Poor (ploughed land) and Good to Very Good (grazing area)		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 25**		
Date visited	27-28/09/2007		
Land terrain Unit	Valley bottom		
Geology / Soils	Andesite / Sepane		
Soil description	Orthic A on Pedocutanic B on unconsolidated material with signs of wetness		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay		
Soil depth A-horizon	300 mm		
Subsoil depth	1000 mm (B1) 1000+ mm (B2)		
Soil erodability	Very High	**Veld Condition**	Overgrazed
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Cynodon dactylon*		
Notes	• Biodiversity expectation = Poor to Very Poor • Very sensitive soils • Riverbank • Site at water point		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 26**		
Date visited	27-28/09/2007		
Land terrain Unit	Footslope-Valley bottom ecotone		
Geology	Andesite		
Soil description	Hydromorphic Not assessed (300m from road)		
Soil texture A-horizon	Not assessed		
Soil texture B1-horizon	Not assessed		
Soil texture B2-horizon	Not assessed		
Soil depth A-horizon	Not assessed		
Subsoil depth	Not assessed		
Soil erodability	Very High	**Veld Condition**	Not assessed
Dominant Species	Grasses = *Eragrostis curvula, Imperata cylindrica*		
Notes	• Biodiversity expectation = Good to Very Good • Near wetland/river		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 27**		
Date visited	27-28/09/2007		
Land terrain Unit	Valley bottom		
Geology / Soils	Andesite / Sepane		
Soil description	Orthic A on Pedocutanic B on unconsolidated material with signs of wetness		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B1-horizon	Sandy Clay		
Soil texture B2-horizon	Not assessed		
Soil depth A-horizon	300 mm		
Subsoil depth	1000 mm (B1) 1000+ mm (B2)		
Soil erodability	Very High	**Veld Condition**	Disturbed
Dominant Species	Forbs and woody species = *Rhus lancea* Grasses = *Sorghum bicolor* Alien invaders and weeds = *Populus canescens*		
Notes	• Biodiversity expectation = Poor to Very Poor • Very sensitive soils • Riverbank		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 29**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest		
Geology / Soils	Andesite / Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	100 mm		
Subsoil depth	100+ mm		
Soil erodability	Slightly erodible	**Veld Condition**	Slightly degraded (south of road) and disturbed (north of road)
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Themeda triandra*		
Notes	• Biodiversity expectation = Very poor (north of road) and Moderate (south of road) • Ploughed (north of road) and grazing area (south of road) • Shallow soils		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 36**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest (Koppie)		
Geology / Soils	Andesite / Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	250 mm		
Subsoil depth	1200+ mm		
Soil erodability	Moderate	**Veld Condition**	Slightly degraded
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Themeda triandra* Alien invaders and weeds = *Cereus peruvianus*		
Notes	• Biodiversity expectation = Good to Very Good • Soil depth decreases closer to the koppie • Site at A53 road crossing		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 38**		
Date visited	27-28/09/2007		
Land terrain Unit	1. Midslope 2. Footslope		
Geology / Soils	Dolerite / Dresden		
Soil description	1. Orthic A on Hard plinthic B 2. Orthic A on Yellow-brown apedal B1 on Plinthic B2		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	1. 250mm 2. 250mm		
Soil subsoil depth of B-horizon to Plinthic horizon	1. 250+ mm 2. 400 mm (B1) 400+ mm (B2)		
Soil erodability	High	**Veld Condition**	Overgrazed (North-eastern side of road) and Disturbed (South-western side of road)
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Hyparrhenia hirta* Alien invaders and weeds = *Melia azedarach*		
Notes	• Biodiversity expectation = Very poor (South-west side of road) and Poor (North-east side of road) • Grazing on North-east side of road (midslope) • Ploughed on South-west side of road (footslope)		
Geophyte Data Plant Species Recorded	• *Boophane disticha* • *Bulbine abyssinica*	**Recommendation** • See main report	

Site number	**Site 41**		
Date visited	27-28/09/2007		
Land terrain Unit	Midslope		
Geology / Soils	Quartzite (Shale on geological map) / Mispah		
Soil description	Orthic A on Hard Rock		
Soil texture A-horizon	Loamy sand		
Soil texture subsoil horizon	N/a (hard rock)		
Soil depth A-horizon	200 mm		
Subsoil depth	200+ mm (Hard Rock)		
Soil erodability	Low	**Veld Condition**	Overgrazed
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Cynodon dactylon, Hyparrhenia hirta*		
Notes	• Biodiversity expectation = Good • Game Farm		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 42**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest		
Geology / Soils	Dolerite / Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	250 mm		
Subsoil depth	1500+ mm		
Soil erodability	Moderate	**Veld Condition**	Disturbed (Old Land)
Dominant Species	Forbs and woody species = *Helichrysum* sp. Grasses = *Eragrostis curvula* Alien invaders and weeds = *Prosopis glandulosa*		
Notes	Biodiversity expectation = Very Poor		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 44**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest/Plain		
Geology / Soils	Quartzite (Sedimentary on geological map)/ Mispah		
Soil description	Orthic A on Hard Rock		
Soil texture A-horizon	Loamy Sand		
Soil texture subsoil-horizon	n/a (hard rock)		
Soil depth A-horizon	300 mm		
Subsoil depth	300+ mm (Hard Rock)		
Soil erodability	Low	**Veld Condition**	Overgrazed
Dominant Species	Forbs and woody species = *Rhus lancea, Ziziphus mucronata* Grasses = *Themeda triandra*		
Notes	• Biodiversity expectation = Poor to Moderate • Grazing area • Site near power line		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 45**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest/Plain		
Geology / Soils	Sedimentary / Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	250		
Subsoil depth	410+		
Soil erodability	Moderate	**Veld Condition**	Disturbed
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Cynodon dactylon* Alien invaders and weeds = *Opuntia ficus-indica*		
Notes	• Biodiversity expectation = Poor • Grazing area • Site near power line		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 48**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest		
Geology / Soils	Dolerite / Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	250 mm		
Subsoil depth	1500+ mm		
Soil erodability	Moderate	**Veld Condition**	Disturbed
Dominant Species	Grasses = *Cynodon dactylon, Sorghum bicolor*		
Notes	• Biodiversity expectation = Very Poor • Site near chicken pens		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 49**		
Date visited	27-28/09/2007		
Land terrain Unit	Footslope		
Geology / Soils	Quartzite (Shale on geological) / Katspruit		
Soil description	Orthic A on G - horizon		
Soil texture A-horizon	Loam		
Soil texture G – horizon	Clay		
Soil depth A-horizon	250 mm		
Depth G – horizon	800+ mm		
Soil erodability	Very High	**Veld Condition**	Disturbed (old land)
Dominant Species	Forbs and woody species = *Acacia karroo, Ziziphus mucronata* Grasses = *Cynodon dactylon* Alien invaders and weeds = *Eucalyptus* sp., *Opuntia ficus-indica*		
Notes	• Biodiversity expectation = Poor to Very poor • Old land		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 50**		
Date visited	27-28/09/2007		
Land terrain Unit	Footslope		
Geology / Soils	Shale / Katspruit		
Soil description	Orthic A on G - horizon		
Soil texture A-horizon	Loam		
Soil texture G-horizon	Clay		
Soil depth A and B horizon ploughed	300+ mm		
Soil erodability	Very High	**Veld Condition**	Disturbed (Ploughed land)
Dominant Species	None recorded as site in ploughed land		
Notes	• Biodiversity expectation = Very poor • Ploughed land		
Red Data Plant Species Recorded	*Bulbine abyssinica* (at edge of ploughed land)	**Recommendation** • See main report	

Site number	**Site 53**		
Date visited	27-28/09/2007		
Land terrain Unit	Footslope		
Geology / Soils	Sedimentary / Bainsvlei		
Soil description	Orthic A on Red Apedal B on Plinthic B		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B1-horizon	Clay Loam		
Soil texture B2-horizon	Clay Loam		
Soil depth A-horizon	250 mm		
Soil subsoil depth of B-horizon to Plinthic horizon	250+ mm		
Soil erodability	Moderate to High	**Veld Condition**	Disturbed
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Eragrostis curvula*		
Notes	• Biodiversity expectation = Very poor • Small holding • Peach Orchard		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 54**		
Date visited	27-28/09/2007		
Land terrain Unit	Footslope		
Geology / Soils	Sedimentary (Dolerite on geological map)/ Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B horizon	Sandy Clay Loam		
Soil depth A-horizon	250 mm		
Subsoil depth	800 mm		
Soil erodability	Moderate	**Veld Condition**	Heavily grazed (northern side of road)
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Themeda triandra*		
Notes	• Biodiversity expectation = Very poor (ploughed area) and Moderate (grazing area) • Ploughed on southern side of road at small holding • Grazing on northern side of road		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 56**		
Date visited	27-28/09/2007		
Land terrain Unit	Footslope		
Geology / Soils	Arenite / Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	250 mm		
Subsoil depth	1500 mm		
Soil erodability	Moderate	**Veld Condition**	Disturbed
Dominant Species	Forbs and woody species = *Acacia karroo* (in adjacent unploughed land) Grasses = *Cynodon dactylon* (in adjacent unploughed land)		
Notes	Biodiversity expectation = Very poor		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 69**		
Date visited	27-28/09/2007		
Land terrain Unit	Midslope		
Geology / Soils	/ Mispah		
Soil description	Orthic A on Hard Rock		
Soil texture A-horizon	Loamy Sand		
Soil texture subsoil-horizon	N/a (hard rock)		
Soil depth A-horizon	50 mm		
Subsoil depth	50+ mm (Hard Rock)		
Soil erodability	Slightly erodible	**Veld Condition**	(Grassland burnt)
Dominant Species	Forbs and woody species = *Rhus pyroides* Grasses = *Digitaria eriantha, Melinis repens* Alien invaders and weeds = *Opuntia ficus-indica*		
Notes	• Biodiversity expectation = Very Good • Site at Rossouw Koppie • Grassland burnt		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 70**		
Date visited	27-28/09/2007		
Land terrain Unit	Crest		
Geology / Soils	/ Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	250		
Subsoil depth	400+		
Soil erodability	Moderate	**Veld Condition**	Disturbed (Old land)
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Cynodon dactylon*		
Notes	• Biodiversity expectation = Very poor (Old land) and Very good (adjacent area) • Old land • Red data reptile species (*Cordylus* sp.) found in area adjacent to the site		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 71**		
Date visited	27-28/09/2007		
Land terrain Unit	Midslope		
Geology / Soils	Hutton		
Soil description	Orthic A on Red Apedal B on Unspecified		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B-horizon	Sandy Clay Loam		
Soil depth A-horizon	Not assessed		
Subsoil depth	Not assessed		
Soil erodability	Moderate	**Veld Condition**	Disturbed (old land and ploughed land)
Dominant Species	Forbs and woody species = *Acacia karroo* Grasses = *Cynodon dactylon* Alien invaders and weeds = *Tagetes minuta*		
Notes	Biodiversity expectation = Very poor in old land near compound and in ploughed land on western side of R53		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 72**		
Date visited	27-28/09/2007		
Land terrain Unit	Footslope		
Geology / Soils	/ Shortlands		
Soil description	Orthic A on Red Structured B		
Soil texture A-horizon	Sandy Clay Loam		
Soil texture B1-horizon	Sandy Clay		
Soil depth A-horizon	250 mm		
Subsoil depth	600+ mm		
Soil erodability	Very High	**Veld Condition**	Disturbed (ploughed maize land)
Dominant Species	None recorded as site in ploughed maize land		
Notes	Biodiversity expectation = Very poor		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 73**		
Date visited	27-28/09/2007		
Land terrain Unit	Footslope		
Geology / Soils	/ Westleigh		
Soil description	Orthic A on Soft Plinthic B		
Soil texture A-horizon	Loamy Sand		
Soil texture B-horizon	Not Assessed		
Soil depth A-horizon	250 mm		
Depth to Plinthic horizon	450+ mm		
Soil erodability	Moderate to high	**Veld Condition**	Disturbed (ploughed maize land)
Dominant Species	None recorded as site in ploughed maize land		
Notes	• Biodiversity expectation = Very poor		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

Site number	**Site 74**		
Date visited	27-28/09/2007		
Land terrain Unit	Midslope		
Geology / Soils	Quartzite / Mispah		
Soil description	Orthic A on Hard Rock		
Soil texture A-horizon	Loamy Sand		
Soil texture underlying-horizon	N/a (hard rock)		
Soil depth A-horizon	250		
Soil subsoil depth of B-horizon to Plinthic horizon	n/a		
Soil erodability	Low	**Veld Condition**	Slightly degraded
Dominant Species	Forbs and woody species = *Acacia robusta* Grasses = *Cynodon dactylon, Hyparrhenia hirta* Alien invaders and weeds = *Melia azedarach*		
Notes	• Biodiversity expectation = Good • Koppie • Farm houses		
Red Data Plant Species Recorded	None recorded	**Recommendation** • See main report	

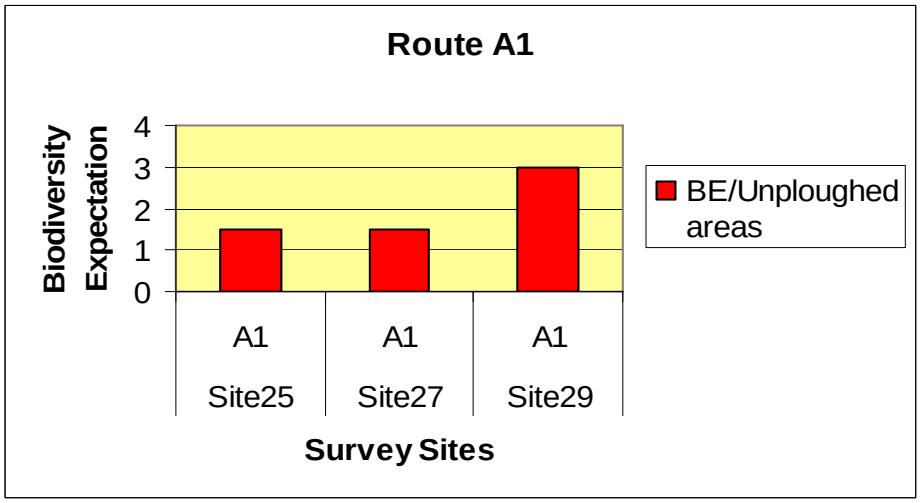
APPENDIX D – WINTER VEGETATION SURVEY – PLANT SPECIES RECORDED

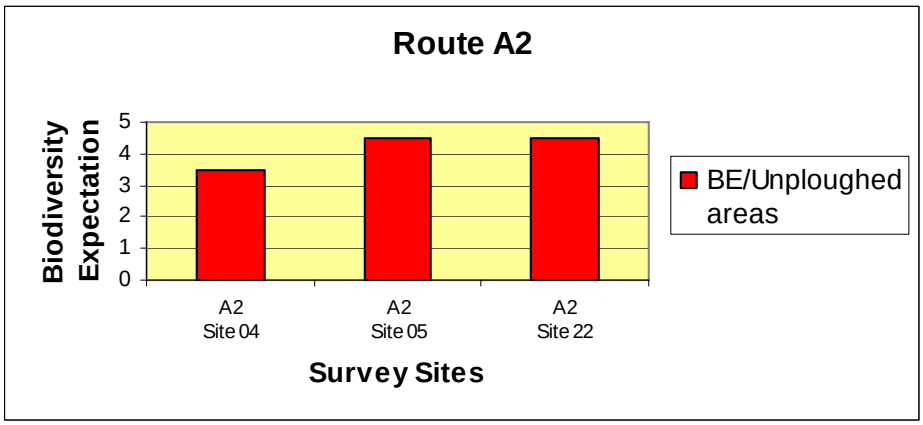
Plant species	Site 4	Site 5	Site 8	Site 9	Site 20	Site 22	Site 24	Site 25	Site 26	Site 27
Grasses										
Aristida adscensionis				✓						
Aristida congesta ssp. *congesta*				✓						
Cymbopogon excavatus										✓
Cynodon dactylon	✓	✓	✓	✓	✓			✓		✓
Digitaria eriantha		✓		✓						
Elionurus muticus		✓		✓						
Eragrostis chloromelas			✓	✓						
Eragrostis curvula									✓	
Eragrostis lehmanniana				✓						
Hyparrhenia hirta	✓	✓	✓	✓			✓			
Imperata cylindrica									✓	
Setaria sphacelata										✓
Sorghum bicolor										✓
Themeda triandra	✓	✓	✓	✓						
Urochloa mosambicensis	✓	✓								
Forbs and woody species										
Acacia caffra	✓									
Acacia karroo		✓		✓		✓				✓
Asparagus sp.				✓						✓
Rhus lancea				✓						
Rhus pyroides										✓
Ziziphus mucronata		✓		✓		✓	✓			✓
Alien invaders and weeds										
Bidens pilosa		✓								
Cirsium vulgare				✓						
Conyza bonariensis				✓						
Melia azedarach				✓						
Opuntia ficus-indica				✓						
Populus canescens										✓
Salix babylonica						✓				
Schinus areira				✓						
Tagetes minuta	✓		✓	✓						
Verbena bonariensis										✓

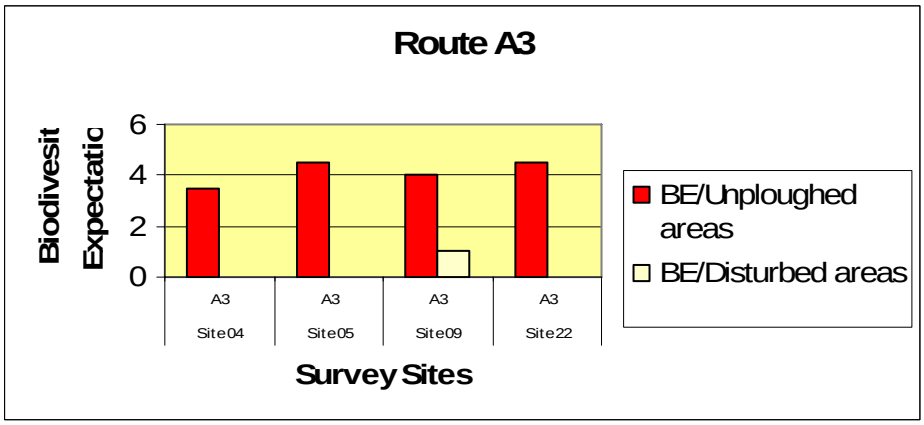
Plant species	Site 29	Site 36	Site 38	Site 41	Site 42	Site 44	Site 45	Site 48	Site 49	Site 50
Grasses										
Aristida adscensionis						✓				
Aristida congesta ssp. *barbicollis*	✓							✓		
Aristida congesta ssp. congesta					✓					
Brachiaria eruciformis										✓
Chloris virgata								✓		
Cymbopogon excavatus	✓									
Cynodon dactylon	✓	✓	✓	✓	✓		✓	✓	✓	✓
Digitaria eriantha						✓		✓	✓	
Elionurus muticus	✓		✓			✓				
Eragrostis curvula					✓	✓	✓	✓		
Eragrostis gummiflua		✓	✓							
Eragrostis lehmanniana	✓		✓			✓				
Eragrostis rigidior		✓								
Eragrostis superba						✓				
Heteropogon contortus	✓		✓							
Hyparrhenia hirta	✓		✓		✓	✓	✓		✓	
Melinis repens	✓			✓					✓	
Pennisetum thunbergii									✓	
Pogonarthria squarrosa					✓		✓			
Setaria incrassata									✓	
Setaria sphacelata		✓								
Sorghum bicolor								✓		
Themeda triandra	✓	✓	✓			✓				
Triraphis andropogonoides						✓				
Forbs and woody species										
Acacia caffra						✓				
Acacia hebeclada						✓				
Acacia karroo	✓	✓	✓	✓			✓	✓	✓	
Aloe greatheadii	✓		✓	✓						
Asparagus sp.			✓				✓	✓		
Boophane disticha			✓							
Bulbine abyssinica			✓							✓
Celtis africana				✓			✓			
Euclea crispa		✓								
Helichrysum sp.					✓					
Rhus lancea						✓			✓	
Rhus pyroides								✓		
Stoebe vulgaris		✓				✓				
Ziziphus mucronata	✓	✓	✓	✓			✓		✓	
Alien invaders and weeds										
Cereus peruvianus		✓								
Cirsium vulgare						✓			✓	
Conyza bonariensis						✓				
Eucalyptus sp.									✓	
Melia azedarach			✓							
Opuntia ficus-indica							✓			
Opuntia imbricata			✓							
Prosopis glandulosa						✓				
Tagetes minuta									✓	

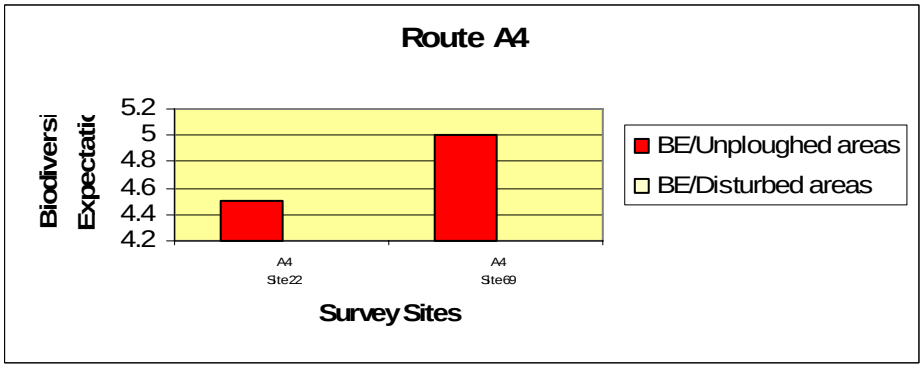
Plant species	Site 53	Site 54	Site 56	Site 69	Site 70	Site 71	Site 72	Site 73	Site 74
Grasses									
Aristida vestita									✓
Cynodon dactylon	✓		✓		✓	✓			✓
Digitaria eriantha		✓		✓					
Eragrostis chloromelas					✓				
Eragrostis curvula	✓				✓				
Eragrostis lehmanniana	✓	✓			✓				✓
Eragrostis rigidior		✓							✓
Eustachys paspaloides		✓							
Heteropogon contortus									✓
Hyparrhenia hirta			✓						✓
Sorghum bicolor			✓						
Themeda triandra	✓	✓							
Urochloa mosambicensis			✓		✓				
Forbs and woody species									
Acacia karroo	✓		✓		✓				✓
Acacia robusta									✓
Aloe greatheadii		✓		✓					
Asparagus sp.		✓	✓		✓				✓
Berkheya setifera				✓					
Mundulea sericea									✓
Rhus lancea	✓								
Rhus pyroides				✓					✓
Ziziphus mucronata		✓							✓
Alien invaders and weeds									
Opuntia ficus-indica				✓					✓
Solanum panduriforme					✓				
Melia azedarach									✓
Tagetes minuta						✓			✓

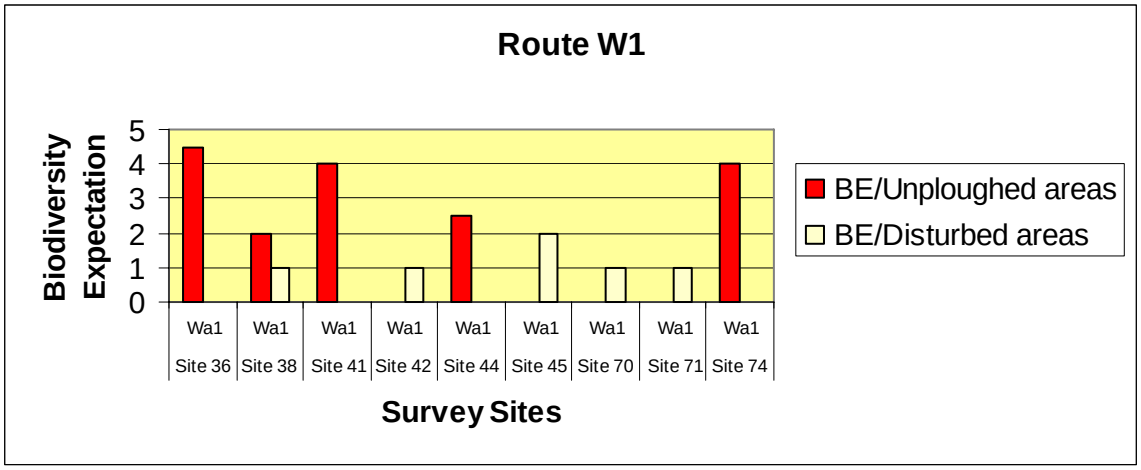
APPENDIX E - BIODIVERSITY EXPECTATION AT ROUTE OPTIONS

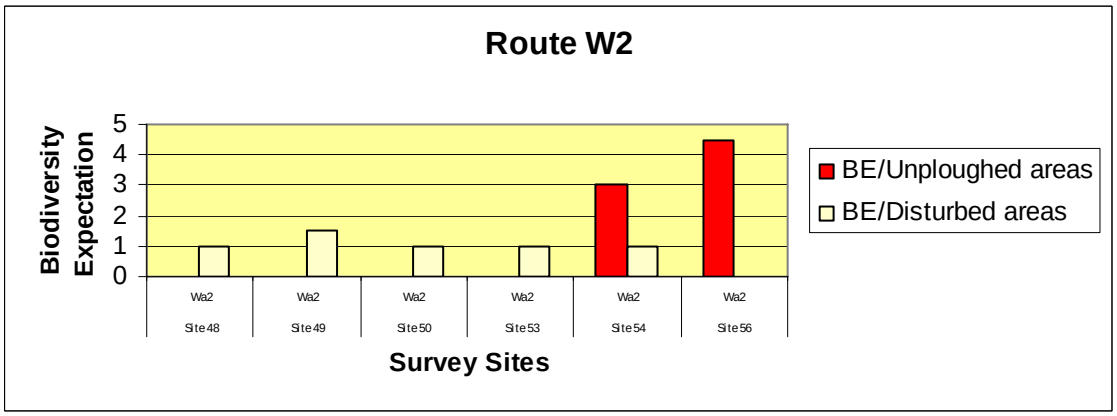


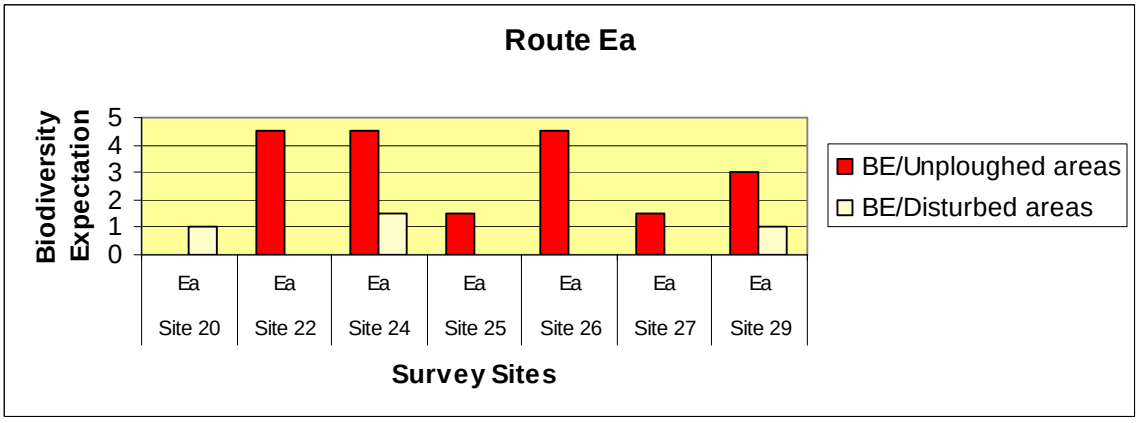


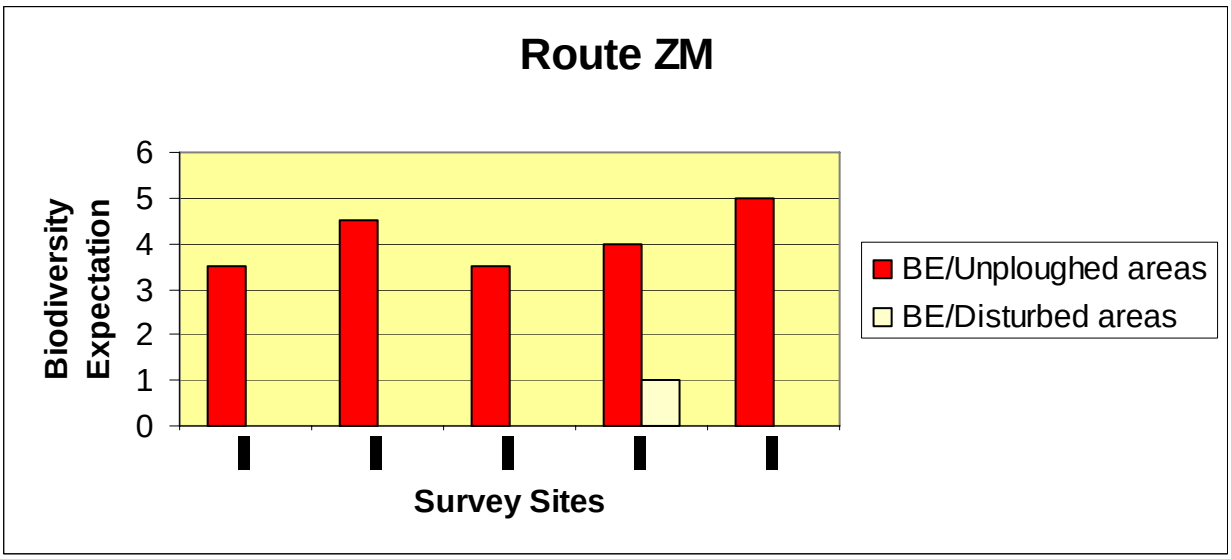





Route W1
Biodiversity Expectation
5
4
3
2
1
0
Wa1 Site 36
Wa1 Site 38
Wa1 Site 41
Wa1 Site 42
Wa1 Site 44
Wa1 Site 45
Wa1 Site 70
Wa1 Site 71
Wa1 Site 74
Survey Sites
BE/Unploughed areas
BE/Disturbed areas

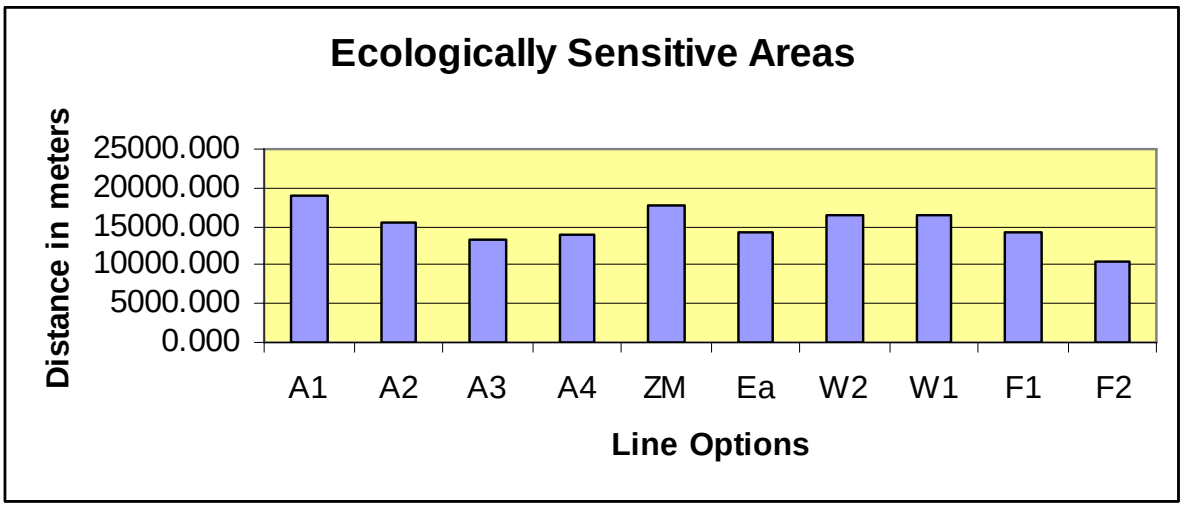

Route W2
Biodiversity Expectation
5
4
3
2
1
0
Wa2 Site 48
Wa2 Site 49
Wa2 Site 50
Wa2 Site 53
Wa2 Site 54
Wa2 Site 56
Survey Sites
BE/Unploughed areas
BE/Disturbed areas


Route Ea
Biodiversity Expectation
5
4
3
2
1
0
Ea Site 20
Ea Site 22
Ea Site 24
Ea Site 25
Ea Site 26
Ea Site 27
Ea Site 29
Survey Sites
BE/Unploughed areas
BE/Disturbed areas

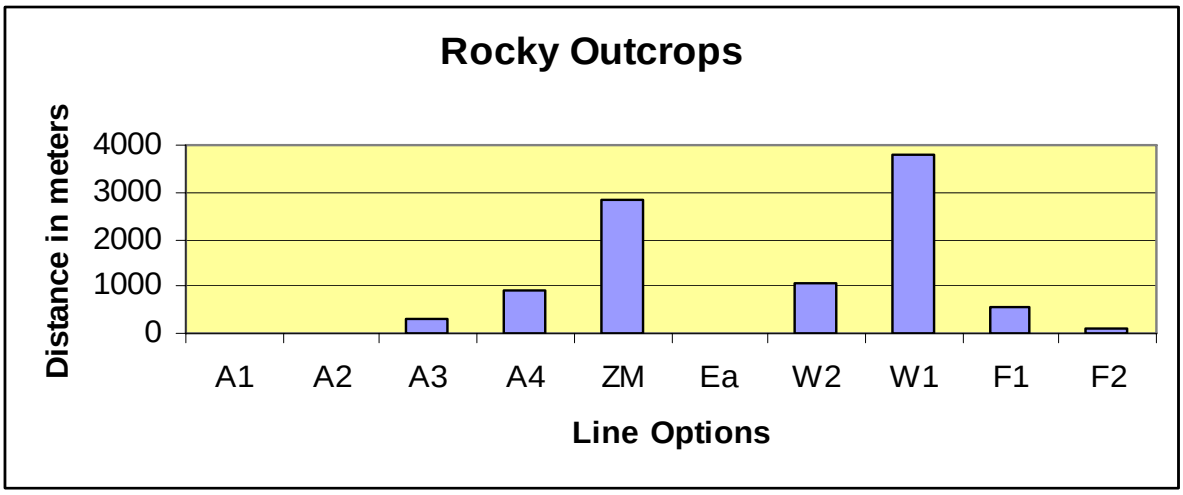

Route ZM
Biodiversity Expectation
6
5
4
3
2
1
0
Survey Sites
BE/Unploughed areas
BE/Disturbed areas

APPENDIX F – PROPORTIONS OF ECOLOGICAL AREAS TRANSECTED BY DIFFERENT ROUTE OPTIONS

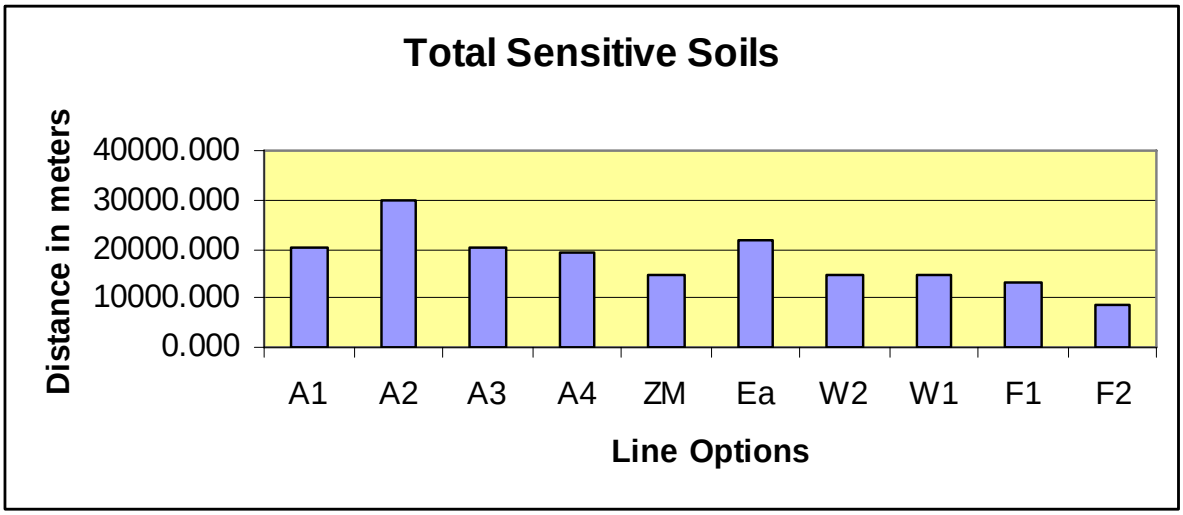
ECOLOGICALLY SENSITIVE AREAS (ROCKY OUTCROPS, ALLUVIAL SOILS AND OTHER SENSITIVE SOILS)



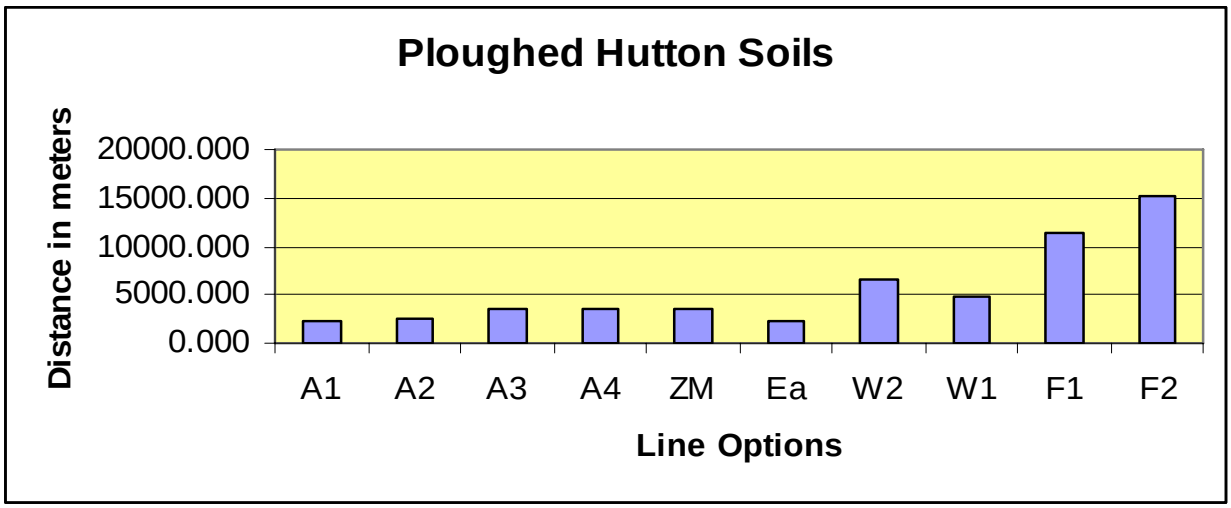
PROPORTIONS OF ROCKY OUTCROPS



PROPORTIONS OF SENSITIVE SOILS



PROPORTIONS OF PLOUGHED LAND ON HUTTON SOILS



APPENDIX G – MAMMAL SPECIES LIST FOR STUDY AREA

1. *Crocidura mariquensis*
2. *Rhinolophus clivosus*
3. *Tadarida aegyptiaca*
4. *Mystromys albicaudatus**
5. *Cryptomys hottentotus*
6. *Mastomys natalensis*
7. *Rattus rattus*
8. *Rhabdomys pumilio*
9. *Lepus capensis*
10. *Lepus saxatilis*
11. *Papio cynocephalus ursinus*
12. *Ictonyx striatus*
13. *Genetta genetta*

* Endemic and vulnerable.

Order: Insectivora
Family: Soricidae — No conservation threats.
Crocidura mariquensis

Order: Chiroptera
Family: Rhinolophidae — No conservation threats.
Rhinolophus clivosus

Order: Chiroptera
Family: Molossidae — No conservation threats.
Tadarida aegyptiaca

Order: Rodentia
Family: Muridae — **Endemic and vulnerable.**
Mystromys albicaudatus

Order: Rodentia **Family:** Bathyergidae *Cryptomys hottentotus*	No conservation threats.
Order: Rodentia **Family:** Muridae *Mastomys natalensis*	No conservation threats.
Order: Rodentia **Family:** Muridae *Rattus rattus*	Introduced, no conservation threats.
Order: Rodentia. **Family:** Muridae. *Rhabdomys pumilio*	No conservation threats.
Order: Lagomorpha **Family:** Leporidae *Lepus capensis*	No conservation threats.
Order: Lagomorpha **Family:** Leporidae *Lepus saxatilis*	No conservation threats.
Order: Primates **Family:** Cercopithecidae *Papio cynocephalus ursinus*	No conservation threats.
Order: Carnivora **Family:** Mustelidae *Ictonyx striatus*	Rare, possible conservation threats. Agriculture and reduction in cover of the herbaceous layer.
Order: Carnivora **Family:** Viverridae *Genetta genetta*	No conservation threats.