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Ridge Ecological Assessment

of

The Proposed Etna - Trade Route 88 kV Power Line and Switching Station

December 2016

Report author: Ms. M. Burger (B.Tech Nat Con., Pr.Sci.Nat.)

DECLARATION OF INDEPENDENCE

I, Marli Burger (820903 0245 087) declare that I:

- am subcontracted as specialist consultant by Galago Environmental CC for the proposed project described in this report

- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them

- abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions

- have no financial interest in the proposed development other than remuneration for work performed

- have or will not have any vested or conflicting interests in the proposed development

- undertake to disclose to Galago Environmental CC and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations, 2014.

Marli Burger
SACNASP no: 115534

TABLE OF CONTENTS

FIGURES:

TABLES:

1. INTRODUCTION

Galago Environmental was appointed to conduct a ridge ecological assessment along the proposed Eskom power line and Switching station on portions of the farm Vlakfontein 303 IQ and Rietfontein 301 IQ. The aims of the study were to determine the classification and to describe the ecology and biodiversity of the ridge along the proposed powerline route.

The term **ridge** refers to rocky outcrops, hills, koppies, mountains, kloofs, gorges, or "any topographic feature in the landscape that is characterized by slopes of 5° or more (i.e. $\geq$ 8.8%, $\geq$ 1 in 11 gradient), **as determined by means of a GIS digital elevation model**" (GDACE, 2001).

Ridges offer similar opportunities as formal gardens, including recreation and relaxation, although the former incorporates conservation and education. However, conservation of natural areas within the urban environment has certain challenges, especially in terms of migration, genetic-material exchange, and the persistence of small populations of fauna and flora. The theory of island biogeography is likely to apply to these increasingly isolated natural areas and planning should take this into consideration (Ellery *et al*, 2001). "Heavily modified landscapes can create barriers to movement and can lead to inbreeding and local extinction, especially if populations are not replenished by immigration" (Michael *et al*, 2010).

Studies of diversity by Burnett *et al.* (1998) proved that areas of high geomorphological heterogeneity also display high diversity for all plant types, combinations and communitites. It follows that these areas provide a greater variety of potential niches for biota than homogenous landscapes. It can be reasonably assumed that faunal communities associated with a particular floral community will also be considerably more diverse in spatially heterogeneous environments (GDACE, 2001). Furthermore, Burnett *et al.* (1998) showed that variability in species dominance was significantly higher in more heterogeneous geomorphological areas. The majority of variability in plant richness and diversity was accounted for by aspect and drainage variation.

Ridges are characterized by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and combinations thereof), slopes and altitudes all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. The temperature and humidity regimes of microsites vary on both a seasonal and daily basis. Biotic communities vary between the tops and bottoms of koppies (GDACE, 2001).

Nutrient and water accumulation is affected by rock weathering and substrate irregularities, which results in a mosaic of habitats on a microtopographic scale. Roughness of substrate determines the composition of plant community parameters and microrelief influences functional groups within a range of adaptive plant strategies. Two limiting factors of substrate include water shortage and mechanical resistance to root growth (Do Carmo *et al*, 2016).

Gauteng covers an area of 18 179km^2 in central north-east South Africa and, with approximately 12.3 million people, is the country's smallest and most densely populated province. The region is a magnet for those seeking better livelihoods. Gauteng's population grew at an average annual rate of 2.7% between 2001 and 2011, surpassing the national average of 1.5%. Fifty-two percent of this growth was attributable to immigration with the remainder due to natural births (StatsSA, 2013). Gauteng will have approximately 5,4 million households by 2020, a doubling of household numbers over the two decades from 2001 (GCRO, 2013). With the explosive population growth and associated increasing urbanization of the region, well-informed, scientific landuse planning is essential to ensure the sustainable use of resources.

The ridges of Gauteng form essential habitat for many threatened or Red Data plant species. The following statistics on Gauteng vegetation are noteworthy:
- 65% of Red Data plant species have been recorded growing on ridges in the province
- 42% of Red Data plant species are limited exclusively to this habitat type and the majority of endemic species are limited exclusively to the ridge habitat.
- 71% of Gauteng's endemic plant species, i.e. plant species that occur nowhere else in the world, have been recorded on ridges (GDACE, 2001).

Alien invasive vegetation competes with indigenous vegetation for resources, such as space, nutrients and water. Often the exotic vegetation is a stronger competitor, because their natural enemies are not present in areas where they do not naturally occur. A study on lizard species in the rocky outcrops in remnant urban bushland of Australia revealed that species richness was significantly lower in sites that had a high ratio of exotic: indigenous plant species. It follows that if invasion by exotic plant species continues, lizard species requiring indigenous plant communities will become increasingly vulnerable to local extinction (Jellinek *et al*, 2004).

The following species types are ecologically important in an ecosystem:
- **Indicator species** indicate the status of other species and key habitats or the effects of an impact,
- **Keystone species** have greater effects on ecological processes than would be predicted from their abundance or biomass alone,
- **Ecological engineers** alter the habitat and, in doing so, modify the fates and opportunities of other species,
- **Umbrella species** either have large area requirements or use multiple habitats and thus overlap the habitat requirements of many other species, and
- **Link species** exert critical roles in the transfer of matter and energy across trophic levels (of a food web) or provide critical links for energy transfer within complex food webs (ESA, 2000).

Insect pollinators are a keystone group of species since more than two-thirds of flowering plants require them for successful reproduction. A decline in pollinators can lead to diminished seed production and fewer viable offspring, which affects any other species that feed on plant seeds or fruits. Land-use changes have negatively impacted plant pollinators in both North America and Europe. Where land was converted to agriculture or urban areas, pollinator density decreases due to the reduced amount of indigenous vegetation available to pollinators. Similarly, habitat fragmentation and pesticide use can reduce or eliminate pollinator populations (ESA, 2000). Similarly, many plant species are dependent on faunal species, as well as environmental mechanisms, for seed dispersal.

Pollination is of particularly important value in ridges, considering the current major pollination crisis. Disruption of pollination systems, and declines of certain types of pollinators, including the honeybee, have been reported on every continent except Antarctica. The crisis, which will have a major impact on both natural and agricultural systems, has been caused by habitat fragmentation and other changes in land use, agriculture and grazing, pesticide and herbicide use, and the introduction of non-native species (GDARD, 2001). Below is an example of pollination seen on site, which is an ecological process that needs to be protected by means of promoting connectivity and habitat conservation.

Figure 1: ***Eurema brigitta brigitta*** **(Broad-bordered Grass Yellow**) known to occur on site (Bathusi, 2016).

Predator-prey relationships form part of the ecology of the ridges on site. Predator species also control pest species and keep prey populations under control (Olivier et al, 2015).

Environmental change is not uncommon, as ecosystems are naturally subject to periodic and persistent changes. However, anthropogenic activities leading to land-use change, carbon emissions, nitrogen-cycle disruption, and invasive species introductions are accelerating the rate and the intensity of environmental change. Rapid changes to the abiotic environment might modify local and regional species pools through environmental filtering and disruption of biotic interactions, leading to changes in the characteristics and interactions that affect ecosystem functioning (Oliver *et al*, 2015).

2. OBJECTIVES OF THE STUDY

“1) Applications involving activities on a ridge that must be subjected to an environmental impact assessment in any form must, in addition to any other requirements of law, be supported by a study or studies which, as a minimum, describe –

(a) the ecological conditions – including the functional, hydrological and compositional aspects – of the ridge,
(b) flora and fauna – including any mammals, birds, reptiles, amphibians and invertebrates - that are present on the ridge,
(c) the impacts of the proposed activity on a) and b),
(d) the stability of the slope and any implications thereof for the application, and

(e) the cultural, historical, open space and visual value aspects as well as the current use and value of the ridge for social purposes and the extent to which the proposed activity will impact on these uses or values."

"2) Applications involving developments on a ridge falling within Class 1, 2 or 3 must also be supported by a study on service provision and access. The study on service provision and access must, as a minimum, describe the location of access roads to the site; what services are available; and - if no services are available - how the site will be serviced and the impact that any new infrastructure contemplated may have on the ridge" (GDACE, 2001).

3. SCOPE OF STUDY

This report:

- Applies to the study site as described in subsection 4.1,
- Briefly describes the biotic and abiotic factors observed during the site visit and report reviews,
- Provides recommendations about the protection of ecologically sensitive areas along the proposed route in accordance with relevant legislation and guidelines,
- Indicates protected areas, red listed species and estimated alien vegetation cover,
- Briefly describes connectivity with natural vegetation in surrounding areas,
- Evaluates the impacts on the functional and compositional habitat aspects, and
- Recommends mitigation measures to reduce or minimise impacts, should the proposed route be approved.

4. STUDY AREA

4.1 The study site

The proposed route of the Etna Power line (Figure1) is as follows: From the existing Etna MTS, which is situated north-east of Lenasia South, it runs west of and parallel to the R553 (Golden Highway) and veers off to the west of Zakaryya Park to the existing Lehae Switching Station and continues north towards the Klip River just opposite the Olifantsvlei Municipal Nature Reserve. It continues in a westerly direction parallel to the Klip River and ends at the Trade Route Switching Station, north of Klipspruit Valley, Lenasia.

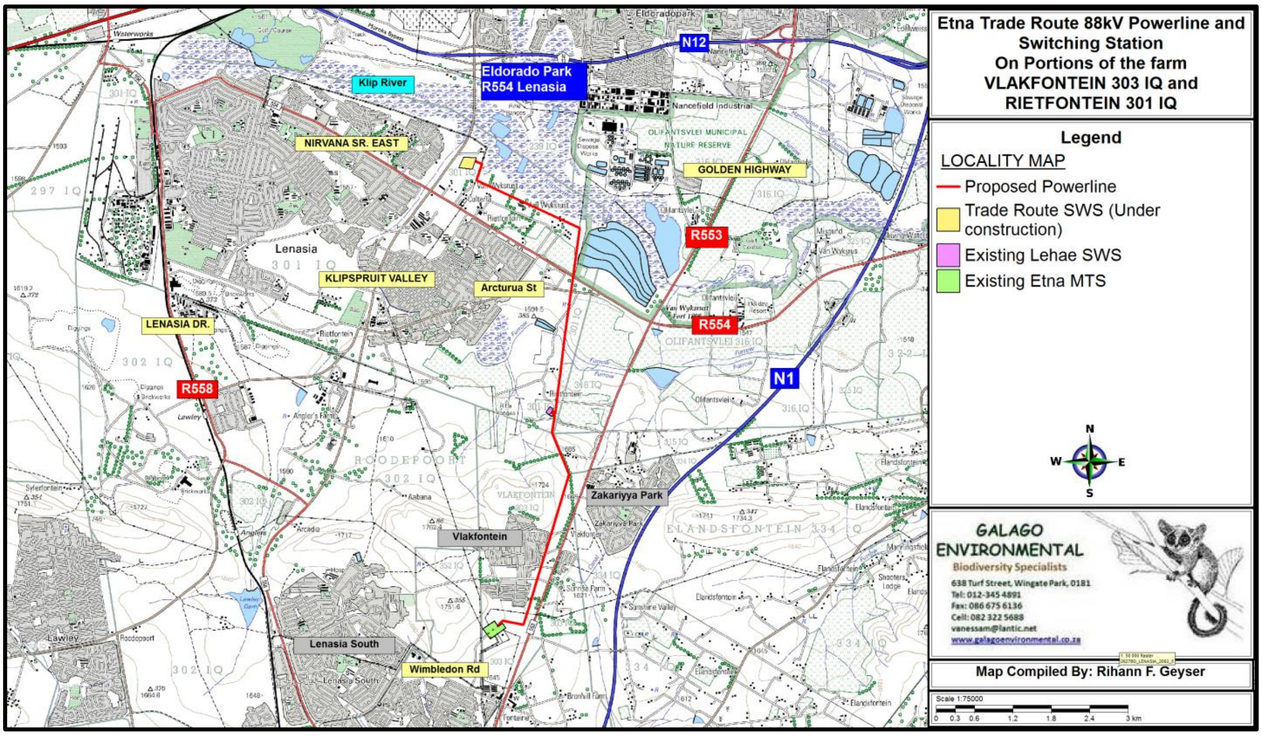


Figure 2: Locality map of the study area.

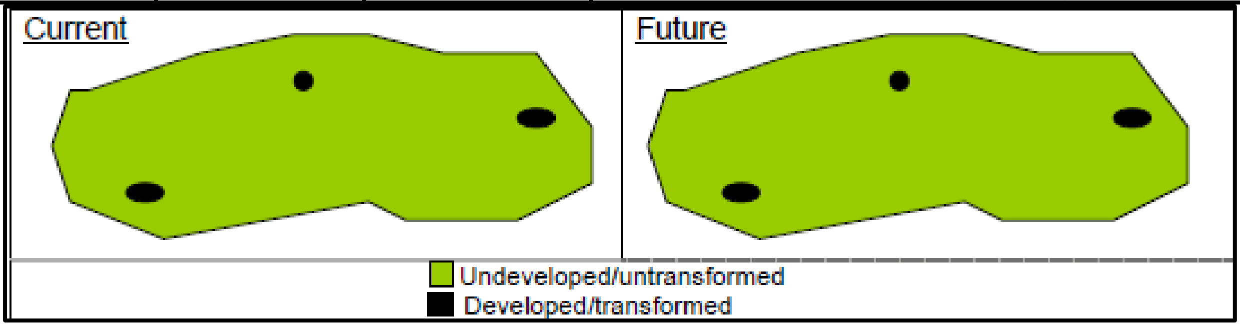
5. METHOD

A desktop study of the ridge class and potential surrounding ridges (within 200m) was done before the site visit. Information about the vegetation, avifauna, herpetofauna and mammals, specifically relating to Red-listed species, were obtained from specialist studies done for the specific site. Information on watercourses and related buffer zones was also obtained from a site specific specialist study. The GDARD Ridges Guidelines (2001; (Table 1) as well as the GDARD Requirements for Biodiversity Assessments (V.3, 2014) were consulted in the compilation of this report.

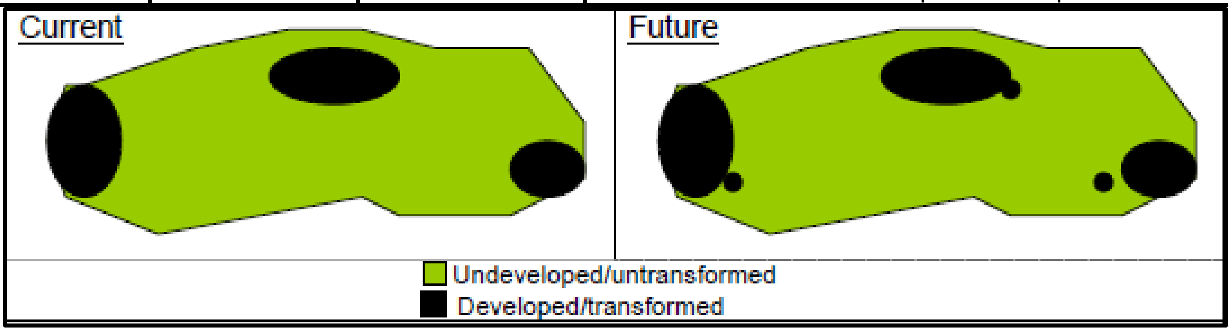
The proposed powerline route was inspected on 8 December 2016 to determine whether the proposed route will impact on the ridge ecology, habitat and species that are likely to occur on or around the site.

Table 1: Ridge Type Requirements as prescribed by GDARD, 2001.

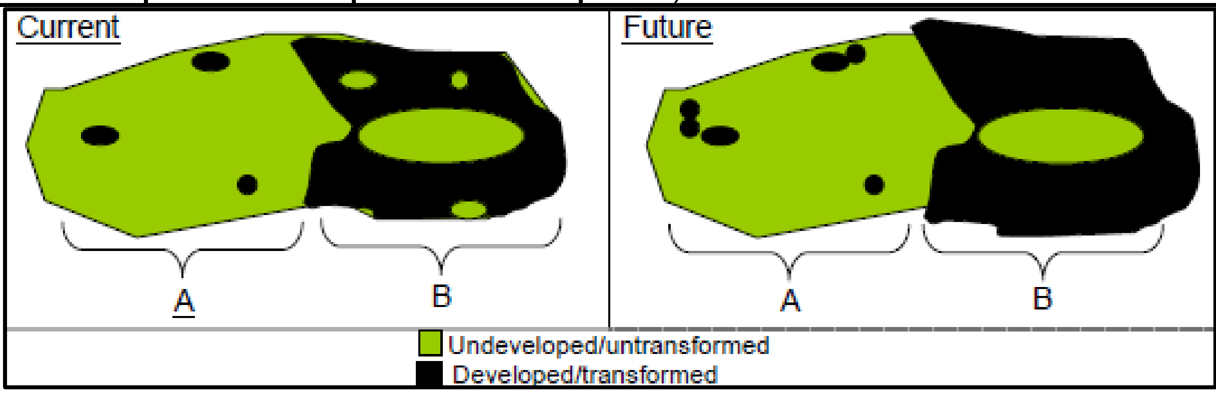
Ridge Type	% of Gauteng Ridges	% Transformed	Policy
Class 1	47%	0 – 5%	No further development allowed 200m buffer zone of low impact development



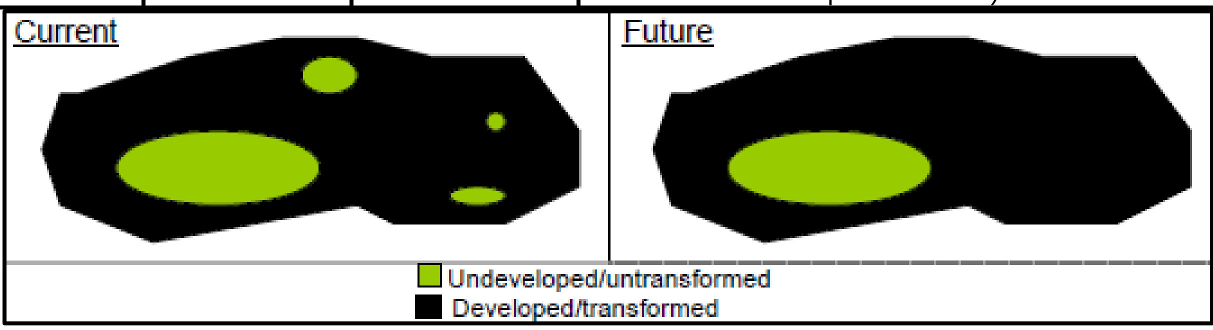
Ridge Type	% of Gauteng Ridges	% Transformed	Policy
Class 2	40%	5 – 35%	Low impact only (< 5% of property) 200m buffer zone of low impact development



Ridge Type	% of Gauteng Ridges	% Transformed	Policy
Class 3	8%	35 – 65%	Low impact areas (< 5% of property) and high impact areas (except if open space >/4ha or Red data species occurs)



Ridge Type	% of Gauteng Ridges	% Transformed	Policy
Class 4	5%	65 – 100%	Can develop >5% of property (except if open space >/4ha or Red data species occurs)



Climatological information was obtained from Mucina and Rutherford (2006). Geological information was obtained from ArcGIS (Accessed December, 2016), Locality maps were obtained from Planet GIS and information about the Critical Biodiversity Areas and Ecological Support Areas were obtained from the GDARD C-Plan 3.3 (2014).

The study site was evaluated in terms of compositional aspects, including Red Data species, geology and substrate heterogeneity, and topography and habitat availability. Factors such as exotic vegetation, species cover and utilization (trade or collect) of specific species were also considered. The functional aspects of the ridge habitat were assessed by considering the connectivity of the ridge to other ridge areas, as well as to adjacent areas of natural vegetation. Impacts on the ridge ecology were rated, discussed and mitigation measures proposed.

6. RESULTS

6.1 Climate

The study area is located in the Mesic Highveld Grassland Bioregion, more specifically spatially represented within the following ecological types (as defined by Mucina and Rutherford, 2006)

- Carletonville Dolomite Grassland (Vulnerable);
- Eastern Temperate Freshwater Wetlands (Vulnerable);
- Gauteng Shale Mountain Bushveld (Vulnerable); and
- Soweto Highveld Grassland (Endangered) (Bathusi, 2016)

The landscape of the Carletonville Dolomite Grassland is highly variable with extensive sloping plains and rocky ridges that are elevated slightly above the undulating surrounding plains. The study site is situated in a summer-rainfall region with an average annual rainfall of between 570 mm to 730 mm with cool-temperate climate and continentality (high extremes between maximum summer and minimum winter temperatures, frequent occurrence of frost, large diurnal thermic difference, especially in autumn and spring) (Mucina and Rutherford, 2006).

Gauteng Shale Mountain Bushveld occurs mainly on the ridge of the Gatsrand south of Carletonville – Westonaria – Lenasia. It also occurs as a narrow band along the ridge that runs from a point between Tarlton and Magaliesberg in the west, through Sterkfontein, Pelindaba, Atteridgeville to Klapperkop and Southeastern Pretoria in the east. Altitude varies between 1 300 and 1 750 m (Bathusi, 2016).

The Soweto Highveld Grassland has summer rainfall and cool-temperate climate with high extremes between maximum summer and minimum winter temperatures, frequent frosts and large thermic diurnal differences, especially in autumn and spring.

6.2 Geology

The proposed route falls in an area consisting of shale and quartzite, as well as in a dolomitic area (Figure 3).

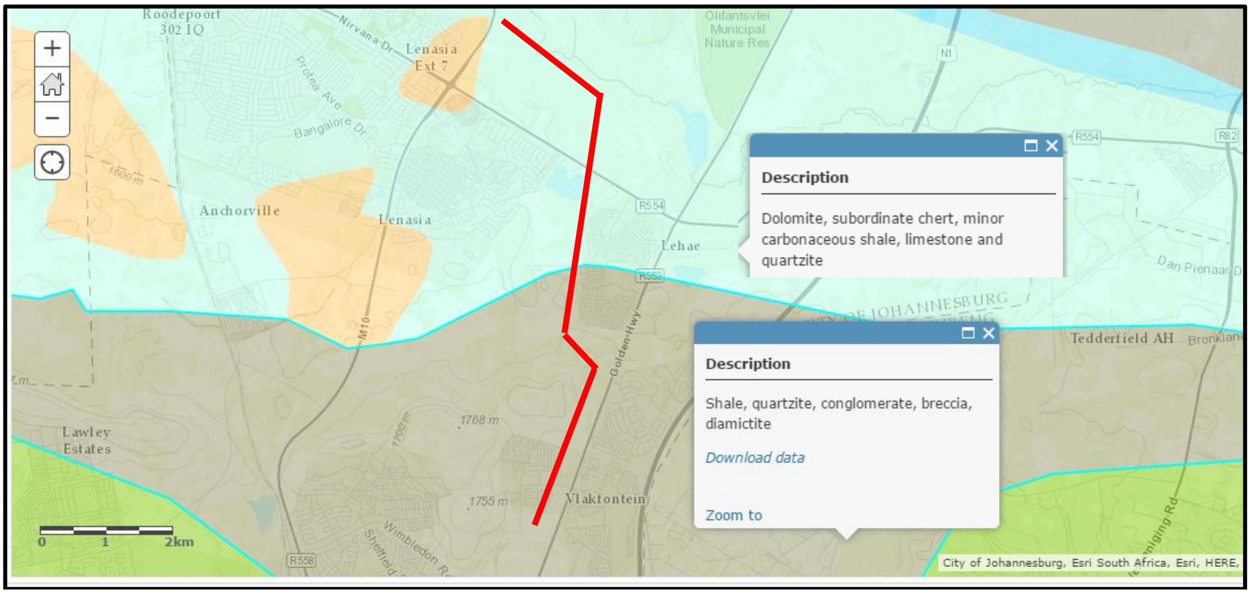


Figure 3: Geology of the study site showing the proposed powerline route in red (ArcGIS, accessed December 2016).


Figure 4: Weathering quartzite substrate on ridges found on the study site

Figure 5: Rocky grassland at the footslope of the Class 2 ridge on site

Figure 6: Quartzite substrate on ridges found on the study site

6.3 Topography

Topography influences nutrient and water movement in the landscape, which contributes to the variety of habitats associated with ridges and, in turn, biodiversity. The ridges on site provide a diverse array of aspect, slope, moisture content and refuges (Figure 6). The elevation profiles below illustrate average slopes of more than 5% respectively, which descend in a southern direction towards the Rietspruit and in a northern direction towards the Klip River (Figures 7-9).

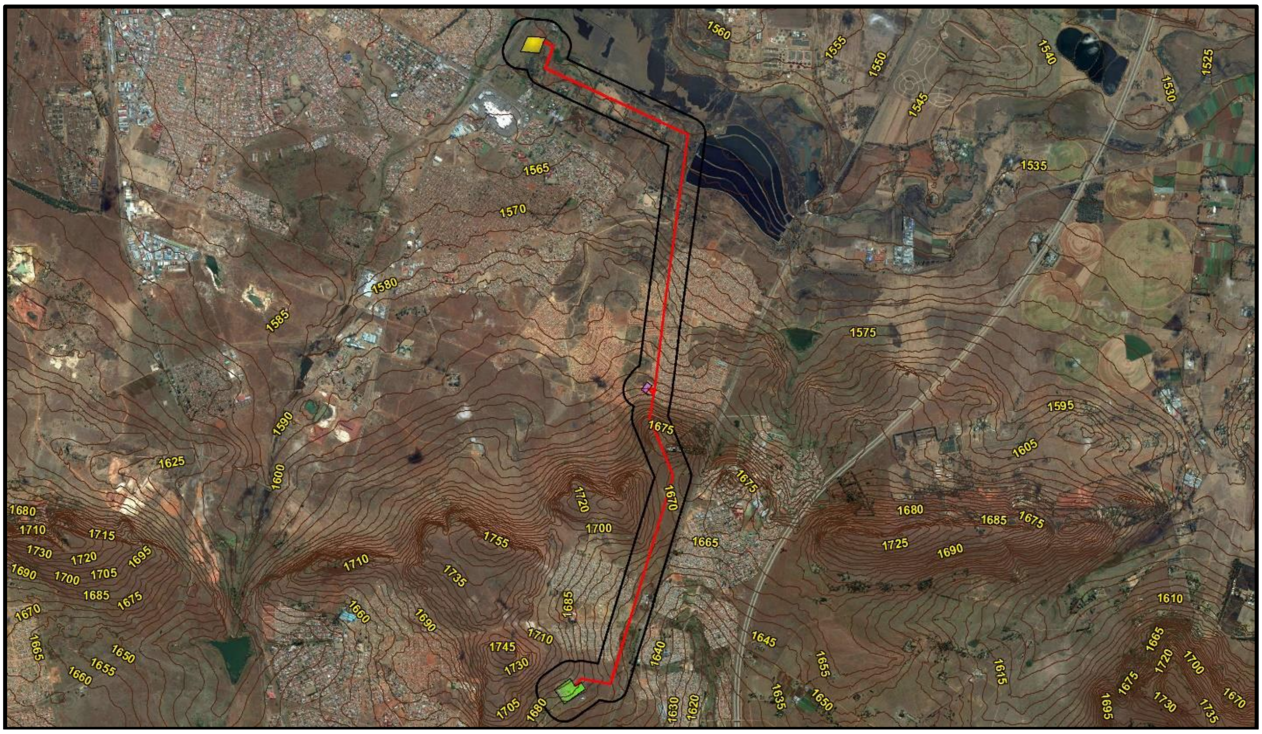


Figure 7: Topographical map of the study route

Figure 8 illustrates the topography of the Class 2 ridge on the study site, which slopes towards the existing Etna Eskom substation with an average slope of 8% over a distance of approximately 1km from the crest to the substation.

The elevation profile in Figure 9 shows the topography of a section of ridge over a distance of approximately 2km from the proposed powerline upgrade.

The topography of the Class 1 ridge is shown in Figure 9.

The topography of a small section of the Class 3 ridge on the study site is shown in Figure 10 below. This ridge is highly transformed by urban development.

Figure 8: East-northwest elevation profile of the southernmost ridge along the proposed route from Etna MTS (green polygon) (average slope 8%).

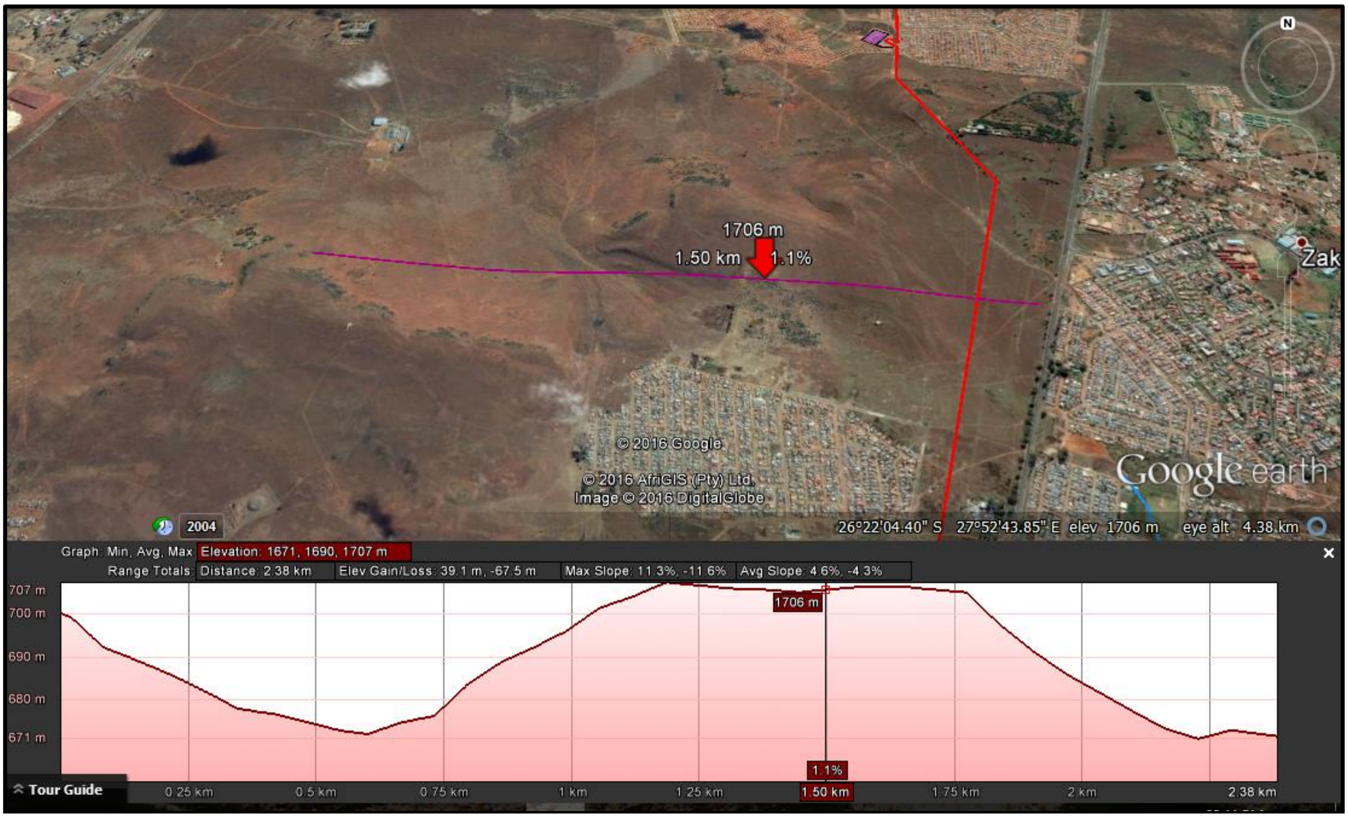


Figure 9: East-west elevation profile of a section of Class 1 ridge along the proposed route (maximum slope 11.3%).

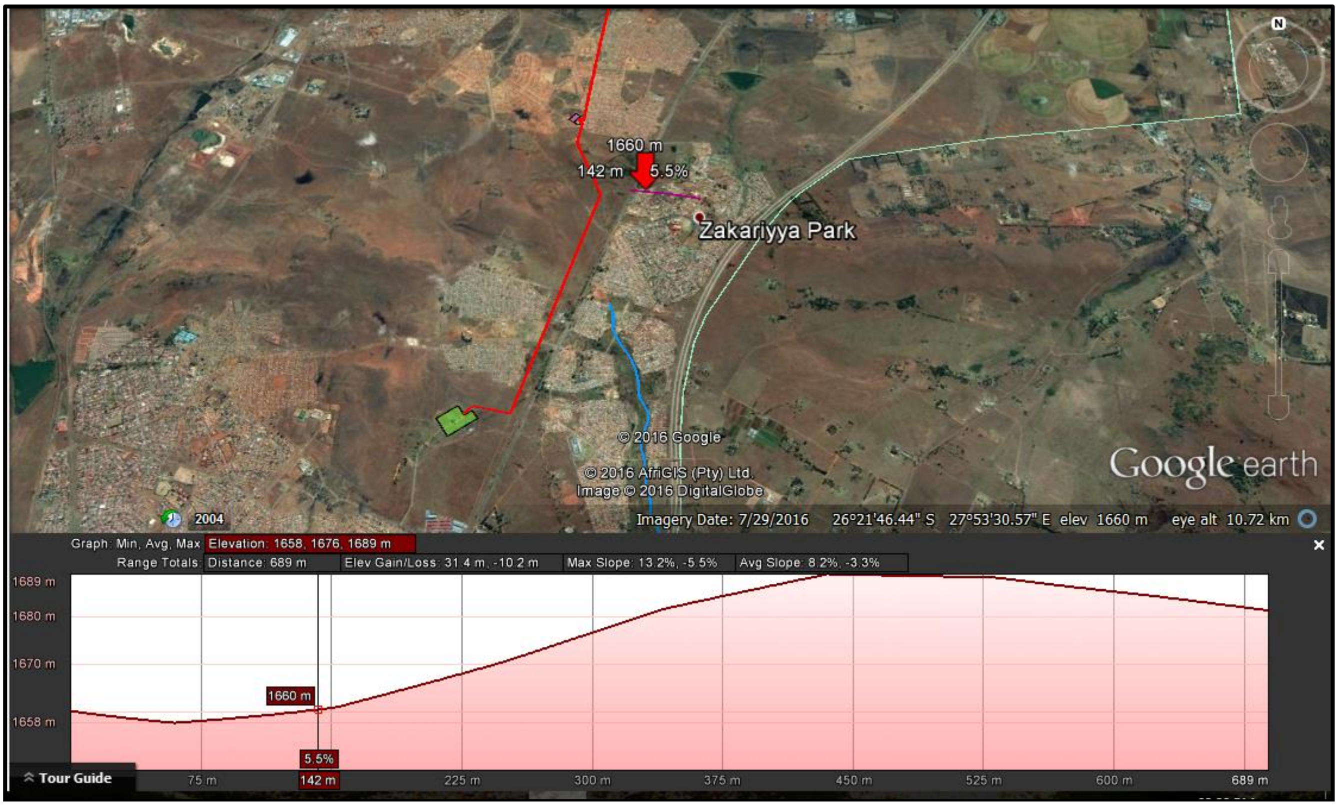


Figure 10: East-west elevation profile of a section of the Class 3 ridge along the proposed route (average slope 8.2%).

6.4 Hydrology

The proposed powerline route fall in the C22A and C22H quaternary catchments (DWS RQIS). Catchment C22A has a Mean Annual precipitation of 695mm and a Mean Annual Runoff of 31.5mm and C22H has a Mean Annual Precipitation of 639mm and a Mean Annual Runoff of 21.9. The immediate catchment slopes towards the Klip River to the north and the Rietspruit to the south.

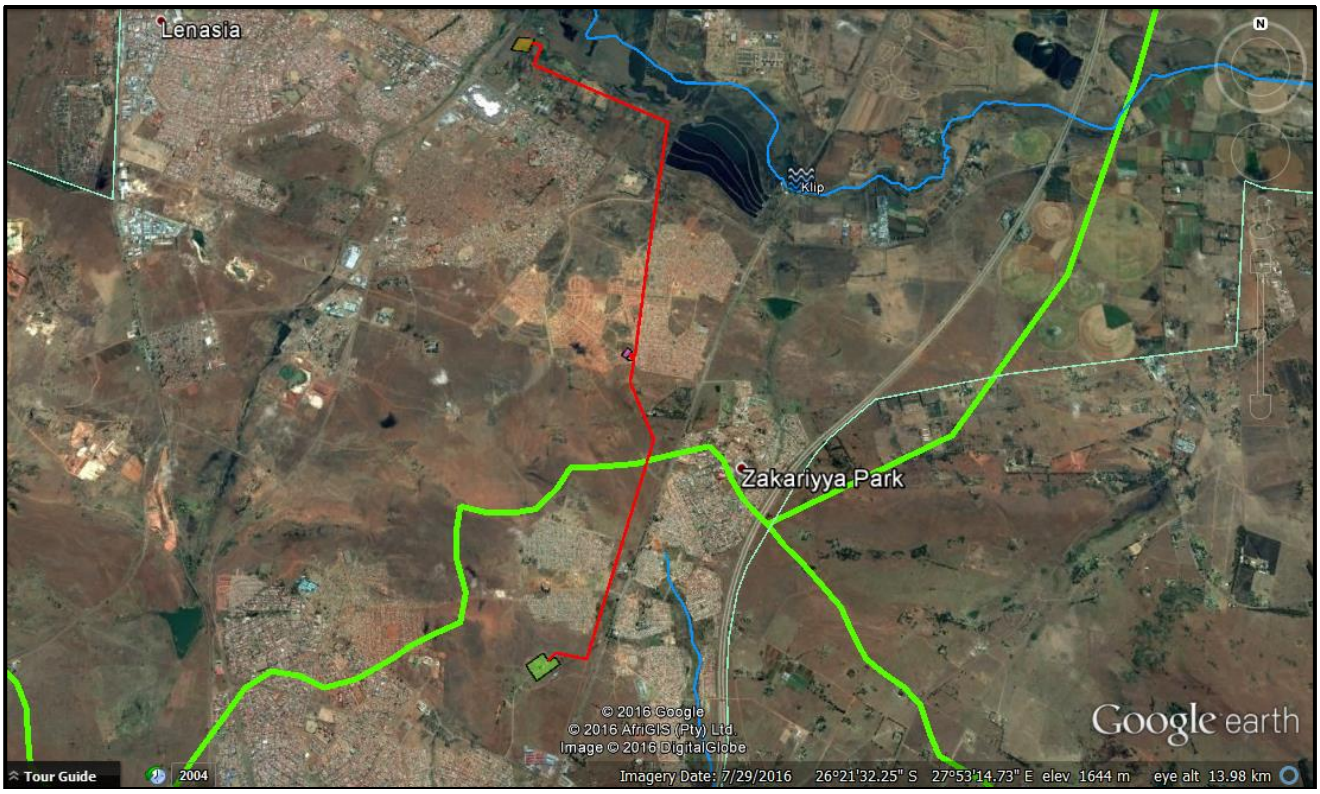


Figure 11: Aquatic systems in the study area.

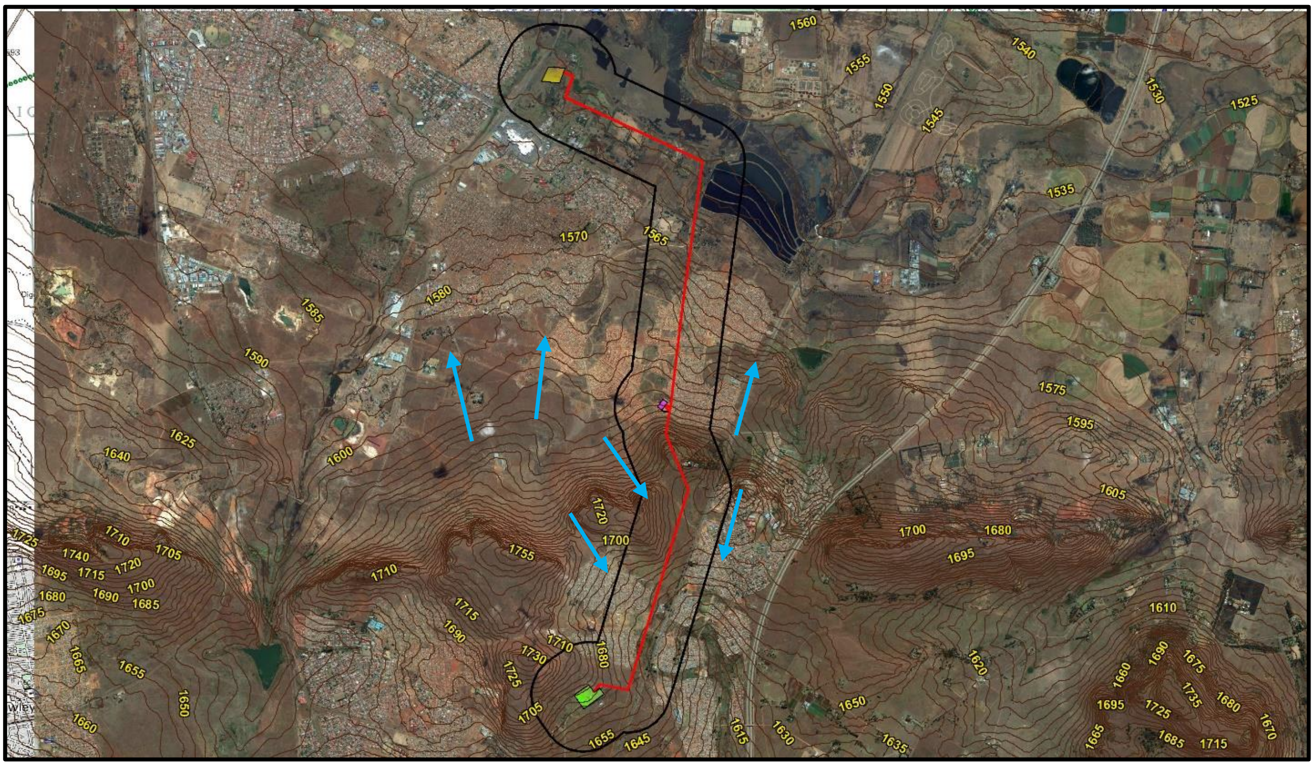


Figure 12: Drainage patterns (blue arrows) of the immediate catchment.

6.5 Vegetation

6.5.1 Regional vegetation

The study area is located in the Mesic Highveld Grassland Bioregion, more specifically spatially represented within the following ecological types (as defined by Mucina and Rutherford, 2006)

- Carletonville Dolomite Grassland (Vulnerable);
- Eastern Temperate Freshwater Wetlands (Vulnerable);
- Gauteng Shale Mountain Bushveld (Vulnerable); and
- Soweto Highveld Grassland (Endangered) (Bathusi, 2016)

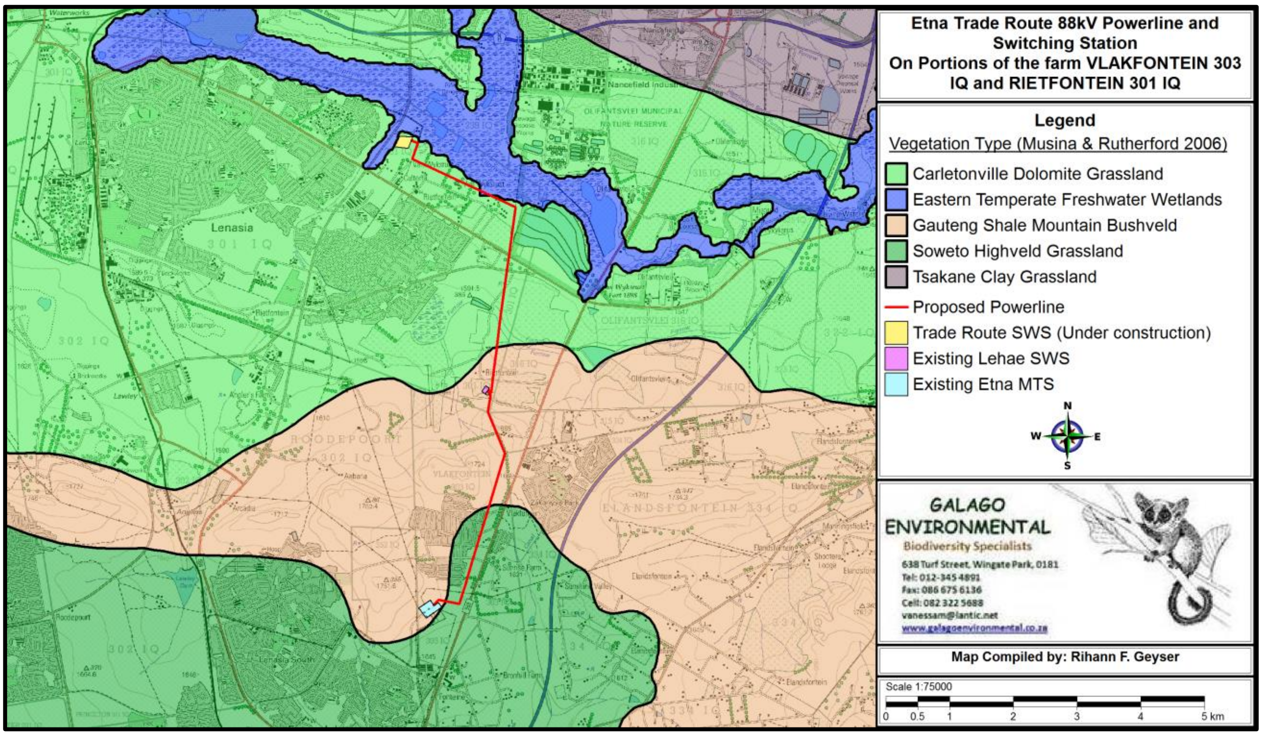


Figure 13: Vegetation types of the proposed powerline.

The landscape of the Carletonville Dolomite Grassland is highly variable with extensive sloping plains and rocky ridges that are elevated slightly above the undulating surrounding plains. The plants within this vegetation type are species-rich, wiry, sour grassland, with small shrubs growing on the rocky ridges and outcrops that occur in isolated areas within this vegetation type. Dominant grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon* and *Elionurus*. Another typical feature of this vegetation type is the high diversity of herbs, many of which belong to the Asteraceae, that grow between the grasses on the open plans. The open plains and rocky outcrops and ridges carry small pockets of sparse woodlands with *Protea caffra* and *P. welwitschii, Acacia caffra* and *Celtis africana* trees, and with shrubs such as the genus *Searsia* (*Rhus*) that grow between these trees.

Gauteng Shale Mountain Bushveld occurs mainly on the ridge of the Gatsrand south of Carletonville – Westonaria – Lenasia. It also occurs as a narrow band along the ridge that runs from a point between Tarlton and Magaliesberg in the west, through Sterkfontein, Pelindaba, Atteridgeville to Klapperkop and Southeastern Pretoria in the east. Altitude varies between 1 300 and 1 750 m. The landscape is low, broken ridges varying in steepness and with high surface rock cover. Vegetation is a short, semi-open thicket dominated by a variety of woody species including *Senegalia caffra, Searsia leptodictya, S. magalismontana, Cussonia spicata,* *Ehretia rigida, Maytenus heterophylla, Euclea crispa, Zanthoxylum capense, Dombeya rotundifolia, Protea caffra, Celtis africana, Ziziphus mucronata, Vangueria infausta, Canthium gilfillanii, Englerophytum magalismontanum, Combretum molle, Ancylobotrys capensis, Olea europaea* subsp. *europaea* and *Grewia occidentalis.* The understory is dominated by a variety of grasses. Some of the ridges form plateaus above the northern slopes that carry scrubby grassland with high surface rock cover (Bathusi, 2016).

The study site also lies in the quarter degree square 2628AD (Springs). Mucina & Rutherford (2006) classified the area as Soweto Highveld Grassland, a gently to moderately undulating landscape on the Highveld plateau supporting short to medium high, dense, tufted grassland dominated almost entirely by *Themeda triandra*, and accompanied by a variety of other grasses. It is in places undisturbed, with scattered small wetlands, narrow stream alluvia and pans. Occasional ridges or rocky outcrops interrupt the continuous grassland cover. This vegetation unit comprises shale, sandstone or mudstone, or the intrusive Karoo Suite dolerites which feature prominently. The soil is deep and red on the flat plains.

This vegetation unit is considered endangered. Its conservation target is 24%. Only few patches are conserved in statutory reserves and a few private nature reserves. Almost 50% of the unit is already transformed by cultivation, urbanization, mining and road infrastructure and some areas have been flooded by dams.

6.5.2 Site vegetation

The following micro habitat types were identified by Bathusi (2016):

- Deteriorated Grassland;
- Natural/ Rocky Grassland Matrix;
- Ridges/ Rocky Grassland Matrix;
- Transformed Areas; and
- Wetland Habitat.

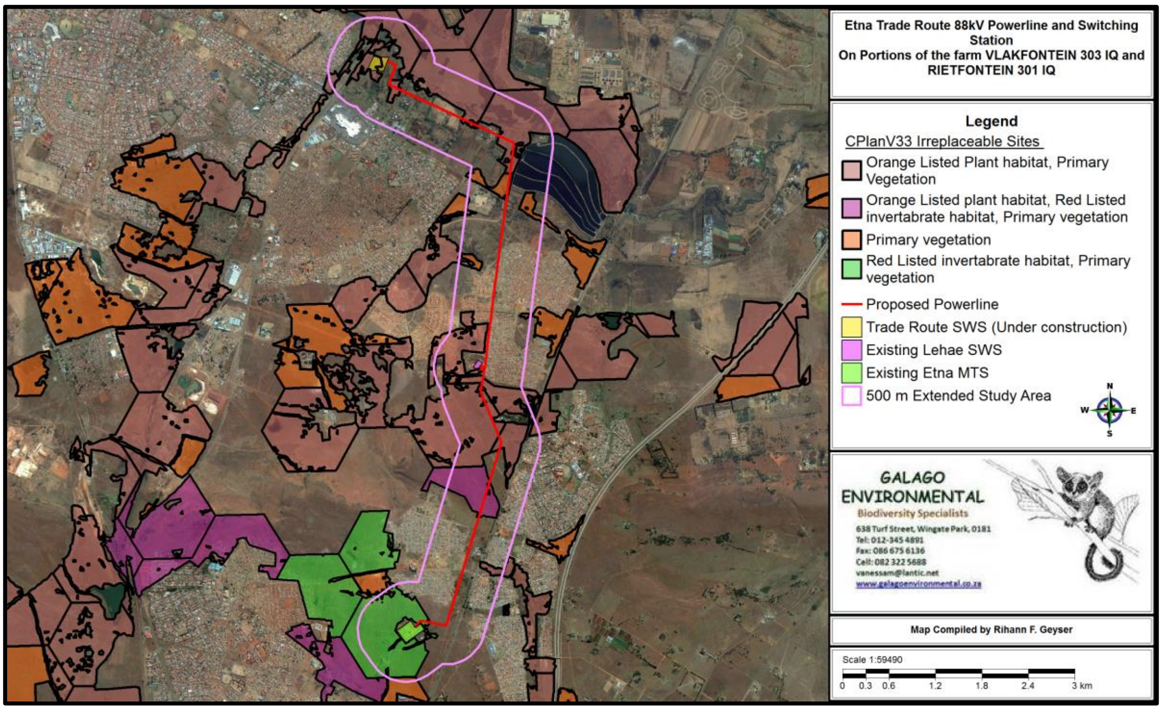


Figure 14: Irriplaceable sites (GDARD C-plan)

These plants represent pristine examples of the Gauteng Shale Mountain Bushveld, physically represented by steep slopes and high rockiness. These terrestrial rocky grasslands and outcrops are situated in upland positions (topographical unit 3); characterized by a short, low cover of herbaceous species, physiognomically dominated by grasses, but with a high diversity of forbs. A high degree of rockiness is characteristic of this unit, varying between 75 % and 30 % cover and manifesting as surface outcrops, often higher than 1 m. The exceptional diversity recorded in this unit attests to the regional diversity of these ecological types. The prominence of isolated stands of trees and shrubs is a characteristic feature of the vegetation. The present status of the vegetation unit is regarded to be a primary climax status, as is attested to by the species composition recorded within this unit (Bathusi, 2016).

Figure 15 shows that only small areas of the Class 1 and 2 ridges are transformed by urban develop, alien vegetation and cultivation. The remainder of these ridges are in pristine condition. The Class 3 ridge in Zakaryya Park is almost completely transformed by residential development.

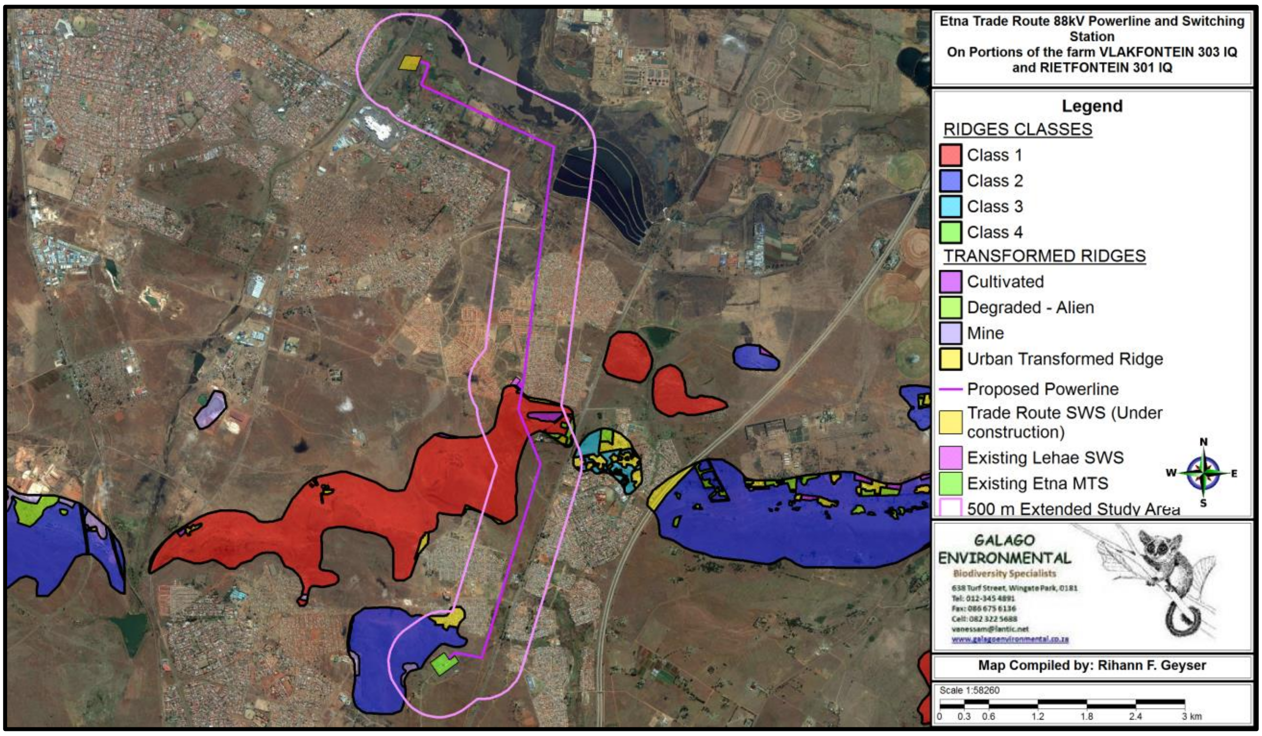


Figure 15: Ridges within 200m and around proposed powerline showing the extent and type of land use transformation on the ridges.

6.5.2 Critical Biodiversity- and Ecological Support Areas

Although the proposed route runs through Critical Biodiversity areas and ecological Support areas, the upgrading of the existing powerline, if mitigated sufficiently, should not have a high impact on biodiversity.

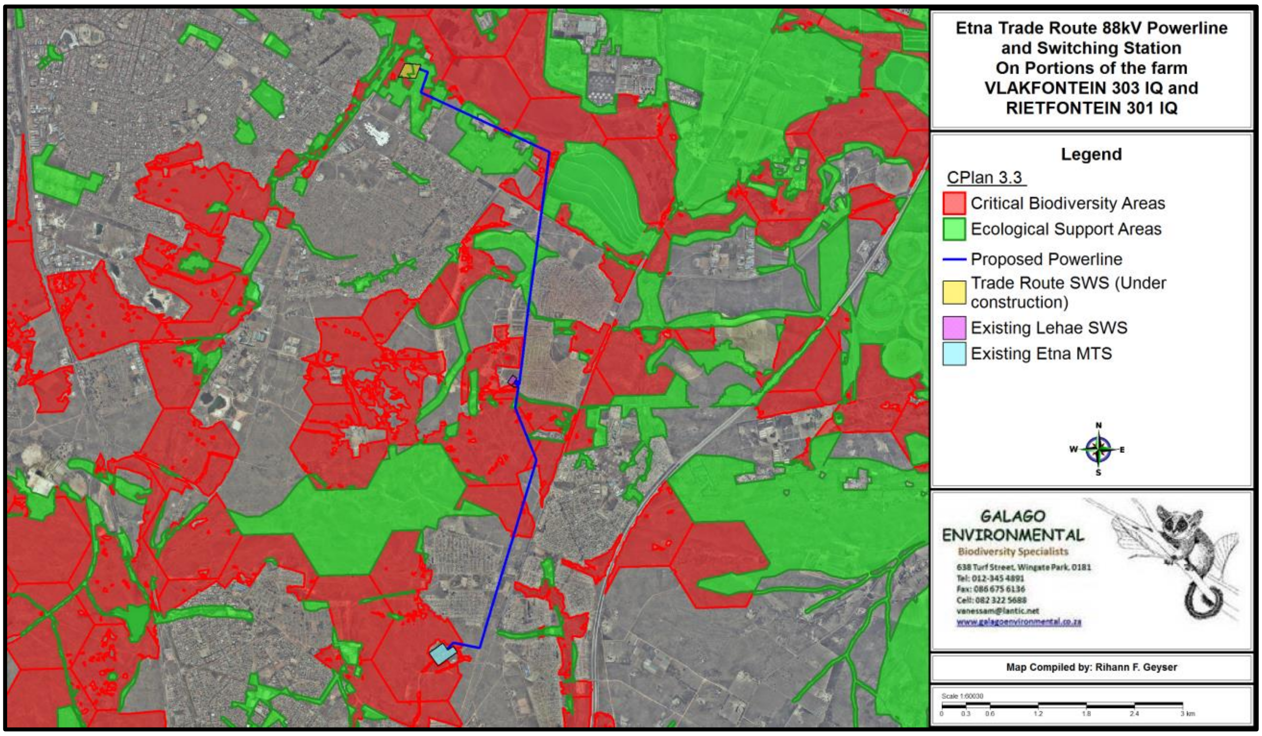


Figure 16: Critical Biodiversity and Ecological Support Areas.

6.5.3 Red data / TOPS species

The following species are regarded likely to persist in the area, based on the habitat variability and status according to Bathusi (2016):

- *Adromischus umbraticola* subsp. *umbraticola;*
- *Boophone disticha;*
- *Cineraria austrotransvaalensis;*
- *Cineraria longipes;*
- *Khadia beswickii;*
- *Lithops lesliei* subsp. *lesliei;* and
- *Myrothamnus flabellifolius*

It is recommended that the Red data species be confirmed on site during the recommended flowering times for these species (Bathusi, 2016).

According to GDARD (2016) the following Red/Orange List plant taxa have been recorded in the quarter degree grid in which the study site is situated.

- *Cineraria longipes*
- *Dioscorea sylvatica*
- *Habenaria mossii*
- *Khadia beswickii*
- *Lepidium mossii*
- *Lithops lesliei* subsp. *lesliei*

6.5.4 Alien invasive species

The alien vegetation that was found on the ridge area included *Eucalyptus* spp. and *Acacia dealbata* and *Acacia mearnsii*. The cover of alien vegetation on the ridges constitutes less than 5% of vegetation on the ridges and can be relatively easily controlled.

6.6 Fauna

6.6.1 General Faunal species

The forty-four animals recorded in the study area represent species that are commonly recorded in the region where natural ecological processes within the rocky grassland and wetland habitats of the area are retained. No evidence of the presence of species of conservation concern (red data or otherwise) were made during the field investigation (Bathusi, 2016). The total of 44 faunal species found by Bathusi (2016) included:

- 6 insect species;
- 36 bird species; and
- 2 mammal species.

6.6.1 Red data / TOPS species

Habitat diversity and status of the study area and surrounds is suitable for some species of conservation concern. Consequently, it is estimated that the Southern African Hedgehog and the African White-tailed Rat, exhibit at least a medium possibility of occurrence for the study area while the Highveld Blue are estimated to exhibit a highly likely presence in the area as a result of suitable habitat (Bathusi, 2016).

6.7 Habitat

The ridges on the study site (within 200m of proposed powerline) falls in the Gauteng shale mountain bushveld. There is no arboreal component on the ridges, except for a small area of indigenous closed savanna on a section of the north-facing slope of the Class 1 ridge on site, and some scattered alien trees. Rupiculous habitat is plentiful, ranging from rocky grassland to larger boulders on the Class 1 ridge.

The majority of the Class 1 & 2 ridges on site are in prinstine condition with minor disturbances by urban development and some related impacts including illegal rubble- and chicken slaughter waste dumping. The cover of alien vegetation on the ridges constitutes less than 5% and can be relatively easily controlled, since these are mostly larger trees including *Acacia mearnsii* and *Eucalyptus spp*.

Figure 16 illustrates a range of ridge habitats along the proposed powerline in Table 2 below.

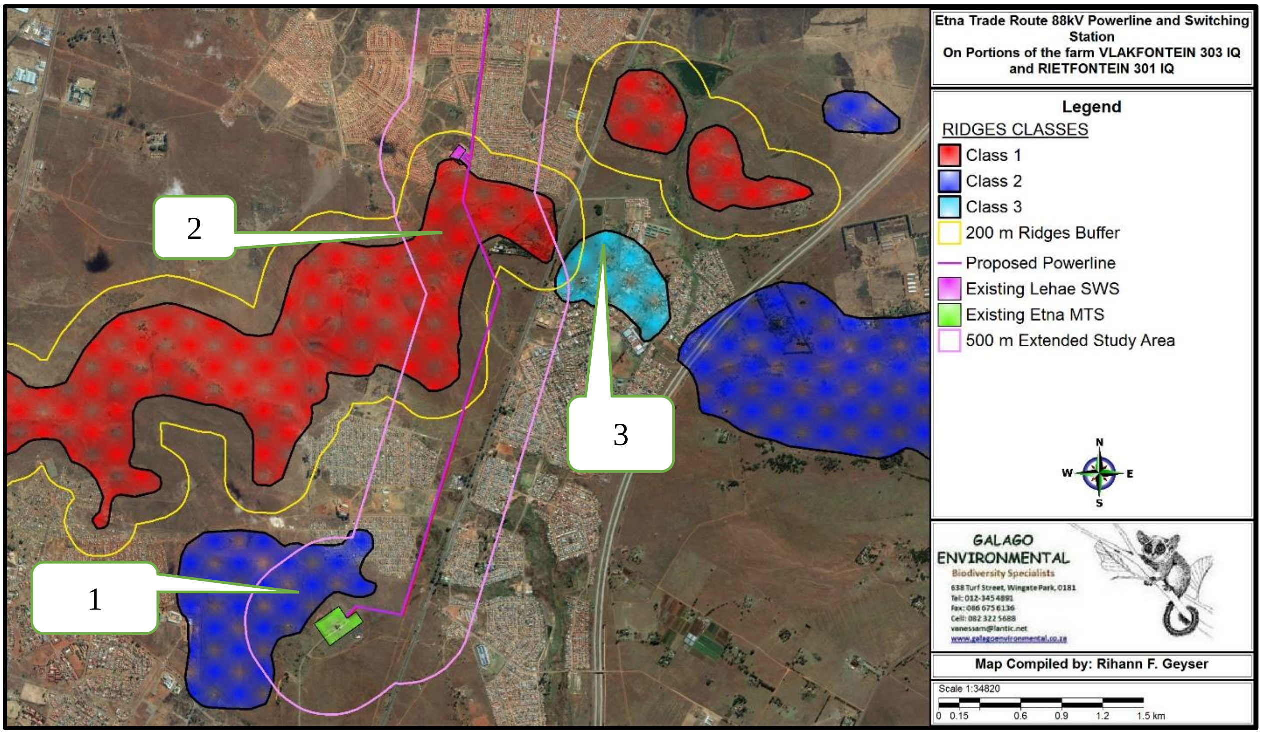


Figure 17: Locality of the assessed ridge areas along the proposed powerline

Table 2: The range of habitats along the proposed powerline

1: View from Koppie 1 in a southeasterly direction. The majority of the substrate is rocky quartzite with shallow soils	
1: View from Koppie 1 in an easterly direction towards the existing powerline. A moderate range of micro-climatic environments were created by rupicuous habitat in the form of rocky grassland	

2: View from Koppie 2 in a northern direction showing the undulating terrain from east to west and urban development in the far background. There is an illegal waste dump in the area where the smoke originates from (burning of waste).	
2: View of Koppie 2 in a westerly direction showing the indigenous closed canopy savanna patch on the northern slope of a section of the Class 1 ridge.	
3: View of Koppie 3 in an eastern direction. This ridge has been mostly transformed by urban development and only a small portion of this ridge has natural vegetation cover.	

Figure 18. Termitaria on the Class 2 ridge showing foraging by mammals

6.8 Utilization of specimens

No utilisation of species were noted on site, however some activities negatively impact the habitat, including illegal dumping of building rubble and waste, illegal burning of waste and, to a lesser extent, footpaths.

6.9 Connectivity

Ecological connectivity of the study area is poor and some of the untransformed faunal habitat fragments of the study area have been degraded to some extent. Human disturbance factors such as noise, dust, physical presence of movement and setting of snares further accounts for the low faunal species richness of the study area (especially for small and medium-sized mammals) (Bathusi, 2016).

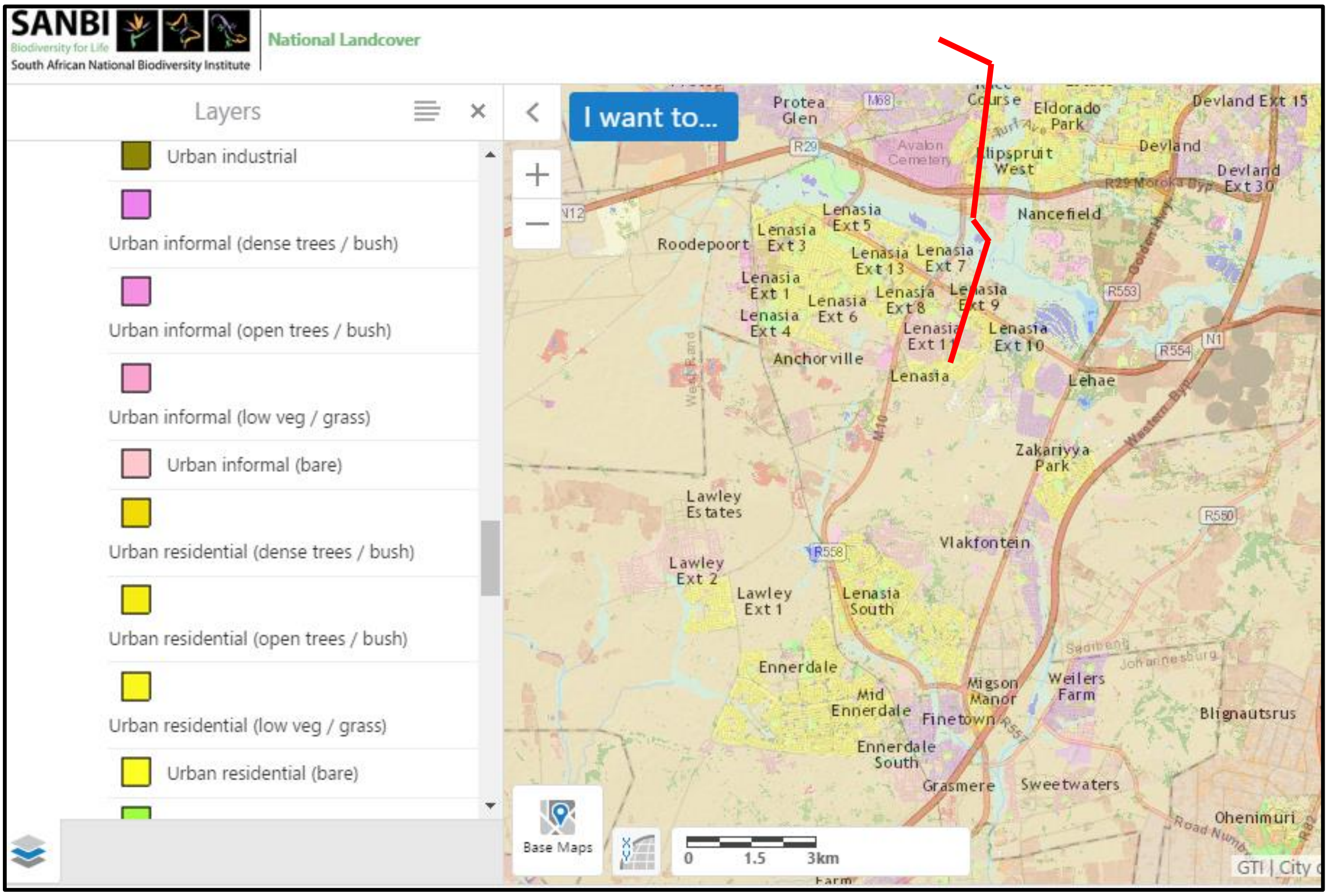


Figure 19: Landcover map (BGIS, accessed 2016) indicating the proposed route in red.

There are still large areas of pristine and near-pristine habitats on the Class 1 and 2 ridges on the study site. Connectivity is essentially limited by the R553 to the east, the R558 to the west and south and the R554 to the north. However, except for the roads mentioned, connectivity to the southwest of the ridges is relatively good, where the landuse is mostly agricultural.

6.10 Service provision and access

The proposed powerline upgrade and associated switching station will provide surrounding areas with electricity. The existing powerline will be upgraded between Etna and Lehae substations and will be extended to link with the new Trade Route Switching station. Construction-, inspection- and maintenance roads will be required along the powerline route. It is recommended that the existing two-track roads be utilised.

6.11 GDARD requirements for ridge buffers

The Class 1 ridges and a buffer area of 200 meters are indicated on Figure 20. The buffer zone is in line with the GDARD minimum requirements, 2014. The Class 2 ridge is mostly untransformed and impacts are less on this ridge than on the Class 3 ridge, which is mostly transformed. With the implementation of all specialist mitigation measures, the powerline can be upgraded without causing severe or long-lasting impacts.

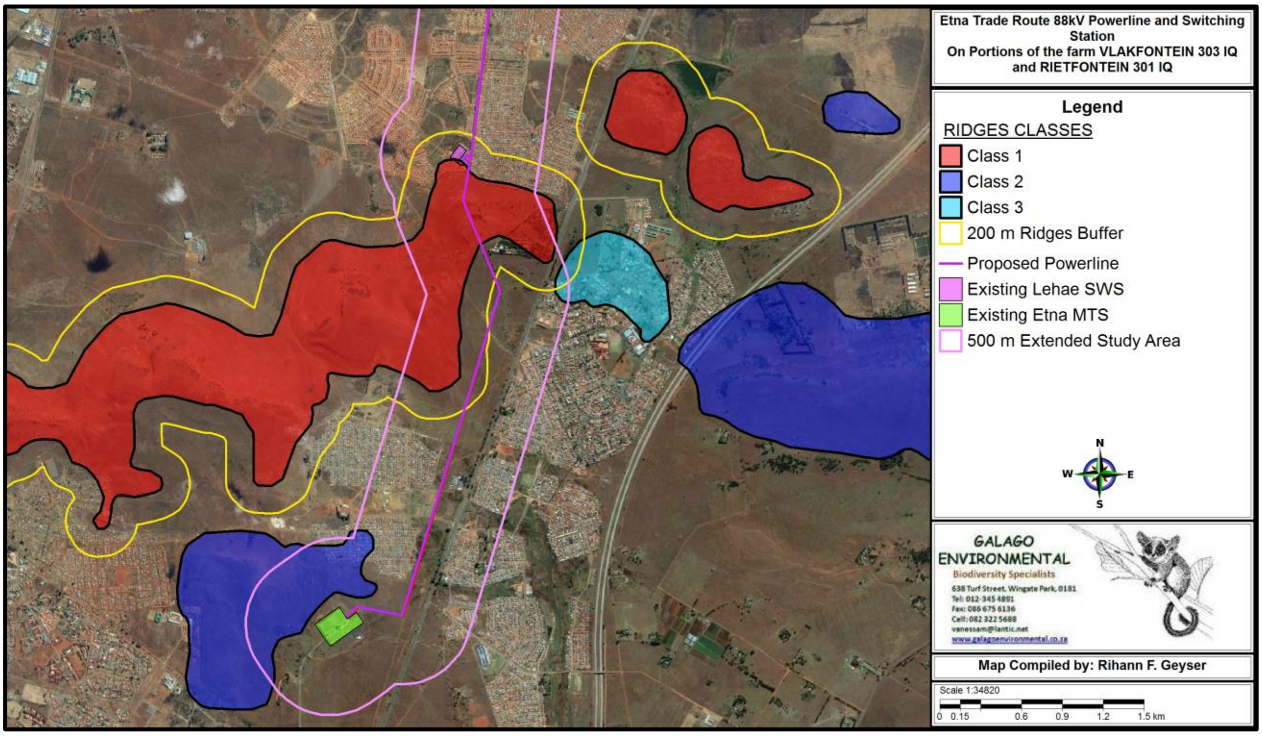


Figure 20: Class 1 ridges with their 200m buffer zones, as well as Class 2 & 3 ridges.

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

Only the ridges within 200m of the proposed route were surveyed, as the other ridges (more than 200m away) will not be impacted by the proposed activity.

Relevant biodiversity specialist reports were consulted, as the author of this report does not claim to be a specialist in those particular fields.

The GDARD minimum requirements (Version 3, 2014) and GDACE Ridge Policy Guidelines (2001) are the only guideline documents from which the ridge report is constructed. However, research also included related scientific journal articles.

8. IMPACT RATING AND DISCUSSION

Anthropogenic impacts, such as clearing of vegetation for agriculture, forestry, building of roads or installing services, may lead to negative effects on the environment. These effects are controlled in large part by their intensity, duration, frequency, timing, and the size and shape of the area affected. Impacts on communities and ecosystems can have surface and subsurface effects, such as habitat structure, species-diversity and -richness alterations, nutrient cycling and productivity losses, decline in migration patterns and exchange of genetic material.

Land-use changes that modify natural disturbance regimes or initiate new disturbances are likely to cause alterations in species richness and distribution, community composition, and ecosystem function. Furthermore, the susceptibility of an ecosystem to other disturbances may be altered (ESA, 2000).

According to the Oxford English Dictionary, **integrity** is "the state of being whole and undivided", "the condition of being unified or sound in construction". Therefore, it is said that a system subject to external disturbance will retain its integrity if it preserves all its components as well as the functional relationships among the components. Karr and Dudley (1981) define integrity as "the capability of supporting and maintaining a balanced, integrated, adaptive, community of organisms having species composition, diversity, and functional organization comparable to that of natural habitats of the region". Ecosystems are organized **structurally** into populations, species, and communities of organisms that interact with each other and with abiotic features of the environment, and **functionally** into production and consumption components that process energy and materials (De Leo & Levin, 1997). Eldridge et. al. (2015) found that even lower grazer densities negatively affect ecosystems in Australia, especially when accounting for attributes such as vegetation litter, -abundance, -cover and faunal richness.

Current illegal dumping is negatively impacting the habitat. There are only a few impacts from the existing powerline including footprint around pylons (only a few) and maintenance roads (servitudes) that show some erosion.

Table 3: Impact classes

Impact scale	Impact Rating	Implication
Low	0.0 – 3.3	Minimum impact with low ecological risk
Medium	3.4 – 6.6	Medium impact requiring mitigation and control, some rehabilitation will be necessary
High	6.7 - 10	High impact requiring more intensive mitigation, control and rehabilitation

Table 4: Criteria for rating the extent or spatial scale of impacts (DEAT, 2002))

Rating	
High	Widespread. Far beyond site boundary. Regional/national/international scale.
Medium	Beyond site boundary. Local area.
Low	Within site boundary.

Table 5: Criteria for rating the intensity or severity of impacts (DEAT, 2002)

Rating	
High	Disturbance of pristine areas that have important conservation value. Destruction of rare or endangered species.
Medium	Disturbance of areas that have potential conservation value or are of use as resources. Complete change in species occurrence or variety.
Low	Disturbance of degraded areas, which have little conservation value. Minor change in species occurrence or variety.

Table 6: Criteria for rating the duration of impacts (DEAT, 2002)

Rating	
High (Long term):	Permanent. Beyond decommissioning. Long term (More than 15 years).
Medium (Medium term):	Reversible over time. Lifespan of the project. Medium term (5 - 15 years).
Low (Short term):	Quickly reversible. Less than the project lifespan. Short term (0 - 5 years).

Table 7: Criteria for rating the mitigatory potential of impacts (DEAT, 2002)

Rating	
High:	High potential to mitigate negative impacts to the level of insignificant effects.
Medium:	Potential to mitigate negative impacts. However, the implementation of mitigation measures may still not prevent some negative effects.
Low:	Little or no mechanism to mitigate negative impacts.

Table 8: Impact determination for the proposed activity

Impact Category	Ecosystem aspect	Severity	Spatial scale	Duration	Impact Score = Sum Aspects x 0.33*	Mitigation	Post-mitigation Impact score = Impact score - {Impact score x Mitigation x 0.1}
Compositional Impacts	Biotic factors	6	5	5	5	5	2.5 (2)
	Abiotic factors	7	5	5	5.7	4	2.3 (2)
	Range/ gradient	6	5	5	5	5	2.5 (3)
Functional Impacts	Energy Flow	3	5	4	4	2	0.8 (1)
	Nutrient cycling	3	5	4	4	2	0.8 (1)
	Ecosystem regulation	4	5	4	4	2	0.8 (1)
Total Impact Score = Sum Impact scores x 0.166*					**4.6**	**Total Post Mitigation Impact Score**	**3.25**

The following ecological concepts provide supplementary information on the relevant ecosystem aspects (Oliver *et al,* 2015; Pujari, Accessed Jun 2016) incorporated in the impact rating table above:

Biotic factors constitute the composition of biological communities and include species richness, -diversity, abundance, density, biomass, life history, distribution or movement.

Abiotic factors constitute the composition of the abiotic environment and include substrate, moisture content, nutrients and solar energy. Slope stability changes, as an example, can influence numerous abiotic factors.

Range/Gradient includes factors such as temperature, light provided by various aspect, slope and topographical diversity.

Energy flow includes mainly the production- and respiration rates of the community. Buildup of energy in vegetation is evident in moribund areas. Abiotic factors, such as solar energy, nutrients and water influence energy flow.

Nutrient cycling can be affected by the rate of decomposition, as well as addition to or removal of nutrients by adding or removing biotic material (of which N, H, O are the main elements) or abiotic material (trace minerals, such as Fe, Zn and Mg). Fire is a necessary disturbance that stimulates seed germination in certain species (such as the *Protea spp*), however can also be detrimental to the ecosystem if it occurs too frequently.

Ecological regulation includes both alteration of organisms by the environment (e.g. photoperiodism) and alteration of the environment by the organism (e.g. nitrogen fixing organisms). Therefore any alteration of soil- or substrate properties, vegetation (including seedbank), hydrological and topographical aspects will have a degree of impact on the existing environment.

The proposed powerline upgrade is supported if all specialist mitigation measures are implemented.

Figure 21: Footprint of the existing pylon at Etna substation. Vegetation cover must be reinstated following installation of pylons.

9. RECOMMENDED MITIGATION MEASURES

The following mitigation measures are proposed if the proposed powerline is to be constructed:

- Bird flight diverters must be installed on the earth cable to minimise impacts on birdlife
- Illegal waste dumping should be controlled
- The occurrence of red and orange listed plant species must be investigated
- Keep activities in the ridge areas to a minimum and keep all construction material out of these sensitive areas
- Erosion prevention must be implemented during construction, as well as during the operational phase on maintenance roads and servitudes. The erosion caused by the existing two track road is moderate but should however be managed, as sections of this road do not run along the natural contours of the landscape.
- Installation of the powerline should take place in the dry season to prevent erosion of the ridge caused by sheetwash.
- Installation of the powerline should be done in sections and all excavations for installation of pylons must be closed and rehabilitated in the shortest time possible. Avoid leaving the excavations open for an extended period of time, as this is a death trap for small mammals and herpetofaunal species.
- A powerline maintenance plan should be compiled and should include conditions on minimising impacts during maintenance and emergency procedures

- The Environmental Management Plan (EMP) and Environmental Authorisation (EA or ROD) must be strictly adhered to during construction and operational phases
- The areas indicated as sensitive must be retained as open spaces in the landscape
- Indigenous vegetation cover must be reinstated following installation of pylons.

The following are applicable general mitigation measures of the GDARD requirements for biodiversity (2014):

- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science.
- Any post-development re-vegetation or landscaping exercise should use species indigenous to South Africa. Plant species locally indigenous to the area are preferred. As far as possible, indigenous plants naturally growing along the route, but would otherwise be destroyed during construction, should be used for re-vegetation / landscaping purposes.
- All stormwater structures on maintenance roads should be designed so as to block amphibian and reptile access to the road surface.
- Where maintenance roads traverse natural corridors such as streams and ridges, traffic control measures are recommended (e.g. 60km/h speed limits and speed bumps).

10. CONCLUSION

Ridges are sensitive areas where biodiversity is generally higher than the surrounding landscape as a result of the topographical diversity. Ridges provide habitat for important conservation species and must be protected. The Gauteng Ridge Guidelines Policy (2001) provides the criteria for ridge classes and specifies the acceptable level of development.

Although no development may take place on the Class 1 ridges and a 200m buffer zone must be implemented around these ridges, it is the findings of this report that the proposed activity will pose minimum risk to the habitat and biodiversity of the ridges, should all mitigation measures be implemented and should the contractors be guided by an ECO on a daily basis for the period of installation. As the proposed powerline installation is of relatively short duration, it is possible to minimise impacts on the ecology of the ridge, which must include rehabilitation of the affected areas.

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