MERCURY - PERSEUS 400 kV TRANSMISSION LINE

VEGETATION AND ZOOLOGICAL STUDY

Prepared by:

Dr. P.J. du Preez
CEBO ENVIRONMENTAL CONSULTANTS CC
P.O. Box 11945, Universitas, Bloemfontein
9321

Prepared for:
STRATEGIC ENVIRONMENTAL FOCUS

P.O. Box 74785
Lynnwood Ridge
0040

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EXECUTIVE SUMMARY

CEBO Environmental Consultants CC was appointed by Strategic Environmental Focus to undertake a Vegetation Survey along the proposed routes for the planned Mercury – Perseus Transmission Line. This is to comply with the requirements stipulated by the EIA process.

The vegetation along the alignments was assessed. The alignments cross nine major communities. They are the Dry Sandy Highveld grassland on red sandy soils, Grassy Pan Veld clayey soils around pans, Karroid Panveld on calcrete outcrops, Floodplain grassland on deep clayey soils next to streams and rivers, Acacia karroo shrub on clayey soils along streams and rivers, Riparian shrub on stream and riverbanks, Seepage areas and Wetland communities, Kimberley Thorn Bushveld on deep aeolian sands and Ghaap-plateau shrub communities on dolerite.

All nine communities show varying degrees of degradation due to human impacts such as overgrazing, trampling, crop production, road construction, e.t.c.

The recommended alignment is alignment 1, as it has the lowest negative environmental impacts. This alignment is cutting through natural veld but also a large section of mainly maize fields. The vegetation along the alignment will not be negatively affected except for those areas where access roads, construction camps and the footprints of the structures will be constructed. No Red Data plants or endemics were found in the corridor of the recommended alignment.

As far as the terrestrial mammals are concerned no permanent negative impacts were identified. During the survey no Red Data terrestrial animals or signs of their presence (burrows, e.t.c.) were found to occur in the corridor of the recommended alignment.

Recommendations are made to assist in mitigating the environmental impact of the proposed development. These should be included as conditions of approval.

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1. INTRODUCTION

CEBO Environmental Consultants CC was appointed by Strategic Environmental Focus to undertake a vegetation and terrestrial mammal Survey along the proposed routes for the planned Mercury – Perseus Transmission Line. This is to comply with the requirements stipulated by the EIA process.

This assessment, together with the recommendations made, should be used in the planning and construction phases of the development, specifically mitigation measures preventing the potential disturbance to any sensitive vegetation, to ensure minimum impact on the environment as a result of the proposed development.

2. BACKGROUND AND BRIEF

The purpose of this study is twofold. The first is to identify the major plant communities of the area, to describe sensitive habitats and to determine the presence of protected and/or Red Data Species in the proposed alignments. The second aim is to identify the fauna of the area and to identify and map sensitive habitats as well as to list protected and Red Data Species.

Terms of reference:

2.1. Vegetation

2.1.1 Identify what possible impacts the proposed Mercury - Perseus 400 kV transmission line could have on the vegetation;

2.1.2 Identify and map the habitats along the route of the proposed transmission line and their species composition;

2.1.3 Identify the possible presence of rare, endangered and endemic species;

2.1.4 Recommend methods to salvage species for re-vegetation, as well as economically important species, where appropriate;

2.1.5 Recommend mitigation measures to ameliorate the negative impacts of the proposed development on the natural environment;

2.1.6 Identify areas proclaimed for nature reserves and map them so they can be avoided by the route of the transmission lines;

2.1.7 Evaluate the impacts of the associated infrastructure of the transmission line (temporary access roads, etc) on the plant communities;

2.1.8 Recommend mitigation and salvage procedures for identified species as well as to make recommendations for specific rehabilitation on particular areas to be included in the Environmental Management Plan;

2.2 Fauna

2.2.1 Identify what possible impacts the proposed development may have on the fauna, **particular regard is to be given to the impact of the transmission line on the flight paths of migrating birds and birds of prey.** (Please note: Eskom Transmission will supply information regarding birds flight paths and habits)

2.2.2 Identify and map the habitats along the route of the proposed transmission line and their species composition;

2.2.3 Identify and map habitats containing rare, endangered or vulnerable species (defined according to the South African Red Data Books), if any;

2.2.4 Identify and map habitats susceptible to degradation ("sensitive areas") as a result of disturbance;

2.2.5 Identify and map habitats with particularly high species diversity along the proposed transmission line;

2.2.6 Identify and map animal communities of conservation, scientific, cultural and educational value, if any;

2.2.7 Evaluate the impacts of the associated infrastructure of the proposed power line (temporary access roads, etc) on animal communities;

2.2.8 Evaluate the potential impacts of the proposed developments on subterranean fauna (e.g. burrowing animals);

2.2.9 Identify areas proclaimed for nature reserves and map them so they can be avoided by the route of the transmission lines;

2.2.10 Recommend mitigation measures to ameliorate the negative impacts of the proposed developments on the natural environment.

3. STUDY APPROACH

3.1 Information base (source)

3.1.1 Existing databases and Red Data Books

3.2 Assumptions

None

3.3 Limitations

This is a more general study. A more detailed study of the route of the selected alignment would reveal much more information. Especially at construction campsites and foot print sites.

3.4 Glossary of terms

Study area: Refers to the entire study area encompassing all the alternative alignments as indicated on the study area map.
Corridor: Refers to a specific alignment as numbered on the study area map (1 – 3)
Alternative alignment: Refers to a specific alignment (1 – 3) with one of the variations (a-b)
Proposed servitude: Refers to the proposed final alignment that the transmission line should follow.
Transmission line: Pylons support the 400 kV transmission line consisting of two steel support structures (supported by guy wires). Transmission lines area suspended between the supports.
Sub-station: A distribution point within the local and national network from which electrical current is rerouted along different power lines as well as distributed to local and municipal networks.
Succession: The natural restoration process of vegetation after disturbance.

3.5 List of abbreviations

EIR Environmental Impact Report
DEAT Department of Environmental Affair and Tourism
DTEEA Department of Tourism, Environmental and Economic Affairs

3.6 Methodology

3.6.1 A desk study was conducted to list all possible major vegetation types as well as fauna present in the area and to note all possible Red Data species.

3.6.2 Site visits were done to evaluate the various alignments and to identify sensitive habitats

4. STUDY AREA

Almost all the above-mentioned major communities will be affected by this planned development except for the Kimberley Thorn Bushveld, which would only be affected when alignment 3 is selected.
Alignment 3 cuts through stands of Camel Thorn (*Acacia erioloba*)(Kimberley Thorn Bushveld). In terms of the Forest Act (Act 122 of 1988) the Camel Thorn Tree (*Acacia erioloba*) protected tree. A permit to cut or remove any Camel Thorns must be obtained before any construction starts.

4.1 Major plant communities

4.1.1 Dry Sandy Highveld grassland on red sandy soils (**Annexure B**)

This type of grassland is typical of the area in the central Free State. The area receives an average rainfall of more than ± 500mm per annum. The rainfall occurs mainly in summer and the temperatures vary between –3 °C and 35 °C, with an average of 16 °C. Due to these climatic conditions, Sweetveld grasses dominate the vegetation.

This is typical sweet grassland with Redgrass (*Themeda triandra*), Fingergrass (*Digitaria eriantha*), Speargrass (*Heteropogon contortus*), Copperwiregrass (*Elionurus muticus*) and Lehmann's Lovegrass (*Eragrostis curvula*) and common Lovegrass (*Eragrostis curvula*) as some of the dominant grass species. In the more disturbed places, especially where the vegetation is overgrazed Redgrass (*Themeda triandra*) and Fingergrass (*Digitaria eriantha*) are absent. Pioneer grasses such as Three-awn grass (*Aristida congesta*) and Couch grass (*Cynodon dactylon, C. hirsutus*) dominate. Other diagnostic species are *Helichrysum dregeanum, H. rugulosum, Gazania krebsiana, Berkheya onopordifolia, B. pinnatifida, Conyza podocephala,* and *Walafrida densiflora*).

Presence of rare, endangered and endemic plant species: None

4.1.2 Grassy Pan Veld clayey soils around pans (**Annexure C**)

This sweet grassland is dominated by White Buffalograss (*Panicum coloratum*), Lovegrass species (*Eragrostis curvula, E. plana*), *Setaria nigrirostris* and *S. spacelata.* Redgrass (*Themeda triandra*), is also present but is not as dominant on the clayey soils as on the deeper red sands. Lovegrass (*Eragrostis spp.*) dominate when overgrazed and in cases of severely degraded veld Three-awn Rolling grass (*Aristida bipartita*) dominates.

Presence of rare, endangered and endemic plant species: None

4.1.3 Karroid Panveld on calcrete outcrops (**Annexure D**)

In areas around pans where outcrops of calcrete are present the typical grassy panveld becomes replaced by species with Karroo affinity. Dominant grasses are also White Buffalograss (*Panicum coloratum*), Lovegrass species (*Eragrostis lehmanniana, E. obtusa*), *Setaria nigrirostris* and *S. spacelata.* Redgrass (*Themeda triandra*), and Saltpan grass (*Sporobolus ludwigii*). Karroid dwarf shrubs such as Bitterkaroo (*Pentzia globosa*), Bloublommetjie (*Felicia muricata*), Kriedoring (*Lycium cinereum*), and Gannabush (*Salsola glabrescens*, *Salsola* spp.) are very prominent in this community.

Presence of rare, endangered and endemic plant species: None

4.1.4 Floodplain grassland on deep clayey soils next to streams and rivers (**Annexure C**).

On floodplains along streams and rivers a typical floodplain grassland community dominate. The only dominant grass is Pangrass (*Diplachne fusca*). Other grasses present are *Setaria nigrirostris* and *S. spacelata.* Forbs present are *Conyza podocephala*, and in seepage areas *Oenothera rosea*, *Juncus rigidus* and a few sedges (*Cyperus* spp.). The only dominant bulbous plant is the Orange River lily (*Crinum bulbispermum*).

Presence of rare, endangered and endemic plant species: None

4.1.5 Acacia karroo shrub on clayey soils along streams and rivers (**Annexure E**)

This is a shrub community associated with floodplains and low-lying areas along streams and rivers. The Sweet Thorn (*Acacia karroo*) is the dominant shrub. Others present are the Buffalo Thorn (*Ziziphus mucronata*), Wild Asparagus (*Asparagus laricinus*) and Blue bush (*Diospyros lycioides*).

White Buffalograss (*Panicum coloratum*), Lovegrass species (*Eragrostis lehmanniana, E. obtusa*), *Setaria nigrirostris* and *S. spacelata* dominate the ground layer. Redgrass (*Themeda triandra*) is present certain areas. Karroid dwarf shrubs such as Bitterkaroo (*Pentzia globosa*), Bloublommetjie (*Felicia muricata*), Kriedoring (*Lycium cinereum*), and Gannabush (*Salsola glabrescens*, *Salsola* spp.) are also present.
Presence of rare, endangered and endemic plant species: None

4.1.6 Riparian shrub on stream and riverbanks (**Annexure F**)

This riparian shrub community dominates the stream and riverbanks. Exotic trees such as Bluegums (*Eucalyptus camaldulensis*, *E. sideroxylon*) and the Weeping Willow (*Salix babylonica*) are present together with indigenous shrubs such as *Salix mucronata*, *Diospyros lycioides*, *Rhus pyroides*, *Lycium hirsutum*, *Acacia karroo* and *Ziziphus mucronata*.
White Buffalograss (*Panicum coloratum*), Lovegrass species (*Eragrostis lehmanniana, E. obtusa*), *Setaria nigrirostris* and *S. spacelata* dominate the ground layer. Redgrass (*Themeda triandra*) is present certain areas. Karroid dwarf shrubs such as Bitterkaroo (*Pentzia globosa*), Bloublommetjie (*Felicia muricata*), Kriedoring (*Lycium cinereum*), and Gannabush (*Salsola glabrescens*, *Salsola* spp.) are also present.
Presence of rare, endangered and endemic plant species: None

4.1.7 Seepage areas and wetland communities (**Annexure D**).

Seepage areas are seasonally wet areas that occur in sandy areas where water seeps into low-lying drainage lines after rains. These areas are usually covered by hygrophytes such as sedges and reeds. The dominant sedge in the study area is *Juncus rigidus*. Sometimes bulrush (*Typha capensis*) and reeds (*Phragmites australis*) also occurs.
Wetlands are of a more permanent nature and occur in low-lying areas such as tributaries of streams and rivers. Here hydrophytes can be found. Typical plants are the Orange River Lily (*Crinum bulbispermum*), bulrush (*Typha capensis*) and reeds (*Phragmites australis*), sedges of the *Cyperus*, *Fuirena* and *Scirpus* genera also occur.
Presence of rare, endangered and endemic plant species: None

4.1.8 Kimberley Thorn Bushveld on deep aeolian sands (**Annexure G**).

This vegetation is characterized by a fairly well-developed tree layer with Camel Thorn (*Acacia erioloba*), Umbrella Thorn (*Acacia tortilisi*), Shepherds Tree (*Boscia albitrunca*), Common Karee (*Rhus lancea*) and Buffalo Thorn (*Ziziphus mucronata*). The shrub layer is moderately developed and individuals of Weeping Candle Thorn (*A. hebecalada*), Karee-thorn (*Lycium hirsutum*), and Raisin bush (*Grewia flava*), dominate this layer. Conspicuous grasses that are found within this vegetation type include Lehmann's Love Grass (*Eragrostis lehmanniana*), Kalahari Sour Grass (*Schmidtia kalahariensis*) which both dominates the dune valleys.
This plant community shows signs of disturbance. Acacia erioloba tends to encroach in overgrazed areas and pioneer species such as *Chrysocoma ciliata, Pentzia globosa, Felicia muricata, Aristida congesta* and *A. stipitata* were noted.

The Camel Thorn (*Acacia erioloba*) is a protected tree (Forest Act (Act 122 of 1988). A permit to clear this tree must be obtained from the Dept of Water Affairs and Forestry
Presence of rare, endangered and endemic plant species: None

4.1.9 Ghaap-plateau shrub communities on dolerite (**Annexure B**)

This is a shrub community, which is restricted to dolerite outcrops. The diagnostic species are the Wild Olive (*Olea europaea* subsp. *africana*), Kuni bush (*Rhus burchellii*), Common Karee (*R. lancea*), Cabbage Tree (*Cussonia paniculata*), Blue bush (*Diospyros lycioides*), Quarri (*Euclea crispa*).
The grass layer is a typical sweet grassland with Redgrass (*Themeda triandra*), Fingergrass (*Digitaria eriantha*), Speargrass (*Heteropogon contortus*), Copperwiregrass (*Elionurus muticus*) and Lehmann's Lovegrass (*Eragrostis curvula*) and common Lovegrass (*Eragrostis curvula*) as some of the dominant grass species.
In the more disturbed places, pioneer grasses such as Three-awn grass (*Aristida congesta*) and Couch grass (*Cynodon dactylon, C. hirsutus*) dominate. Other diagnostic species are *Helichrysum dregeanum, H. rugulosum, Rhynchosia totta, Gazania krebsiana, Berkheya onopordifolia, B. pinnatifida, Conyza podocephala,* and *Walafrida densiflora*).
Presence of rare, endangered and endemic species: None

4.2 Notes on the Red Data and protected plant species found in the study area:

No rare, endangered and endemic species (Red Data plants) were found in the study area. However a number of protected plants species were found to occur in the study area

LIST OF RARE AND PROTECTED PLANT SPECIES FOUND IN THE STUDY AREA

1.	*Acacia erioloba*	-	deep sandy soils
2.	*Aloe dentata*	-	dolerite outcrops
3.	*Ammocharis corannica*	-	deep clayey soils
4.	*Asclepias eminens*	-	sandy soils
5.	*Boophane disticha*	-	deep sandy and well drained gravely soils
6.	*Boscia albitrunca*	-	deep sandy soils
7.	*Brachystelma foetidum*	-	deep sandy soils
8.	*Brunsvigia radulosa*	-	deep sandy soils
9.	*Crinum bulbispermum*	-	deep clayey soils
10.	*Cyphostemma hereroense*	-	deep sandy soils
11.	*Eucomis autumnalis*	-	deep sandy soils
12.	*Nerine laticoma*	-	deep sandy soils
13.	*Raphionacme dyeri*	-	deep sandy soils
14.	*Raphionacme hirsuta*	-	shallow to deep well-drained soils
15.	*Schizobasis intricata*	-	shallow gravely soils

4.3 General study area description for each of the alternatives:

Alignment 1 (**Annexure A**):

This alignment cuts through the following major plant communities:

Dry Sandy Highveld grassland

Grassy Panveld

Karroid Panveld

Floodplain Grassland

Acacia karroo shrub

Riparian shrub

Wetland communities

This alignment misses the following major plant communities:

Kimberley Thorn bushveld

Ghaap – plateau shrub communities

Alignment 2 (**Annexure A**):

This alignment cuts through the following major plant communities:

Dry Sandy Highveld grassland

Grassy Panveld

Karroid Panveld

Floodplain Grassland

Acacia karroo shrub

Riparian shrub

Wetland communities

This alignment misses the following major plant communities:

Kimberley Thorn bushveld

Ghaap – plateau shrub communities

Alignment 3 (**Annexure A**):

This alignment cuts through the following major plant communities:

Dry Sandy Highveld grassland

Grassy Panveld

Karroid Panveld

Floodplain Grassland

Acacia karroo shrub

Riparian shrub

Wetland communities

Kimberley Thorn bushveld

This alignment misses the following major plant communities:
Ghaap – plateau shrub communities

These abovementioned major communities are broad vegetation units. Only Alignment 3 cuts through the Kimberley Thorn Bushveld, which is situated to the west of the study area.

4.4 Terrestrial mammals

List of Red Data Terrestrial Mammals that could be found in the study area (Smithers 1986):

1.	Aardwolf	*Proteles cristatus*
2.	African Striped weasel	*Poecilogale albinucha*
3.	African Wild Cat	*Felis lybica*
4.	Antbear	*Orycteropus afer*
5.	Honey Badger	*Mellivora capensis*
6.	Small spotted Cat	*Felis nigripes*
7.	South African Hedgehog	*Artelerix frontalis*
8.	White-tailed mouse	*Mystromys albicaudata*
9.	Brown hyena	*Hyeana brunnea*

Habitats of the listed animals

Most of the above-mentioned animals area free roaming animals and could be present in the study area. They are **not very habitat restricted and could occur in any of the above mentioned major plant communities,** however the riparian shrub is usually frequented as it provides shelter as well as more food resources as it is always associated with water.

1. Aardwolf (*Proteles cristatus).* A wide variety of grassland as well as karroid communities where food is available throughout the year. It also frequents dry streambeds and open areas around pans.

2. African Striped weasel (*Poecilogale albinucha).* They frequent rocky outcrops, savanna, dry streambeds, open grassland, and riparian shrub communities.

3. African Wild Cat (*Felis lybica).* This cat occurs in almost any habitat. In the study area it will frequent dry streambeds, reed beds and tall grass communities where it can hide during daytime. It will also hide in maize and wheat fields.

4. Antbear (*Orycteropus afer).* These animals are relatively widespread and not very rare although their numbers are declining due to road kills, and habitat destruction. They are mainly found in savanna, grassland and karroid communities.

5. Honey Badger (*Mellivora capensis).* Due to its adaptability this animal could be found in almost any habitat. They frequent rocky outcrops, savanna, dry streambeds, open grassland, and riparian shrub communities.

6. Small spotted Cat (*Felis nigripes).* In the study area it would occur in dry streambeds, tall grass communities as well as old antbear and springhare holes where it can hide during daytime.

7. South African Hedgehog (*Artelerix frontalis)* A wide variety of grassland as well as karroid communities where food is available throughout the year. A requirement is a dry sheltered place where it rears its young.

8. White-tailed mouse (*Mystromys albicaudata)* A wide variety of grassland as well as karroid communities.

9. Brown hyaena (*Hyaena brunnea).* This animal frequents open shrubveld and savanna. Sheltered sites are also a requirement. It is very rare in the region due to habitat destruction and farmers who will shoot it on sight.

Sensitive habitats

a) Riparian shrub communities (**Annexure D, F & K**)

The availability of shelter and a variety of food resources in the riparian shrub communities attracts a high diversity of terrestrial mammals as well as bird species. This makes the riparian shrub community a sensitive ecosystem as far as the fauna is concerned. It acts as corridor for birds and mammals such as the Vervet Monkey (**Annexure K**) to migrate up and down river systems.

b) Pan communities (**Annexure C & J**)

Pans are usually seasonally inundated. During these periods they attract large numbers of waterfowl, waders and flamingoes (**Annexure J**). The fact that pans are endoreic means that they are on the receiving end of what happens in the catchments. Pans are usually rich in nutrients and seasonal algal blooms provide food to the above-mentioned birds.

c) Wetlands communities (**Annexure D, F & J**)

During wet periods wetlands attract large numbers of waterfowl, waders and sometimes flamingoes (**Annexure J**). Wetlands are also rich in nutrients the sedges and hydrophytes provide food to the above-mentioned birds.

4.5 Assessment of potential environmental impacts in terms of the following

The potential impacts are applicable to all the above-mentioned major vegetation units.

Construction Phase

This is the most destructive part of the planned development. During the construction phase various impacts could cause degradation and destruction of vegetation and animal habitats.

Access roads

The floodplain grassland, *Acacia karroo* shrub and riparian shrub communities are usually situated on soils which erode easily once the vegetation cover has been removed.

The wetland communities are sensitive to disturbance and not access road must go through a wetland.

Contractors' camps

Care must be taken to select the sites outside the tree and shrub communities (*Acacia karroo* shrub and riparian shrub communities). If not possible then the damage to the vegetation must be limited to the demarcated area of the camp.

Footprints of the pylons

At the footprints of the pylons care must be taken to keep the topsoil separate from the deeper soil. The topsoil must be placed back on top after construction. This layer has a seed bank, which could help the disturbed areas to revegetate quicker.

Bush clearing

The area has relatively few shrub communities (only near rivers and on dolerite outcrops). This impact is not of high significance, as succession will restore the plant community over time.

Except for the foundations of the pilons the disturbance of vegetation could be of temporary nature, if the construction phase is conducted in a responsible manner. Due to the nature of vegetation to restore itself after disturbance, by means of succession, the degraded areas would be covered after a relatively short period.

Operation / Maintenance

During this phase the impacts on the vegetation and habitat of the fauna would be relatively low.

Access roads

Maintenance of the two-track road must be done. Areas where erosion is taking place must be restored. Berms must be constructed in the roads to prevent erosion especially in areas close to stream and riverbanks.

Contractors must drive in existing tracks as far as possible to prevent the formation of unnecessary tracks.

Contractors' camps

During this phase no new impacts would be caused at these sites.

Regular monitoring of disturbed areas at these camps must be done.

No firewood may be collected from the veld.

Footprints of the pylons

Regular monitoring of disturbed areas at these areas must be done.

Measures to prevent erosion such as berms, gabions, and mats must also be installed where necessary.

Bush clearing

Those cleared areas must be monitored to check for signs of degradation.

5. IDENTIFICATION OF RISK SOURCES

Construction phase:

Possible Risks	**Source of the risk**
Actually identified risks	
Erosion	Destruction of vegetation due to clearance of vegetation at construction camps, access roads, e.t.c.
Habitat destruction	Destruction of vegetation due to clearance of vegetation at construction camps, access roads, e.t.c.
Anticipated risks	
Veld fires	Accidental fires could start where construction activities is taking place (grinding of steel, e.t.c.)

Operation phase:

Possible Risks	**Source of the risk**
Actually identified risks	
Bird collisions	The close proximity of the planned power line to a high density of pans could result in collisions when the water fowl, waders and flamingos migrate from pan to pan
Anticipated risks	
Veld fires	Accidental fires could start where maintenance activities is taking place (smoking, e.t.c.)

Since the proposed development will result in either benefits or impacts to the environment relative to the current state, the risks need to be expressed relative to the current situation.

6. IMPACT DESCRIPTION AND ASSESSMENT

Table 6.1: Impacts on STUDY AREA

Stage in project lifecycle	Extent	Duration	Intensity	Probability of occurrence/ risk	Significance		Status	Confidence
					WOMM	WMM		
Construction								
Habitat destruction	Local	Medium	Medium	Definite	Low to medium	Low to medium		Highly confident
Erosion	Local	Medium to Long term	Medium	Highly probable	Medium to high	Low		Highly confident
Veld fires	Local	Short term	Medium	Low	Medium	Low		Confident
Operation								
Bird collisions	Local	Long term	Medium	Highly probable	Medium to high	Low to medium		Confident
Veld fires	Local	Short term	Medium	Low	Medium	Low		Confident

WOMM: Without mitigation measures
WMM: With mitigation measures

7. RECOMMENDED MITIGATION / MANAGEMENT MEASURES

Minimizing of habitat destruction:

- The Contractor shall provide the Engineer with a plan detailing the layout of site offices and facilities, such as chemical toilets, areas for stock piling of materials and for storage of hazardous materials.
- The site for the chemical toilets, areas for stock piling of materials and for storage of hazardous materials must be as far away from watercourses as possible.
- No fires may be lit on private property. If fires are lit with the permission of the landowners or in the construction camp, provision must be made that no accidental fires are started.
- No firewood may be collected in the veld.
- Fire extinguishers must be available on site and in the construction camp.
- Vehicles should be driven at a moderate speed on private roads.
- Camp and offices should be removed and rehabilitated on completion of the contract. The site should be rehabilitated as close as possible to its original condition.

Chemicals

- Chemicals such as oil, fuel, etc must be properly stored. There should be controlled access to the chemicals.

Sewage treatment

- Adequate chemical toilet facilities are to be provided.
- Use of veld for sanitation or ablution purposes shall not under any circumstances be permitted.
- The Contractor shall be entirely responsible for enforcing the use of toilet facilities and for maintaining such toilets in a clean and sanitary condition, to the satisfaction of the Engineer.
- Toilets shall be positioned within walking distance from wherever employees are employed on the works.

Waste management

Waste management and waste minimization must be implemented at the outset of the contract

Litter

- No littering by anyone will be permitted. During the construction period the facilities shall be maintained in a neat and tidy condition and the site is to be kept litter free.

Removal of solid waste

- Solid waste is to be stored in an appointed area for collection and disposal.
- A refuse control system must be established for the collection and removal of refuse to the satisfaction of the Engineer. This entails that sufficient waste bins are available on site and in the construction camp. The waste should preferably be dumped at an approved waste disposal site.

Hazardous waste

- Hazardous waste is to be stored in an appointed area for collection and disposal at a Department of Water Affairs and Forestry (DWAF) licensed landfill site.

Soil management

Topsoil

- In the event of topsoil being stripped it shall be stockpiled on the site for later reuse. (Topsoil is considered to be a minimum of thickness of ± 300mm of the natural soil, including all vegetation and organic matter).
- Weeds appearing on stockpiled topsoil shall be removed by hand before seeding.
- Soil contaminated by hazardous substances shall be disposed of in a Department of Water Affairs and Forestry (DWAF) licensed landfill site.

Vegetation

The following recommendations are made to assist in mitigating the environmental impact of the proposed development.

Construction phase

- Vegetation may not be destroyed unnecessary
- Measures to prevent erosion such as berms, gabions, and mats must also be installed where necessary

Post construction phase

- Rehabilitation of damaged areas must be done
- Measures to prevent erosion such as berms, gabions, and mats must also be installed where necessary

Fauna

- Areas where bird collisions are likely to occur is near pans, and where the transmission line crosses wetlands and rivers. In order to prevent bird collisions conductors must be made more visible by attaching bird flappers.
- Regular inspections of the line must be conducted to determine areas where bird collisions occur. Bird flappers must be attached to the conductors in these identified areas.

8. ALTERNATIVES

Alignment 1 is the **most suitable** one for the following reasons:

a) The distance between large concentrations of pans and the alignment is the longest. This will lower the impact of bird collisions to some extent.

b) It crosses extensive areas of already disturbed land such as maize fields, planted pasture, e.t.c.

c) It is also the shortest distance between Mercury and Persius.

Alignment 3 is **not suitable** for the following reasons (**Annexure A**).

a) It cuts through a high concentration of pans north of Dealesville and Wesselsbron.

b) Near Hertzogville the alignment cuts through stands of the Kimberley Thorn Bushveld, which is dominated by *Acacia erioloba* (a protected species).

Alignment 2 is also **not suitable** for the following reasons (**Annexure A**).

a) It is situated near high concentrations of pans east of Bultfontein and north of Wesselsbron.

b) The large pan to the east of Bultfontein is regularly visited by large flocks of flamingoes during periods of inundation. This alignment passed this pan on its eastern shores, which could cause bird collisions.

c) Directly north of Bultfontein this alignment passes close to the Penspan. This pan is relatively deep and holds water for longer periods than other pans in the region. It is a refuge area for waterfowl and flamingoes when other pans in the study area have dried up.

9. DISCUSSION

All three alignments will cause various impacts on the vegetation and subsequently the habitats of animals. Many of the impact to the vegetation would be of a medium term impact. Succession and active rehabilitation would help to restore the vegetation.

As far as the terrestrial mammals are concerned many of the species would move away during the construction phase but after construction has stopped and the habitat has restored itself, they would return.

Mitigation measures

Vegetation:

- It is vital that during excavations the topsoil must be stored separately. This must be put back on top after construction.
- Revegetation should be conducted in identified areas where degradation occurred due to the construction activities
- Yearly inspections of the rehabilitated areas must be conducted to monitor the succession of the vegetation.

Fauna

- Areas where bird collisions are likely to occur is near pans, and where the transmission line crosses wetlands and rivers. In order to prevent bird collisions conductors must be made more visible by attaching bird flappers.
- Regular inspections of the line must be conducted to determine areas where bird collisions occur. Bird flappers must be attached to the conductors in these identified areas.

10. CONCLUSION

In view of information obtained from literature and results obtained from the site visit, the following is concluded:

- Alignment 1 is the best of the three options

Reasons: a) The distance between this alignment and large pans as well as large concentrations of pans makes this alignment the most suitable one.

b) Crop farming, mainly maize production has already destroyed large areas of natural vegetation in the study area. A lower percentage of natural veld would be affected.

c) This alignment does not cut through the Kimberley Thorn Bushveld, which is a relatively sensitive vegetation type (White-backed Vultures use Camel Thorns to breed).

A more detailed study could reveal more relevant information once the suitable alignment was selected and the surveyors had stake out the positions of the footprints and contractor's camps

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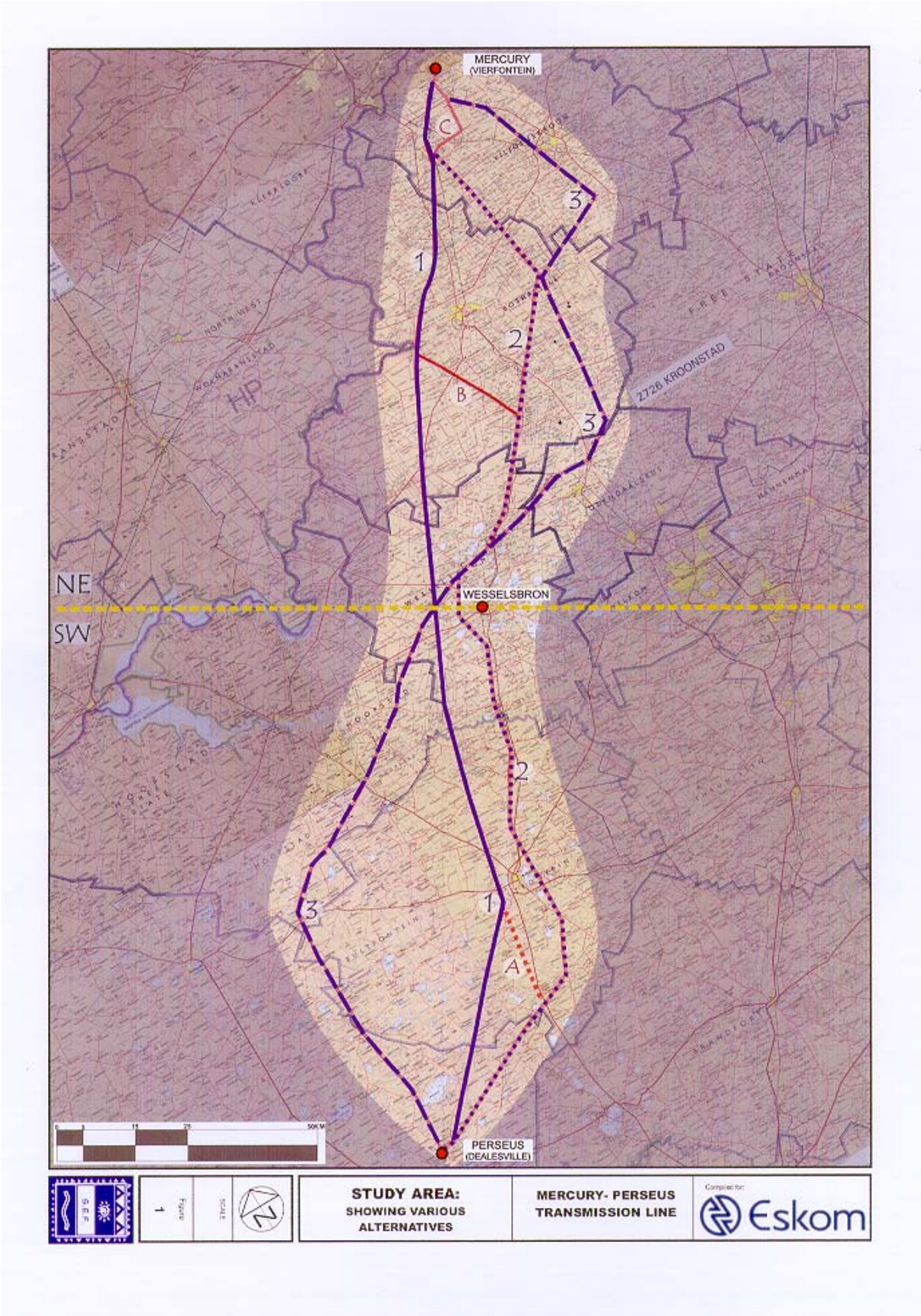
ANNEXURE A


MERCURY
(VIERFONTEIN)
C
1
3
2
B
3
2726 KROONSTAD
HP
NE
SW
WESSELSBRON
2
3
1
A
PERSEUS
(DEALESVILLE)
Figure
1
SCALE
STUDY AREA:
SHOWING VARIOUS
ALTERNATIVES
MERCURY- PERSEUS
TRANSMISSION LINE
Compiled for:
Eskom

ANNEXURE B

A degraded grassland. Note the karroo-bushes in the foreground.

Ghaap Plateau shrub community on the dolerite hill. In the foreground is a dry sandy Highveld Grassland community.

ANNEXURE C

Diplachne fusca dominated floodplain near the Vet River.

Typical grassy pan surrounded by grassland.

ANNEXURE D

Seepage area. Note the stands of reeds, sedges and bullrushes.

Karroid Panveld on calcrete.

ANNEXURE E

Acacia karroo shrub community near the Vals River.

ANNEXURE F

A typical wetland community.

Riparian shrub community.

ANNEXURE G

Kimberley Thorn Bushveld dominated by *Acacia erioloba*.

A dead Camel Thorn with Sociable Weaver nests.

ANNEXURE H

Existing transmission lines crossing maize fields.

ANNEXURE I

Brunsvigia radulosa

ANNEXURE J

Flamingoes on a pan.

Wetlands are frequented by waterfowl. Note the Spurwinged Geese.

ANNEXURE K

Vervet monkey in riparian shrub.

ANNEXURE L

LIST OF PLANT SPECIES FOUND IN THE VARIOUS MAJOR COMMUNITIES

1. Dry Sandy Highveld grassland on red sandy soils (**Annexure B**)

Grasses
Aristida congesta
Cymbopogon plurinodis
Cynodon dactylon
Cynodon hirsutus
Digitaria eriantha
Elionurus muticus
Eragrostis chloromelas
Eragrostis curvula
Eragrostis obtusa
Eragrostis superba
Heteropogon contortus
Setaria sphacelata
Themeda triandra
Tragus koeleroides

Forbs
Barleria macrocarpa
Berkheya onopordifolia
Berkheya pinnatifida
Blepharis integrifolia
Conyza bonariensis
Conyza podocephala
Crabbea acaulis
Gazania krebsiana
Helichrysum dregeanum
Helichrysum rugulosum
Walafrida densiflora

Bulbous plants
Albuca setosa
Boophane disticha
Brunsvigia radulosa
Dipcadi viride

Shrubs
Diospyros austro-africana
Lycium horridum
Rhus ciliata

2. Grassy Pan Veld clayey soils around pans (**Annexure C**)

Grasses
Aristida bipartita
Aristida congesta
Cynodon dactylon
Cynodon hirsutus
Eragrostis chloromelas
Eragrostis obtusa
Eragrostis plana

Panicum coloratum
Setaria nigrirostris
Setaria sphacelata
Themeda triandra
Tragus koeleroides

Forbs
Berkheya onopordifolia
Berkheya pinnatifida
Conyza bonariensis
Conyza podocephala
Gazania krebsiana
Helichrysum dregeanum
Helichrysum rugulosum
Walafrida densiflora

Bulbous plants
Albuca setosa
Brunsvigia radulosa
Dipcadi viride

Dwarf Shrubs
Chrysocoma ciliata
Felicia muricata
Lycium horridum
Menodora africana
Pentzia incana
Salsola glabrescens
Salsola kali

3. Karroid Panveld on calcrete outcrops (**Annexure D**)

Grasses
Aristida bipartita
Aristida congesta
Cynodon dactylon
Cynodon hirsutus
Eragrostis obtusa
Eragrostiss lehmanniana
Panicum coloratum
Setaria nigrirostris
Setaria sphacelata
Sporobolus ioclados
Sporobolus ludwigii
Themeda triandra
Tragus koeleroides

Forbs
Berkheya onopordifolia
Berkheya pinnatifida
Conyza bonariensis
Conyza podocephala
Gazania krebsiana

Helichrysum dregeanum
Helichrysum rugulosum
Walafrida densiflora

Bulbous plants
Albuca setosa
Brunsvigia radulosa
Dipcadi viride

Dwarf Shrubs
Chrysocoma ciliata
Felicia muricata
Lycium cinereum
Lycium horridum
Menodora africana
Pentzia incana
Salsola glabrescens
Salsola kali

4. Floodplain grassland on deep clayey soils near streams & rivers (**Annexure C**).

Grasses
Aristida bipartita
Aristida congesta
Cynodon dactylon
Cynodon hirsutus
Diplachne fusca
Eragrostis obtusa
Eragrostiss lehmanniana
Panicum coloratum
Setaria nigrirostris
Setaria sphacelata
Sporobolus ludwigii
Themeda triandra
Tragus koeleroides

Forbs
Berkheya onopordifolia
Berkheya pinnatifida
Conyza bonariensis
Conyza podocephala
Gazania krebsiana
Helichrysum dregeanum
Helichrysum rugulosum
Juncus rigidus
Oenothera rosea
Walafrida densiflora

Bulbous plants
Albuca setosa
Brunsvigia radulosa
Crinum bulbispermum
Dipcadi viride

Dwarf Shrubs
Chrysocoma ciliata
Felicia muricata
Lycium cinereum
Lycium horridum
Menodora africana
Pentzia incana
Salsola glabrescens
Salsola kali

5. *Acacia karroo* shrub on clayey soils along streams and rivers (**Annexure E**)

Grasses
Aristida congesta
Cynodon dactylon
Cynodon hirsutus
Eragrostis chloromelas
Eragrostis curvula
Eragrostis obtusa
Eragrostis superba
Panicum coloratum
Setaria sphacelata
Themeda triandra
Tragus koeleroides

Forbs
Berkheya onopordifolia
Berkheya pinnatifida
Conyza bonariensis
Conyza podocephala
Gazania krebsiana
Helichrysum dregeanum
Helichrysum rugulosum
Walafrida densiflora

Bulbous plants
Albuca setosa
Brunsvigia radulosa
Crinum bulbispermum
Dipcadi viride

Dwarf Shrubs
Chrysocoma ciliata
Felicia muricata
Lycium cinereum
Lycium horridum
Pentzia incana
Salsola glabrescens
Salsola kali
Salsola spp.

Shrubs

Asparagus cooperi
Asparagus laricinus
Clematis brachiata
Diospyros lycioides
Felicia muricata
Lycium horridum
Rhus pyroides

Trees
Acacia karroo
Ziziphus mucronata

6. Riparian shrub on stream and riverbanks (**Annexure F**)

Grasses
Aristida congesta
Cynodon dactylon
Cynodon hirsutus
Eragrostis curvula
Panicum coloratum
Setaria sphacelata

Forbs
Berkheya pinnatifida
Conyza bonariensis
Conyza podocephala
Walafrida densiflora

Bulbous plants
Albuca setosa
Crinum bulbispermum
Dipcadi viride

Dwarf Shrubs
Chrysocoma ciliata
Felicia muricata
Lycium cinereum
Lycium horridum
Pentzia incana
Salsola glabrescens
Salsola kali
Salsola spp.

Shrubs
Asparagus cooperi
Asparagus laricinus
Clematis brachiata
Diospyros lycioides
Felicia muricata
Lycium horridum
Rhus pyroides

Trees

Acacia karroo
Eucalyptus sideroxylon
Eucalyptus camaldulensis
Salix babylonica
Salix mucronata
Ziziphus mucronata

7. Seepage areas and wetland communities (**Annexure D**).

Grasses
Aristida bipartita
Cynodon dactylon
Cynodon hirsutus
Eragrostis curvula
Panicum coloratum
Setaria sphacelata
Sporobolus ioclados
Sporobolus ludwigii
Tragus koeleroides

Sedges
Cyperus bellus
Fuirena spp.
Juncus rigidus
Scirpus spp.

Reeds
Phragmites australis
Typha latifolius

Forbs
Conyza bonariensis
Conyza podocephala
Oenothera rosea
Verbena bonariensis

Bulbous plants
Crinum bulbispermum
Dipcadi viride

8 Kimberley Thorn Bushveld on deep aeolian sands (**Annexure G**).

Grasses
Aristida congesta
Aristida stipitata
Cynodon dactylon
Cynodon hirsutus
Eragrostis chloromelas
Eragrostis lehmanniana
Eragrostis obtusa
Eragrostis pallens
Eragrostis superba
Panicum kalahariense

Schmidtia kalahariensis
Setaria sphacelata
Themeda triandra
Tragus koeleroides

Forbs
Berkheya onopordifolia
Berkheya pinnatifida
Conyza bonariensis
Conyza podocephala
Dicoma macrocephala
Gazania krebsiana
Helichrysum dregeanum
Helichrysum rugulosum
Hermannia tomentosa
Walafrida densiflora

Bulbous plants
Albuca setosa
Brunsvigia radulosa
Dipcadi viride

Dwarf Shrubs
Chrysocoma ciliata
Felicia muricata
Lycium cinereum
Lycium horridum
Salsola spp.

Shrubs
Asparagus cooperi
Asparagus laricinus
Diospyros lycioides
Grewia flava
Lycium hirsutum

Trees
A. hebecalada
Acacia erioloba
Acacia tortilis
Boscia albitrunca
Rhus lancea
Ziziphus mucronata

9. Ghaap-plateau shrub communities on dolerite (**Annexure B**)
Grasses
Aristida congesta
Cymbopogon plurinodis
Digitaria eriantha
Elionurus muticus
Eragrostis chloromelas
Eragrostis curvula

Eragrostis obtusa
Eragrostis superba
Heteropogon contortus
Themeda triandra
Tragus koeleroides

Forbs
Barleria macrocarpa
Berkheya onopordifolia
Berkheya pinnatifida
Blepharis integrifolia
Conyza bonariensis
Conyza podocephala
Crabbea acaulis
Gazania krebsiana
Helichrysum dregeanum
Helichrysum rugulosum
Walafrida densiflora

Bulbous plants
Albuca setosa
Boophane disticha
Brunsvigia radulosa
Dipcadi viride

Shrubs
Cussonia paniculata
Diospyros austro-africana
Diospyros lycioides
Euclea crispa
Olea europaea subsp. *Africana*
Rhus burchellii
Rhus ciliata
Rhus lancea
Tarchonanthus camphoratus