

SUPPLEMENTARY BOTANICAL ASSESSMENT
PROPOSED GAMMA-KAPPA ESKOM POWER LINE (OPTION 2 ROUTE)

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1 INTRODUCTION

This report investigates the vegetation types traversed by the proposed new Kappa-Gamma power line between the Kappa substation 25 km north of Touws River and the Gamma substation 6 km northwest of the N1-R63 (Victoria West road) intersection. Encroaching on the Western Cape Province's northern boundary, the proposed route traverses three biomes, namely Succulent Karoo (western section), Fynbos Biome (western section) and Nama Karoo (central and eastern sections), as well as azonal vegetation types (rivers and associated floodplains). Within these biomes, eight mapped vegetation types will be affected by the project, namely Tanqua Karoo, Tanqua Wash Riviere, Central Mountain Shale Renosterveld and Koedoesberge-Moordenaars Karoo in the western part of the study area, and Gamka Karoo, Southern Karoo Riviere, Upper Karoo Hardeveld and Eastern Upper Karoo in the central and eastern parts. None of the vegetation types are considered to be threatened (DEA 2011).

2 METHODOLOGY

Spot surveys along the preferred power line route (Option 2) were undertaken on 17-18 June 2016 (central and eastern section), 15-16 July 2016 (eastern section), 15-16 November 2016 (western section), 23 March 2017 (western and central section) and 4 December 2017 (western section). Maps 1-3 below represent Google Earth aerial photos of the western, central and eastern sections, respectively. A brief assessment of the selected sites was undertaken where plant species, disturbances, presence of alien species and land use were recorded. Plant species not identified in the field, were collected or photographed and identified at the Compton Herbarium at Kirstenbosch. Mucina & Rutherford's vegetation map and the latest floristic taxonomic literature and reference books were used for the purpose of this specialist study. Any plants classified as rare or endangered in the Red List were highlighted.

This report supplements the Terrestrial Ecological Assessment Report (dated 2013) prepared for the same project by Scientific Aquatic Services. Three route options were presented and assessed in the above assessment report. The preferred route option as further investigated in this report corresponds with Option 2 in the above report.

Limitations to the study: Given the time and budget constraints it was deemed impossible or impractical to do a more thorough assessment of the proposed power line route. Long sections of the route are also inaccessible and precluded the possibility of more sampling points. In response to certain comments in CapeNature's comment letter, dated 11 July 2014, the following:

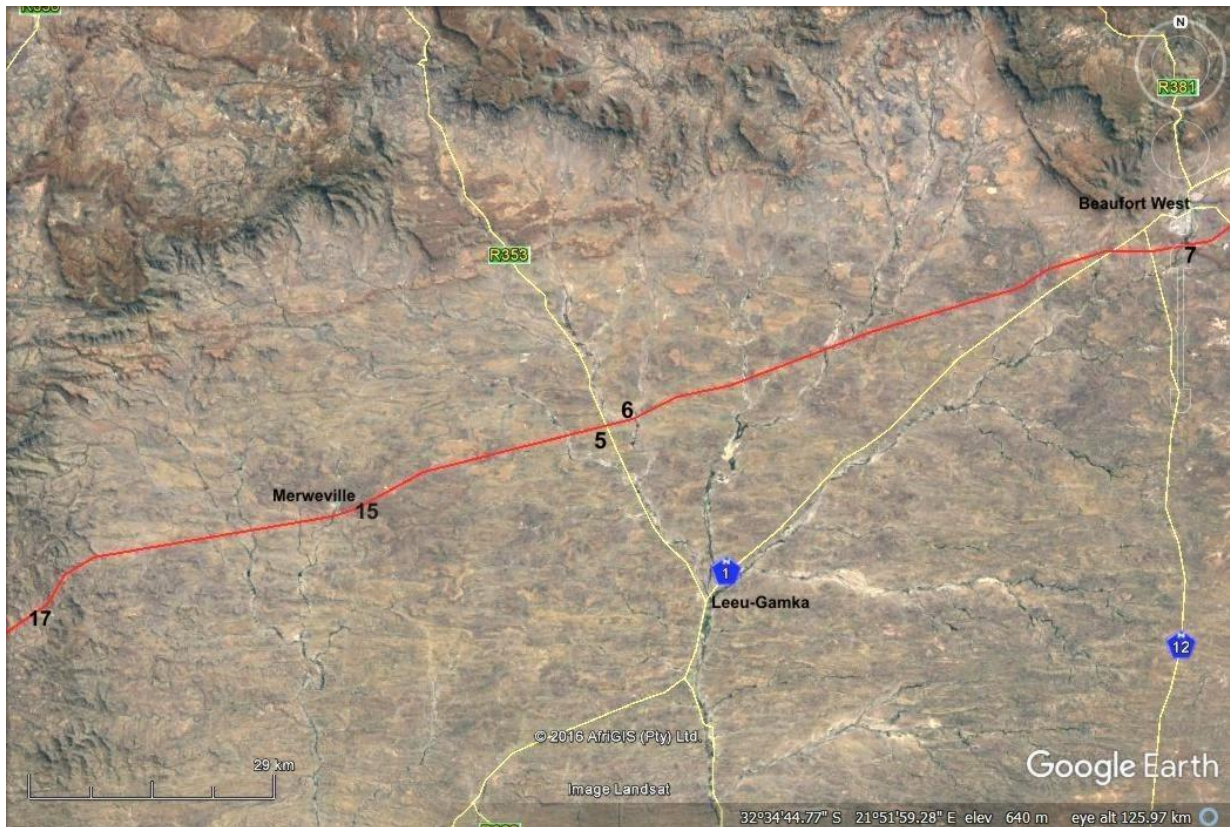
- CapeNature recommends that the actual pylon footprints be assessed in more detail. This is impossible to achieve and considered impractical due to the length (374 km) of the route and that it is currently unknown exactly where the preferred route would run. It is assumed that it

will run alongside one of the existing power lines. There is also more than one power line running alongside each other. If the exact route is unknown, the pylon and access road footprints cannot be assessed. Please note that numerous farm roads/tracks crisscross the landscape, which can potentially be used to access the power line route during construction.

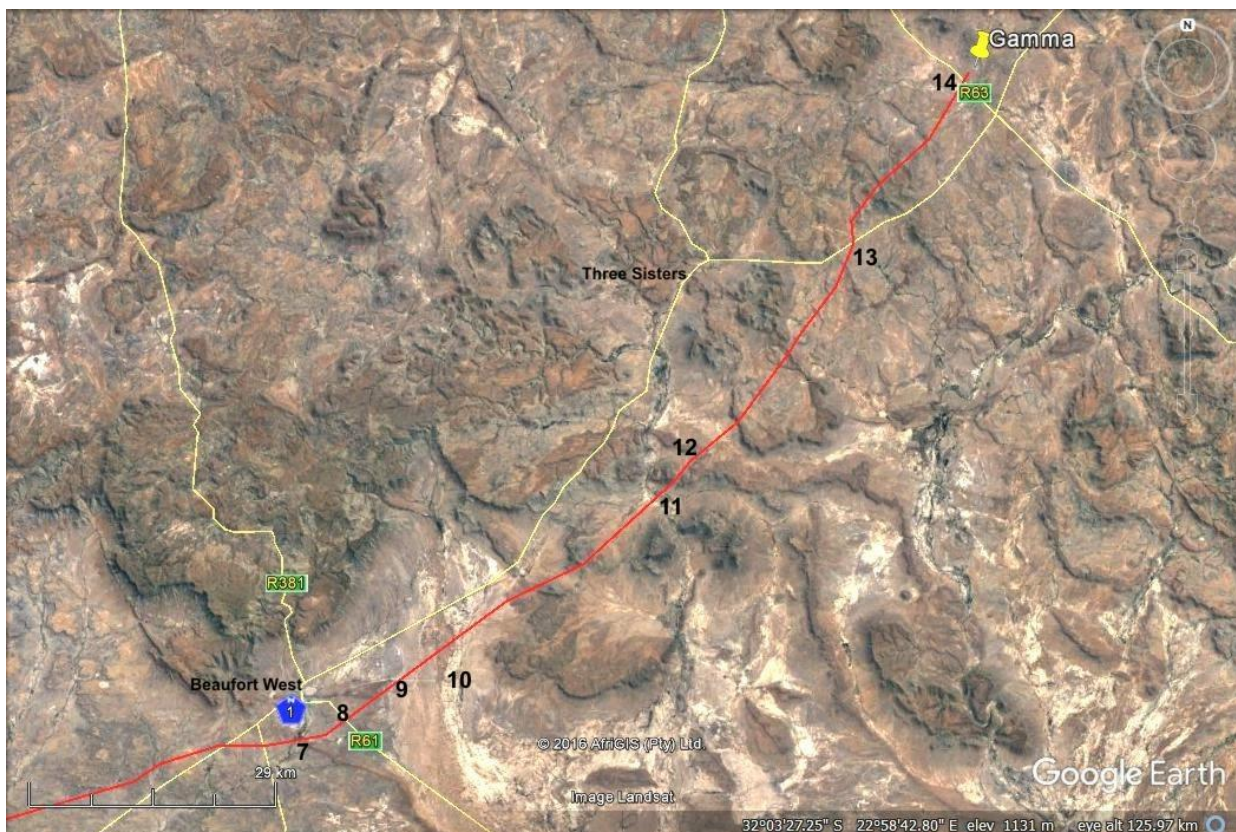
- Comment is made of the many dwarf woody shrubs (e.g. *Pentzia* species and *Eriocephalus* species) that are very old and sensitive to trampling. This comment is appreciated, but it must be stated that these species are widespread throughout the Karoo and will be impossible to avoid. Attention should be devoted to restrict disturbance as far as practically possible to existing farm roads/tracks in order to access the pylon sites. The latter should be positioned on the most disturbed or bare sites, preferably under the supervision of a suitably experienced botanist.
- It was commented that “the level of detail and the scale of maps provided for the sensitivity assessment are not adequate to accurately determine all areas of high sensitivity. Sensitive areas must be groundtruthed and mapped in detail.” Detailed groundtruthing of all the sensitive areas, e.g. CBA’s, can take years to complete, involving several specialists. Access is also a major constraint, which include the obtaining of permission from landowners.



Map 1 Google Earth photo of the western section of proposed power line route. Spot surveys were undertaken in Tanqua Karoo (site 1), Tanqua Wash Riviere (site 2), Central Mountain Shale Renosterveld (sites 3, 19 & 20), Koedoesberge-Moordenaars Karoo (sites 4 & 18) and Gamka Karoo (sites 16 & 17). The green circle indicates a SKEP biodiversity hotspot.



Map 2 Google Earth photo of the central section of proposed power line route. Spot surveys were undertaken in Gamka Karoo (sites 5, 7, 15 & 17) and Southern Karoo Riviere (sites 6 & 7).

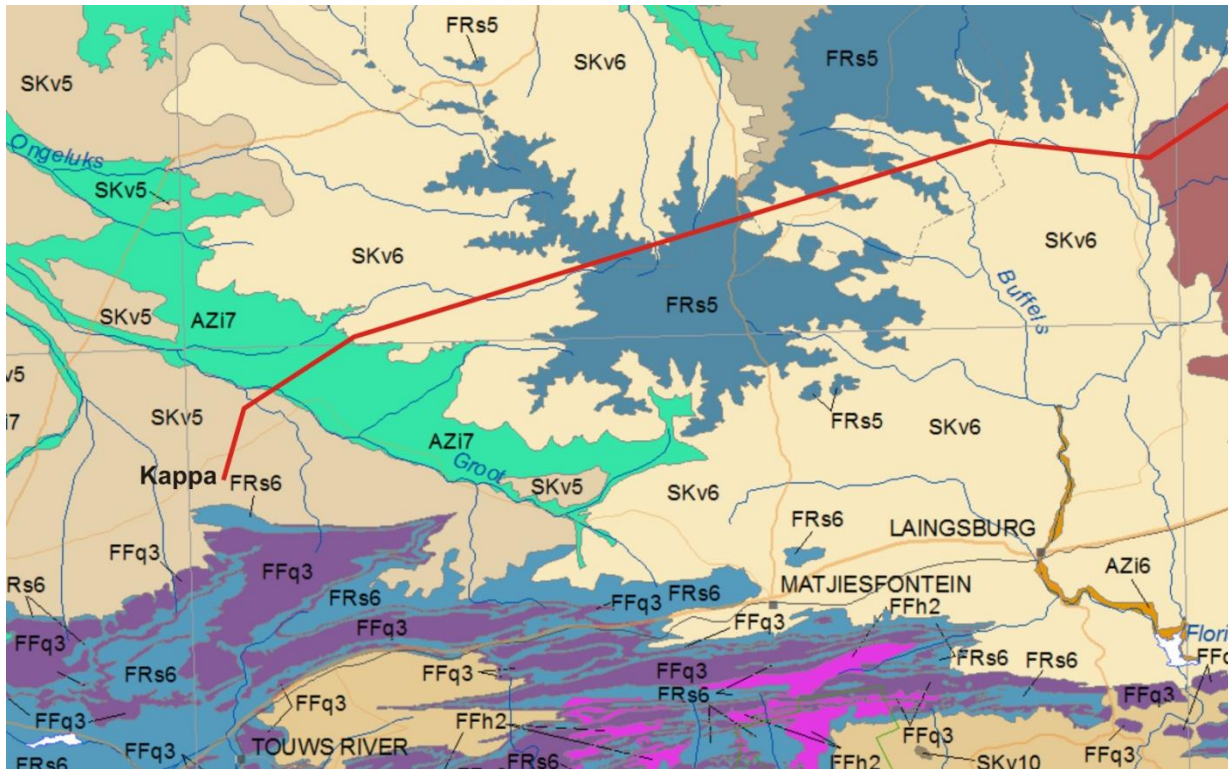


Map 3 Google Earth photo of the eastern section of proposed power line route. Spot surveys were undertaken in Gamka Karoo (sites 7, 8, 9 & 12), Southern Karoo Riviere (sites 7, 10 & 11) and Eastern Upper Karoo (sites 13 & 14).

3 STUDY AREA & BRIEF DESCRIPTION OF THE AFFECTED VEGETATION TYPES

The proposed power line route follows an almost straight line between the two substations across the western and central Karoo basin between the Cape Fold Belt and the Great Escarpment mountains, mounting the latter along the easternmost section. While the western and eastern sections can be described as undulating (koppies), the central section is relatively flat to mildly undulating, crossing numerous ephemeral rivers. Altitude above sea level ranges from 650 m at the western end to over 1400 m in the eastern part. The power line also crosses the Klein Roggeveld at a maximum altitude of 1300 m in the western part.

The proposed route traverses eight mapped vegetation types, namely Tanqua Karoo, Tanqua Wash Riviere, Central Mountain Shale Renosterveld and Koedoesberge-Moordenaars Karoo in the western part of the study area, and Gamka Karoo, Southern Karoo Riviere, Upper Karoo Hardeveld and Eastern Upper Karoo in the central and eastern parts (see Maps 4-6). The Karoo is known to support the richest desert flora in the world and the largest variety of succulents found anywhere. Over 9000 plant species have been reported in the region. Descriptions of the vegetation types were obtained from Mucina & Rutherford (2006).



Map 4 Extract of the SA Vegetation Map (Mucina & Rutherford 2006), showing the western section of the proposed power line route (red line) within Tanqua Karoo (SKv5), Tanqua Wash Riviere (AZI7), Central Mountain Shale Renosterveld (FRs5) and Koedoesberge-Moordenaars Karoo (SKv6).

The westernmost section of the proposed route runs through Tanqua Karoo before it crosses Tanqua Wash Riviere. Tanqua Karoo occurs in the Western and Northern Cape Provinces and stretches from the Cederberg in the west to the Roggeveld Escarpment in the east. The landscape is described as a slightly undulating basin, sheltered by the steep mountain slopes. The plain is interrupted by dolerite koppies, sheet-washes and carved in river channels (Tanqua Wash Riviere). The plains are sparingly vegetated, comprising a low, succulent shrubland. Members of the vygie family are common, such as *Ruschia*, *Drosanthemum* and *Aridaria* species. The geology comprises mudrocks of the Ecca Group, Dwyka Group diamictites and Bokkeveld Group sandstones. Precipitation falls mainly during the winter months. About 10% of Tanqua Karoo is formally conserved in the Tanqua Karoo National Park. Tanqua Karoo is an important local centre of endemism housing one endemic genus, namely *Didymaotus* of the vygie family.

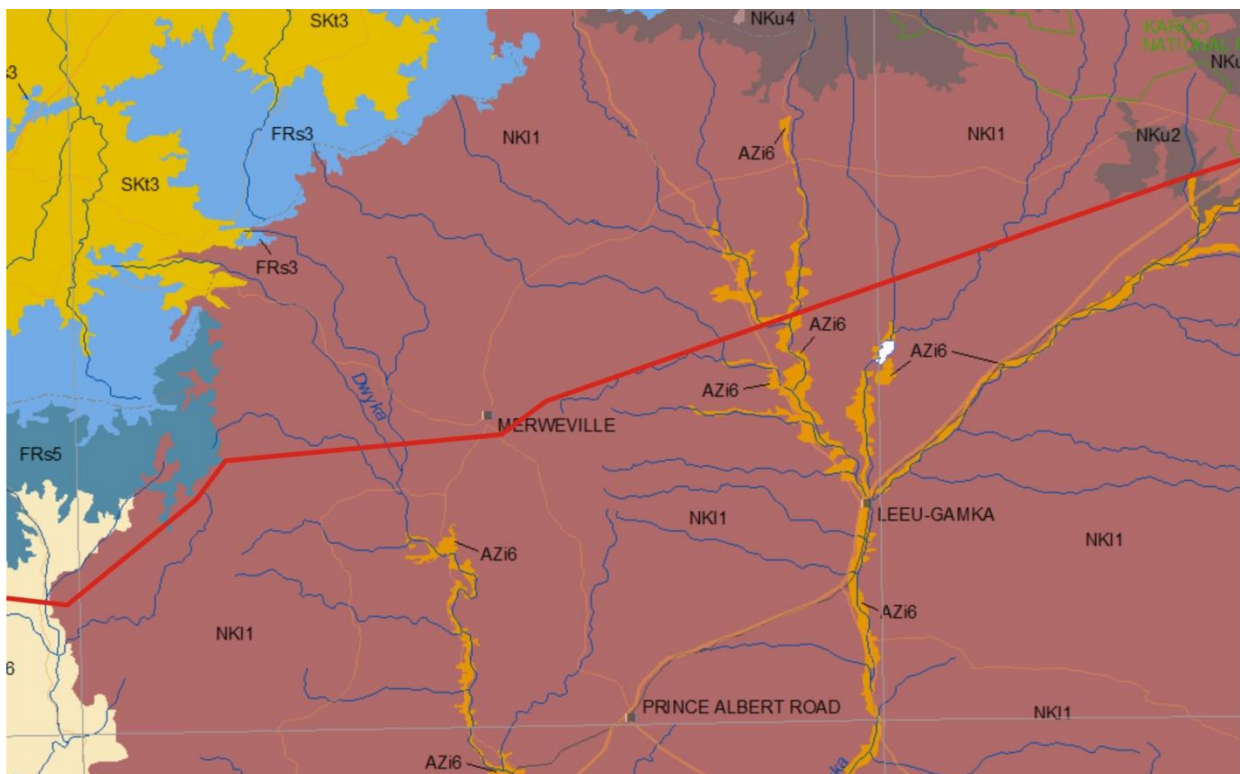
The proposed route then runs through Tanqua Wash Riviere for about 11 km. The latter occurs in the Western Cape and to a lesser extent in the Northern Cape Provinces. It is found in incised river valleys, supporting a mixture of succulent shrublands with *Salsola* and *Lycium* alternating with *Vachellia karroo* thickets. The vegetation types include riparian thickets, alluvial shrublands and herblands, and sheet washes. About 13% is formally conserved in the Tankwa National Park.

A considerable section of the route runs through Koedoesberge-Moordenaars Karoo, with sporadic high-lying portions in Central Mountain Shale Renosterveld. It is not easy to distinguish between these two vegetation types as they are floristically very similar. Koedoesberge-Moordenaars Karoo is distributed in the Western Cape and Northern Cape Provinces on a slightly undulating to hilly landscape between the Tanqua and Gamka Karoo vegetation types. The landscape is covered by low succulent scrub and dotted by scattered tall shrubs and patches of grass. The most conspicuous dominants being dwarf shrubs of *Pteronia*, *Drosanthemum* and *Galenia*. The geology comprise mudstone (mainly), shale and sandstone of the Beaufort Group, as well as sandstone, shale and mudstone of the Ecca Group. A small portion is formally conserved in the Gamkapoort Nature Reserve.

Central Mountain Shale Renosterveld is distributed in the Northern and Western Cape Provinces on the southern and south-eastern slopes of the Klein Roggeveld Mountains and Komsberg below the Roggeveld section of the Great Escarpment, as well as further east towards Merweville. Along with Upper Karoo Hardeveld and Eastern Upper Karoo, it is one of the highest lying vegetation types found along the proposed power line route. It occurs on the slopes and broad ridges of low mountains and escarpment, with tall shrubland dominated by renosterbos with mainly non-succulent karoo shrubs and geophytes. Geology comprises clayey soils overlying Beaufort Group mudstones and sandstones. The climate is arid to semi-arid. Rainfall is relatively even, with a slight

high in autumn to winter. A portion of Central Mountain Shale Renosterveld is also formally conserved in the Tanqua National Park.

The majority of the proposed route runs through Gamka Karoo. It occurs mainly in the Western Cape and Eastern Cape Provinces, between the Great Escarpment (Nuweveld Mountains) in the north and the Cape Fold Belt mountains (mainly the Swartberg Mountains) in the south. The landscape can be described as slightly undulating plains, covered with dwarf spinescent shrubland and scattered low trees. Sometimes drought-resistant grasses dominate on sandy basins after good rains. The geology comprises mainly mudstones and sandstones of the Beaufort Group and some Ecca shales. It supports very shallow and stony soils. Being located in the rain shadow of the Cape Fold Belt, it is considered as one of the most arid units of the Nama-Karoo Biome. Rainfall occurs mainly in summer and autumn, with a peak in March. About 2% is formally conserved in the Karoo National Park and very little (<1%) is transformed.

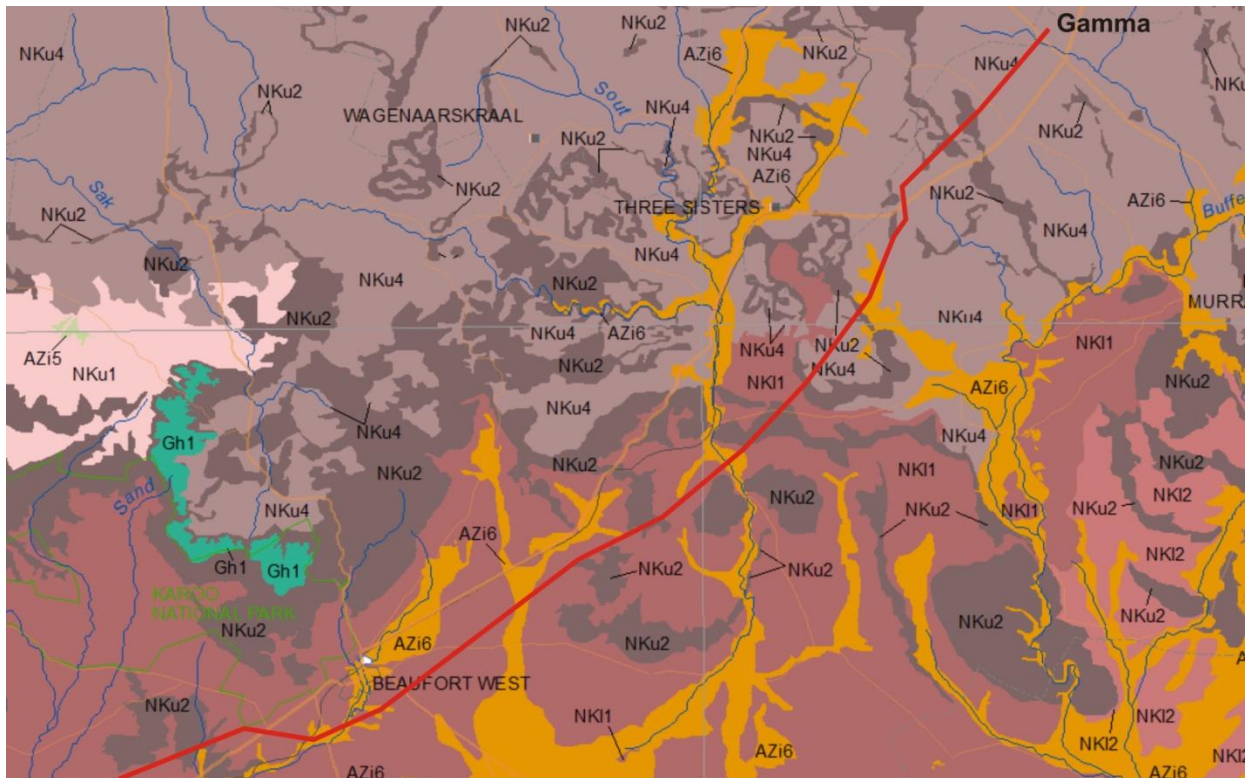


Map 5 Extract of the SA Vegetation Map (Mucina & Rutherford 2006), showing the central section of the power line route (red line) within Gamka Karoo (NK1), Southern Karoo Riviere (AZi6) and Upper Karoo Hardeveld (NKu2).

Closely associated mainly with Gamka Karoo in the study area, Southern Karoo Riviere is crossed frequently by the power line route. It occurs in the Western and Eastern Cape Provinces on the alluvial plains of among other the Buffels, Dwyka and Gamka Rivers. Altitude ranges considerably between 250 and 1550 m. It comprises narrow riverine flats supporting *Vachellia karroo* or *Tamarix usneoides* thickets, bordered by *Salsola* (saltbush)-dominated shrubland. About 1.5% is formally

conserved in the Karoo National Park, and a few other nature reserves, including the Gamkapoort and Karoo Nature Reserves.

Upper Karoo Hardeveld, which is encountered on the steeper slopes of the eastern part of study area, is distributed in the Northern, Western and Eastern Cape Provinces, on slopes and ridges spanning from Middelpos in the west to Richmond and Nieu Bethesda in the east. It typically occurs on the steep slopes of koppies and parts of the Great Escarpment, supporting sparse dwarf Karoo scrub with drought-tolerant grasses of genera such as *Aristida*, *Eragrostis* and *Stipagrostis*. The geology comprises skeletal soils in rocky areas over sedimentary rocks such as mudstones and arenites of the Karoo Supergroup. About 3% is formally conserved in the Karoo National Park and Karoo Nature Reserve. It is considered one of the richer floras of the Nama-Karoo Biome.



Map 6 Extract of the SA Vegetation Map (Mucina & Rutherford 2006), showing the eastern section of the power line route (red line) within Gamka Karoo (NK1), Southern Karoo Riviere (AZi6), Upper Karoo Hardeveld (NKu2) and Eastern Upper Karoo (NKu4).

Finally, the route enters the Eastern Upper Karoo on the high-lying eastern part of the study area. It is distributed in the Northern Cape, Eastern Cape and Western Cape Provinces. It occurs on flats and gently sloping plains, interspersed with hills and rocky areas of Upper Karoo Hardeveld in the west. It is dominated by dwarf small-leaved shrubs, with grasses of the genera *Aristida* and *Eragrostis*. The geology comprises mainly mudstones and sandstones of the Beaufort Group. Rainfall occurs mainly in summer and autumn, with a peak in March. About 2% is formally conserved in the Mountain Zebra and Karoo National Parks, as well as in Oviston, Commando

Drift, Rolfontein and Gariiep Dam Nature Reserves. About 2% has been transformed, mainly due to the building of dams.

4 RESULTS

The total length of the proposed power line is estimated at 374 km. As stated previously, the vegetation in which the project is located is largely untransformed. Disturbances noted include the footprints of existing power line pylons and access tracks, farm roads, farming activities (pastures and grazing) and associated overgrazing, tourist activities and alien plant infestation (see Photo 1). The estimated sections through the respective vegetation types (as presented on the South African vegetation map) are as follows:

Vegetation type:	Estimated portion of the power line:
Tanqua Karoo	8 km
Tanqua Wash Riviere	11 km
Central Mountain Shale Renosterveld	19 km
Koedoesberge-Moordenaars Karoo	61 km
Gamka Karoo	191 km
Southern Karoo Riviere	18 km
Upper Karoo Hardeveld	26 km
Eastern Upper Karoo	41 km

4.1 Description of vegetation types and flora encountered (from west to east)

Tanqua Karoo in the vicinity of the Kappa substation can be described as a low, open succulent shrubland (see Photo 2). Plant cover (during the dry season) varies between 35 and 70%. The flora is dominated by succulents (mainly vygies) and asteraceous shrubs. The following species were recorded, namely: *Eriocephalus microphyllus*, *Pteronia pallens*, *P. flexicauulis*, *Berkheya spinosa*, *Galenia africana*, *Euphorbia multiceps*, *Pelargonium crithmifolium*, *Crassula deltoidea*, *Tylecodon wallichii*, *Malephora crassa*, *Ruschia spinosa*, *Mesembryanthemum junceum*, *M. nitidum*, *M. noctiflorum* and *Lacomucinaea lineata*. *Eriocephalus microphyllus*, *Pteronia pallens*, *P. flexicauulis*, *Berkheya spinosa*, *Euphorbia multiceps*, *Pelargonium crithmifolium*, *Tylecodon wallichii*, *Ruschia spinosa*, *Mesembryanthemum junceum*, *M. nitidum* and *M. noctiflorum* are restricted to the western part of the study area, while *Malephora crassa* is considered a Tanqua Karoo endemic. The succulent flora is evidently more diverse on the rockier low ridges or koppies. No Species of Conservation Concern were recorded.



Photo 1 Disturbances noted, with transformed Central Mountain Shale Renosterveld (top left), an Eskom pylon footprint in Gamka Karoo in the SKEP hotspot (top right), a farm track inside Gamka Karoo east of Beaufort West (bottom left) and sheep farming in Central Mountain Shale Renosterveld (bottom right).

An estimated 40 prominent seasonal (ephemeral) river courses/washes are crossed, which include the Groot and Buffels Rivers in the western part, Dwyka and Gamka in the central part, and the Platdoring, Sout and Taaibosch Rivers in the eastern part. While none of the rivers were in flow, pools of standing water were noted in several of the major rivers. In the western part, the vegetation associated with the rivers is classified as Tanqua Wash Riviere (see Photo 3), while the central and eastern part rivers are grouped under Southern Karoo Riviere (see Photo 4). *Vachellia karroo*, *Lycium cinereum*, *Salsola aphylla*, *Atriplex vestita*, *Malephora crocea* and *Phragmites australis* are prominent in both azonal types. Also recorded in Tanqua Wash Riviere and adjacent saline flats are *Scirpoides dioecus*, *Osteospermum incanum*, *Chrysocoma ciliata*, *Galenia africana*, *Mesembryanthemum noctiflorum*, *Ruschia grisea* and *Muraltia spinosa*. *Osteospermum incanum*, *Mesembryanthemum noctiflorum* and *Muraltia spinosa* are restricted to the western part of the study area, while the rest are widespread.



Photo 2 View across Tanqua Karoo in the vicinity of the Kappa substation (top left and right). *Euphorbia multiceps* (lower left) and *Tylecodon wallichii* (lower right) are two succulents recorded in the area.

In the Southern Karoo Riviere the following additional species were recorded, namely *Pentzia incana*, *Felicia muricata*, *Searsia lancea*, *S. burchellii*, *S. pyroides*, *Drosanthemum hispidum*, *D. lique*, *Delosperma multiflorum*, *Ruschia spinosa*, *Lycium pumilum*, *L. horridum*, *L. oxycarpum*, *Tamarix usneoides*, *Tetraena microcarpa* and *Juncus acutus*. Photo 5 illustrates some of the recorded species. All these species are widespread and common. *Delosperma multiflorum* (recorded on the washes east of Beaufort West) and *Searsia pyroides* are restricted to the eastern part of study area. Alien species recorded include *Prosopis glandulosa* (an invasive thorn tree resembling *Vachellia karroo*), *Salsola kali*, *Atriplex lindleyi* subsp. *inflata*, *Atriplex nummularia*, *Schinus molle*, *Opuntia elata* (south of Beaufort West) and *Cylindropuntia fulgida* var. *mamillata* (south of Beaufort West). *Schinus molle* (Australian Pepper) has invaded the Southern Karoo

Riviere in the eastern part of the study site. No Species of Conservation Concern were recorded in Tanqua Wash Riviere and Southern Karoo Riviere.



Photo 3 Distance and close-up views (top left and right) of the Groot River (Tanqua Wash Riviere), just south of the proposed power line route. Saline flats along the Groot River (bottom left). *Mesembryanthemum noctiflorum* (bottom right) is a common vygie found in both Tanqua Karoo and Tanqua Wash Riviere.

The vegetation to the east of Tanqua Karoo has been mapped Koedoesberge-Moordenaars Karoo (Photo 6) and Central Mountain Shale Renosterveld (Photo 7), with the latter found on the higher lying areas. While differences in structure and floristic composition between the latter and Gamka Karoo, which occurs further away to the east, are evident, the author could not easily distinguish (given the level of investigation) between mapped Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld in the west and Gamka Karoo to the east, respectively. The latter two are probably more extensive along the power line route between the R354 (Sutherland Rd) and the SKEP hotspot than shown on the vegetation map. Plant cover varies between 40 and 65%.



Photo 4 An Eskom power line crossing the Koedoeskloof Stream, a tributary of the Vanderbylskraal River south of Merweville (top left). Koekemoers River (top right), a tributary of the Gamka northwest of Leeu-Gamka, and the Gamka River (bottom left), south of Beaufort West. Saline flats next to the Platdoring (bottom right). These rivers are grouped under Southern Karoo Riviere.

Compared to Tanqua Karoo, asteraceous shrubs are more prominent in Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld at the expense of succulents. The following species were recorded in mapped Koedoesberge-Moordenaars Karoo, namely *Eriocephalus microphyllus*, *Elytropappus rhinocerotis* (renosterbos), *Pteronia incana*, *Euryops lateriflorus*, *Athanasia flexuosa*, *Lycium cinereum*, *Hermannia cuneifolia*, *Galenia africana*, *Ruschia cradockensis*, *Cheiridopsis namaquensis*, *Antimima pumila*, *Crassula deltoidea*, *Tylecodon wallichii* and *Calobota spinescens*. *Ruschia cradockensis* was found to be dominant in area between the Spitzkop protected environment and the SKEP hotspot, which is indicative of severe overgrazing or drought conditions. The dwarf vygies *Cheiridopsis namaquensis* and *Antimima pumila* are restricted to the western part of the study area.



Photo 5 Flora of the Southern Karoo Riviere: *Malephora crocea* (top left), *Felicia muricata* (top right), and invasive cacti *Cyllindropuntia fulgida* var *mamillata* (bottom left) and *Opuntia elata* (bottom right).

The following species were recorded in mapped Central Mountain Shale Renosterveld, namely *Elytropappus rhinocerotis* (dominant shrub), *Eriocephalus microphyllus*, *Pteronia incana*, *Euryops lateriflorus*, *Oedera genistifolia*, *Athanasia flexuosa*, *A. microcephala*, *Helichrysum hamulosum*, *Dimorphotheca cuneata*, *Hirpicium alienatum*, *Berkheya* sp, *Gomphocarpus fruticosus*, *Galenia africana*, *Ruschia cradockensis*, *R. multiflora*, *Lycium cinereum*, *Nenax cinerea*, *Convolvulus sagittatus*, *Hermannia cuneifolia*, *Selago albida* and the grass *Tenaxia cf stricta*. *Ruschia multiflora* is restricted to the western part of the study area. Despite similarities in floristic composition with Karoo vegetation types, Central Mountain Shale Renosterveld has been grouped under the Fynbos Biome. No Species of Conservation Concern were recorded.



Photo 6 Koedoesberge-Moordenaars Karoo east of the R354, with a general view (top left), severely degraded veld (top right), Spitzkop protected environment (bottom left), and *Cheiridopsis namaquensis* and *Antimima pumila* growing next to each other (bottom right).



Photo 7 Central Mountain Shale Renosterveld next to the R354. The proposed power line will probably run alongside the power line seen in the pictures.

Moving further east along the proposed power line route towards Merweville, one enters the Nama-Karoo Biome. Gamka Karoo is the predominant vegetation type found along the route, with plant cover ranging between 15 and 35% (see Photos 8 & 9). Tree and tall shrub species recorded in Gamka Karoo include *Vachellia karroo*, *Searsia buchellii*, *S. lancea*, *S. longispina*, *Lycium horridum*, *L. oxycarpum*, *L. pumilum*, *L. cinereum*, *L. schizocalyx*, *Grewia robusta*, *Diospyros lycioides*, *Gymnosporia buxifolia* and *G. szyszyłowiczii* subsp *szyszyłowiczii* (Merweville and SKEP hotspot).



Photo 8 Severely degraded Gamka Karoo northwest of Leeu-Gamka (top left). Also, Gamka Karoo south of Beaufort West (top right), in the SKEP hotspot (bottom left) and at Merweville (bottom right).

Low shrub species and annuals recorded in Gamka Karoo include *Berkheya spinosa*, *Macledium spinosum*, *Pentzia incana*, *Gazania krebsiana*, *G. lichtensteinii*, *Osteospermum sinuatum*, *Garuleum bipinnatum*, *Leysera gnaphalodes*, *Rosenia humilis*, *Felicia hirsuta*, *F. muricata*, *Geigeria filifolia*, *Chrysocoma ciliata*, *Asparagus striatus*, *A. retrofractus*, *A. suaveolens*, *A. aethiopica*, *A. mucronatus*, *Hermannia cuneifolia*, *H. desertorum*, *H. grandiflora*, *Galenia glandulifera*, *Drosanthemum lique*, *Malephora crocea*, *Mesembryanthemum splendens* subsp. *pentagonum*, *Ruschia grisea*, *R. cradockensis*, *R. spinosa*, *R. intricata*, *Rhinephyllum graniforme* (SKEP hotspot), *Stomatium difforme* (SKEP hotspot), *Rhigozum obovatum*, *Barleria stimulans*,

Blepharis mitrata, *Selago cf. geniculata*, *Aptosimum indivisum*, *Monsonia camdeboense*, *Gomphocarpus filiformis*, *Hoodia gordonii* (SKEP hotspot and south of Beaufort West), *Aloe claviflora* (koppies near Nelspoort), *A. microstigma* (SKEP hotspot), *Cotyledon orbiculata*, *Crassula muscosa*, *C. hemisphaerica*, *C. deltoidea*, *Euphorbia mauritanica*, *E. rhombifolia*, *E. braunsii* (Merweville) and *Lacomucinaea lineata*.



Photo 9 A few Gamka Karoo plants in flower, *Aptosimum indivisum* (top left), *Geigeria filifolia* (top right), *Rhinephyllum graniforme* (middle left), *Gazania lichtensteinii* (middle right), *Hoodia gordonii* (bottom left) and *Stomatium difforme* (bottom right).

Only a few geophyte species were recorded in Gamka Karoo namely *Ledebouria* sp, *Oxalis commutata* and *Moraea polystachya*. Grasses recorded include *Eragrostis curvula*, *Panicum cf. maximum*, *Fingerhuthia africana*, *Aristida diffusa*, *Pennisetum cf. thunbergii* and *Schmidtia kalahariensis*. *Tephrocactus articulatus* is an invasive cactus recorded south and east of Beaufort West. Species with a restricted distribution in the study area include *Rhinephyllum graniforme* (regional endemic), *Stomatium difforme* (regional endemic), *Monsonia camdeboense* (eastern part), *Grewia robusta* (eastern part), *Gymnosporia szyszyłowiczii* subsp *szyszyłowiczii* (central part), *Aloe claviflora* (eastern part) and *Euphorbia braunsii* (central part). No Species of Conservation Concern were recorded.

Due to the geographic position of Upper Karoo Hardeveld between Gamka Karoo and Eastern Upper Karoo one would expect that the majority of species will be shared with the latter two vegetation types. This was confirmed during a spot survey of an area mapped as Upper Karoo Hardeveld next to a gravel road 6 km east of Nelspoort, 50 km north-east of Beaufort West (see Photo 10). Vegetation cover here was estimated at 30%. *Aloe claviflora* plants were noted on the steeper slopes. The proposed power line briefly skirts Upper Karoo Hardeveld where it runs along the steeper slopes of the higher koppies and mountains.

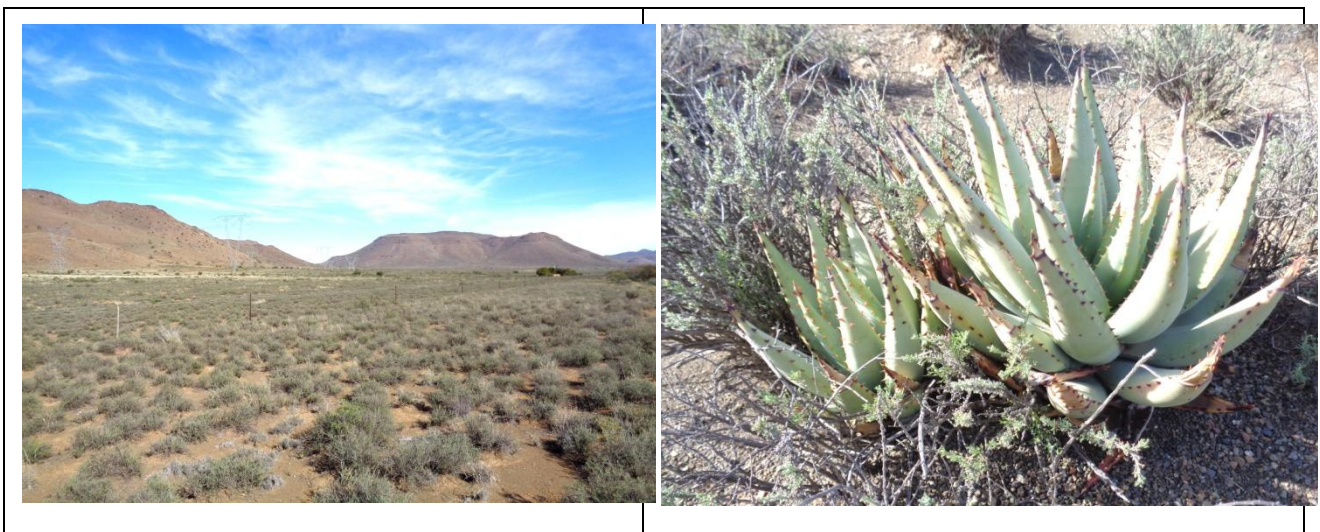


Photo 10 Typical view (left) of Upper Karoo Hardeveld on koppies in the background. *Aloe claviflora* spotted in Upper Karoo Hardeveld east of Nelspoort.

The eastern most section of the proposed power line route runs through Eastern Upper Karoo (see Photo 11). Plant cover has been estimated between 15 and 45%. Shrub species recorded here include *Diospyros lycioides*, *Lycium* sp, *Pentzia incana*, *P. spinescens*, *Gazania krebsiana*, *Eriocephalus ericoides*, *Hertia cluytiifolia*, *Senecio niveus*, *Osteospermum spinescens*, *Felicia cf. hirsuta*, *Pseudognaphalium undulatum*, *Caroxylon aphyllum*, *Salsola aphylla*, *Atriplex cinerea* subsp. *bolusii*, *Mesembryanthemum guerichianum*, *M. junceum*, *Melianthus comosus* and

Melolobium candicans. *Boophone disticha* is the only geophyte recorded. Grasses recorded include *Hyparrhenia hirta*, *Eragrostis curvula* and *Fingerhuthia africana*. Alien species recorded include *Salsola kali*, *Opuntia robusta*, *Echinopsis schickendantzii* and *Agave americana*. Recorded species with a restricted distribution are *Hertia cluytiifolia* (Eastern Upper Karoo) and *Senecio niveus* (also Eastern Upper Karoo). No Species of Conservation Concern were recorded.

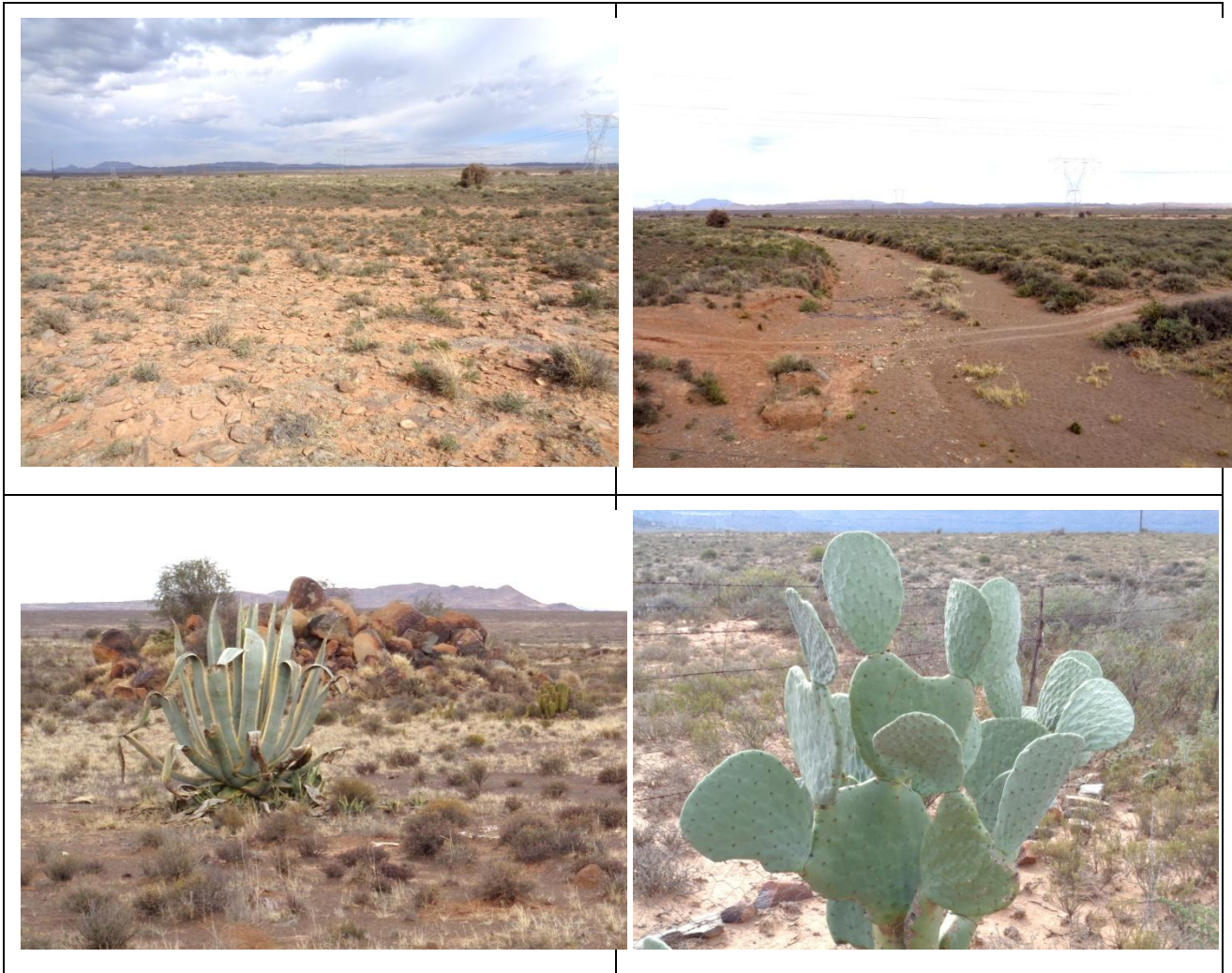


Photo 11 Eastern Upper Karoo (top left) and a dry streambed in the vicinity of the Gamma substation (top right). Two conspicuous alien species found in the area, namely *Agave americana* (bottom left) and *Opuntia robusta* (bottom right).

4.2 Species of Conservation Concern

Species of Conservation Concern expected to occur along the proposed power line route are listed in Appendix A (information obtained from Ismail Ebrahim of CREW, online Red List of South African Plants, Nick Helme and Jan Vlok). The majority of these species are found in the rockier/gravelly areas of the western part of the study area, and only three in the central and eastern parts. Botanical centres of endemism such as the Roggeveld Escarpment and the Nuweveld Mountains west of Beaufort West, will not be affected by the power line. Quartz patches,

which are typically found in the Little Karoo and Knersvlakte, are often described as a habitat type extremely rich in small succulents and insects. These patches are believed to be caused by silica that seeped into cracks in the shale millions of years ago (Esler *et al.* 2010). No quartz patches are known or have been recorded along the route, although gravelly areas with a fair number of succulents are found between the R354 and Klipfontein se Berg, and at Merweville.

In a vegetation study near Beaufort West, Todd (2003) compared species richness within several habitat types and found that dolerite hills, shale gravel hills and drainage lines had significantly higher species richness than calcrete and sandy plains. In his study about a quarter of the species found on rocky hill are unique and not found elsewhere. Therefore, a significant section of the power line in the central part (from Merweville to Nelspoort) is expected to have a lesser impact on plant diversity than in the more hilly western and eastern parts.

4.3 Protected areas and critical biodiversity areas (CBA's)

The Karoo National Park, located northwest of Beaufort West, is the only formal conservation area in the eastern part of study area encroached by the proposed power line. The proposed line runs past the southern boundary of the Park (just north of the N1), and does not cross it. It is uncertain if it will impact on future initiatives of the Park, such as further expansion towards the N2. The proposed power line runs through the Steenbokkie Private Nature Reserve, located a few kilometres east of Beaufort West. The latter has no formal conservation status and comprises mainly a guest farm offering tourist accommodation, game viewing, hiking, hunting and mountain biking.

In the western part of the study area, the line runs through the recently established Spitzkop protected environment, which is also mapped as a critical biodiversity area (see Maps 7 & 9). Spitzkop is a 7639 ha area, which form part of the CapeNature stewardship programme. The latter facilitates conservation on privately owned land through agreements between the landowners and CapeNature. It must be noted that the route follows the same route as an existing power line and gravel road through the Spitzkop area.

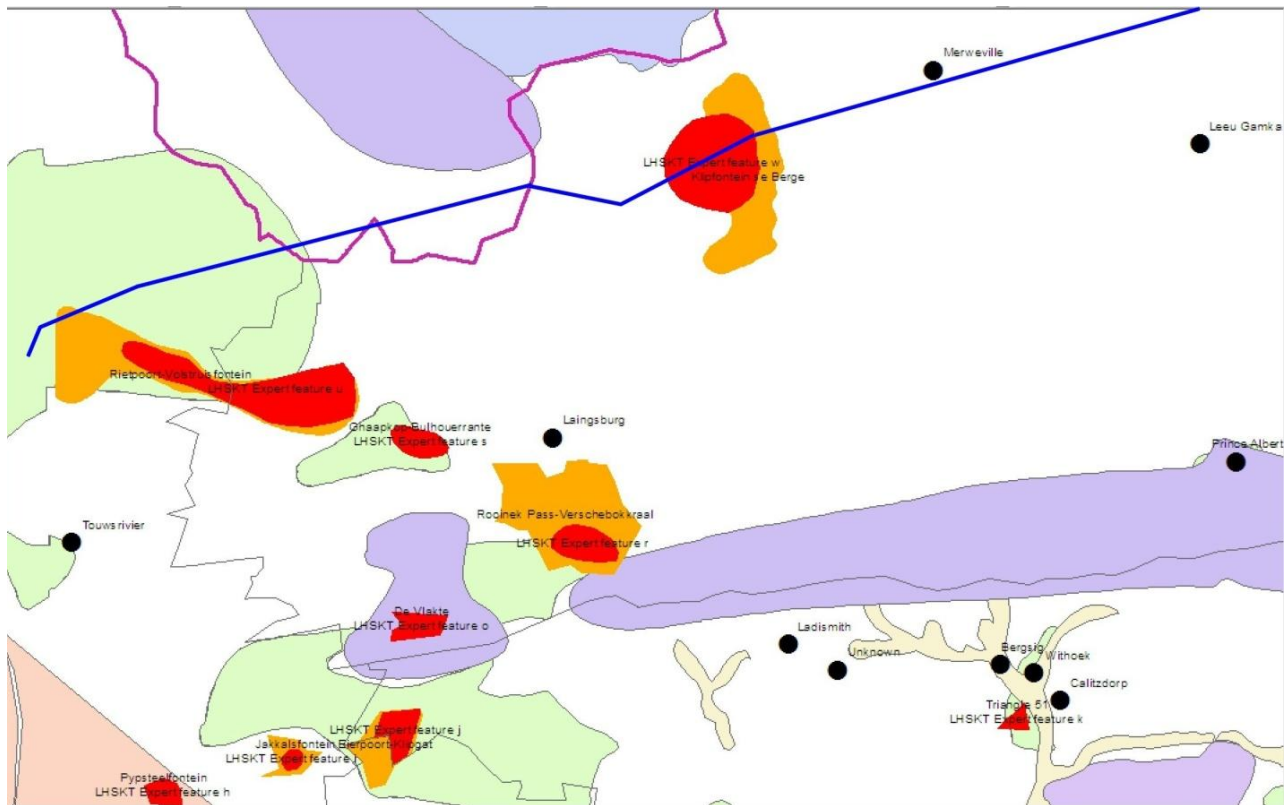


Map 7 Location of the Spitzkop protected environment (large yellow polygon), located 80 km northeast of Kappa in Koedoesberge-Moordenaars Karoo.

The biodiversity assessment for the Central Karoo District, including the north-eastern portion of the Cape Winelands District, was designed to identify an efficient set of critical biodiversity areas (CBA's) and ecological support areas (ESA's) that meet the targets for the underlying biodiversity features in areas with least conflict with other activities (Skowno *et. al.* 2009). Of critical importance is that these areas are identified in order to facilitate the functioning of ecological processes (both currently and in the face of climate change) which are required to ensure that the biodiversity features persist in the long term (Skowno *et. al.* 2009). These areas include high priority unfragmented landscapes, riparian corridors, areas of high topographical variability, south-facing slopes and kloofs. Like the existing lines, the proposed power line is expected to largely avoid the steeper slopes and mountains. The crossing of numerous seasonal rivers is however unavoidable.

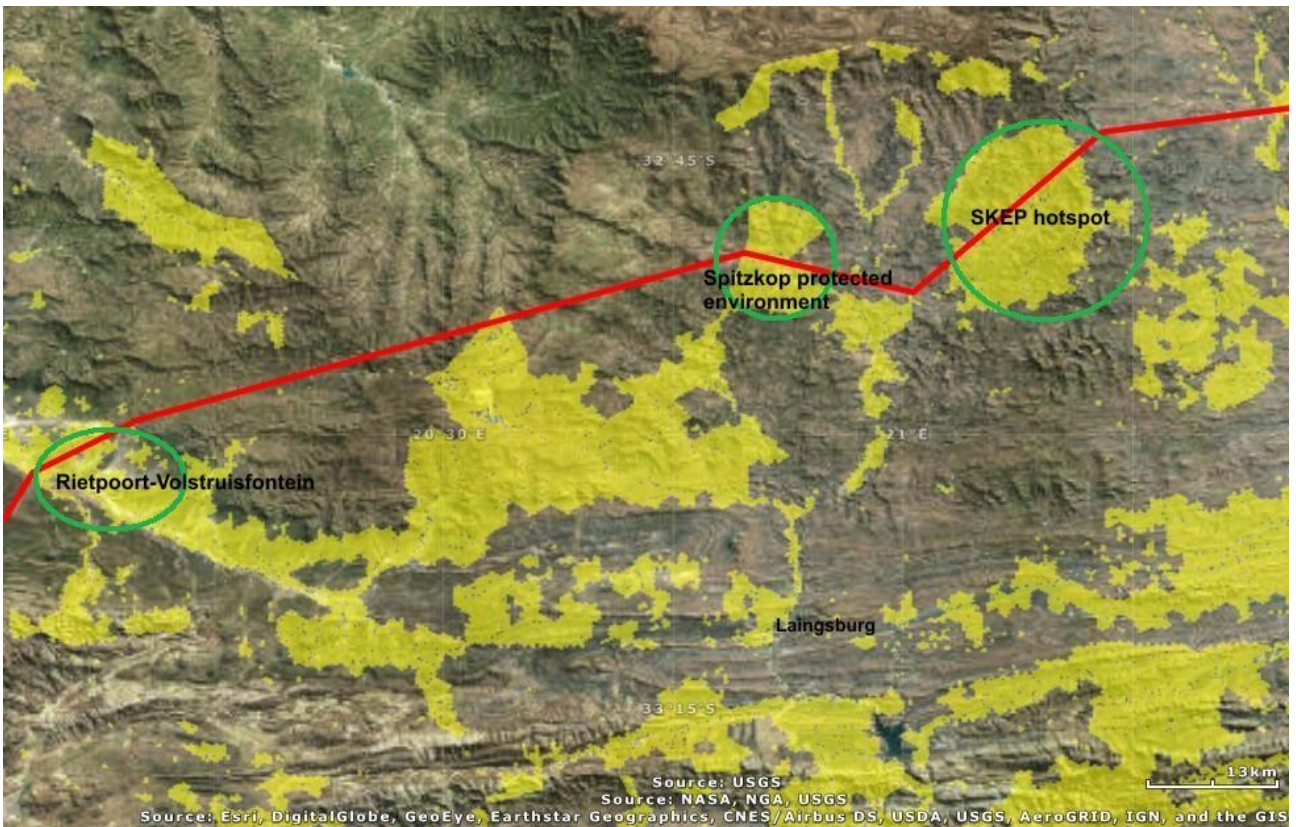
CBA's incorporate areas that need to be safeguarded in order to meet national biodiversity thresholds; areas required to ensure the continued existence and functioning of species and ecosystems; and important locations for biodiversity features or rare species (Skowno *et. al.* 2009). ESA's, on the other hand, are supporting zones required to prevent the degradation of CBA's and Protected Areas. Two biodiversity hotspots have been identified during the SKEP initiative in the western part of the study area, one of which (i.e. Klipfontein se Berg) is crossed by the proposed power line (see Map 8). The existing power lines actually bypass Klipfontein se Berg to the north and it is assumed that the new line will follow a similar route close by. Gravelly areas like those

associated with Klipfontein se Berg are home to the *Tanquana* vygie, a regional endemic genus. It is important that construction work in this area avoids the gravelly/rocky areas as far as possible.

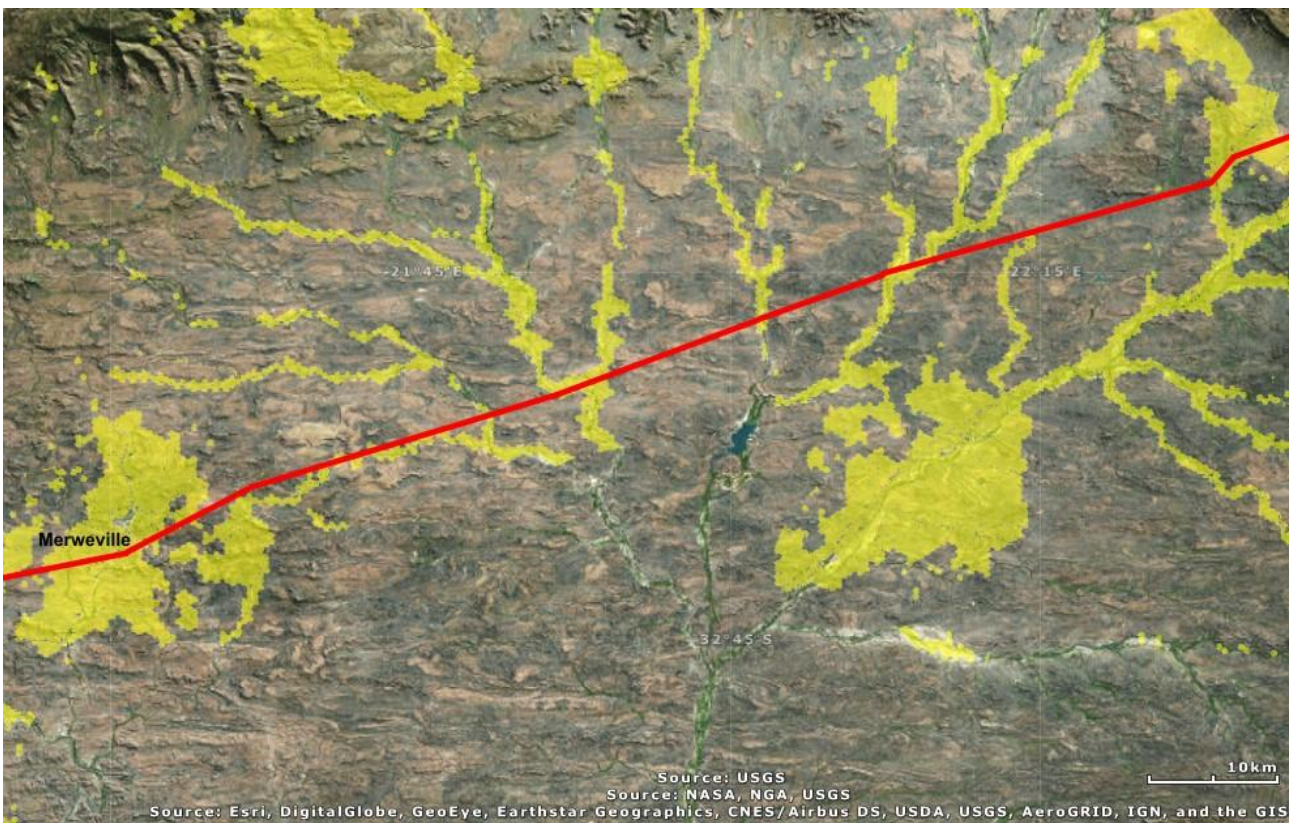


Map 8 Biodiversity hotspots in the western part of the study area (map supplied by Dr Philip Desmet). The proposed power line (dark blue line) cuts across the large circular SKEP hotspot northeast of Laingsburg. The red areas are previous SKEP identified areas of interest, which are spatially very general. The orange areas are the most recently mapped areas and therefore more accurate.

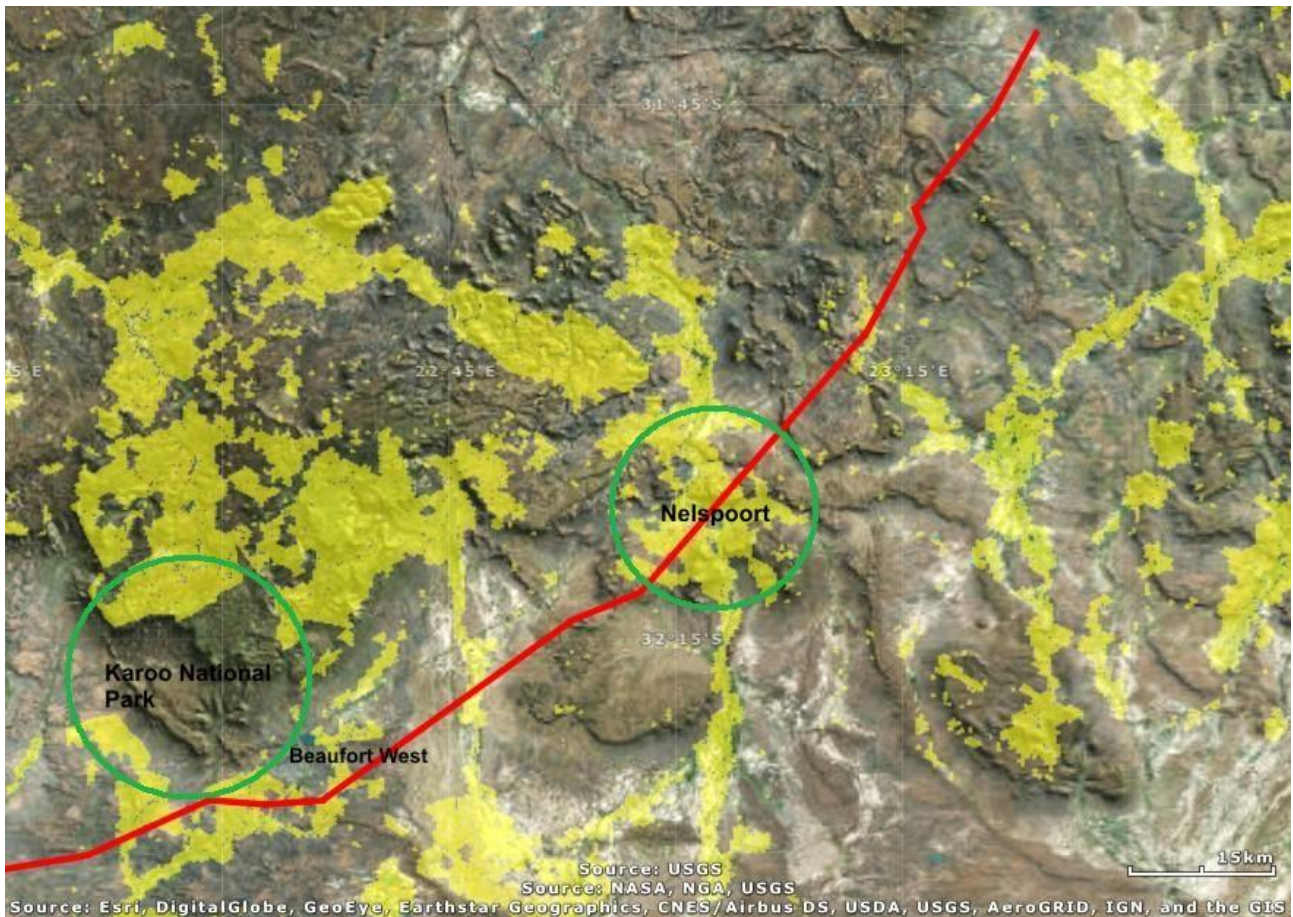
An approximately 17 km section of the power line runs through the initially mapped SKEP hotspot area (see Map 1), which has been incorporated in a CBA between the R354 and Merweville. SKEP hotspots were initially identified during the SKEP initiative (Driver *et al.* 2003). Essentially all the significant rivers crossed by the proposed power line are considered to be priority rivers according to the National Protected Areas Expansion Strategy (NPAES) freshwater priorities and were classified as either critically endangered or endangered rivers. They are therefore indicated as CBA's in the Central Karoo District CBA network (see Maps 9-11). The crossing of these CBA's, which run in a roughly north-south direction across the study area, is therefore unavoidable. The impact however can be mitigated by avoiding or minimising the positioning of pylons inside the riparian zones. Where the floodplains are too wide these cannot be avoided though.



Map 9 Critical Biodiversity Area (CBA) map of the western section of the proposed power line route (red line). The CBA areas are shown in yellow.



Map 10 Critical Biodiversity Area (CBA) map of the central section of the proposed power line route.



Map 11 Critical Biodiversity Area (CBA) map of the eastern section of the proposed power line route.

4.4 Land use and Disturbance

Mainly grazing and to a much lesser extent cropping are the main land-uses in the study area. As can be observed on the Google Earth photos, the Karoo veld along the entire route of the proposed power line is in a largely untransformed state. Experts on the Karoo flora, such as Jan Vlok, Richard Dean and Sue Milton, have noted that many areas in the Karoo still have a high vegetation cover, but that species composition has altered significantly due to overgrazing (Skowno *et. al.* 2009). It could be argued that these areas contribute little to the biodiversity of the region, and that many more habitat types are under threat (Skowno *et. al.* 2009).

Disturbances noted along the route include poor farming practices, overgrazing and associated erosion problems, farm roads, disturbances (spoiling and earthworks) caused by road works (noted along the R354), off-road vehicle activities (south of Beaufort West) and alien infestation (mainly along rivers and areas to the south and east of Beaufort West). The existing power lines also contribute to the impact on Karoo vegetation, through continuous maintenance activities. Skowno *et. al.* (2009) mapped two large areas east of Beaufort West which are severely degraded, due to soil erosion and a reduction in plant cover. Upon inspection of one of these areas it was found that the 'degraded' area comprises a large floodplain covered by a hard protective soil crust (pers.

obs.). Its degradation may thus have been overestimated. The proposed power line does not encroach significantly onto the mapped degraded areas.

Van der Merwe *et al.* (2008) noted that inadequate farming practices, due to lack of infrastructure such as fencing, pose a serious threat to the vegetation. Esler *et al.* (2006) further added that “although damage can happen fast, recovery in the Karoo is very slow, as it depends mainly upon unpredictable rainfall events”. Although a substantial portion of the Succulent Karoo biome (in the south-western part of study area) is at risk from overgrazing, only 5% has been irreversibly transformed (Driver *et al.* 2003). Livestock grazing, a land-use that dominates 90% of the Succulent Karoo, is however compatible with biodiversity conservation if managed properly (Driver *et al.* 2003). Presently about 12% of the Karoo district’s ecosystems are transformed or degraded, with mining, agriculture and urbanization the main reasons of biodiversity loss (Skowno *et al.* 2009). Recently, the prospects of uranium mining and shale gas exploration have also come under the spotlight.

5 DISCUSSION

Depending on the amount of maintenance required in the long term on the power line, the impact on biodiversity is expected to manifest itself mainly during the construction period. The latter will involve the clearing of veld required for the pylon footprints, as well as the establishment of access roads (informal tracks) to the footprints. The pylon footprints are roughly 400 m apart. It was previously noted that the proposed power line will follow the same route of existing power lines. Existing roads and tracks can therefore be used to access the proposed route. However, a track along the new route will still be needed in order to allow the depositing or stringing of pylon infrastructure and cables. Given the fact that the vegetation types affected by the proposed power line are still well represented in the area, the impact on vegetation type *per se* is of a lesser concern. Disturbance around the pylon footprints can be contained by means of temporary demarcation (fencing).

Concern is expressed where the proposed power line crosses biodiversity hotspots, CBA’s and protected areas. These areas cannot be easily avoided, such as the numerous north-south trending river courses that will need to be crossed. The impact can be mitigated by not allowing any construction work (pylons footprints) inside the riparian zones and restricting access through the CBA’s to existing farm roads as far as practically possible. This can only be enforced during the determination of the exact alignment prior to the construction phase. A biodiversity specialist must be appointed to advise during this phase of the project. With regards to the large CBA’s (Klipfontein se Berg and Spitzkop) between the R354 and Merweville, and at Nelspoort, it is recommended that gravelly areas, which contain a higher diversity of succulents and bulbs, be avoided under the supervision of a suitably experienced botanist. In order to avoid these areas by

diverting the power line around the southern or northern sides of the CBA's may in all likelihood increase the impact since inaccessible areas will need be entered away from existing access roads. The proposed route follows the same route as existing power lines through these areas. Where the power line crosses riverine CBA's, it is recommended that the line crosses the rivers at a narrow point and avoid the floodplains as far as possible. Disturbance of the riparian vegetation and protective soil crust in these areas will exacerbate erosion problems.

Karoo soils are susceptible to erosion and take decades to recover if allowed to rehabilitate. In undisturbed natural veld there are two natural features that protect the soil and enrich them, namely the biogenic crust and plant litter mulch (Jacobs & Jangle 2008). These protect the soil against erosion and provide the ideal conditions for seeds to germinate. Disturbance and reduction of vegetation cover lead to destruction of the biogenic crust and subsequent erosion (Jacobs & Jangle 2008). Plant litter also slows the water flow and allows for infiltration. Therefore, by minimising the footprint areas and access roads for the power line, disturbance of soil will be minimised. Unless the created access roads can be closed off permanently and rehabilitated, road maintenance and erosion control will be important in the long term, especially in steep and riverine areas. Where tracks are needed on steep slopes, permanent concrete strips or berms are recommended to curb erosion (see Photos 12 & 13).

Probably of a lesser concern would be the invasion of disturbed areas by invasive species. Invasive plants in the Karoo are mainly annuals that were brought into the region with fodder from other parts of the world, and of which many have been naturalised over the centuries (Van der Merwe *et al.* 2008). Disturbed areas around water points and feeding areas are usually invaded by *Prosopis glandulosa* (Van der Merwe *et al.* 2008). *Prosopis glandulosa* was observed in the riverine areas (Southern Karoo Riviere) directly south of Beaufort West. Invasive cacti species, such as *Opuntia elata*, *O. robusta*, *Echinopsis schickendantzii* and *Cylindropuntia fulgida* var. *mamillata* which were observed to the south and east of Beaufort West, can easily spread along the power line route as parts can break off and spread by sticking to the wheels of construction vehicles.

A useful mitigation measure, but with a financial implication, would be to propose biodiversity offset areas for the sections where the proposed power line passes through protected areas, such as the Spitzkop protected environment (7 km). The offset area can be determined by multiplying the footprint area (obtained from the servitude width of the power line and the length of the section passing through the protected area) with ten. Such offset areas can then be obtained or bought from the landowner(s) and formally conserved. It is normally recommended that offset areas be obtained in areas similar to that where loss in biodiversity is expected.



Photo 12 Concrete track below an Eskom line east-east of Merweville.

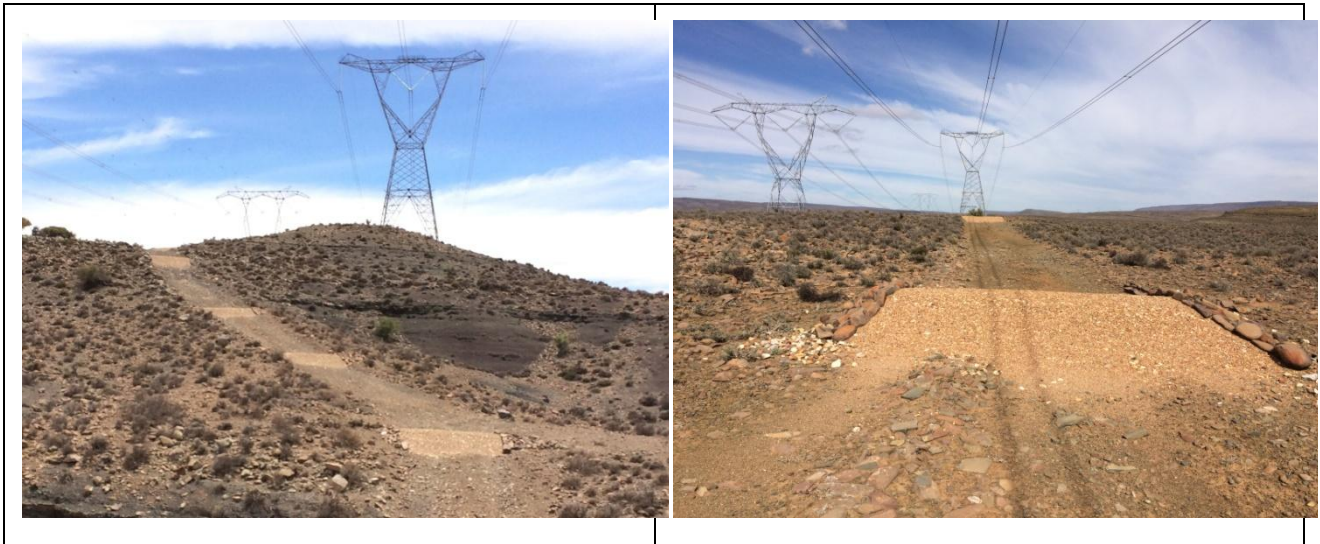


Photo 13 Erosion control measures (berms) in Gamka Karoo (SKEP hotspot).

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APPENDIX A

Species of Conservation Concern expected to occur along the proposed power line route.

Species of Conservation Concern	Red status	Distribution in study area
<i>Eriocephalus grandiflorus</i>	Rare	Koedoesberge-Moordenaars Karoo & Central Mountain Shale Renosterveld
<i>Euryops zeyheri</i>	Critically Endangered, possibly extinct	Southern Karoo Riviere, Gamka River south of Beaufort West
<i>Phymaspermum thymelaeoides</i>	Currently not threatened, but shale gas extraction a possible future threat	Koedoesberge-Moordenaars Karoo & Upper Karoo Hardeveld
<i>Calobota elongata</i>	Vulnerable	Tanqua Karoo
<i>Lotononis venosa</i>	Vulnerable	Koedoesberge-Moordenaars Karoo & Central Mountain Shale Renosterveld
<i>Cleretum lyratifolium</i>	Rare	Tanqua Karoo & Koedoesberge-Moordenaars Karoo
<i>Didymaotus lapidiformis</i>	Vulnerable	Tanqua Karoo & Tanqua Wash Riviere, recorded in the gravelly areas close to the Kappa substation
<i>Drosanthemum crassum</i>	Near Threatened	Tanqua Karoo
<i>Octopoma nanum</i>	Vulnerable	Tanqua Karoo, Tanqua Wash Riviere & Koedoesberge-Moordenaars Karoo
<i>Peersia macradenia</i>	Local endemic	Tanqua Karoo & Koedoesberge-Moordenaars Karoo
<i>Pleiospilos bolusii</i>	Vulnerable	Gamka Karoo, gravelly flats in Beaufort West area
<i>Ruschia karrooica</i>	Local endemic	Gamka Karoo, Klipfontein se Berg
<i>Tanquana archeri</i>	Vulnerable	Koedoesberge-Moordenaars Karoo
<i>Adromischus humilis</i>	Rare	Gamka Karoo, Klipfontein se Berg
<i>Adromischus phillipsiae</i>	Rare	Tanqua Karoo & Koedoesberge-Moordenaars Karoo
<i>Hoodia dregei</i>	Vulnerable	Gamka Karoo, Merweville to Beaufort West
<i>Geissorhiza karooica</i>	Near Threatened	Koedoesberge-Moordenaars Karoo & Central Mountain Shale Renosterveld
<i>Geissorhiza cantharophila</i>	Local endemic	Koedoesberge-Moordenaars Karoo & Central Mountain Shale Renosterveld
<i>Romulea eburnea</i>	Vulnerable	Koedoesberge-Moordenaars Karoo & Central Mountain Shale Renosterveld
<i>Lachenalia comptonii</i>	Local endemic	Tanqua Karoo, Koedoesberge-Moordenaars

Species of Conservation Concern	Red status	Distribution in study area
		Karoo & Central Mountain Shale Renosterveld
<i>Lachenalia longituba</i>	Vulnerable	Central Mountain Shale Renosterveld
<i>Lachenalia whitehillensis</i>	Near Threatened	Koedoesberge-Moordenaars Karoo & Central Mountain Shale Renosterveld
<i>Brunsvigia josephinae</i>	Vulnerable	Central Mountain Shale Renosterveld & Koedoesberge-Moordenaars Karoo?
<i>Haemanthus tristis</i>	Vulnerable	Tanqua Karoo & Tanqua Wash Riviere
<i>Cyanella alba</i> subsp. <i>minor</i>	Vulnerable	Tanqua Karoo
<i>Pauridia breviscapa</i>	Rare	Tanqua Karoo
<i>Trachyandra sanguinorhiza</i>	Rare	Tanqua Karoo

APPENDIX B

CURRICULUM VITAE

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DRIVERS LICENCE: Code EB

LANGUAGES: Proficient in speaking, reading and writing English and Afrikaans

QUALIFICATIONS: BSc (1988) University of Stellenbosch (majored in Botany and Zoology)
 BSc-Hons in Botany (1991) University of Stellenbosch
 MSc in Botany (1993) Nelson Mandela Metropolitan University
 PhD in Botany (2000) Nelson Mandela Metropolitan University

CAREER SUMMARY: **1997-2005:** Employed as an environmental specialist at **Planning Partners**, a multi-disciplinary consultancy specialising in town and regional planning, environmental planning and landscape architecture.
 Started **Mark Berry Environmental Consultants** in **June 2005**.

EXPERIENCE: **Environmental Impact Assessments (EIA's)** for residential, commercial, industrial, agricultural and civil engineering projects. EIA applications include the upgrading of Murray's Bay Harbour at Robben Island; an abalone farm near Saldanha; several bulk sewer and stormwater pipelines; the upgrading of access to and restoration of an archaeological site (Klipgat Cave) near De Kelders; the rehabilitation of the flood-damaged Koringlands River in Swellendam; a regional shopping mall in Hawston; low-cost housing projects; and cell phone masts in the Mossel Bay area.

With a PhD in the botanical field, I regularly undertake **biodiversity assessments** of fynbos, strandveld, renosterveld, thicket and karoo vegetation types as part of the EIA application process. For my PhD I have assessed the impact of informal settlement on the coastal vegetation and flora of the south-eastern Cape coastal zone.

Environmental Management Plans (EMP's) for a wide range of activities, including golf estates, residential and commercial developments, wineries, bulk municipal infrastructure, a harbour and several borrow-pits/quarries.

Environmental Control Officer (ECO) on construction sites, including residential and commercial developments, the upgrading of a harbour and other civil engineering projects.

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EXAMINER: Between 2000 and 2006 I have acted as examiner for the Board of Control for Landscape Architects (BOCLA), responsible for the setting up and marking of the Environmental Planning Section of exam paper.

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