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AVIFAUNAL AND ECOLOGICAL ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF A 400kV SUBSTATION AND POWER LINE FOR THE ACWA POWER KHANYISA IPP PROJECT, eMALAHLENI, MPUMALANGA

CONTENTS

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I, Dr LR Taylor, hereby declare that,

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Limitations of this Investigation

The report is based on an investigation within the area encompassed and does not include any long-term consideration of the biophysical attributes. Should additional information come to light subsequent to this report, such information may not be reflected in this report and hence Taylor Environmental reserves the right to amend the report, recommendations or conclusions at any stage of the project should such information become available.

Acknowledgements

ECOREX Consulting Ecologists (2010) are acknowledged for the baseline data sourced from their report entitled, “Terrestrial Ecology Assessment of the proposed Khanyisa Power Plant and Ash Pit, Witbank, Mpumalanga”.

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Executive Summary

An avifaunal and ecological assessment of the footprint for the construction of a 400kV substation and powerline on the Farm Klipfontein 322JS, Klippoort 334JS and Naauwpoort 335JS, eMalahleni, Mpumalanga was undertaken. The area of investigation extended from the footprint for the substation (25°57.685'S, 29°14.784'E) in a westerly direction for approximately 2.22km, as far as the footprint of the proposed ACWA Power Khanyisa IPP Project (25°58.217'S, 29°13.649'E).

The terms of reference and methodology included a description of the regional environment by examining Google Earth™ images for the area for the period 2001 to 2015, a literature review pertaining to the ecological status of the terrestrial environment in the area, including the listing of Red Data species for the flora and fauna, a description of the Present Ecological Status of the terrestrial environment of the footprint and impact zone for the Khanyisa 400kV substation and power line and an assessment of impacts, with mitigation measures and recommendations proposed.

In order to determine the broad ecological status of the environment along and adjacent to the footprint of the 400kV substation and power line, information for the area as stated in the Mpumalanga Biodiversity Sector Plan (MBSP) (MTPA, 2014) was examined. The significantly disturbed and fragmented nature of the area and its ecosystems is reflected in the fact that the area along and adjacent to the substation project is classified into a number of categories,, namely Heavily Modified, Moderately Modified, Other Natural Areas and CBA Optimal. The MBSP (MTPA, 2014) considers high impact industry to be permissible on heavily modified areas, but also considers quarrying, opencast mining, prospecting and underground mining to potentially compromise biodiversity objectives and thus only be permissible under certain conditions. Waterworks, sewage works, pipelines, canals and power lines are permissible. In terms of other natural areas, biodiversity objectives will be compromised by high impact industry, quarrying, opencast mining, prospecting, underground mining, waterworks, sewage works, pipelines, canals and power lines, and hence should thus also only be permissible under certain conditions. In terms of optimal CBAs, only waterworks, sewage works, pipelines, canals and power lines are permissible under certain conditions. In irreplaceable CBAs only waterworks and sewage works are permissible under certain conditions and excludes pipelines, canals and power lines.

Using the DWAF (2007) tool for the assessment of a Wetland Index of Habitat Integrity (Wetland-IHI), Emross Consulting (2015) classified the wetland seepage area, immediately south of the substation footprint to be Largely to Seriously Modified.

It is clear from Google Earth™ images for the period from 2001 to 2015 that land-use and changes in the vicinity of the substation project footprint over the last 14 years, have been associated with agricultural activity and surface mining. These activities support the classification of the immediate area around the substation project footprint by MTPA (2014) as predominantly Moderately to Heavily Modified. Curiously, the northern and eastern boundaries adjacent to the substation footprint are classified as a CBA Optimal area and two small areas crossing directly over the powerline footprint are classified as Other Natural Areas.

Thirty plant species or taxa were identified and/or collected during the field surveys, one of which, Hypoxis sp, is of conservation importance. Seven of the species were alien plants. The mid-winter conditions and recent burning of the area were significant limiting factors in terms of the diversity of species present at the time. The footprint of the ACWA Power Khanyisa IPP substation is characterised by Transformed Forestry (Black Wattle, Acacia mearnsii) (9.15ha for the total footprint) along its northern border adjacent to the tarred road, Secondary Grassland (5.51ha) in the footprint itself and a wetland to the south (9.9ha). The footprint of

the power line is significantly transformed by anthropogenic activity and is represented by degraded secondary grassland (18.45h), an area transformed by mining activity (5.38ha) and transformed forestry (Black Wattle, Acacia mearnsii and Saligna Gum, Eucalyptus grandis) (a total of 9.15ha). Given the above and the classification of the substation project footprint by MTPA (2014) predominantly as Moderately Modified (old lands) (67.66ha), Other Natural Areas (total area in the region of 434.842ha) and CBA Optimal (a total area in the region of 965.467ha), the footprint, from the point of view of Present Ecological Status (PES) may be described as being Moderately Modified, where a loss and change in habitats, biota and ecosystems has occurred.

Fifty species of birds were identified for the area on 16th June 2015, 12 of them not on the expected list. With the latter included, the observed number represents 32% of the expected number. None of the six conservation-important species of birds were identified on site during the survey. Although no mammals were directly observed during the surveys, there is extensive evidence throughout the site of the presence of either the Meerkat, Suricata suricatta (Least Concern; IUCN, 2015), or the yellow mongoose, Cynictis penicillata (Least Concern, IUCN, 2015), as a number of areas with an extensive network of burrows or warrens were found. The sandy soil and grassland-dominated flora on site represents ideal habitat for these animals. Scats of the African Porcupine (Hystrix africaeaustrlis) and possibly the Black-backed Jackal (Canis mesomelas) or Serval (Leptailurus serval) (Near Threatened) were found along the 400kV power line footprint. No reptiles or amphibia were observed along the footprint during the surveys.

The ecological sensitivity varies along the substation project footprint, from Medium-Low for the wetland adjacent and to the south of the substation area, Medium for the substation area itself and Very low to Medium along the linear footprint for the 400kV power line in a westerly direction from the substation. Hence, depending on the position along the footprint for the substation project, ecological functioning varies from Moderately to Seriously and irreversibly Modified.

The significance of the potential impact of the deterioration of the PES of the degraded grasslands along the 400kV power line may be considered to be low after mitigation. The significance, on the other hand, of the deterioration of the PES of the Secondary Grasslands in the footprint of the substation may be considered to be medium after mitigation. The significance of the impact of the construction of the substation on the CBA Optimal area, on the northern border of the substation footprint, may be considered to be of low significance. The significance of the potential impact of the loss of conservation-important flora may be considered to be medium after mitigation. The impact of the increased invasion by alien plant species as a result of construction at the substation and along the footprint for the 400kV power line may be considered to be of low significance. The impact of the construction of the substation on the wetland seepage area may be considered to be of medium significance after mitigation.

The impact of loss of habitat for conservation-important fauna may be considered to be of low significance and the disruption to their life-history cycles may be considered to be of low significance. The impact of the disruption to fauna due to construction activities may be considered to be of low significance.

Mitigation measures and recommendations are proposed.

1. INTRODUCTION

Aurecon SA (Pty) Ltd contracted Taylor Environmental CC to undertake an avifaunal and ecological assessment of the footprint for the pproposed construction of a 400kV substation and power line for the ACWA Power Khanyisa IPP Project, eMalahleni, Mpumalanga (hereinafter referred to as the *substation project*). The area of investigation extended from the footprint for the sub-station (25º57.685'S, 29º14.784'E) in a westerly direction for approximately 2.22km, as far as the footprint for the proposed Khanyisa Power Plant (25º58.217'S, 29º13.649'E) (Figure 1).

Key: Orange area: approximate footprint for the 400KV power line; Purple area: footprint for the Khanyisa electrical sub-station.

Figure 1. The footprint for the substation project

The study area is found within *Eastern Highveld Grasslands* (GM12, *Mesic Highveld Grasslands*), with the vegetation dominated by short dense grassland, including small scattered rocky outcrops with wiry sour grasses and some woody species.

The area is at an altitude of approximately 1540mamsl and is predominantly flat with undulating plains. The mean annual precipitation for eMalahleni is 636mm (monthly range of 6 to 117mm) and the mean monthly temperature varies between a minimum of 1.0ºC and a maximum of 24.5ºC (www.meoweather.com/history/SouthAfrica/).

The geology of the area is predominantly Ecca Group arenite, shale and coal of the Vryheid Formation. The land type is Ba4 and the soils are red, yellow and greyish with a low to medium base status (www.agis.agric.za).

The dominant land-use within the immediate vicinity includes agricultural cultivation, surface mining and industry and rural residential development.

2. TERMS OF REFERENCE

The terms of reference and methodology for the avifaunal and ecological assessment for the substation project were as follows:

(1) Describe the regional environment by examining Google Earth™ images for the area,
(2) Conduct a literature review pertaining to the ecological status of the terrestrial environment in the area, including the listing of Red Data species for the flora and fauna,
(3) Describe the Present Ecological Status of the terrestrial environment of the footprint and impact zone for the substation project by (i) conducting a field survey, (ii) locating conservation-important biota, (iii) assessing the conservation importance of the area and (iv) providing an ecological sensitivity map.
(4) Assess impacts, propose mitigation measures and make recommendations.

3. LITERATURE REVIEW

3.1. Characteristics and the conservation status of the area

3.1.1. Flora

The Graminoids found in the Eastern Highveld Grasslands include *Aristida aequiglumis* (d[1]), *A. congesta* (d), *A. junciformis* subsp. g*alpini* (d), *Brachiaria serrata* (d), *Cynodon dactylon* (d), *Digitaria monodactyla* (d), *D. tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E plana* (d), *E racemosa* (d), *E sclerantha* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Setaria sphacelata* (d), *Sporobolus africanus* (d), *S. pectinatus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *T. rehmannii* (d), *Alloteropsis semialata*

[1] Dominant

subsp. *eckloniana, Andropogon appendiculatus, A schirensi, Bewsia biflora, Ctenuim concinnum, Diheteropogon amplectens, Eragrostis capensis, E. dummiflua, E. patentissima, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyruim sanguineum, Setaria nigrirostris* and *Urelytrum agropyroides (*Mucina and Rutherford*,* 2006 *In* Environomics, *undated*).

Herbs include Berkheya setifera (d), *Haplocarpha scaposa* (d), *Justicia anagalloides* (d), *Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gifillani, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H caespititium, H. callicomum, H. oreophilum, H. caespititium, H. oreophilum, H rugulosum, lpomoea crassipes, Pentanisia prunelloides subsp. latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala* and *Wahlenbergia undulata*.

Geophytic herbs include *Gladiolus crassifolius, Haemanthus humilis* subsp. *hirsutus, Hypoxis rigidula* var. *pilosissima* and *Ledebouria ovatifolia and the* succulent herb *Aloe ecklonis. Low shrubs include Anthospermum rigidum* subsp*. pumilum and Stoebe plumosa.*

In a study on a site directly adjacent to the western point of the footprint for the substation project, ECOREX (2010) recorded 65 indigenous and nine alien species of plants on the site in November 2010. The authors divided the site into five communities, including *Fuirena-Helichrysum* Wetland, *Seriphium-Imperata* Secondary Grassland, *Themeda-Tristachya* Untransformed Grassland, Transformed Grassland and Transformed Land. Eighty-five species of plants, including 14 conservation-important ones (Section 3.1.2) and nine alien ones, were listed in preparation for the present study (Appendix A).

The Mesic Highveld Grasslands are made up of highly productive sourveld grasslands characterised by long-lived grasses that favour re-sprouting, and other plants that show a tendency to store carbohydrates in specialised underground storage organs. Plants withstand above-ground disturbance by being long-lived with only occasional replacement from seed. These grasslands are adapted to a climate characterised by high summer rainfall (700 – 1 200 mm mean annual precipitation), combined with warm summer temperatures and cool to cold winters with a moderate to high incidence of frost. They occur at mid-altitudes (1 300 – 1 800 m) in varied landscapes that include extensive flat or undulating plains broken by low hills and *tafelbergs*, rocky outcrops, steep boulder-strewn slopes and deep river valleys (SANBI, 2013). They occur on soils that are generally deep, fertile and free-draining but can have impervious layers of hardpan or ‘ouklip’ (impervious soil layers, often infused with

minerals such as calcium carbonate or iron oxide). The diversity of soil types is influenced by the underlying geology, which includes base layers of sedimentary rock (shales, mudstones and sandstones), cut through by dykes and ridges of dolerite, quartzite and gabbro.

The main issues, vulnerabilities or pressures include any activity that disrupts the hydrology such as reducing vegetation cover, disrupting the soil profile, and modifying water runoff or filtration through the soil. The main concerns in these grasslands arise from the expansion of activities such as coal-mining, commercial agriculture and unplanned urban development.

The signs specific to a healthy Mesic Highveld Grasslands include (1) the presence of numerous geophytes, (2) a high diversity of flowering plants other than grasses, (3) low frequency or occurrence of *Hyparrhenia* and related grasses, (3) intact, healthy wetlands and river ecosystems and healthy populations of grassland animals, especially birds and butterflies.

The original extent of Eastern Highveld Grasslands was 1 232 256ha, of which only 432 278ha (35%) remains natural today. The target for protection is 24%, with only 12.99% presently being protected. Hence, the present protection status is defined as poorly protected, making the Eastern Highveld Grassland Vulnerable in terms of threat status. The grassland can also be classified as near-endemic.

ECOREX (2010) determined that the *Transformed Grassland* and *Secondary Grassland* vegetation types were of Low conservation value and the *Untransformed Grassland* of Medium-High importance for conservation-important plants.

In order to determine the broad ecological status of the environment along and adjacent to the footprint of the substation project, information for the area as stated in the Mpumalanga Biodiversity Sector Plan (MBSP) (MTPA, 2014) was examined. The significantly disturbed and fragmented nature of the area and its ecosystems is reflected in the fact that the area along and adjacent to the substation project is classified into a number of categories (Table 1; Figure 2), namely Heavily Modified, Moderately Modified, Other Natural Areas and CBA Optimal.

Table 1. The classification of the area along and adjacent to the Khanyisa substation project

Footprint of Substation Project (from substation end)	
On footprint	**Adjacent to footprint**
CBA Optimal (965.467ha) and Moderately Modified - Old Lands (47.954ha)	Other Natural Areas (55.564ha)
Moderately Modified - Old Lands (47.954ha)	-
Other Natural Areas (434.842ha)	
Other Natural Areas (434.842ha)	Moderately Modified - Old Lands (19.706ha) and Heavily Modified (351.14ha)
Other Natural Areas (434.842ha)	
Heavily Modified (3.743ha)	Other Natural Areas (434.842ha)

The Mpumalanga Biodiversity Sector Plan (MBSP) (MTPA, 2014) considers high impact industry to be permissible on *heavily modified* areas, but also considers quarrying, opencast mining, prospecting and underground mining to potentially compromise biodiversity objectives and thus only be permissible under certain conditions. Waterworks, sewage works, pipelines, canals and power lines are permissible. In terms of other natural areas, biodiversity objectives will be compromised by high impact industry, quarrying, opencast mining, prospecting, underground mining, waterworks, sewage works, pipelines, canals and power lines, and hence should thus also only be permissible under certain conditions. In terms of *optimal CBAs*, only waterworks, sewage works, pipelines, canals and power lines are permissible under certain conditions. In *irreplaceable CBAs* only waterworks and sewage works are permissible under certain conditions and pipelines, canals and power lines are not permissible.

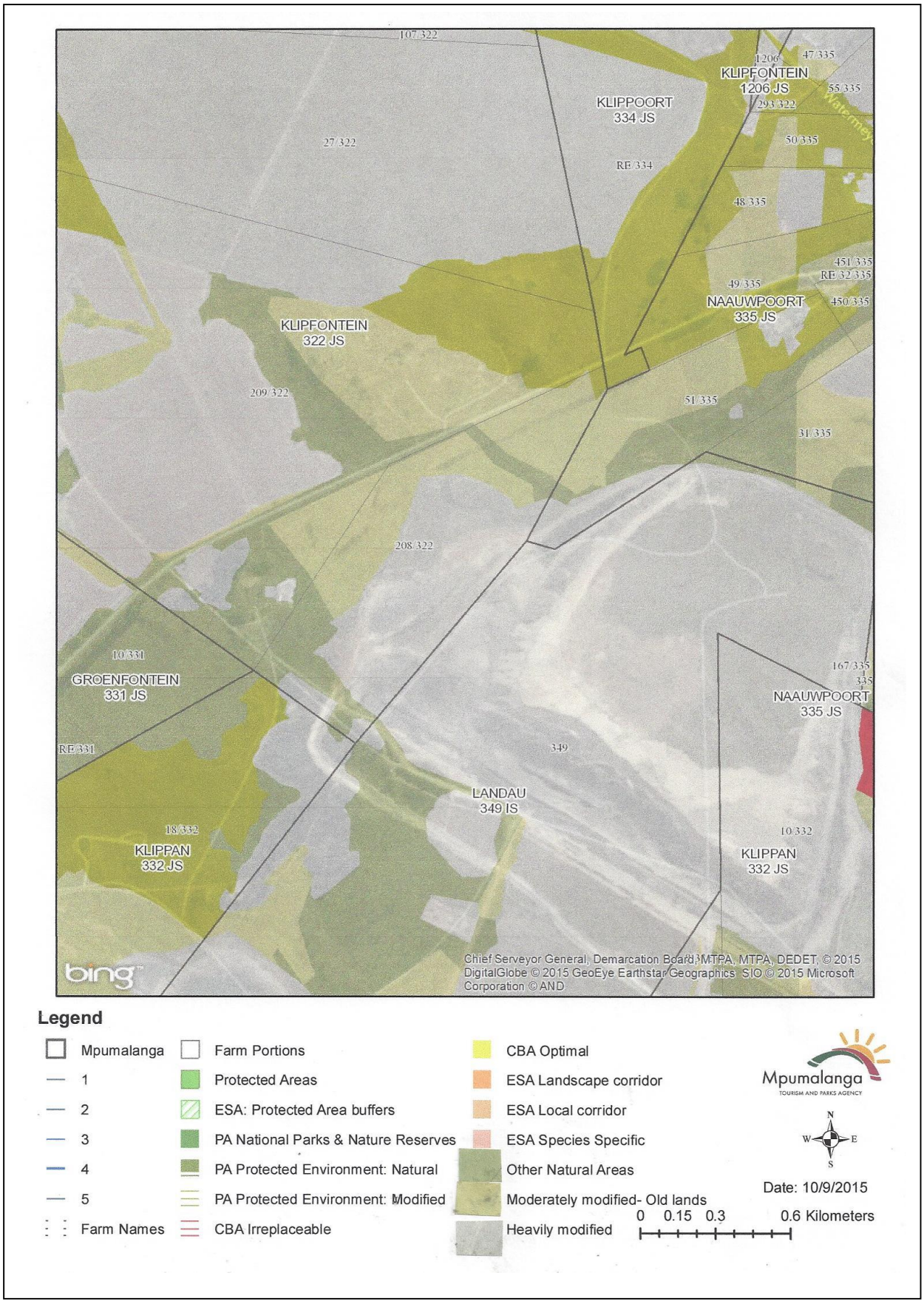

Figure 2. The MBSP classification for the site of the substation project

3.1.2. The conservation-important plants potentially found in the area of the substation project.

Using the Mpumalanga Tourism and Parks Agency (MTPA) database for conservation-important biota for topographic grid references 2529CC, 2529CD, 2629AA and 2629AB, representing the region in which the site and the Farms Groenfontein 331 JS, Klippan 332 JS, Klipfontein 322 JS and Naauwpoort 335JS are situated, 14 species of conservation-important plants may potentially occur on the site (Table 2, Figures 3 to 14).

However, in most cases, the predominantly Moderately Modified status of the terrestrial ecosystems along the substation project footprint implies the probability of occurrence may be described as improbable (less than 5%) for most of the conservation-important plants mentioned.

Table 2. Conservation-important plants that may potentially occur in the area of thesubstation project

Common Name	Species Name	Conservation Status	Grid Reference & Farm	Likelihood along substation project footprint
	Callilepis leptophylla	Declining	2529CC (Blesboklaagte 296JS), 2529CD (Vaalbank 289JS), 2629AA (Blesbokfontein 38IS).	Possible, Other Natural Areas
River Lily Orange River Lily	*Crinum macowanii C. bulbispermum*	Declining	2629AA (Kromfontein 30IS), 2629AB (Steenkoolspruit 18 IS).	Improbable, wet conditions required.
	Frithia humilis	Endangered	2529CC (Elandsfontein 309JS, Kalbasfontein 284JS), 2529CD (Blauwpoort 335JS), 2629AA (Kleinkopje 15IS), 2629AA (Zaaiwater 11 IS).	Improbable, Moderately Modified and Other Natural Areas.
Bushman Poison Bulb	*Boophone disticha*	Declining	2529CD (Vaalbank 289JS), 2629AB (Steenkoolspruit 18 IS),	Improbable, Moderately Modified and Other Natural Areas.
	Brachycorythis conica ssp. transvaalensis	Endangered	2529CD (Townlands 287JS), 2629AB (Steenkoolspruit 18 IS).	Improbable, Moderately Modified and Other Natural Areas.
	Hypoxis hemerocallidea	Declining	2529CD (Vaalbank 289JS).	Probable, Moderately Modified and Other Natural Areas.

Common Name	Species Name	Conservation Status	Grid Reference & Farm	Likelihood along substation project footprint
	Anacampseros subnuda var. lubbersii	Vulnerable	2529CD (Rietfonten 314JS, Vaalbank 289JS)	Improbable, Moderately Modified and Other Natural Areas.
Olifants River Cycad	*Encephalartos lanatus*	Near Threatened	2529CD (Kalbasfontein 284JS)	Improbable, Moderately Modified and Other Natural Areas.
Common Pineapple Lily	*Eucomis autumnalis*	Declining	2529CD	Improbable, wet conditions required.
	Pachycarpus suaveolens	Vulnerable	2529CD	Improbable, Moderately Modified and Other Natural Areas.
	Habenaria schimperiana	Rare	2529CD (Rietfonten 314JS)	Improbable, Moderately Modified and Other Natural Areas.
	Habenaria bicolor	Near Threatened	2529CD	Improbable, Moderately Modified and Other Natural Areas.
	Elephantorrhiza obliqua	Data 10Deficient	2529CD (Vaalbank 289JS)	Improbable, Moderately Modified and Other Natural Areas.

Key: Improbable, <10% chance; Possible, 5 to 20% chance; Probable, 20 to 80% chance; Highly probable, 80 to 95% chance; Definite, >95% chance.

Figure 3. The Wild Daisy, *Callilepis leptophyla*

Description for *Callilepis*: Perrenials or shrublets. Leaves alternate, +- hairless with glandular hairs. Flowerheads solitary and pedunculate, radiate, with three rows of bracts;receptacle with boat-shaped scales. Ray florets female, white; disc florets fertile, 5-lobed purple. Fruit 3-angled and flattened, with a pappus of scale-like bristles. Plants are very poisonous and used in traditional medicine (Manning, 2009). Grassland or open woodland, often on rocky outcrops or rocky hill slopes (http://redlist.sanbi.org/species.php?species=2999-6).

Figure 4. The River (*Crinum macowanii*) and Orange River (*C. bulbispermum*) Lilies (After Manning (2009))

Description for *Crinum macowanii:* Perennial to 1.0m, channeled leaves, 20-160mm wide, and white to pale pink, funnel-shaped flowers, with a tube 30-110mm long; stamens arching downwards, black anthers, fruits strongly beaked. Rocky grassland near rivers (Manning, 2009).

Description for *Crinum bulbispermum*: Perennial to 1.0m, with channeled leaves to 110mm wide, and narrowly funnel-shaped white to pink flowers striped with red, with a tube 50-110mm long; stamens arching downwards, greyish or light brown anthers. Seasonal wetlands and along streams (Manning, 2009).

Figure 5. The Fairy Elephant's Feet (*Frithia humilis*)
(http://www.plantzafrica.com/plantefg/frithhum.htm)

Description for *Frithia humilis*: Minute plant, comprises a cluster of succulent, spirally arranged leaves, windowed at the tips. Stems reduced and during periods of drought the plants retract into the sandy soil. Flowers white with a yellow centre, sometimes tipped with light pink, 15-20 mm in diameter, borne singly on very short stalks or stalk-less, subtended by five unequal sepals, closely resembling the cylindrical leaves. The petals number 20-30 and usually have acuminate tips. Fruits delicate, spongy capsules resembling a barrel and open when wetted and close again when they dry out. Capsules become detached from the plants and break up shortly after ripening, releasing seeds.
(http://www.plantzafrica.com/plantefg/frithhum.htm)

Figure 6. The Bushman's Poison Bulb (*Boophone disticha*)
(http://www.plantzafrica.com/plantab/boophdist.htm)

Description for *Boophone disticha:* Deciduous bulbous plant with a thick covering of dry scales above the ground. The large, round heads on such short stems and appear to grow directly from the bulb, almost at ground level. Flowers vary from shades of pink to red and are sweetly scented. Pedicels elongate after flowering to form a large seed-head. This breaks off at the top of the scape and tumbles across the veld dispersing the seed. Greyish green leaves are erect, arranged in a conspicuous fan and produced after flowering. This spring-flowering species will flower even if it does not receive any water in winter. Bulbs very poisonous. *Boophone disticha* has many medicinal uses, for example the Bushman once used the poison for their arrows, and traditional healers use it to treat pain and wounds. (http://www.plantzafrica.com/plantab/boophdist.htm).

Figure 7. The Orchid, *Brachycorythis conica ssp. transvaalensis* (redlist.sanbi.org)

Description for *Brachycorythis conica ssp. transvaalensis*: Found in short, open grassland and wooded grassland, on sandy gravel overlying dolomite, sometimes also on quartzite, 1 000 to 1 705 m.

Figure 8. The Star Flower, *Hypoxis hemerocallidea* (www.bihrman.com)

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Description of *Hypoxis hemerocallidea*: Tuberous perennial plant with strap-like leaves and yellow star-shaped flowers. Leaves up to 400 mm long, neatly arranged one above the other in 3 ranks, broad, stiff and arching outwards with prominent ribs and tapering towards the tips. Lower surface is densely hairy with white hairs. Leaves appear above ground in spring before the flowers. Flowers are carried on 5 or 6 slender erect inflorescences, each carrying 5–13 bright yellow, star-shaped flowers with 6 tepals. Six free stamens arise from the base of the tepals with prominent anthers. The style is short and fat, carrying the robust stigma. The flowers are short-lived and close at midday. Flowers open sequentially from the base to the apex. Usually 1–3 flowers are open at the same time, thus encouraging cross-pollination. Large dark brown tuber is covered with bristly hairs, and is bright yellow when freshly cut. It has an unpleasant bitter taste. Tuberous rootstock is traditionally used to treat a wide variety of ailments (http://www.plantzafrica.com/planthij/hypoxishemero.htm).

Figure 9. The Love Plant, *Anacampseros subnuda var. lubbersii*
(http://www.djibnet.com/photo/suid-afrika/anacampseros-subnuda-var-lubbersii-flower-2352361336.html)

Description of *Anacampseros subnuda var. lubbersii*: A habitat specialist that is potentially threatened by mining and urban expansion.

Figure 10. The Olifants River Cycad, *Encephalartos lanatus*
http://www.plantzafrica.com/plantefg/encephlanat.htm

Description of *Encephalartos lanatus*: Slow growing small tree with stems usually about 1,5 - 2,5m long, and 25–30 cm in diameter. The young grey leaves are woolly and have a curved

apex. Mature leaves are greyish green and about 60–80 cm in length. Both male and female cones are densely woolly when young and become yellow with age. They are dioecious. Female cones are barrel-shaped, 25–30 cm long and 12–15 mm in diameter. Male cones are cylindrical, 25–30 cm long and 5–6 cm in diameter. *E. lanatus* sometimes sends out suckers at the base of the main stem. The mature seeds are yellow and fleshy.

Figure 11. The Common Pineapple Lily, *Eucomis autumnalis*
http://www.plantzafrica.com/plantefg/eucomisautum.htm

Description of *Eucomis autumnalis*: Deciduous, summer growing bulb. The bulbs are large (8-10cm diameter), ovoid in shape, and give rise to a rosette of large, broad, soft-textured, fleshy, wavy-edged leaves, about 12-35 cm long x 60-75 cm wide. The inflorescence is a dense cylindrical raceme on a stout stalk, crowded with up to ±125 starry yellowish-green flowers with a tuft of leaf-like bracts at the tip. The inflorescence pushes the overall height of the plant up to ±50-60 cm. After pollination, whilst the seeds are developing inside the swelling ovaries, the flowers turn green and the inflorescence remains decorative into autumn. The fruit is a tri-locular capsule containing shiny black rounded seeds. Although the bulb is toxic, *Eucomis autumnalis* is used medicinally in South Africa.

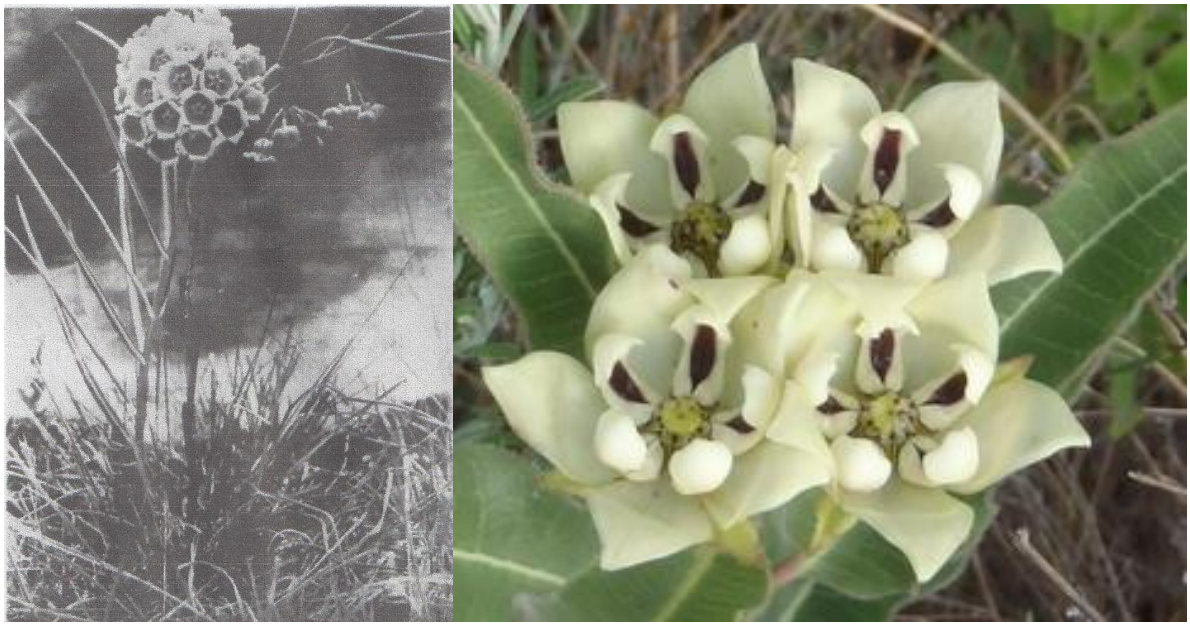

Figure 12. ***Pachycarpus suaveolens*** (Nicholas, A and Goyder, 1990) and (https://www.google.co.za/search?q=Photo+of+pachycarpus+suaveolens&tbm=isch&imgil=eb-MNw6kGMji5M%253A%253BBD3WN461cssvdM%25)

Figure 13. ***Habenaria schimperiana*** **and** ***H. bicolor.***

(www.ispotnature.org)

Figure 14. The Elephant Root, *Elephantorrhiza obliqua*
(Schmidt et al, 2002)

Description of *Elephantorrhiza obliqua*: Main stem herbaceous, ridged and unbranched, growing almost flat on the ground. Leaves twice compound 2-8prs pinnae, 4-13 prs leaflets. Leaflets large, broad and sides unequal. Leaflet base asymmetrical and square. Midrib and side vein prominent. Flowers in creamy white spikes. 35-60mm long. Fruit flat woody pod (Schmidt et al, 2002).

3.1.3. Fauna

3.1.3.1. Aves

ECOREX (2010) confirmed that 143 species of birds potentially existed in the area of the proposed power line and substation of the ACWA Power Khanyisa IPP Project, which is located directly adjacent to the western point where the 400kV power line footprint ends. It is likely, given the following, that the species listed for the power station may also be applied to the substation and power line project footprint:

- the close proximity of the power station site to the 400KV power line footprint;
- the similarity in habitat (open grassland on flat undulating plains with no rocky outcrops);
- similar anthropogenic activity (surface mining and infrastructure and agriculture); and

- the ubiquitous nature of avian species on a local scale, it is likely that the ECOREX (2010) identified 35 species during field surveys.

Species of conservation importance included the African Grass-Owl (*Tyto capensis*) (Vulnerable, NEMBA protected), African Marsh-Harrier (*Circus ranivorus*) (Vulnerable, NEMBA) and Lanner Falcon (*Falco biarmicus*) (Near Threatened).

A total of 151 species of birds were listed in preparation for this study (Appendix A), including eight conservation-important ones [African Grass-Owl (*T. capensis*), African Marsh-Harrier (*C. ranivorus*), Black Stork (*Ciconia nigra*), Broad-tailed Warbler (*Schoenicola brevirostris*), Lanner Falcon, Lesser Kestrel (*Falco naumanni*), Secretarybird (*Sagittarius serpentarius*) and Southern Bald Ibis (*Geronticus calvus*)]

3.1.3.2. Mammalia

ECOREX (2010) confirmed 15 species of mammals for the power station, including four Red Data or NEMBA Protected species [Aardvark (*Orycteropus afer*) (Near Threatened, Mpumalanga Nature Conservation Act), Bat-eared Fox (*Otocyon megalotis*) (Near Threatened, Mpumalanga Nature Conservation Act), Highveld Golden Mole (*Amblysomus septentrionalis*) (Near Threatened) and Serval (*Leptailurus serval*) (Near Threatened, NEMBA). The presence of four of the 15 species was noted during the field surveys. In this study 17 species of mammals were listed in preparation (Appendix A), including six conservation-important ones [Aardvark (*O. afer*), Bat-eared Fox (*O. megalotis*), Highveld Golden Mole (*A. septentrionalis*), Serval (*L. serval*), Oribi (*Ourebia ourebi*), Southern African Hedgehog (*Atelerix frontalis*)].

ECOREX (2010) confirmed 43 species of reptiles for the power station, none of which were observed on site during the field surveys. Three conservation-important species were listed, including the Coppery Grass Lizard (*Chamaesaura aenea*) (Vulnerable), Large-scaled Grass Lizard (*Chamaesaura macrolepis*) (Vulnerable) and Striped Harlequin Snake (*Homoroselaps dorsalis*). In this study the same list of species was prepared for the fieldwork (Appendix A), including the three conservation-important species as stated above.

3.1.3.3. Amphibia

Ecorex (2010) confirmed 15 species of frogs for the power station, none of which were observed during the field surveys. The Giant Bullfrog, *Pyxicephalus adspersus,* was the only conservation-important (Near Threatened, NEMBA) frog listed for the area. In this study the same list of species was prepared for the fieldwork (Appendix A), including the conservation-important species as stated above.

3.1.3.4. Other biota

Although ECOREX (2010) considered the Invertebrata, including baboon spiders, scorpions, dragonflies, damselflies, cicadas, beetles and butterflies, these taxa were not considered in the present study. Given that the study was conducted in the winter months in an area recently subjected to fire in places, it was not likely that any useful information would be derived from such a study.

3.1.4. Wetlands

The wetland delineation undertaken by EMROSS Consulting (2015) describes a seepage wetland (9.9ha) 250m to the south of the substation footprint (Section 5.2.1). The wetland has been affected by a dam, dirt roads, mining rehabilitation, furrows, overgrazing, firebreaks and agricultural activities. The shallow dam creates a permanent wetland zone covered by the Bullrush (*Typha capensis*). The dam and wetland area above the dam has been affected by sediment load washed into the wetland from adjacent opencast mining. Furrows have been dug into the wetland above and below the dam, draining the wetland areas. Firebreaks have been ploughed through the seasonal and temporary wetland areas surrounding the *Typha* wetland area. Dirt roads have been built through the wetland area. The wetland area is heavily grazed and some areas are used for hay bailing.

The PES of the seepage wetland is considered to be Ecological Category D/E, where the ecosystems may be described as Largely to Seriously Modified with a large to extensive loss of natural habitat, biota and basic ecosystem functions. The wetland has been affected by the opencast mining, dam, furrows, roads, firebreaks and agricultural activities and the catchment has been affected by opencast mining activities and rehabilitation. The wetland may thus be classified as having a Medium-Low Ecological Sensitivity (Table 3) due to the extent of transformation within the wetland and surrounding catchment (EMROSS, 2015).

The proposed 400kV power line servitude does not cross any wetland areas or streams.

4. METHODOLOGY

4.1. A description of the area for the period 2001 to 2015

The change to the site of the substation project footprint was examined for anthropogenic activity and concomitant impact on the biophysical environment for the period 2001 to 2015, using available basic Google Earth™ satellite imagery. The changes, if any, and the characteristics thereof, are reported here and utilised in the analysis of the ecological status for the footprint of the substation project.

4.2. The Flora and Fauna

Field surveys for the flora and fauna were conducted diurnally on the footprint of the substation on 13 August 2015 and linearly along the footprint for the 400KV powerline on 27 August 2015. A separate field survey for avifauna in the area was undertaken prior to this on 16 May 2015. The data obtained and analysed for the field surveys on 16 May and the 13 and 27 August 2015 were used to determine the ecological sensitivity of the footprint of the substation project.

4.3. Ecological Sensitivity Analysis

The ecological sensitivity of the area represented by the footprint of the substation project is based on the available data as reported in the literature review in Section 3 and the results obtained and analysed for the field surveys undertaken on 16 May and the 13 and 27 August 2015. The sensitivity is determined on a descriptive scale from **Very Low to High** (Table 3), where **Very Low** reflects a **highly transformed** natural environment with little or no ecological sensitivity, typically applicable to areas where there is existing infrastructure, to **High,** which may be described as **Natural and Unmodified.**

Table 3. The classification system used to describe the ecological sensitivity of the site

Description of sensitivity	Comment
Very Low	No ecological significance. Highly transformed, dominated by infrastructure development. Ecological functions may be considered nearly irreversibly impaired.
Low	Low ecological significance. Highly transformed, dominated by agriculture development. Ecological functions seriously modified.
Medium-Low	Low to medium ecological significance. Ecological functions largely modified.
Medium	Medium ecological significance. Ecological functions moderately modified.
Medium-High	Medium to high ecological significance. Ecological functions with few modifications.
High	High ecological significance. Ecological functions unmodified.

Note: Classification partly based on that represented for EcoClassification determination as stated in Kleynhans and Louw (2008).

4.4. Impact Assessment, Mitigation Measures and Recommendations

4.4.1. Introduction

In this section, impacts, mitigation measures and recommendations, as identified for the footprint of the substation project, will be dealt with.

4.4.2. Assessment Method to determine impact significance

An *environmental issue* may be defined as a perceived or realised observation of an anthropogenic activity that may have, has or will lead to a change in the bio-physical state of the environment in a given time and space. An *environmental impact* describes the change of state and takes into account the consequences (negative, positive or neutral) that the anthropogenic activity has on the receiving environment. In the protocol used in this study the degree or level of *significance* is dependent on drivers including (1) *extent* or spatial scope (geographical over), (2) *magnitude,* intensity or severity, (3) *duration* and (4) *probability*. In addition, a *confidence* rating is assigned to the determination of the significance for the environmental issue and a *reversibility* rating is assigned to each environmental issue as well. The designated value for each driver is obtained from a scale of 1 to 5, with concomitant descriptors, where the influence of the driver on the significance of the impact is lowest for the value of 1 and highest for the value of 5 (Tables 4 to 9). *Significance* is subjectively determined by finding the sum of the drivers and applying the resultant value to a pre-determined scale or range of values, each value or set of values of which descriptively characterises the present

state of the biophysical environment, either as a qualified statement or as a statement relative to a perceived reference condition.

Table 4. The probability (p) of the environmental issue

Description	Value
Improbable (almost never, almost impossible, <10% chance).	1
Possible (very seldom, highly unlikely, 5 to 20% chance).	2
Probable (likely, 20 to 80% chance).	3
Highly probable (often, regularly, 80 to 95% chance).	4
Definite (daily, highly likely, definitely, >95% chance).	5

Table 5. The magnitude (m), intensity or severity of the environmental issue

Description	Value
Zero (non-harmful or insignificant).	1
Very low (potentially harmful or small).	2
Low (slightly to moderately harmful).	3
Medium (harmful to very harmful).	4
High (Extremely harmful to disastrous).	5

Table 6. The duration (d) of the environmental issue

Description	Value
Very short term (Up to a month).	1
Construction phase (1 to 2 years).	2
Short Term (1 to 5 years).	3
Medium Term (5 to 15 years).	4
Long term or permanent (>15 years).	5

Table 7. The extent (e) or spatial scope (geographical cover) of the environmental issue

Description	Value
Activity specific (immediately where the activity manifests itself).	1
Area specific (within the site).	2
Whole Site and neighbouring environs (up to 5km from the site).	3
Regional (beyond 5km of the proposed activity).	4
National (on a very broad scale).	5

Table 8. The confidence rating for the determination of the significance for the environmental issue

Description	Confidence Rating
Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.	Certain

Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.	Sure
Limited useful information on and understanding of the environmental factors potentially influencing the impact.	Unsure

Table 9. The reversibility rating for the impact of the environmental issue

Description	Confidence Rating
The activity will lead to an impact that is permanent.	Irreversible
The impact is reversible within 2 to 10 years after anthropogenic activity (construction, development).	Long Term
The impact is reversible within the construction period (1 to 2 years).	Short Term

A score is determined for each driver, both in terms of the impact in its unmitigated state and in its mitigated state. Each mitigated score is used for the summation where, significance (S), is calculated as,

$S = p + m + d + e.$

Significance is then described according to a range of values for three classes of description (Table 10), namely *Low, Medium* or *High Significance*.

Table 10. The range of values for each of the classes of significance, their descriptions and implications for decision-making

Level of Significance	Description	Value Range
Low	Positive and negative impacts of *Low Significance* are considered to have no or little influence on the state of the biophysical environment.	4 - 9
Medium	Positive impact: *Medium Significance* will imply that a decision to continue with the activity/development should be made. Negative impact: Should be mitigated to a level where the impact would be of *Medium Significance* before the activity/development is approved.	10 - 15
High	Positive Impact: High *Significance* will imply that a decision to continue with the activity/development should be made. Negative Impact: *High Significance* should weigh towards a decision to terminate the activity/development, or mitigation should be performed to reduce significance to at least a Medium Significance rating.	16 – 20

Scores for a given number of environmental issues for a development or construction site can also be totalled together and then compared with the total for the same set of issues at an alternative site, hence allowing for alternative site comparisons and choices.

4.4.3. Subjectivity in Assigning Significance

To facilitate informed decision-making, studies must endeavour to come to terms with the significance of the potential environmental issues associated with particular development activities. Despite their attempts at providing a completely objective and impartial assessment of the environmental implications of development activities, the process can never completely escape the subjectivity inherent in attempting to define significance. Recognising this, there is an attempt here to address potential subjectivity in the current process as follows:

(1) Being explicit about the difficulty of being completely objective in the determination of significance, as outlined above.

(2) Developing an explicit methodology for assigning significance to impacts and outlining this methodology. Having an explicit methodology not only forces the assessor to come to terms with the various facets contributing toward determination of significance, thereby avoiding arbitrary assignment, but also provides the reader with a clear summary of how the assessor derived the assigned significance.

(3) Wherever possible, differentiating between the likely significance of potential environmental issues as experienced by the various affected parties.
Although these measures may not totally eliminate subjectivity, they provide an explicit context within which to review the assessment of impacts.

4.4.4. Consideration of Cumulative Impacts

The National Environmental Management Act requires the consideration of cumulative impacts as part of any environmental assessment process. EIA's have traditionally, however, failed to come to terms with such impacts, largely as a result of the following considerations:

(1) Cumulative effects may be local, regional or global in scale and dealing with such impacts requires co-ordinated institutional arrangements; and

(2) Studies are typically carried out on specific developments, whereas cumulative impacts may result from broader biophysical, social and economic considerations, which typically cannot be addressed at the project level.

5. RESULTS

5.1. A description of the area for the period 2001 to 2015

The footprint for the substation project and immediate environs around it was examined using Google Earth™ images for 22/06/2001, 14/2/2007, 14/6/2010, 6/5/2013 and 2/7/2015. It is clear from the images for the entire period from 2001 to 2015 that the footprint is significantly affected by anthropogenic activity, including agriculture, rural residential development and surface mining. Notable changes that have occurred in the area of the substation foorprint itself and environs over the 14-year period include the following:

(1) Sedimentation of the stream and wetland as a result of runoff from the surface mining area to the west (2007, 2013, 2015);
(2) Vegetation removal/harvesting from the stream and wetland (2007, 2013);
(3) Anthropogenic activity characterised by numerous, pockmarked, circular areas of exposure (each of up to 10m^2) of the ground (2001, 2015); and
(4) Further development and expansion of agricultural activity.

Changes that have occurred along the footprint for the 400kV power line and environs include the following:

(1) Increase in the surface mining footprint and infrastructure development (2007);
(2) The planting of stands of alien trees in order to serve as barriers to obscure the visibility of the mining footprint and/or reduce the aerial movement of exposed surface particulate matter; and
(3) The expansion of the remnant stands of alien trees, planted in the area prior to 2001.

Hence, land-use and changes in the vicinity of the substation project footprint over the last 14 years, have been associated with agricultural activity and surface mining. These activities support the classification of the immediate area around the substation project footprint by MTPA (2014) as predominantly Moderately to Heavily Modified. Curiously, the northern and eastern boundaries adjacent to the substation footprint are classified as a CBA Optimal area and two small areas crossing directly over the powerline footprint are classified as Other Natural Areas. These latter classifications are not consistent with the conditions observed on site during this assessment.

5.2. Flora and Fauna

5.2.1. Flora

Thirty plant species or taxa (30% of the indigenous species expected) were identified and/or collected during the field surveys (Appendix B) along transects (Figure 15) for the substation project footprint on 13 and 27 August 2015. One of these species is of conservation importance (*Hypoxis* sp, Declining) (see Section 3.1.2). Seven of the species were alien plants. The footprint of the substation itself is characterised by Transformed Forestry (Black Wattle, *Acacia mearnsii*) (9.15ha for the total footprint) along its northern border adjacent to the tarred road, Secondary Grassland (5.51ha) in the footprint itself and a wetland to the south of the footprint (9.9ha) (Figure 16). Although difficult to identify under winter condition in some cases, the grasses included *Eragrostis plana, E. curvula, Sporobolus africanus, Hyparrhenia cymbaria, Setaria sphacelata* and *Pogonarthria squarrosa*, amongst others. Shrubs *Seriphium plumosum* and *Verbena bonariensis* dominate the northern part of the Secondary Grassland and *Helichrysum callicomum* and *H. nudifolium* the southern part.

The mid-winter conditions and recent burning of the area were significant limiting factors in terms of the diversity of species present at the time along the footprint for the 400kV power line. The footprint of the power line is significantly transformed by anthropogenic activity and is represented by degraded secondary grassland (18.45h), an area transformed by mining activity (5.38ha) and transformed forestry (Black Wattle, *Acacia mearnsii* and Saligna Gum, *Eucalyptus grandis*) (a total of 9.15ha) (Figure 16).

Given the above and the classification of the substation project footprint by MTPA (2014) predominantly as Moderately Modified (Old Lands) (67.66ha), Other Natural Areas (total area in the region of 434.842ha) and CBA Optimal (a total area in the region of 965.467ha), the substation project footprint may be described as being Moderately Modified, where a loss and change in habitats, biota and ecosystems has occurred.

Figure 15. The four transects traversed during the assessment of the flora along the footprint for the Khanyisa substation project

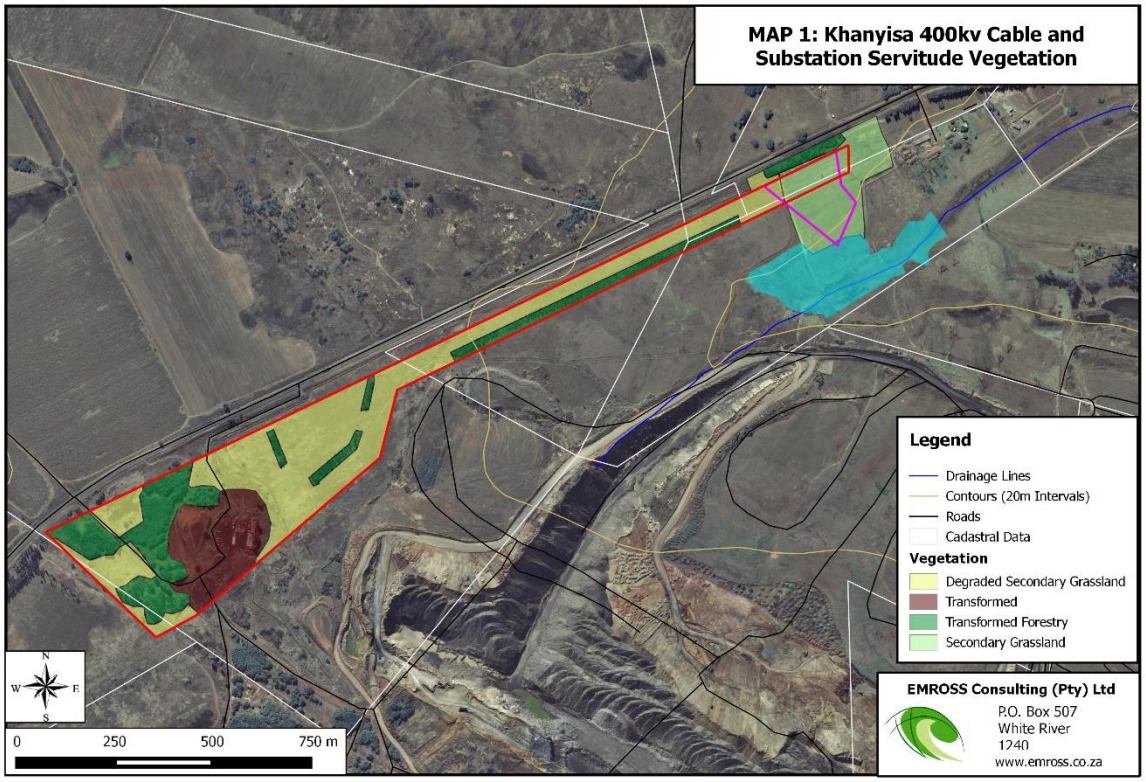

Figure 16. The vegetation communities determined for the Khanyisa substation project

5.2.2. Fauna

5.2.2.1. Aves

Fifty species of birds were identified for the area on 16 June 2015 (Appendix C), 12 of them not on the expected list (Appendix A). With the latter included, the observed number represents 32% of the expected number. ECOREX (2010) identified 34 of the expected 145 species that were listed during their survey (23%). ***None of the six conservation-important species of birds [African Marsh-Harrier (Circus ranivorus) (Vulnerable, VU), Lanner Falcon (Falco biarmicus) (Near Threatened, NT), Black Stork (Ciconia nigra) (NT), Secretarybird (Sagittarius serpentarius) (NT), Lesser Kestrel (Falco naumanni) (VU)*** **(non-breeding Palearctic migrant),** ***Southern Bald Ibis (Geronticus calvus) (VU) and Broad-tailed Warbler (Schoenicola brevirostris) (NT) (uncommon breeding migrant)] were identified on site during the survey.***

Given that the 400kV power line will be aboveground, due consideration must be given to the effect of support towers and transmission lines on bird flight through the immediate area. The potential for collisions with thin earth wires is a serious consideration, especially for large birds that are not able to avoid such obstructions quickly enough whilst in flight. Electrocution, on the other hand, occurs when large birds land on or alight from transmission line towers, creating short circuits between live conductors or between live conductors and earth wire (ECOREX 2010). Hence, larger birds of conservation importance likely to occur in the area that may be affected negatively by support towers and transmission lines include the above-mentioned species, except the Broad-tailed Warbler (*Schoenicola brevirostris*). In a further analysis, ECOREX (2010) reported that a further 50 species of birds not listed as of conservation importance may also be affected negatively by the presence of support towers and transmission lines. Four of these species, namely the Spur-winged Goose (*Plectropterus gambensis*), Egyptian Goose (*Alopochen aegytiacus*), Long-crested Eagle (*Lophaetus occipitalis*) and Black-shouldered Kite (*Elanus caerulus*), were confirmed present in the area of the substation project footprint during the survey on 16 May 2015. It must be stated that three support towers and transmission lines already exist on the footprint of the substation.

5.2.2.2. Mammalia, Reptilia and Amphibia

Although no mammals were directly observed during the surveys, there is extensive evidence throughout the site of the presence of either the Meerkat, *Suricata suricatta* (Least Concern;

IUCN, 2015), or the Yellow Mongoose, *Cynictis penicillata* (Least Concern, IUCN, 2015), as a number of areas with an extensive network of burrows or warrens were found. The sandy soil and grassland dominated flora on site represents ideal habitat for these animals. Scats of the African Porcupine (*Hystrix africaeaustrlis*) and possibly the Black-backed Jackal (*Canis mesomelas*) or Serval (*Leptailurus serval*) (Near Threatened) were found along the 400kV power line footprint. Other mammalian, as well as reptilian and amphibian, conservation-important species that may be present in the area include the Aardvark (*Orycteropus afer*) (NT), Bat-eared Fox (*Otocyon megalotis*) (NT), Highveld Golden Mole (*Amblysomus septentrionalis*) (NT), Oribi (*Ourebia ourebi*) (Endangered, EN), Southern African Hedgehog (*Atelerix frontalis*) (NT), Coppery Grass Lizard (*Chamaesaura aenea*) (VU), Large-scaled Grass Lizard (*Chamaesaura macrolepis*) (VU), Striped Harlequin Snake (*Homoroselaps dorsalis*) (NT) and Giant Bullfrog (*Pyxicephalus adspersus*) (VU).

5.3. Ecological Sensitivity Analysis

The Ecological Sensitivity Analysis was applied to the five habitats along the substation project footprint, as identified and described in this study, namely (1) Transformed (mining), (2) Transformed Forestry, (3) Degraded Secondary Grassland, (4) Secondary Grassland and (5) Wetland (Table 11, Figure 16).

The ecological sensitivity (ES) varies along the substation project footprint (Table 11), from Medium-Low for the wetland adjacent and to the south of the substation area, Medium for the substation area itself and Very low to Medium along the linear footprint for the 400kV power line in a westerly direction from the substation. Hence, depending on the position along the footprint for the substation project, ecological functioning varies from Moderately to Seriously and irreversibly Modified.

Table 11. The ecological sensitivity analysis for the 400kV substation and power line footprint

Habitat	Ecological Sensitivity	Description	Comment
Transformed (Mining)	Very Low to Low	No to Low ecological significance. Highly transformed, dominated by mining development. Ecological functions irreversibly to seriously modified.	1. Classified by MTPA (2014) as Heavily Modified. 2. A total of 30% of expected indigenous floral species identified. PES for vegetation, Moderately Modified.

Habitat	Ecological Sensitivity	Description	Comment
Transformed Forestry	Medium-Low	Low to Medium ecological significance. Ecological functions largely modified.	1. Classified by MTPA (2014) as Moderately (Old Lands) and Other Natural Areas. 2. Predominantly stands of Black Wattle and Saligna Gum. 3. A total of 30% of expected indigenous floral species identified. PES for vegetation, Moderately Modified.
Degraded Secondary Grassland	Medium	Medium ecological significance. Ecological functions moderately modified.	1. Classified by MTPA (2014) as Moderately Modified (Old Lands) and CBA Optimal. 2. A total of 30% of expected indigenous floral species identified. PES for vegetation, Moderately Modified. 3. African Potato or Stargrass (*Hypoxis* sp) (Declining) and possibly Serval (*Leptailurus serval*) (Near Threatened) observed.
Secondary Grassland	Medium	Medium ecological significance. Ecological functions moderately modified.	1. Classified by MTPA (2014) as Moderately Modified (Old Lands) and CBA Optimal. 2. A total of 30% of expected indigenous floral species identified. PES for vegetation, Moderately Modified.
Wetlands	Medium-Low	Low to medium ecological significance. Ecological functions largely modified.	1. Classified by MTPA (2014) as Other Natural Areas. 2. Classified by EMROSS Consulting (2015) as Ecological Category D/E, Largely to Seriously Modified, where there is an up to extensive loss of natural habitat, biota and basic ecosystem functions.

6. IMPACT ASSESSMENT, MITIGATION MEASURES AND RECOMMENDATIONS

6.1. Introduction

The impacts that will be considered for substation project footprint include:

(1) Further deterioration of the degraded secondary grasslands, secondary grasslands and CBA optimal along the substation project footprint and concomitant loss of conservation-important plant species,
(2) Further deterioration of the seepage wetland area,
(3) Increased invasion by alien plant species,
(4) Loss of habitat for conservation-important fauna (mammals, birds, reptiles and amphibians),
(5) Disruption to the life-history cycle of conservation-important fauna, and,
(6) Disruption to fauna due to construction activities (dust, noise, chemical pollutants).

Mitigation measures and recommendations are provided in each case.

6.2. Further deterioration of degraded secondary grasslands, secondary grasslands and CBA optimal area along the footprint and concomitant and loss of conservation-important plant species

The Transformed (mining and forestry) areas along the 400kV power line footprint have Very Low to Medium-Low ecological sensitivity and are consequently not included in the impact assessment. It is not likely that the construction of an overhead 400kV power line with support towers will have any further impact on the ecological status of the footprint area under question, given that ecological functioning in these areas is considered to be largely to seriously and irreversibly modified.

Most of the 400kV power line footprint falls within the Degraded Secondary Grasslands, classified by MTPA (2014) as Moderately Modified, with a small section on the substation footprint classified as CBA Optimal. Given that the ecological sensitivity may be considered to be Medium, with the extent of impact on an area specific scale, the **significance** of the potential impact of the deterioration of the PES of the degraded secondary grasslands along the 400kV power line may be considered to be **low** after mitigation (Table 12).

The substation footprint itself falls within the Secondary Grasslands and is classified by MTPA (2014) to be CBA Optimal for the northern part and Moderately Modified for the central and southern part, with Medium ecological sensitivity. A seepage wetland borders the substation footprint further to the south. Hence, the **significance** of the potential impact of the deterioration of the PES of the **Secondary Grasslands** in the footprint of the substation may be considered to be **medium** after mitigation (Table 12).

The CBA Optimal area (MTPA, 2014) borders the northern part of the substation footprint, and although classified as such, it is affected by agricultural activity and a large stand of Black Wattle (*Acacia mearnsii*). Hence, the impact of the construction of the substation on the **CBA Optimal area** may be considered to be of **low significance**.

Given the description for the substation and the 400kV power line as stated above, as well as the fact that Stargrass / African Potato (*Hypoxis* sp) was found near the western end of the 400kV power line footprint, the **significance** of the potential impact of the **loss of conservation-important flora** may be considered to be **low** after mitigation. It is very important that as a ***mitigation measure***, a walk through for conservation-important plants must be undertaken as soon as possible in the summer along the line of the substation and 400kV power line footprint. Plants of conservation-importance found, where appropriate, could be replanted in the adjacent grasslands as part of a rehabilitation program.

Although the Transformed (Forestry) area, or close to it, would be the preferred line along which the 400kV power line should be constructed, this is impractical as the plantation along the Transformed (Forestry) area (1) serves to obscure the visual impact of the surface mining, (2) probably acts as a barrier to restrict dust from the mining operations and (3) would involve extensive felling, de-stumping and rehabilitation of the footprint.

Another mitigation measure that may be proposed for the substation footprint in particular, includes clearing of the stand of Black Wattle, *Acacia mearnsii*, along the northern border of the footprint and rehabilitation with indigenous vegetation (as part of the entrance area to the substation infrastructure). In addition, ***as a further mitigation measure***, an attempt must be made to avoid the destruction of the entire Secondary Grassland in which the footprint of the substation lies, but rather to leave parts of the grassland around the substation untransformed to facilitate linear connectivity with neighbouring grassland habitats.

Table 12. Assessment of the further deterioration of degraded grasslands, secondary grasslands and CBA Optimal Area and loss of conservation-important plant species along the 400kV power line footprint and at the substation footprint

Issue	Probability (p)		Magnitude (m)		Duration (d)	Extent (e)	Confidence	Reversibility	Mitigated Impact	Significance
	Unmitigated	Mitigated	Unmitigated	Mitigated						
Deterioration of degraded secondary grasslands along the 400kV power line footprint	3	2	3	2	2	2	Sure	Short Term	8	Low
Deterioration of the secondary grassland on the substation footprint	3	2	4	3	4	2	Sure	Long Term	11	Medium
Deterioration of the CBA Optimal area	2	2	2	2	3	2	Sure	Long Term	9	Low
Loss of conservation-important plant species	3	2	3	2	2	2	Uncertain	Short Term	8	Low

6.3. Further deterioration of the seepage wetland

Given that the area of the seepage wetland (Figure 16) is classified by MTPA (2014) as Other Natural Areas, and notwithstanding the fact that EMROSS Consulting (2015) has classified the seepage wetland as PES category D/E (Largely to Seriously Modified) and the Ecological Sensitivity in this study was determined to be Medium-Low, the impact of the construction of the substation on the seepage wetland may be considered to be of **Medium Significance**

after mitigation (Table 13). Of concern will be the transport of sediment from construction into the wetland. Wetlands, as with rivers per se, function in a four-dimensional realm, namely longitudinal, lateral, vertical and time.

In terms of ***mitigation***, measures must be put into place to contain and restrict the loss of topsoil and the deposition by erosion and water flow of sediments in the wetland to the south of the footprint, as well as that of potentially hazardous solutions, solvents or chemicals (including concrete, lubricants and fuels) utilised during construction. ***A strong mitigation measure*** will be to consult Russell (2009) for guidelines and methods for wetland rehabilitation. A 30m buffer zone must be established from the edge of the wetland to the southern border of the substation. It is advisable then that the actual footprint of the substation must be positioned as far as possible towards the northern edge of the area proposed (Figure 16).

Table 13. Assessment of the further deterioration of the seepage wetland adjacent to the substation footprint

Issue	Probability (p)		Magnitude (m)		Duration (d)	Extent (e)	Confidence	Reversibility	Mitigated impactmpact	Significance
	Unmitigated	Mitigated	Unmitigated	Mitigated						
Further deterioration of the seepage wetland adjacent to the substation footprint	**3**	**2**	**3**	**2**	**3**	**3**	**Sure**	**Short Term**	**10**	**Medium**

6.4. Increased invasion by alien plant species

Clearing of the area and vegetation during construction will provide a base for invasion of alien plants, especially pioneer species that thrive on bare soil. Alien plant invasions have the potential to change vegetation communities and out-compete indigenous species, hence lowering species diversity. The impact of the **increased invasion by alien plant species** as a result of construction at the substation and along the footprint for the 400kV power line may be considered to be of **Low Significance** (Table 14).

In mitigation, it is proposed that an alien plant control program be included in the EMPr for the project. A team must be trained and equipped to manage invasions of alien plants during the construction and operations phases of the project. An adequate budget should be made

available for equipment and materials. The strategy must include monitoring to detect invasions at an early stage.

Table 14. Assessment of the increased invasion by alien plant species at the substation and along the 400kV power line footprint

Issue	Probability (p)		Magnitude (m)		Duration (d)	Extent (e)	Confidence	Reversibility	Mitigated impact itigated impact	Significance
	Unmitigated	Mitigated	Unmitigated	Mitigated						
The impact of increased invasion by alien plant species at the substation and along the 400kV power line footprint	3	2	3	2	2	3	Sure	Short Term	9	Low

6.5. Loss of habitat for conservation-important fauna (mammals, birds, reptiles and amphibians)

The Degraded Secondary Grassland, Secondary Grassland, CBA Optimal area and seepage wetland provide habitat for fauna, especially for conservation-important species. There are potentially 11 conservation-important species of mammals, birds, reptiles and amphibians that inhabit the area. Although burrows of the Aardvark, *Orycteropus afer*, were not found at the substation and along the 400kV power line footprint, there is evidence of the presence of these mammals on the adjacent site for the construction of the ACWA Power Khanyisa IPP Project. Scats of the African Porcupine (*Hystrix africaeaustralis*) and possibly the Black-backed Jackal (*Canis mesomelas*) or Serval (*Leptailurus serval*) (Near Threatened) were found along the 400kV power line footprint.

There is evidence at the substation site of the presence of either the Meerkat, *Suricata suricatta* or Yellow Mongoose, *Cynictis penicillata*, as a number of areas with an extensive network of burrows or warrens were found. It is also possible that the burrows are inhabited by species of rodents. The sandy soil and grassland dominated flora on site represents ideal habitat for these animals.

Due to the amount of habitat, the permanent availability of water and reed beds and the presence of temporary wetlands in the region, there is an extremely strong possibility that both Marsh Owl *(Asio capensis)* and (more importantly) African Grass Owl (*Tyto capensis)* will occur in the immediate area. The surrounding grasslands offer perfect hunting territory for both species and rank grassland and reed beds offer potential nesting habitat.

The impact of **loss of habitat for conservation-important fauna** may be considered to be of **Low Significance** (Table 15).

In mitigation, when earthwork for the preparation of the site for construction occurs, cognisance must be taken of the fact that there will potentially be displacement of mammals, birds, reptiles and amphibians. The procedures put in place for the earthworks should be such that biota are disturbed as little as possible, and if translocation is possible, this should be employed, or animals should be allowed some opportunity for escape.

Table 15. Assessment of the loss of habitat for conservation-important fauna at the substation and along the 400kV power line footprint

Issue	Probability (p)		Magnitude (m)		Duration (d)	Extent (e)	Confidence	Reversibility	Mitigated impact	Significance
	Unmitigated	Mitigated	Unmitigated	Mitigated						
Impact of the loss of habitat for conservation-important fauna at the substation and along the 400kV powerline footprint.	**2**	**2**	**3**	**2**	**2**	**2**	**Unsure**	**Short Term**	**8**	**Low**

6.6. Disruption to the life-history cycles of conservation-important fauna

Construction activity may have a disruptive impact on the life-history cycle (for example breeding) of conservation-important species, especially Aardvark (*Orycteropus afer*) and other potentially occurring species such as the Serval (*Leptailurus serval*) and African Grass-Owl (*Tyto capensis*). The impact of the **disruption to the life-history cycles of conservation-important fauna** may be considered to be of **Low Significance** (Table 16)

In terms of ***mitigation measures***, the potential disruption of the life-history cycles of conservation-important species of fauna would only be mitigated by planning for construction outside of the breeding periods (broadly October to June), which is unlikely to be feasible.

Table 16. Assessment of the impact to the disruption of the life-history cycles of conservation-important fauna at the substation and along the 400kV power line footprint

Issue	Probability (p)		Magnitude (m)		Duration (d)	Extent (e)	Confidence	Reversibility	Mitigated impactitigated	Significance
	Unmitigated	Mitigated	Unmitigated	Mitigated						
Impact to the disruption of the life-history cycles of conservation-important fauna	3	**2**	**3**	**2**	**2**	**2**	**Unsure**	**Short Term**	**8**	**Low**

6.7. Disruption to fauna due to construction activities (dust, noise, chemical pollutants).

It is possible that construction activities, including the generation of dust, noise due to the use of machinery and the loss of chemical pollutants to the environment (solutions, solvents, fuels, amongst others) may have an effect on resident biota. The impact of the **disruption to fauna due to construction activities** may be considered to be of **Low Significance** (Table 17).

Cognisance must be taken of these issues and appropriate ***mitigation measures*** must be included in the EMPr to (1) limit dust by wetting road and hard surfaces frequently, (2) limiting construction to normal day hours, masking noise levels by machinery where possible and keeping equipment in good order and (3) employing adequate control over the use of chemicals.

Table 17. Assessment of the disruption to fauna due to construction activities (dust, noise, chemical pollutants)

Issue	Probability (p)		Magnitude (m)		Duration (d)	Extent (e)	Confidence	Reversibility	Impact	Significance
	Unmitigated	Mitigated	Unmitigated	Mitigated						
The impact of the disruption to fauna due to construction activities	**3**	**2**	**3**	**2**	**2**	**2**	**Sure**	**Short Term**	**8**	**Low**

7. CONCLUSION

The Ecological Sensitivity of the Transformed (mining and forestry) area along the 400kV power line footprint may be considered to be Very Low to Medium Low. The Ecological Sensitivity of the Degraded Secondary Grassland along the power line footprint is considered to be Medium. At the substation footprint the Ecological Sensitivity for the CBA Optimal area in the northern part and the Secondary Grasslands in the central and southern parts is considered to be Medium. The Wetland Seepage area to the south of the substation footprint is considered to be of Medium Low Ecological Sensitivity.

Significance for impacts identified varies from Low to Medium. Mitigation measures for the construction of the substation and 400kV power line are proposed and recommendations made.

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APPENDIX A

DATA SHEET KHANYISA, EMALAHLENI, MPUMALANGA

Date: _____Time: _____ Locality: _____

Climate: Cloud cover _____ Wind _____ Rainfall _____ Temperature _____

Sheet Ref: _____

Description:

Species	Common name	Family	Growth Form	Reference/ Status	Site Position	Sample reference	Comments
Acacia mearnsii •	Black Wattle	Fabaceae	Tree	S156			
Acacia melanoxylon •	Blackwood	Fabaceae	Tree	S156			Grassland, forest margins. Fl. pale yellow balls, simple leaves.
Acalypha angustata	False Nettle, Copper Leaf	Euphorbiaceae	Herb	(S262) Ph			False Nettle. Leaves toothed, flower reddish, cone-shaped.
Acalypha punctata	False Nettle. Sticky broom	Euphorbiaceae	Herb	(S262) Ph			False Nettle. Reddish leaves. Called sticky brooms and brushes.
Albuca glauca	Slime Lily	Hyacinthaceae	Geophyte	(M84) Ph			Slime Lily. Yellow flower?

Alloteropsis semialata	Black Seed Grass	Poaceae	Grass	V233			Black Seed Grass, grassland, edges forests. Digitate panicle. Spikelets dark grey. Fl Sep to Mar
Anthospermum cf. dregei		Rubiaceae	Herb	(S615) Ph			Small leaves, no petiole, yellow flower.
Asparagus suaveolens	Katdoring	Asparagaceae	Dwarf shrub	Ph			Thin green fleshy leaves. Green fruit.
Becium obovatum		Lamiaceae	Herb	Ph			Hairy leaves. White flower, purple streaks.
Brachiaria serrata	Velvet Signal Grass	Poaceae	Grass	V253			Velvet Signal Grass, stony places, undisturbed, sandveld, vleis Velvety purple and red spikelets. crooked peduncle. Fl Oct to Mar.
Callilepis leptophylla		**Asteraceae**	**Herb**	**(M406) De De Ph**			**2529CC (Blesboklaagte 296JS). 2529CD. Vaalbank 289JS 2629AA (Blesbokfontein 38IS).**
Chaetacanthus setiger		Acanthaceae	Herb	(O182) Ph			Small hairy leaves. White tubular flower.
Conyza sp .•	Fleabane	Asteraceae	Herb	(B224)			Fleabane. Not enough information.
Crinum macowanii / *bulbispermum.* (no flowers)	**River Lily** **Orange River Lily**	**Amaryllidaceae**	**Grass**	**M60 De MNCA**			**River lily. Rocky grassland near rivers. Smaller flower. Orange River Lily. Seasonal streambeds. Red stripes on outside of flower. Fl. Oct to Feb / Sep to Dec. 2629AA (Kromfontein 30IS). 2629AB (Steenkoolspruit 18 IS).**
Cyanotis speciosa	Dolls Powderpuff	Commelinaceae	Herb	M50			Dolls Powderpuff. Cluster mauve/blue flowers on stalks, hairy. Grasslands. Flowers all yr.
Cynodon dacetylon	Couch Grass	Poaceae	Grass	V229			Couch Grass. Mat forming. Digitate. Disturbed places. Fl Sep to May.
Cyperus sp.		Cyperaceae	Sedge				Not suffic ient information
Oigitaria tricholaenoides	Purple Finger Grass	Poaceae	Grass	V223			Digitate, purple to off-white hairy spikelets. Leaf sheaths densely hairy. Open grassland, undisturbed areas. Fl Nov to Mar.
Eleocharis dregeana		Cyperaceae	Sedge	Ph			Thick, fleshy, green sten. Small compact inflorescence at top.
Elionurus muticus	Wire Grass	Poaceae	Grass	V79			Mature inflorescences curl back sickle-shape. White. Fl Sep to May.
Eragrostis curvula	Weeping Love Grass	Poaceae	Grass	V177			Long loose hanging leaves. Open panicle. Spikelets darkm grey to dark olive green. Disturbed places. Fl Aug to June.
Eragrostis plana	Tough Love Grass	Poaceae	Grass	V194			Entire plant hairless. Panicle with lonf narrow contracted tip. Spikelets with serrated margins. Disturbed damp places. Fl Sep to Mar.
Eragrostis racemosa	Narrow Heart Love Grass	Poaceae	Grass	V125			Spikelets olive green. Culms study and erect. Flat cone-like spikelets. Fl Sep to Mar. Sandy, gravelly soil, damp.
Eucalyptus sp .•	Saligna Gum Tree	Myrtaceae	Tree	S475			-
Euphorbia striata		Euphorbiaceae	Herb	(S280) Ph			Fleshy tall green stem. Cup-like broad leaves, yellow flowers.

Felicia muricata		Asteraceae	Herb	(S410) Ph			Daisy-like. Yellow and long white /mauve petals.
Fuirena pubescens		Cyperaceae	Sedge	Ph			Untidy, clump-like.
Gomphrena celosioides *	Prostrate Globular Amaranth	Amaranthaceae	Herb	B312			Hairy weed. Whitish-green conelike flower.
Grass sp. 1		Poaceae	Grass				Not enough information.
Haplocarpha lyrata	Gerberas	Asteraceae	Herb	(M376) Ph			Daisy-like. Leaf dark green, heavily-lobed.
Harpochloa falx	Caterpillar Grass	Poaceae	Grass	V73			One sided grey spike fl, curls back when ripe. Leaves still, blunt. Stony slopes, undisturbed. Fl. Sep to April.
Helichrysum appendiculatum		Asteraceae	Herb	(O208), (M348) Ph			Yellow everlasting. Long leaves.
Helichrysum aureonitens		Asteraceae	Herb				Yellow flower. Whitish, hairy leaves.
Helichrysum coriaceum		Asteraceae	Herb				White flower. Leaves at base. Long, light grey leaves.
Helichrysum nudifolium		Asteraceae	Herb				Lightish-yellow, clustered flowers. Long lightish green, thin leaves.
Helichrysum rugulosum		Asteraceae	Herb				Long whitish flowers. Stamens stick out.
Hermannia transvaalensis		Malvaceae	Herb	(O138) (M214) Ph			Yellow cup-like flower. Hairy, purple sepals and stalks, bumpy leaves.
Hibiscus aethiopicus	Dwarf Hibiscus	Malvaceae	Herb	M220			Cream-coloured, yellow or pink flowers, no dark eye, buttercup-like. Fl Aug to Dec.
Hyparrhenia tamba	Blue Thatching Grass	Poaceae	Grass	V55			Spikelets covered in long white hairs. Racemes with 2-4 awns. Rivers, vleis, roads. Fl. Jan to June.
Hypericum lalandii	(St Johns Wort)	Hypericaceae	Herb	(O134) (M252) Ph			Yellow reddish flower. Small leaves, no petiole
Hypoxis obtusa		Hypoxidaceae	Geophyte	(M94) Ph			Yellow flower
Hypoxis rigidula	Stiff-leaved Stargrass	Hypoxidaceae	Geophyte	M94			Stiff, erect, fibrous shaft-like, white hairy leaves, cluster of yellow fl. Stony grassland. Fl.Aug to Mar.
Imperata cylindrica	Cotton Wool Grass	Poaceae	Grass	V99			Water loving, dense stands. Dense, hairy silver-white panicle. Leaves hard, stiff, red-brown in winter. Prominent midrib. Fl Aug to June.
Juncus exsertus		Juncaceae	Sedge	Ph			Untidy, clumped inflorescence.
Juncus punctorius		Juncaceae	Sedge	Ph			Small atypical flower-like inflorescence.
Justicia sp. (no flowers)	(Justicia)	Acanthaceae	Herb	(M432)			Blue-purple orchid like flower. Not enough information.
Kohautia amatymbica		Rubiaceae	Herb	O196			Slender, tall, narrow leaves, Inflorescence terminal, small white flowers with 4 petals. Mountains, foothills. Fl Mid-winter to Mid-summer.
Lactuca capensis		Asteraceae	Herb	Ph			Long thin purple petals. Fleshy stems. Fine long seeds.
Ledebouria cf. cooperi	Cooper's Ledebouria	Hyacinthaceae	Geophyte	M88			Long bright green leaves with purple streaks beneath. Raceme of pink, fleshy flowers, magenta filaments. Wet, marshy grassland.

Lobelia erinus	Edging Lobelia	Lobeliaceae	Herb	M336			Weak, lance to paddle-shaped leaves. Blue, violet, pink or white flowers, white centre, awl-like sepals. Mountain slopes. Fl Sep to Dec.
Lotononis calycina	Hairy Lotononis	Fabaceae	Herb	(M294) Ph			Yellow flower, very hairy leaves. Ground plant.
Loudetia simplex	Common Russet Grass	Poaceae	Grass	V133			Open to contracted light brown panicle, long awns. Open grassland. Fl Nov to Jan.
Melinis repens	Natal Red Top	Poaceae	Grass	V149			Hairy spikelets. Long velvety, red, pink or white hairs. Disturbed places. Fl Sep to June.
Monopsis decipiens	Butterfly Lobelia	Lobeliaceae	Herb	M334			Narrow awl-like leaves. Hairy on margins. Blue and purple flowers with two yellow crests. Very similar to *L. erinus*. Damp grassland. Fl Sep to Mar.
Nemesia fruticans	Common Wild Nemesia	Scrophulariaceae	Herb	M464			Shrublet, lance, toothed leaves, margins rolled under. Pink or lilac flowers, oblong cushion like hump on lower lip and pointed spur. Stony slopes, road sides Fl. Sep to Nov.
Oxygonum dregeanum subsp. *canescens*		Polygonaceae	Herb				White flower, fleshy stem, needle-like leaves.
Pygmaeothamnus zeyheri	Sand Apple	Rubiaceae	Herb				Large green leaves, small white flower, on ground.. Relatively large green fruit.
Rhynchosia adenodes		Fabaceae	Herb	(S220) (M286) Ph			Small trifoliate creeper with long flower spike.
Richardia brasiliensis *	Mexican Richardia	Rubiaceae	Herb	B345			Weed, small white flowers .Ground cover, hairy stems.
Rumex crispus *	(Sorrel)	Polygonaceae	Herb	(O92) Ph			Alien. Tall, red flowers, flanged seeds.
Schoenoplectus corymbosus		Cyperaceae	Sedge				Typical sedge, edges of dams.
Senecio etubescens		Asteraceae	Herb	(M380) Ph			Pinkish, purple flower, whitish stamens, hairy.
Senecio inornatus		Asteraceae	Herb	(M380) Ph			Yellow flower, long petals.
Seriphium plumosum	Bankrupt bush	Asteraceae	Dwarf shrub				Ugly, untidy, greyish, on ground.
Silene burchellii	Gunpowder Bush	Caryophyllaceae	Herb	O73			Erect, slender, narrow leaves, Blooms all faced same way. Tubular calyx with maroon ribs and swelling in upper part 5 pink petals deeply slashed. Seeds resemble gunpowder. Open grasslands on mountains and foothills.
Solanum incanum	(lichtensteinii) Grey Bitter Apple	Solanaceae	Dwarf shrub	S596			Flowers white to mauve. Yellow fruit. Fl. Oct to Feb.
Sonchus dregeanus *	(Sow Thistle)	Asteraceae	Herb	(B239) Ph		1	Ty;pical weed. Long green leaves, very lobed, yellow flower.
Sphenostylis angustifolia		Fabaceae	Herb				
Themeda triandra	Red Grass	Poaceae	Grass	V50			Spikelet pairs have long twisted dark awns. Plant has red clour late in season. Fl Oct to July.

Trachypogon spicatus	Giant Spear Grass	Poaceae	Grass	V67			Long awns covered with velvety white hairs. Awns stick out untidily. Stamens conspicuously yellow or orange. Fl. Dec to May.
Tristachya leucothrix	Hairy Trident Grass	Poaceae	Grass	V108			Leaves hairy and curled when dry. Spikelets in groups of 3 with each group having 3 awns. Fl. Oct to Mar.
Typha capensis		Typhaceae	Sedge				
Verbena bonariensis *	Purple Top	Verbenaceae	Herb	B306			Tall with purple flower at apex.
Vernonia oligocephala	(Vernonia)	Asteraceae	Herb	(M358) Ph			Tall, purple flower, bushy.
Frithia humilis		**Aizoaceae**	**Geoophyte**	**En En Ph**			**2529CC (Elandsfontein 309JS, Kalbasfontein 284JS). Pinkish white flower,geophyte. Fenestrated leaves. 2529CD (Blauwpoort 335JS). 2629AA (Kleinkopje 15IS). 2629AA (Zaaiwater 11 IS).**
Boophone disticha	**Bushman Poison Bulb**	**Amaryllidaceae**		**De De Ph**			**2529CD. Red candelabra-like flower. Monocot. Vaalbank 289JS. 2629AB (Steenkoolspruit 18 IS),**
Brachycorythis conica transvaalensis		**Orchidaceae**		**En En Ph**			**2529CD. Purple flowers. Orchid. Townlands 287JS. 2629AB (Steenkoolspruit 18 IS).**
Hypoxis hemerocallidea		**Hypoxidaceae**		**De De Ph**			**2529CD. Yellow flowers. Vaalbank 289JS.**
Anacampseros subnuda lubbersii		**Portulacaceae**		**Vu Vu Ph**			**2529CD. Succulent, small ball-like structure, green. Rietfonten 314JS. Vaalbank 289JS**
Encephalarctos lanatus		**Zamiaceae**		**S50 NT NT**			**2529CD (Kalbasfontein 284JS)**
Eucomis autumnalis	**Common Pineapple Lily**	**Hyacinthaceae**		**De De M90**			**2529CD**
Pachycarpus suaveolens		**Apocynaceae**		**(M260) Vu Vu**			**2529CD. Cannot find an image!**
Habenaria schimperiana		**Orchidaceae**		**(M150) - Ra Ph**			**2529CD. Rietfonten 314JS**
Habenaria bicolor		**Orchidaceae**		**(M150) NT – Ph**			**2529CD**
Elephantorrhiza obliqua		**Fabaceae**		**DD DD S178**			**2529CD (Vaalbank 289JS).**

Common Name	Scientific Name	Red Data (RSA, MTPA)	Protected	Source	Site Position	Comments
			Mammals			
Aardvark	***Orycteropus afer***	**NT**	**MNCA**	**S131, W115**		

Bat-eared Fox	***Otocyon megalotis***	**NT**	**MNCA**	**S105, W53**		
Black-backed Jackal	*Canis mesomelas*			S106, W57		
Cape Porcupine	*Hystrix africaeaustralis*			S59, W41		
Common Duiker	*Sylvicapria grimmia*			S167, W172		
Greater Cane Rat	*Thryonomus swinderianus*			W37		
Highveld Golden Mole	***Amblysomus septentrionalis***	**NT**				
Meerkat	*Suricata suricatta*			S120, W77		
Multimammate Mouse	*Mastomys couch* a			S80		
Scrub Hare	*Lepus saxatilis*			S50, W30		
Serval	***Leptailurus serval***	**NT, NT**	**NEMBA**	**S105, W111**		**2529CC (Blesboklaagte 296JS), 2629AA (Steenkoolspruit 18IS).**
Southern African Vlei Rat	*Otomys irroratus*			S72		
Striped Mouse	*Rhabdomys pumilio*			S74		
Water Mongoose	*Atilax paludinosus*			S128, W82		
Yellow Monqoose	*Cynictis penicillata*			S122, W79		
Oribi	***Ourebia ourebi***	**EN, EN**		**S174, W163**		**2529CD (Elandsdrift 291JS, Kalbasfontein 284JS).**
Southern African Hedgehog	***Atelerix frontalis***	**-, NT**		**S4, W18**		**2529CD (Zeekoewater 311JS)**
			Birds			
African Black Swift	*Apus barbatus*			SABAP2 R70		
African Grass-Owl	***Tyto capensis***	**- VU**	**NEMBA**	**SABAP2 R76**		**2529CC (Weltevreden 324JS). 2529CD (Goedehoop 315JS, Townlands 287JS, Naauwpoort 385JS, Rietfontein 314JS). 2629AA (Blesbokfontein 38IS, Frischgewaagd 60IS, Goedgevonden 10IS, Kleinkopje 15IS, Klipplaat 14IS, Klippoortje 32IS, Nooitgedacht 59IS, Rietvlei 62IS, Roodeblom 58IS, Roodepoort 40IS). 2629AB (Dorstfontein 71IS, Rietkuil 558IS, Rietkuil 57IS, Welstand 55IS).**
African Hoopoe	*Upupa africana*			SABAP2 R46		
African Marsh-Harrier	***Circus ranivorus***	**VU**	**NEMBA**	**SABAP2 R150**		
African Palm-Swift	*Cypsiurus parvus*			SABAP2 R72		
African Pied Wagtail	*Motacilla aguimp*			SABAP2 R340		
African Pipit	*Anthus cinnamomeus*			This study R344		

African Quailfinch	*Ortygospiza atricollis*			SABAP2 R326		
African Sacred Ibis	*Threskiornis aethiopicus*			SABAP2 R182		
African Snipe	*Gallinago nigripennis*			SABAP2 R102		
African Stonechat	*Saxicola torquatus*			This study R298		
African Wattled Lapwing	*Vanellus senegallus*			This study R124*		
Alpine Swift	*Tachymarptis melba*			SABAP2 R70		
Amethyst Sunbird	*Chalcomitra amethystina*			SABAP2 R310*		
Amur Falcon	*Falco amurensis*			SABAP2 R166		Nov to May
Anteating Chat	*Myrmecocichla formicivora*			This study R302		
Banded Martin	*Riparia cincta*			SABAP2 RF232		Aug to May
Barn Swallow	*Hirundo rustica*			This study R234		Sept to May
Black Crake	*Amaurornis flavirostris*			SABAP2 R98		
Black-chested Prinia	*Prinia flavicans*			This study R268		
Black-collared Barbet	*Lybius torquatus*			SABAP2 R38		
Black-headed Heron	*Ardea melanocephala*			SABAP2 R178		
Black-shouldered Kite	*Elanus caeruleus*			This study R142		
Blacksmith Lapwing	*Vanellus armatus*			SABAP2 R122		
Black-throated Canary	*Crithagra atrogularis*			This study R348		
Bokmakierie	*Telophorus zeylonus*			SABAP2 R214		
Brown-throated Martin	*Riparia paludicola*			SABAP2 R232		
Cape Glossy Starling	*Lamprotornis nitens*			SABAP2 R304		
Cape Grassbird	*Sphenoeacus afer*			SABAP2 R244		

Cape Longclaw	*Macronyx capensis*			This study R342		
Cape Robin-Chat	*Cossypha caffra*			This study R294		
Cape Sparrow	*Passer melanurus*			This study R338		
Cape Turtle-Dove	*Streptopelia capicola*			This study R86		
Cape Wagtail	*Motacilla capensis*			SABAP2 R340		
Cape Weaver	*Ploceus capensis*			This study R320		
Cape White-eye	*Zosterops virens*			SABAP2 R260		
Capped Wheatear	*Oenanthe pileata*			This study R300		
Cardinal Woodpecker	*Dendropicos* fuscescens			SABAP2 R36		
Cattle Egret	*Bubulcus ibis*			SABAP2 R176		
Chinspot Batis	*Batis molitor*			SABAP2 R220		

Cinnamon-breasted Bunting	*Emberiza tahapisi*			SABAP2 R352		
Cloud Cisticola	*Cisticola textrix*			This study R266		
Common Fiscal	*Lanius collaris*			This study R224		
Common House-Martin	*Delichon urbicum*			SABAP2 R238		Sep to May
Common Myna	*Acridotheres tristis*			SABAP2 R306		
Common Waxbill	*Estrilda astri/d*			This study R330		
Crested Barbet	*Trachyphonus vaillantii*			SABAP2 R38		
Crowned Lapwing	*Vanellus coronatus*			SABAP2 R124		
Cuckoo Finch	*Anomalospiza imberbis*			SABAP2 R336		Oct to May
Dark-capped Bulbul	*Pycnonotus tricolor*			SABAP2 R240		
Desert Cisticola	*Cisticola aridulus*			SABAP2 R266		
Diderick Cuckoo	*Chrysococcyx caprius*			This study R62		Sep to Mar
Dusky Indigobird	*Vidua funerea*			SABAP2 R334*		
Eastern Clapper Lark	*Mirafra fascio/ata*			SABAP2 R274		
Egyptian Goose	*Alopochen aegyptiacus*			SABAP2 R28		
European Bee-eater	*Merops apiaster*			This study R56		Oct to Apr
Fan-tailed Widowbird	*Euplectes axillaris*			SABAP2 R324*		
Fiscal Flycatcher	*Sigelus silens*			SABAP2 R288		
Glossy Ibis	*Plegadis falcinellus*			SABAP2 R182		
Great Egret	*Egretta alba*			SABAP2 R176		
Greater Kestrel	*Falco rupicoloides*			SABAP2 R164		
Greater Striped Swallow	*Hirundo cucullata*			SABAP2 R236		July to May
Green Wood-Hoopoe	*Phoeniculus purpureus*			SABAP2 R46		
Grey Go-away-bird	*Corythaixoides con color*			SABAP2 R74		
Grey Heron	*Ardea cinerea*			SABAP2 R178		
Hadeda Ibis	*Bostrychia hagedash*			SABAP2 R182		
Hamerkop	*Scopus umbretta*			SABAP2 R180		
Helmeted Guineafowl	*Numida meleagris*			This study R22		
Horus Swift	*Apus horus*			SABAP2 R72		Visitor
House Sparrow	*Passer domesticus*			SABAP2 R338		
Jackal Buzzard	*Buteo rufofuscus*			This study R156		
Karoo Thrush	*Turdus smithi*			SABAP2 R286*		
Kittlitz's Plover	*Charadrius pecuarius*			SABAP2 R120		
Kurrichane Thrush	*Turdus libonyanus*			SABAP2 R286		
Lanner Falcon	***Falco biarmicus***	**- NT**		**SABAP2 R168**		**2529CD (Doornpoort 312JS)**

Laughing Dove	*Streptopelia senegalensis*			This study R86		
Lesser Striped Swallow	*Hirundo abyssinica*			SABAP2 R236*		July to Apr
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*			SABAP2 R250		
Levaillant's Cisticola	*Cisticola tinniens*			This study R264		
Little Egret	*Egretta garzetta*			SABAP2 R176		
Little Rush-Warbler	*Bradypterus baboecala*			SABAP2 R248		

Little Swift	*Apus affinis*			SABAP2 R72		
Long-billed Pipit	*Anthus similis*			SABAP2 R346		
Long-crested Eagle	*Lophaetus occipitalis*			SABAP2 R162		
Long-tailed Widowbird	*Euplectes progne*			This study R324		
Marsh Owl	Asio *capensis*			This study R76		
Mountain Wheatear	*Oenanthe monticola*			SABAP2 R300		
Natal Spurfowl	*Pternistis natalensis*			SABAP2 R20		
Neddicky	*Cisticola fulvicapilla*			SABAP2 R266		
Northern Black Korhaan	*Afrotis afraoides*			SABAP2 R92*		
Olive Thrush	*Turdus olivaceus*			SABAP2 R286*		
Orange-breasted Wax bill	*Amandava subflava*			This study R326		
Pied Crow	*Corvus albus*			SABAP2 R222		
Pied Starling	*Spreo bicolor*			SABAP2 R306		
Pin-tailed Whydah	*Vidua macroura*			This study R336		
Plain-backed Pipit	*Anthus leucophrys*			SABAP2 R344		
Purple Heron	*Ardea purpurea*			SABAP2 R178		
Red-backed Shrike	*Lanius collurio*			SABAP2 R224		Nov to Apr
Red-billed Quelea	*Quelea quelea*			SABAP2 R322**		Nov to Mar (Natal)
Red-capped Lark	*Calandrella cinerea*			SABAP2 R282		
Red-chested Cuckoo	*Cuculus solitarius*			This study R60		Sept to Mar
Red-chested Flufftail	*Sarothrura rufa*			SABAP2 R96		
Red-collared Widowbird	*Euplectes ardens*			SABAP2 R324		
Red-eyed Dove	*Streptopelia semitorquata*			SABAP2 R86		
Red-headed Finch	*Amadina erythrocephala*			SABAP2 R326		
Red-throated Wryneck	*Jynx ruficollis*			SABAP2 R36		
Red-winged Starling	*Onychognathus morio*			SABAP2 R302		
Rock Dove	*Columba livia*			SABAP2 R88		

Rock Martin	*Hirundo fuligula*			SABAP2 R238		
Rufous-naped Lark	*Mirafra africana*			SABAP2 R274		
Sand Martin	*Riparia riparia*			SABAP2 R232		Sep to Apr
Sedge Warbler	*Acrocephalus schoenobaenus*			SABAP2 R248		Oct to Apr
South African Cliff-Swallow	*Hirundo spilodera*			SABAP2 R238		Aug to Apr
Southern Grey-headed Sparrow	Passer *diffusus*			SABAP2 R338		
Southern Masked-Weaver	*Ploceus velatus*			This study R318		
Southern Red Bishop	*Euplectes orix*			This study R322		
Speckled Mousebird	*Colius striatus*			SABAP2 R58		
Speckled Pigeon	*Columba guinea*			SABAP2 R84		
Spike-heeled Lark	*Chersomanes albofasciata*			SABAP2 R280		
Spotted Eagle-Owl	*Bubo africanus*			SABAP2 R78		
Spotted Thick-knee	*Burhinus capensis*			SABAP2 R116		
Spur-winged Goose	*Plectropterus gambensis*			SABAP2 R28		
Squacco Heron	*Ardeola ralloides*			SABAP2 R176		
Steppe Buzzard	*Buteo vulpinus*			SABAP2 R156		Oct to Apr
Streaky-headed Seedeater	*Crithagra gularis*			SABAP2 R350		
Striped Pipit	*Anthus lineiventris*			SABAP2 R342		
Swainson's Spurfowl	*Pternistis swainsonii*			SABAP2 R22		
Tawny-flanked Prinia	*Prinia subflava*			SABAP2 R268		
Thick-billed Weaver	*Amblyospiza albifrons*			SABAP2 R326		
Three-banded Plover	*Charadrius tricollaris*			SABAP2 R120		
Village Weaver	*Ploceus cucullatus*			This study R318		
White-fronted Bee-eater	*Merops bulfockoides*			SABAP2 R54		

White-rumped Swift	*Apus caffer*			SABAP2 R72		Aug to May (some in winter)
White-throated Swallow	*Hirundo albigularis*			SABAP2 R234		Jul to May
White-winged Widowbird	*Euplectes albonotatus*			SABAP2 R324		
Willow Warbler	*Phylloscopus trochilus*			This study R254		Oct to Apr
Wing-snapping Cisticola	*Cisticola ayresii*			This study R266		
Yellow Wagtail	*Motacilla flava*			SABAP2 R340		Oct to Apr
Yellow-billed Duck	*Anas undulata*			This study R26		

Yellow-crowned Bishop	*Euplectes afer*			SABAP2 R322		
Yellow-fronted Canary	*Crithagra mozambicus*			SABAP2 R348		
Zitting Cisticola	*Cisticola juncidis*			This study R266		
Black Stork	***Ciconia nigra***	**- NT**		**R184**		
Secretarybird	***Sagittarius serpentarius***	**- NT**		**R162**		**2529CD (Doornpoort 312JS)**
Lesser Kestrel	***Falco naumanni***	**- VU**		**R164**		**Migrant 2529CD (Townlands 287JS)**
Southern Bald Ibis	***Geronticus calvus***	**- *VU***		**R182**		**2529CD (Townlands 287JS)**
Broad-tailed Warbler	***Schoenicola brevirostris***	**- NT**		**R248****		**Kameldoorn Olifants River**
Reptiles						
Aurora House Snake	*Lamprophis aurora*			SARCA B75/25		
Bibron's Blind Snake	*Afrotyphlops bibronii*			MTPA B55/39		
Bibron's Stiletto Snake	*Atractaspis bibronii*			SARCA B62/38		
Black-headed (Cape) Centipede-eater	*Aparallactus capensis*			MTPA B64/26		
Boomslang	*Dispholidus typus*			SARCA B99/31		
Brown House Snake	*Lamprophis capensis (fuliginosus)*			SARCA B74/28		
Brown Water Snake	*Lycodonomorphus rufulus*			MTPA B73/32		
Cape Thick-toed Gecko	*Pachydactylus capensis*			MTPA B252/83		
Cape Skink	*Trachylepis (Mabuya) capensis*			SARCA B152/52		
Cape Wolf Snake	*Lycophidion capense*			SARCA B76/36		
Common Flap-neck Chameleon	*Chamaeleo dilepis*			SARCA B227/96		
Common (Transvaal) Girdled Lizard	*Cordylus vittifer*			SARCA B194/67		
Coppery (Transvaal) Grass Lizard	***Chamaesaura aenea***	**(VU) NT NT**		**MTPA B185/50***		**2529CC (Elandsfontein 309JS), 2529CD (Bankfontein 340JS),**
Distant's Ground Agama	*Agama aculeata distanti*			SARCA B212/78		
Distant's Thread Snake	*Leptotyphlops distanti*			SARCA B57/40**		
Eastern Cape (Peter's) Thread	*Leptotyphlops scutifrons conjunctus*			MTPA B57/40		
Highveld Garter Snake	*Elapsoidea sundevallii media*			SARCA B106/32		
Large-scaled Grass Lizard	***Chamaesaura macrolepis***	**VU**		**SARCA B185/50****		
Mole Snake	*Pseudaspis cana*			SARCA B80/18/28/35		
Mozambique Spitting Cobra	*Naja mossambica*			SARCA B108/27		

Puff Adder	*Bitis arietans*			SARCA B114/3/12		
Red-lipped Snake	*Crotaphopeltis hotamboeia*			MTPA B87/33		
Rhombic Egg-eater	*Dasypeltis scabra*			MTPA B95/15		
Rhombic Night Adder	*Causus rhombeatus*			SARCA B113/15		
Rinkhals	*Hemachatus haemachatus*			MTPA B109/20/35		
Short-snouted Grass Snake	*Psammophis brevirostris*			MTPA B91/34		
Snouted Cobra	*Naja annulifera*			SARCA B106/20/27		
South African Slug-eater	*Duberria lutrix*			SARCA B79/28		
Southern Rock Agama	*Agama atra*			MTPA B214/76		
Speckled Rock Skink	*Trachylepis punctatissima*			MTPA B157/53		
Speckled Shield (nose) Cobra	*Aspidelaps scutatus scutatus*			SARCA B104/18/26		
Spotted Dwarf Gecko	*Lygodactylus ocel/atus*			SARCA B248/91/110		
Spotted (Rhombic Skaapsteker) Grass Snake	*Psammophylax rhombeatus*			MTPA B88/17/22		
Striped Grass (skaapsteker) Snake	*Psammophylax tritaeniatus*			SARCA B88/22		
Striped Harlequin Snake	***Homoroselaps dorsalis***	**NT NT**		**MTPA B103/20/24****		**2529CD (Bankfontein 340JS)**
Sundevall's Writhing Skink	*Mochlus (Lygosoma) sundevallii*			SARCA B150/49**		
Thin-tailed Legless Skink	*Acontias gracilicauda*			SARCA B133/44*		

Transvaal (Thick-toed) Gecko	*Pachydactylus affinis*			SARCA B250/82		
Variable Skink	*Trachylepis varia*			SARCA B157/53		
Wahlberg's Snake-eyed Skink	*Afroblepharus (Panaspis) walbergii*			SARCA B159/51		
Water Monitor	*Varanus niloticus*			SARCA B210/63		
Western Natal (Eastern) Green Snake	*Philothamnus natalensis occidentalis*			SARCA B95/30		
Yellow-throated Plated Lizard	*Gerrhosaurus flavigularis*			SARCA B178/3/65		
Frogs						
Guttural Toad	*Amietophrynus (Bufo) gutturalis*			SAFAP, duP142		

Raucous Toad	*Amietophrynus (Bufo) rangeri*			SAFAP, duP154		
Red Toad	*Schismaderma carens*			SAFAP, duP190		
Bubbling Kassina	*Kassina senegalensis*			SAFAP, duP276		
Rattling Frog	*Semnodactylus wealii*			SAFAP, duP278*		
Boettger's Caco	*Cacosternum boettgeri*			SAFAP, duP364		
Snoring Puddle Frog	*Phrynobatrachus natalensis*			SAFAP, duP296		
Common Platanna	*Xenopus laevis*			SAFAP, duP332		
Common River Frog	*Amieta (Afrana) angolensis*			SAFAP, duP396		
Cape River Frog	*Amieta (Afrana) fuscigula*			SAFAP, duP400*		
Striped Grass Frog	*Ptychadena porosissima*			SAFAP, duP318		
Giant Bullfrog	***Pyxicephalus adspersus***	**NT VU**	**NEMBA**	**MTPA, duP414**		**2529CD (Elandspruit 291JS, Rietfontein 286JS), 2629AA (Boschmansfontein 12IS)**
Striped Stream Frog	*Strongylopus fasciatus*			SAFAP, duP422		
Tremolo Sand Frog	*Tomopterna cryptotis*			SAFAP, duP434		
Natal Sand Frog	*Tomopterna natalensis*			SAFAP, duP444		

APPENDIX B

Plants identified and/or collected during the field surveys on 13 and 27 August 2015

No.	Common Name	Species Name	Habitat / Comments/Status
1	-	*Senecio sp*	-
2	Purple top	*Verbena bonariensis*	Alien
3	-	*Tenrhynea phylicifolia*	Least Concern (LC)
4	-	*Helichrysum caespititium*	LC
5	Bankrupt bush	*Seriphium plumosum*	LC, reduces grassland carrying capacity.
6	-	*Juncus oxycarpus*	LC, wetlands
7	Wireleaf Daba Grass	*Miscanthus junceus*	LC, wetlands, Increaser I grass.
8	Tough Love Grass	*Eragrostis plana*	LC, Increaser II grass. Disturbed places, old cultivated lands.
9	Ratstail Dropseed	*Sporobolus africanus*	LC, Disturbed places, near streams and damp places, increaser III grass.
10	Tall Khaki Weed	*Tagetes minuta*	Alien
11	-	*Berkheya* sp	-
12	-	*Dicoma anomala*	LC, stony grassland
13	-	*Helichrysum nudifolium*	LC
14	-	*Lopholeana segmentata*	LC
15	-	*Senecio inornatus*	LC
16	Cockle-bur	*Xanthium spinosum*	Alien
17	-	*Juncus sp. B*	-
18	Boat Thatching Grass	*Hyparrenia cymbaria*	LC, Increaser I grass
	-	*Juncus sp. C*	-
19	Vleiklapper	*Gomphocarpus fruticosus*	LC, Sandy soil, disturbed places, wetlands.
20	Weeping Love Grass	*Eragrostis curvula*	LC, Increaser II Grass
21	-	*Wahlenbergia sp*	-
22	-	*Helichrysum callicomum*	LC
23	-	*Pogonarthria squarrosa*	LC
24	-	*Senecio erubescens*	LC
25	Golden Bristle Grass	*Setaria sphacelata*	LC, Decreaser Grass, disturbed places, wetlands.
26	Firethorn	*Pyracantha sp*	Alien
27	Star Flower (African Potato)	*Hypoxis sp (hemerocallidea?)*	Declining
28	Blackwood	*Acacia melanoxylon*	Alien
29	Black Wattle	*Acacia mearnsii*	Alien
30	Saligna Gum	*Eucalyptus grandis*	Alien

APPENDIX C

Avian survey conducted on 16th May 2015

Cape Turtle Dove
Laughing Dove
Brown-throated Martin
Wire-tailed Swallow
Hadeda Ibis
Red-eyed Dove
Village Weaver
Cape Weaver
Common Fiscal
Red-faced Mousebird
Levaillant's Cisticola
Zitting Cisticola
Black-throated Canary
Western Cattle Egret
Black-chested Prinia
Orange-breasted Waxbill
Brown-backed Honeybird
Red-collared Widowbird
White-winged Widowbird
Long-tailed Widowbird
Black-collared Barbet
African Stonechat
Spur-winged Goose
Egyptian Goose
Cape Grassbird
Cape Longclaw
Lesser Swamp Warbler
Cape White-eye
Black-headed Heron
Red-crested Coot
Long-crested Eagle
Black-shouldered Kite
Kurrichane Thrush
Cape Robin-Chat
Green-winged Pytilia
Cape Wagtail
Fork-tailed Drongo
Crested Barbet
Green Woodhoopoe
Grey Go-Away-Bird
Brown-hooded Kingfisher
Southern Black Flycatcher
Cape Sparrow
Southern Grey-headed Sparrow

Tawny-flanked Prinia
African Pied Starling
Southern Boubou
Common Myna
Pied Crow
Eastern Black-headed Oriole