PROPOSED TAUNUS-DIEPSKLOOF 132kV POWERLINE and PROPOSED SUBSTATIONS Gauteng Province

Vegetation Assessment

Date: November 2015

Report drafted for:

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The Environmental Impact Assessment Regulations (Government Notice No. R982 of 4 December 2014), requires that certain information is included in specialist reports. The terms of reference, purpose of the report, methodologies, assumptions and limitations, impact assessment and mitigation (where relevant to the scope of work) and summaries of consultations (where applicable) are included within the main report. Other relevant information is set out below:

Expertise of author:

- Working in the field of ecology, and in specific vegetation related assessments, since 2007;
- Is registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions in the field of ecology (Reg. No. 400019/11); and
- Has been working with plants indigenous to South Africa since 1997.

Declaration of independence:

Dimela Eco Consulting in an independent consultant and hereby declare that it does not have any financial or other vested interest in the undertaking of the proposed activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998). In addition, remuneration for services provided by Dimela Eco Consulting is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.

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Based on information provided to Dimela Eco Consulting by the client, and in addition to information obtained during the course of this study, Dimela Eco Consulting present the results and conclusion within the associated document to the best of the authors professional judgement and in accordance with best practise.

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Antoinette Eyssell Date

SACNASP Reg. No. 400019/11

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EXECUTIVE SUMMARY

Envirolution Consulting (Pty) Ltd is undertaking the environmental authorisation process for the construction of the proposed Eskom 132kv powerline between the existing Taunus and Diepkloof substations, Gauteng. In addition, two new substations, situated between Taunus- and Diepkloof substations, are proposed namely Substation 1 and Substation 2. Two alternatives for Substation 2 is proposed.

As part of the Environmental Impact Assessment (EIA) process, Envirolution Consulting appointed Dimela Eco Consulting, to undertake a vegetation assessment of the area proposed for the development. The terms of reference was interpreted as follows:

- Status quo and description of the vegetation found to be present along the proposed powerline route and alternatives, as well as the proposed substation localities;
- Comparison of the findings with the regional vegetation expected to occur and the Gauteng Conservation Plan;
- Localities of plants or plant communities that are of conservation concern (e.g. Red Data listed species) that were confirmed to occur or are likely to occur;
- Assessment of the expected impacts that the proposed development could have on the vegetation observed, as well as cumulative impacts on nearby sensitive vegetation communities – if present; and
- Recommendations to conserve threatened species or sensitive vegetation groupings if found to be present.

The assessment entailed a literature review which included short listing plants of conservation concern that could potentially occur on or in the vicinity of the proposed powerline routes and substation localities, a two day site visit to the proposed area and reporting. The site visit undertaken on the 20th and 21st of October 2015. At the time of the site visit, the area was dry as limited rainfall was experienced. In addition, portions of vegetation along the powerline routes were grazed short or burnt, which hampered positive identification of grasses in particular. Some plants might have been dormant or not in flower at the time of the site visit, and therefore possibly overlooked. Some areas were inaccessible during the time of the site visit; for example the property owned by the nuclear fuels corporation of South Africa.

The proposed powerline development is situated in the vicinity of Soweto in the Gauteng Province. The proposed 132kV line will originate in the western extent of the proposed development at the existing Taunus substation, situated on the farm Zuurbekom 297 IQ. From here the line will align across the R559 in a westerly direction. It then turns south on the western boundary of the West Rand Garden Agricultural holdings after which the line crosses the N12 and deviates in an easterly direction. It crosses the farm Zuurbekom 297 IQ and continues east traversing Olifantsvlei 316 IQ adjacent to the N12 thereafter crossing the Klip River and running just south of the Nancefield Industrial Area. The line

thereafter aligns north, crossing the N12, the R553 and the Chris Hani Road (M68) before connecting to the existing Diepkloof substation. Two deviations to the line is proposed: Deviation 1 will be located to the south of the West Rand Agricultural Holdings and traverses the farm Zuurbekom 297 IQ. It runs south of the primary alignment for this section of the line. Deviation 2will be located to the south of the Klip River near Lenasia. It is situated south of N12 and to the south of the primary alignment in the area of the Moroka Bypass on the N12. The proposed development will also include the construction of two new substations on the farm Zuurbekom 297IQ.

Hydrology

Existing spatial layers indicated that much of the eastern extent of the proposed powerline, and in particular Deviation 2, will traverse the perennial Klip River and associated wetland areas, as well as some of the Klip River tributaries.

National vegetation map and listed ecosystems

The majority of the proposed powerline and substation localities are situated in the Grassland Biome with a small portion of the north-eastern extent of the proposed powerline, just south of the Diepkloof substation, situated in the Savanna Biome. Grassland. The grassland vegetation types traversed by the proposed development includes, the Soweto Highveld Grassland (Endangered), the Tsakane Clay Grassland (Endangered) and the Carletonville Dolomite Grassland (Vulnerable). The portion of savanna falls within the Andesite Mountain Bushveld (Least Threatened), while wetland areas forms part of the Eastern Temperate Freshwater Wetland (Endangered). The eastern portion of the proposed powerline route will be situated within the original extent of the Kliprivier Highveld Grassland ecosystem that is listed as a Critically Endangered ecosystem by Section 52(1) (a) of the National Environmental Management: Biodiversity Act (Government Gazette 34809, Government Notice 1002, 9 December 2011).

Gauteng Conservation Plan and Ridges

As per the Gauteng Conservation Plan (C-plan), CBA: Important areas, as well as Ecological Support Areas (ESAs) are present along the eastern extent of the proposed powerline route. The Important areas are set aside as it likely comprises primary vegetation and include sensitive landscape features such as wetlands. ESAs provide vital connections between areas of high or critical biodiversity importance and are therefore not necessarily good condition or primary vegetation, nonetheless it plays an important role in maintaining biodiversity. These areas also coincide with the Klipriviersberg Highveld Grassland Ecosystem. A portion of the proposed powerline will traverse the Olifantsvlei Municipal Nature Reserve, under the management of City of Johannesburg Metropolitan Municipality. The proposed powerline will traverse a small portion of the Kliprivierberg, which is classified as a Class 3 ridge as defined by the Gauteng Guideline for Developing on Ridges.

Results

The proposed Tanus Diepkloof 132 KV line traversed semi-natural grassland, bushveld and wetland vegetation, as well as large portions of transformed land that included pastures and fallow lands.

The broad vegetation groups comprised:

1. Secondary and historically disturbed grassland,
2. Disturbed Mountain Bushveld,
3. Moist grassland and wetland, and
4. Transformed land (pasture, fallow lands and built up areas including roads and railways).

1. Vegetation associated with the **moist grassland** was classified as being of high sensitivity, taking into account that the vegetation is important in maintaining the functionality thereof and that all watercourses are protected by national legislation. The moist grassland is also situated within an Important area of the Gauteng C-plan. Although vegetation associated with some of the moist grasslands were disturbed with a degree of alien vegetation, the vegetation is highly functional in preventing soil erosion and degradation of surrounding vegetation, as well as downstream watercourses.
2. **The mountain bushveld** is present on the class 3 ridge portion, as well as important conservation areas according to C-plan. Hoever, the vegetation group was found to be severely degraded. No provincially protected plant species were observed during time of the site visit. Species diversity was not high and there was a vast number of alien invasive species present. Habitat loss for plant species occurred in this vegetation group due to trampling, grazing as well as rubble and rubbish dumping. Sensitive and protected plants may have been lost due to the loss of habitat. Therefore it was regarded as being of medium to low sensitivity to the proposed development.
3. The **secondary and disturbed grassland** comprised mainly of land that was historically cultivated or disturbed and typically included a higher frequency of pioneer species, a low diversity of indigenous species and a low basel cover. It is assumed that cultivation removed plant species of conservation concern from these areas. Only one individual of a Declining species was noted in this vegetation group and it was classified as medium to low sensitivity.
4. Transformed areas had limited to no natural habitat remaining and therefore are of low sensitivity to the proposed Tanus-Diepkloof 132 kV line.

Impact statement

The greatest impact of the proposed development on vegetation is expected to occur in the disturbed moist grasslands. Due to the transformed and disturbed state of the remainder of the vegetation, the impacts are envisaged to be minimal. The most significant impact is expected to occur during the construction phase. While the excavation of soil for the base of pylons would remove vegetation, the vegetation could be replanted after the construction and its re-establishment monitored to ensure that the soil and vegetation rehabilitated. The greatest threat to the rehabilitation of the land disturbed by

construction (in the mountain bushveld, secondary grassland, moist grassland and transformed vegetation), are the potential of invasive plant species to colonise the disturbed soil and spread into adjacent natural areas. If remedial measures and monitoring is properly employed, the vegetation that will be disturbed during construction could rehabilitate well over time, and long term impacts on vegetation and faunal habitats could thus be minimal.

Prior to the commencement of the construction activities it is recommended that all building rubble and domestic wastes should be removed from the footprint area of the proposed Tanus-Diepkloof line. Not only are these piles of rubble and rubbish harmful to the health of the workers whom will be constructing the proposed line but it also limits the habitat for vegetation to grow and re-establish. During rehabilitation, waste skips should be placed on intersections with main roads for the community to dispose of their wastes and allow the re-establishment of vegetation in the footprint area.

The preferred Taunus-Diepkloof 132kV line does not pose any significant threat to the vegetation and are supported from a vegetation perspective. The preferred route and Deviation 1 are considered as feasible options if all of the mitigation measures and recommendations are adhered to. Deviation 2 traverse a large section of the sensitive moist grassland vegetation group and is not considered a feasible option. Due to transformed state of the vegetation at the preferred substation site, as well as the alternative site, no long term impact on natural vegetation is likely to occur. However, both sites included signs of elevated soil moisture. The wetland assessment report needs to be consulted with regards to the functionality of these transformed / artificial moist grasslands and which site would have the least impact on hydrology.

In conclusion, the proposed development could proceed provided that the mitigation measures a set out in this report is implemented as a minimum.

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1. INTRODUCTION

Envirolution Consulting (Pty) Ltd is undertaking the environmental authorisation process for the construction of the proposed Eskom 132kv powerline between the existing Taunus and Diepkloof substations, Gauteng. In addition, two new substations, situated between Taunus- and Diepkloof substations, are proposed namely Substation 1 and Substation 2. Two alternatives for Substation 2 is proposed.

As part of the Environmental Impact Assessment (EIA) process, Envirolution Consulting appointed Dimela Eco Consulting, to undertake a vegetation assessment of the area proposed for the development.

1.1 Terms of reference

The terms of reference was interpreted as follows:

- Status quo and description of the vegetation found to be present along the proposed powerline route and alternatives, as well as the proposed substation localities;
- Comparison of the findings with the regional vegetation expected to occur (Mucina & Rutherford, 2006) and the Gauteng Conservation Plan (GDARD, 2011);
- Localities of plants or plant communities that are of conservation concern (e.g. Red Data listed species) that were confirmed to occur or are likely to occur;
- Assessment of the expected impacts that the proposed development could have on the vegetation observed, as well as cumulative impacts on nearby sensitive vegetation communities – if present; and
- Recommendations to conserve threatened species or sensitive vegetation groupings if found to be present.

1.2 Assumptions and Limitations

Vegetation studies should be conducted during the growing season of all plant species that may potentially occur. This may require more than one season's survey with two visits undertaken preferably during November and February. However, this report relied on a single site visit undertaken on the 20th and 21st of October 2015.

At the time of the site visit, the area was dry as limited rainfall was experienced. In addition, portions of vegetation along the powerline routes were grazed short or burnt, which hampered positive identification of grasses in particular. Some plants might have been dormant or not in flower at the time of the site visit, and therefore possibly overlooked. Some areas were inaccessible during the time of the site visit; for example the property owned by the nuclear fuels corporation of South Africa. The entire length of the line was not walked by the specialist as indicated in Appendix A.

1.3 Methodology

The assessment entailed a literature review which included short listing plants of conservation concern that could potentially occur on or in the vicinity of the proposed powerline routes and substation localities, a two day site visit to the proposed area and reporting. The detailed methodology used in the assessment is listed in Appendix A and abbreviated below.

Literature Review:
The description of the regional vegetation relied on literature from Mucina & Rutherford (2006). Plant names follow Van Wyk & Van Wyk (1997), Van Wyk & Malan (1997), Pooley (1998), Henderson (2001), Van Oudtshoorn (2002) and Bromilow (2010). The study was undertaken in accordance with the Requirements for Biodiversity Assessments Version 2 (GDARD, 2012a).

Field survey:
The site visit took place on the 20th and 21st of October 2015. Random transects were walked in accessible areas and representative vegetation sampled. At the time of the assessment, the route alignment and a 100m around the route were sampled. Any additional information on any other feature thought to have ecological significance within the affected area, such as dominant species cover abundance, rocky cover, alien/exotic/invasive plants, as well as plant species of conservation concern and/or their habitat were also recorded. Plant identification and vegetation description relied on species recorded in the sampling plots and along the walked transects.

2. BACKGROUND TO THE STUDY SITE

2.1 Locality

2.1.1 Powerline route and alternative deviations:

The proposed powerline development is situated in the vicinity of Soweto in the Gauteng Province. The proposed 132kV line will originate in the western extent of the proposed development at the existing Taunus substation, situated on the farm Zuurbekom 297 IQ. From here the line will align across the R559 in a westerly direction. It then turns south on the western boundary of the West Rand Garden Agricultural holdings after which the line crosses the N12 and deviates in an easterly direction. It crosses the farm Zuurbekom 297 IQ and continues east traversing Olifantsvlei 316 IQ adjacent to the N12 thereafter crossing the Klip River and running just south of the Nancefield Industrial Area. The line thereafter aligns north, crossing the N12, the R553 and the Chris Hani Road (M68) before connecting to the existing Diepkloof substation (Figure 1).

Two deviations to the line is proposed:
Deviation 1 will be located to the south of the West Rand Agricultural Holdings and traverses the farm Zuurbekom 297 IQ. It runs south of the primary alignment for this section of the line.

Deviation 2 will be located to the south of the Klip River near Lenasia. It is situated south of N12 and to the south of the primary alignment in the area of the Moroka Bypass on the N12. The position of all the alternatives is shown on the map in Figure 1.

2.1.2 Proposed substations

The proposed development will also include the construction of two new substations on the farm Zuurbekom 297IQ.

Substation 1: A site of about 1 ha (100 m x 100 m), located approximately 2 km west of the existing Taunus substation, has been identified for the construction of the Substation 1.
Substation 2: Two alternative for the proposed Substation 2 (about 100m x 100m), were also identified and investigated north-west of Lenasia (Figure 1). Substation 2 (Alternative 1) (preferred) is located south of the railway line, south of the pump station. Substation 2 (Alternative 2) is located between the N12 Highway and the railway line.

2.2 Climate

The study area receives summer rainfall and winters are typically very dry with frequent frost. The Mean Annual Precipitation ranges from 600-720mm. Summer temperatures can reach an average of 30°C, while average lows in winter can reach 0°C (Mucina & Rutherford, 2006).

2.3 Hydrology

Existing spatial layers indicated that much of the eastern extent of the proposed powerline, and in particular Deviation 2, will traverse the perennial Klip River and associated wetland areas, as well as some of the Klip River tributaries (Figure 2). Another wetland area is situated south of the most western corner of the proposed 132kV line.

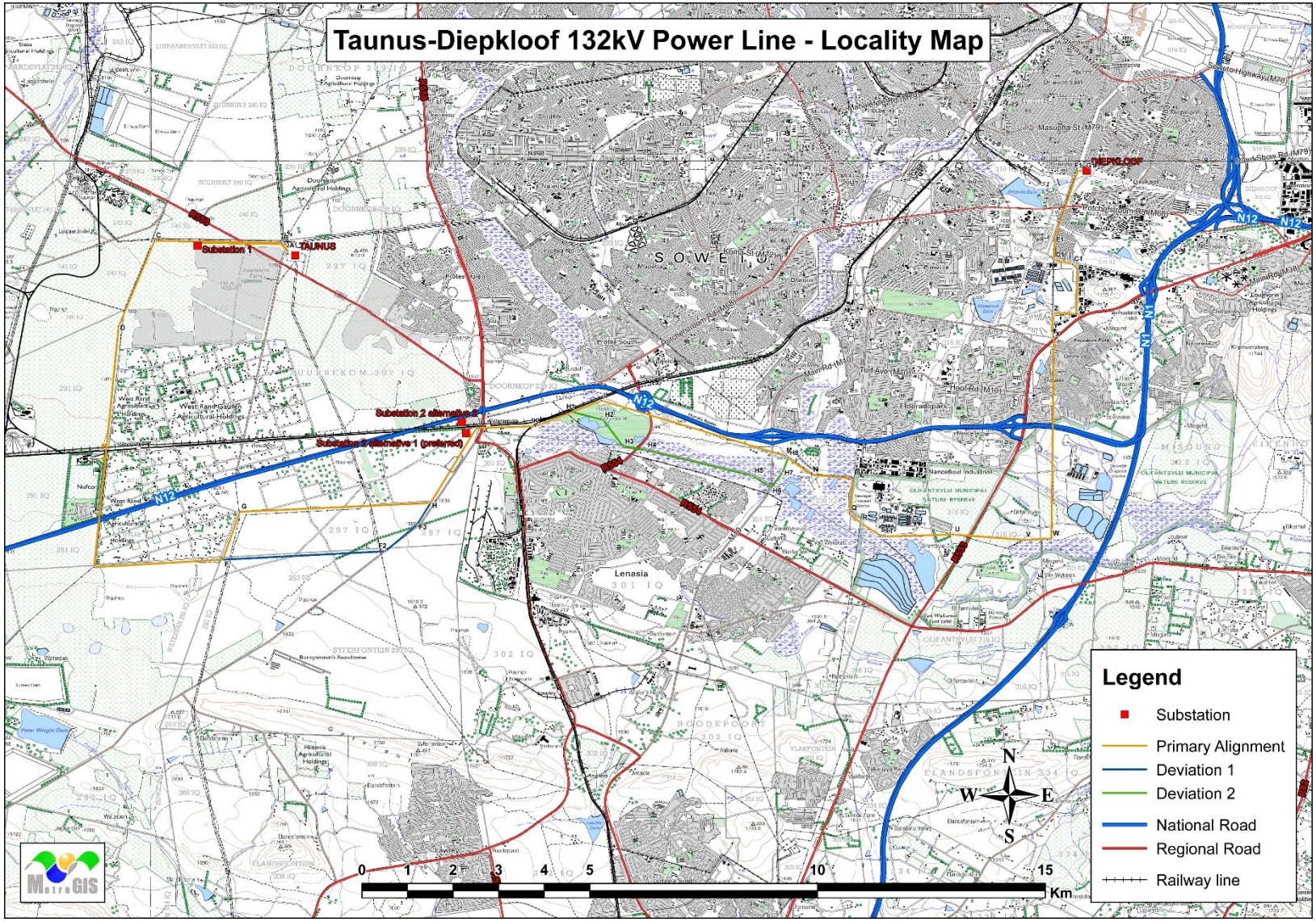


Figure 1: Locality map

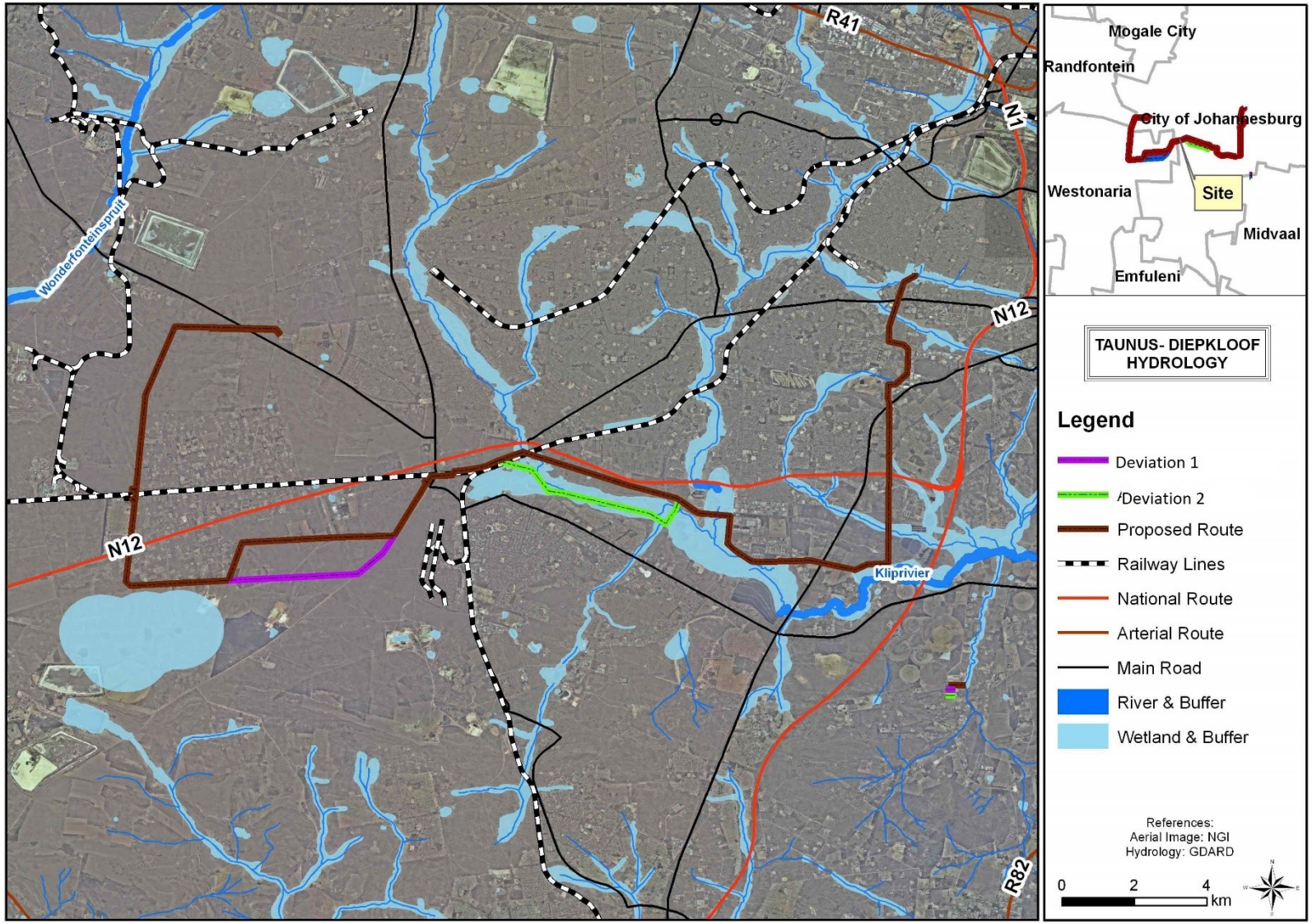


Figure 2: Hydrology of the area that the proposed 132kV powerline and proposed substations are situated in (as per the existing spatial layers (GDARD, 2011))

2.4 Expected Vegetation

The majority of the proposed powerline and substation localities are situated in the Grassland Biome. The Grassland Biome experience summer rainfall and dry winters with frost (and fire), which are unfavourable to tree growth. Therefore, grasslands comprise mainly of grasses and plants with perennial underground storage organs, for example bulbs and tubers and suffrutex species. In some grassland areas, the surface topography (e.g. rocky hills and protected valleys) creates habitats that are favourable to shrublands and trees (Mucina & Rutherford, 2006). Generally, the higher the surface rock cover, the higher the occurrence of woody vegetation such as trees and shrubs, relative to herbaceous vegetation (Mucina & Rutherford, 2006). The Grassland Biome comprises a number of vegetation types of which three (3) types are traversed by the proposed powerline route (Mucina & Rutherford, 2006) (Figure 3; Table 1). The proposed Substation 1 locality, as well as the two alternatives for Substation 2, are proposed to be situated within the same grassland vegetation type (Table 1).

A small portion of the north-eastern extent of the proposed powerline, just south of the Diepkloof substation, is situated in the Savanna Biome. The Savanna biome is the largest biome in southern Africa, occupying over one-third of the surface area of the country (Mucina & Rutherford, 2006). It is characterised by a grassy ground layer and a distinct upper layer of woody plants. Summer rainfall, coupled with winter fire and regular grazing ensures that the grass layer remains dominant. In addition, the lack of sufficient rainfall prevents the upper layer (trees) from dominating. However, where grazing intensity is high, and fire frequencies low, the tree layer could become increasingly dominant. The proposed routes traverses the Andesite Mountain Bushveld savanna vegetation type (Figure 3; Table 1)

Large wetland areas, forming part of the azonal (water-logged and salt-laden habitats) will also be traversed by the proposed powerline, particularly Deviation 2 (Figure 3; Table 1).

Table 1: Summary of the regional vegetation types traversed by the proposed powerline and at the proposed substation localities (adapted from Mucina & Rutherford, 2006)

Biome	Vegetation type	Description	Conservation status
Grassland	Soweto Highveld Grassland	Grows on a moderately undulating landscape that supports short to medium high and dense grassland dominated mainly by *Themeda triandra* (red grass) Wetlands, rocky outcrops and ridges are embedded in this grassland.	Endangered
	Tsakane Clay Grassland	Occurs on flat to slightly undulating plains. This short, dense, grassland comprises a mixture of common Highveld grasses (*Themeda triandra, Heteropogon contortus, Elionorus muticus* and *Eragrostis* spp.) and forbs from the Asteraceae, Rubiacea, Malvaceae, Laminaceae and Fabaceae families. Disturbance in this vegetation type leads to an increase in the grass *Hyparrhenia hirta* and *Eragrostis*	Endangered

Biome	Vegetation type	Description	Conservation status
		chloromelas.	
	Carletonville Dolomite Grassland	Occurs on undulating plains bisected by rocky ridges. This species-rich grassland forms a complex mosaic pattern dominated by many species	Vulnerable
Savanna	Andesite Mountain Bushveld	Dense, medium-tall thorny bushveld with a well-developed grass layer on hill slopes – undulating landscape	Least Threatened
Azonal	Eastern Temperate Freshwater Wetland	Occurs in flat landscapes or shallow depressions filled with water. The water bodies contain aquatic zones and outer parts with hygrophilous vegetation of temporary flooded grasslands.	Endangered

The grassland biome is under severe threat from urbanisation, industrialisation, mining and agriculture, especially in Gauteng. This vegetation assessment thus aimed to determine the state of the grassland vegetation along the proposed route to determine how much of the vegetation is still in a largely natural condition that should be regarded as sensitive.

2.5 Listed Ecosystems

The South African Biodiversity Act (Act 10 of 2004) provides for the listing of threatened or protected ecosystems. These ecosystems are grouped into Critically Endangered-, Endangered-, Vulnerable- and Protected Ecosystems (Section 52(1) (a) of the National Environmental Management: Biodiversity Act (Government Gazette 34809, Government Notice 1002, 9 December 2011)).

The eastern portion of the proposed powerline route will be situated within the original extent of the Kliprivier Highveld Grassland ecosystem that is listed as a Critically Endangered ecosystem (Figure 4). This ecosystem is listed under criterion: F which indicates priority areas for meeting explicit biodiversity targets (fauna and flora) as defined in a systematic biodiversity plan. These areas are of a very high irreplaceability. Only about 1% of the ecosystem is protected in the Klipriviersberg Nature Reserve and Rondebult Bird Sanctuary. Therefore, any natural vegetation found to be present within this ecosystem should be regarded as sensitive to any development and degradation avoided or rehabilitated.

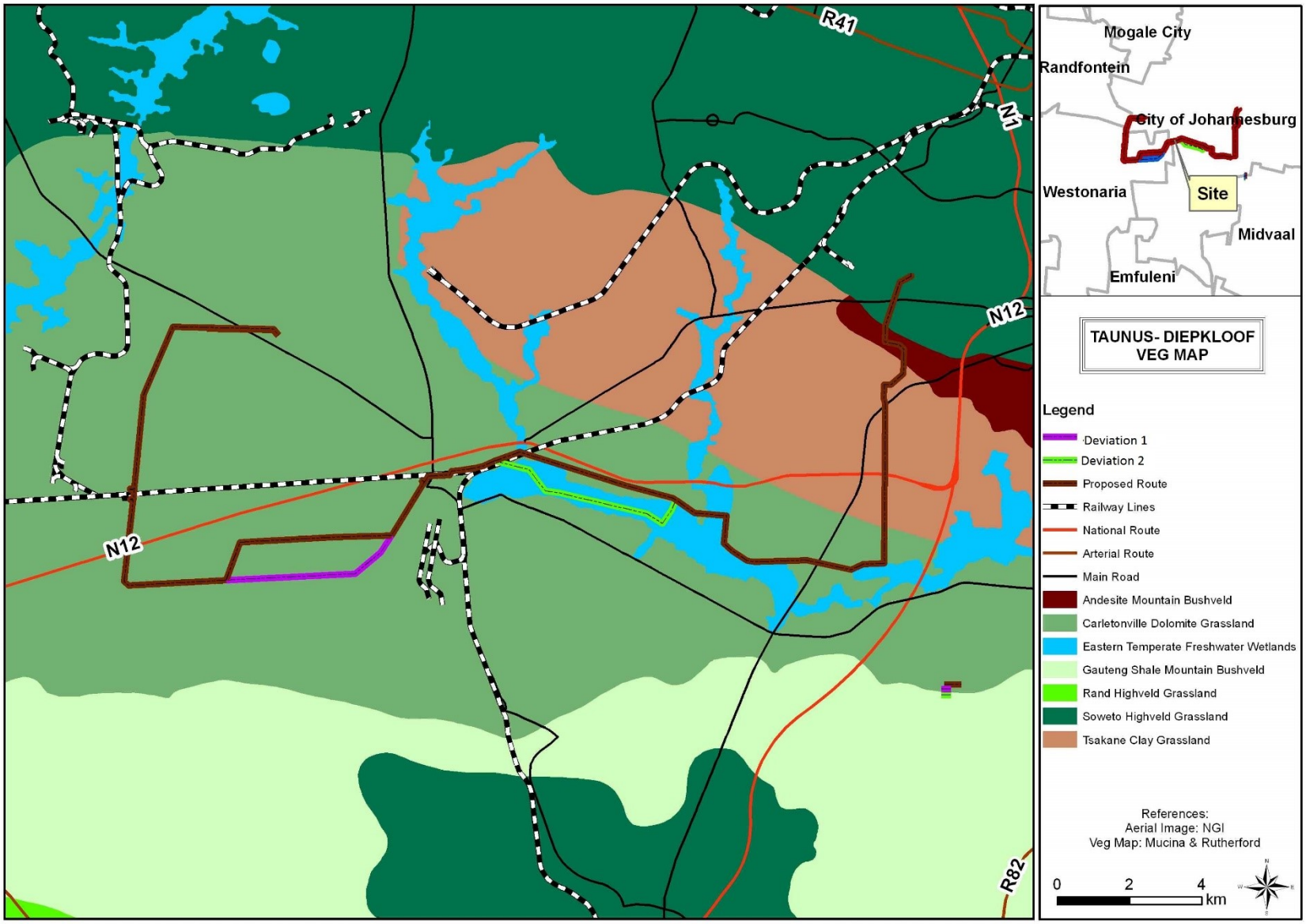


Figure 3: National vegetation types that are traversed by the proposed 132 Taunus-Diepkloof powerline route

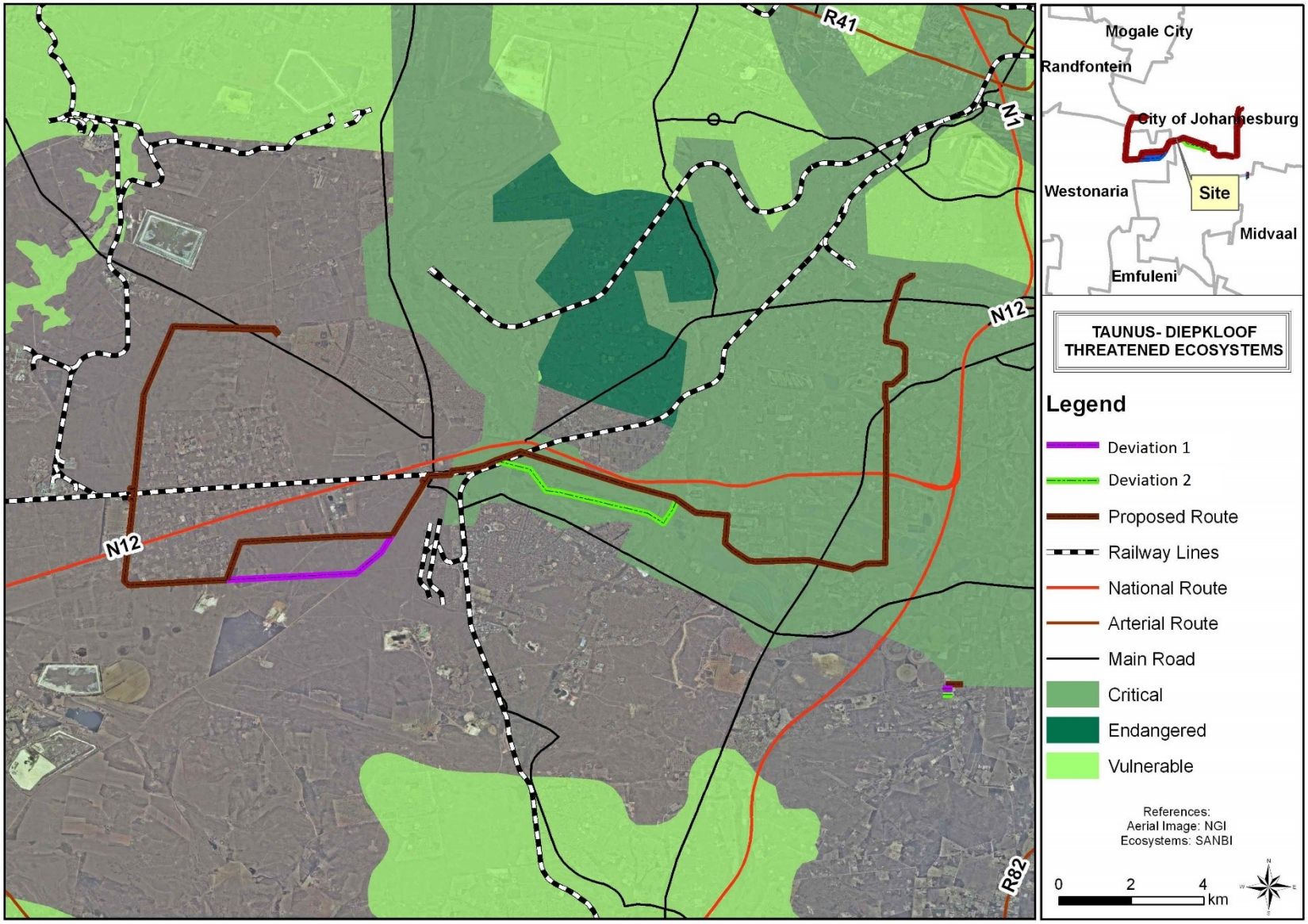


Figure 4: The proposed powerline route in relation to Threatened Ecosystems

2.6 Gauteng Conservation Plan (C-plan)

The Gauteng Conservation Plan (Version 3.3) (GDARD, 2011) classified areas within the province on the basis of its contribution to reach the conservation targets within the province. These areas are either Critical Biodiversity Areas (CBAs) that comprise 'Irreplaceable' areas (areas that must be conserved to reach conservation targets) or 'Important' areas (areas important to reach the conservation targets of the province) or 'Ecological Support Areas' (ESAs) that aim to ensure sustainability in the long term.

As per the Gauteng Conservation Plan (C-plan), CBA: Important areas, as well as Ecological Support Areas (ESAs) are present along the eastern extent of the proposed powerline route (Figure 5). The Important areas are set aside as it likely comprises primary vegetation and include sensitive landscape features such as wetlands. ESAs provide vital connections between areas of high or critical biodiversity importance and are therefore not necessarily good condition or primary vegetation, nonetheless it plays an important role in maintaining biodiversity. These areas also coincide with the Klipriviersberg Highveld grassland Ecosystem

In addition, a portion of the proposed powerline will traverse the Olifantsvlei Municipal Nature Reserve, under the management of City of Johannesburg Metropolitan Municipality (Figure 5).

2.7 Gauteng Ridge Policy

Ridges are protected environments within Gauteng province (GDACE, 2006). The term ridge refers to hills, koppies, mountains, kloofs and gorges and/or a landscape type or topographic feature that is characterized by two or more of the following features: a crest, plateau, cliff or footslope. The conservation of ridges in Gauteng allow for the protection of the habitat for significantly high numbers of species ensuring for their continued survival in a rapidly urbanizing province. Ridges also form ecological corridors for the movement of species, especially in urbanised environments.

The proposed powerline will traverse a small portion of the Kliprivierberg, which is classified as a Class 3 ridge as defined by the Gauteng Guideline for Developing on Ridges (GDACEL, 2006, updated April 2006) (Figure 6). Class 3 ridges include ridges of which 35% or more, but less than 65%, of their surface area has been converted to urban development, quarries and/or alien vegetation. The consolidation of properties on Class 3 ridges is supported, while the guidelines for Class 2 ridges should be applied to areas of the ridge that have not been significantly impacted on by human activity (e.g. only low impact development will be supported if it is not feasible to avoid the ridge entirely. However, the guidelines for Class 4 ridges should be applied to areas of the ridge that have been significantly impacted on by human activity.

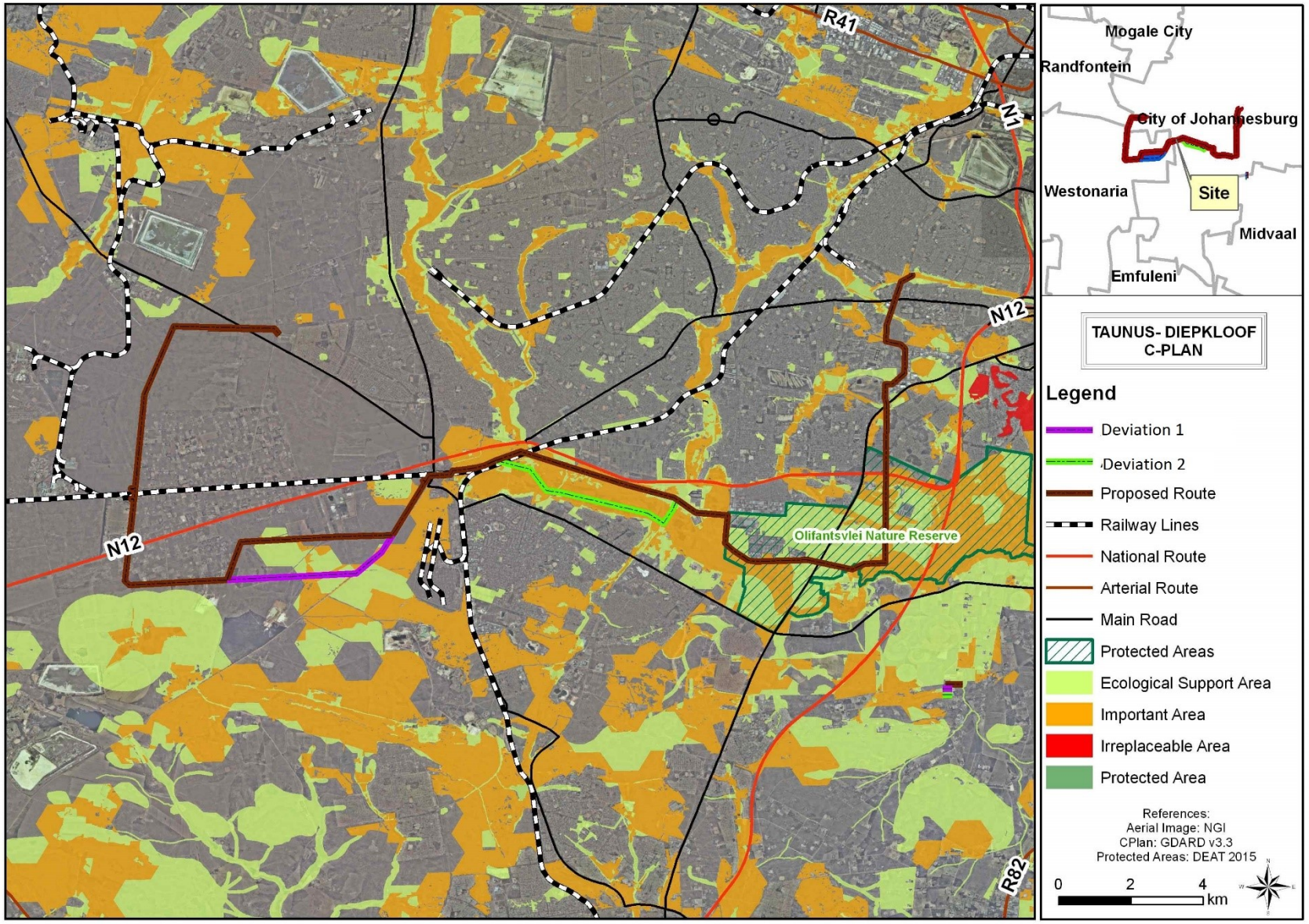


Figure 5: The proposed powerline development in relation to the Gauteng Conservation plan (GDARD, 2011)

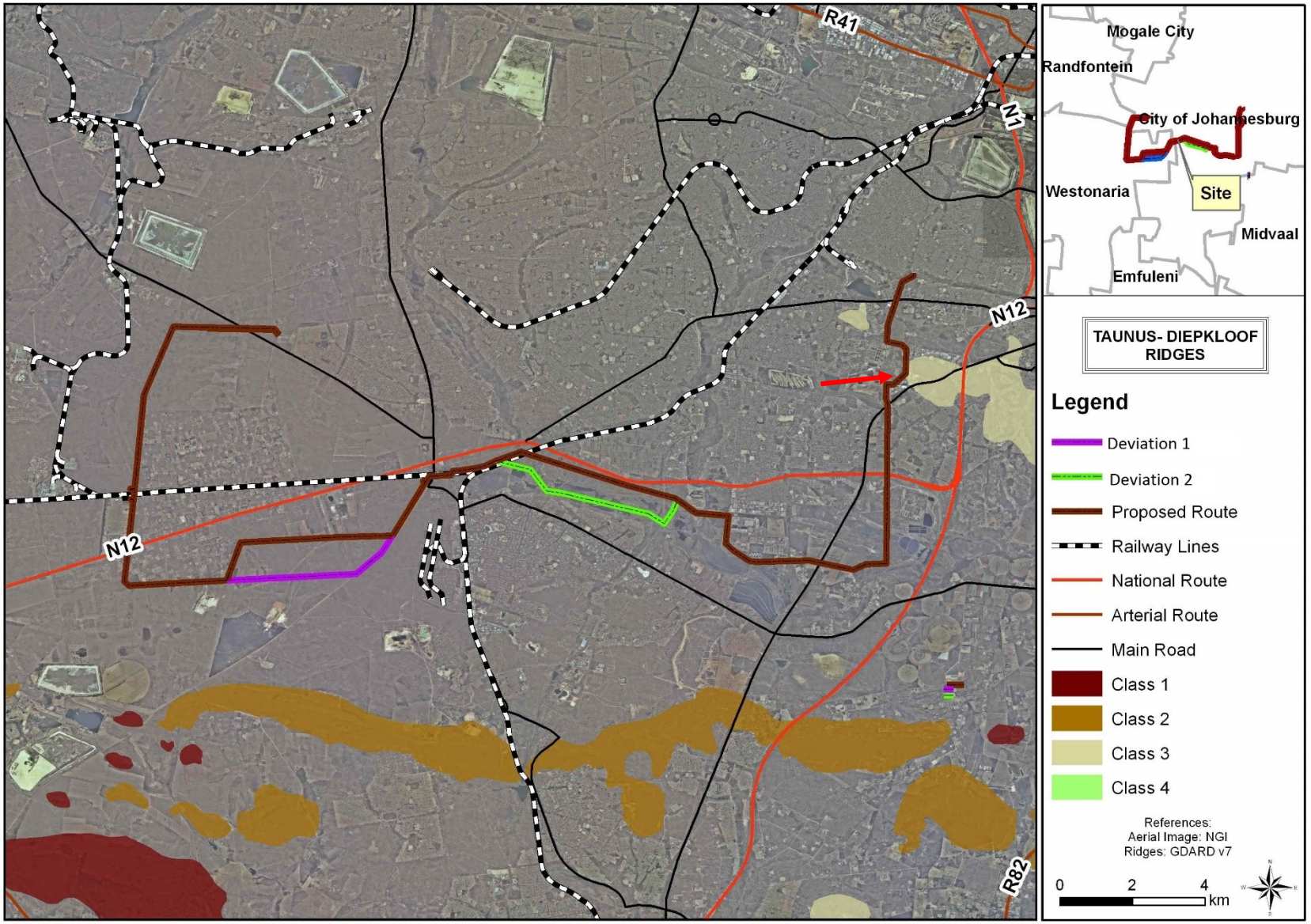


Figure 6: Class 3 ridge in the northern extent of the proposed powerline, south of the Diepkloof substation

3. RESULTS OF THE FIELD ASSESSMENT

3.1 Land use

Land use along the proposed Tanus Diepkloof 132 KV line varied significantly. The western and eastern portions of the land uses are described separately due to the vast extent of the line.

At the commencement of the western portion of the line there is an existing substation and there is an existing powerline which runs to the north of the township of Protea Glen. The Protea Glen Township contains houses and tarred roads and is currently under expansion. Rubbish dumping which comprises mainly of domestic waste and building materials is a frequent occurrence. West of the Protea Glen Township and current expansion, secondary vegetation was observed. The West Rand Agricultural smallholdings are situated south west of the Protea Glen Township. The N12 crosses the western portion of the Tanus Diepkloof 132 KV line along with a railroad. The Tanus Diepkloof 132 KV line runs to the west of the R558. Land use of the south of the western portion of the Tanus Diepkloof 132 KV line is mainly secondary grassland which is utilised for grazing by cattle and goats. The southern section of the proposed route runs past a waste dump as well as a quarry (Figure 7).

Land use along the eastern portion of the Tanus Diepkloof 132 KV line. Once again at the start of the eastern portion there is an existing substation and power line present. The Bara Mall is situated to the north of the M63 (Chris Hani Road) and the University of Johannesburg Soweto Campus lies to the south of the M63 road. South of the Bara Mall the main land use is best described as informal settlements along the Tanus Diepkloof 132 KV line. As the Tanus Diepkloof 132 KV line turns slightly more to the east it passes a petrol port. Between the informal settlements and the R553 crossing the Tanus Diepkloof 132 KV line passes mainly industrial land uses, but there is also a municipal waste dump just north of the R553 crossing. A BP filling station is present to the south of the R553 crossing. From the R553 crossing to the N12 crossing there are some open spaces which are mainly used as dumping site. The main land use after crossing the R553 is residential houses, as well as informal settlements (Figure 8).

Land use south of the N12 is mainly fallow lands and pastures. A Rand Water facility is present to the south of the N12. South of this facility there is a newly planned cemetery with high fences present which stretches to the southern point of the eastern portion of the Tanus Diepkloof 132 KV line. As soon as the Tanus Diepkloof 132 KV line crosses the R553 for the second time the land use to the west of the R553 is mainly small holdings and pastures. There is a large water treatment works to the west of the R553. As the eastern portion of the Tanus Diepkloof 132 KV line turns north the surrounding land use is mainly industrial. A cemetery is present between the N12 and the Tanus Diepkloof 132 KV line before crossing the M10. Land use between the M10 and R554 is mainly open space which consists of secondary grassland and wetland vegetation. A railway line runs close the Tanus Diepkloof 132 KV line between the R554 and R558 south of the N12. The Township of Lenasia is situated to the south of the proposed Tanus Diepkloof 132 KV line. Rand water has a facility to the west of the R558 (Figure 8).

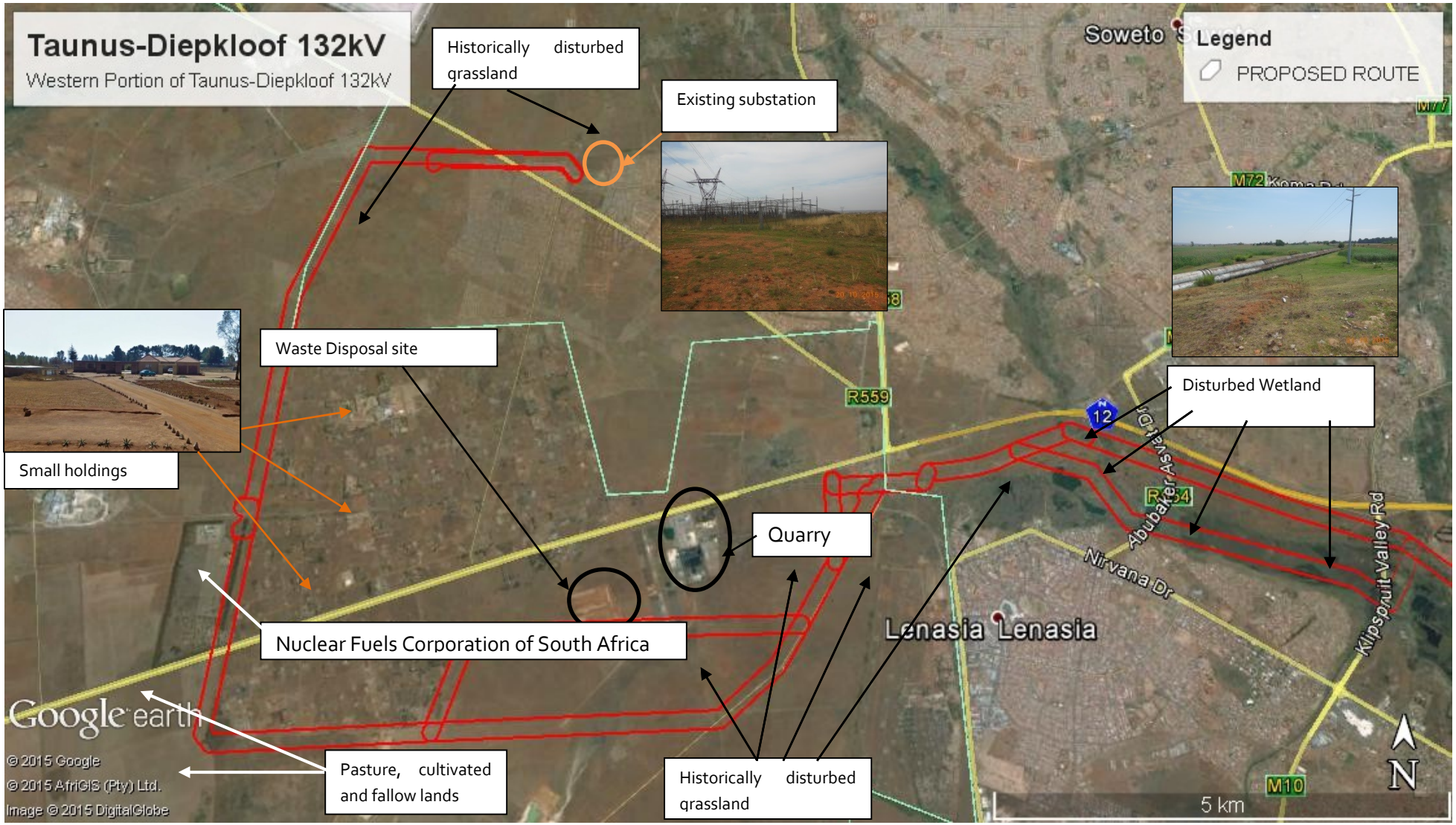


Figure 7: Land uses and transformed vegetation along the western portion of the Tanus Diepkloof 132 kV route Google Earth image, 2015)

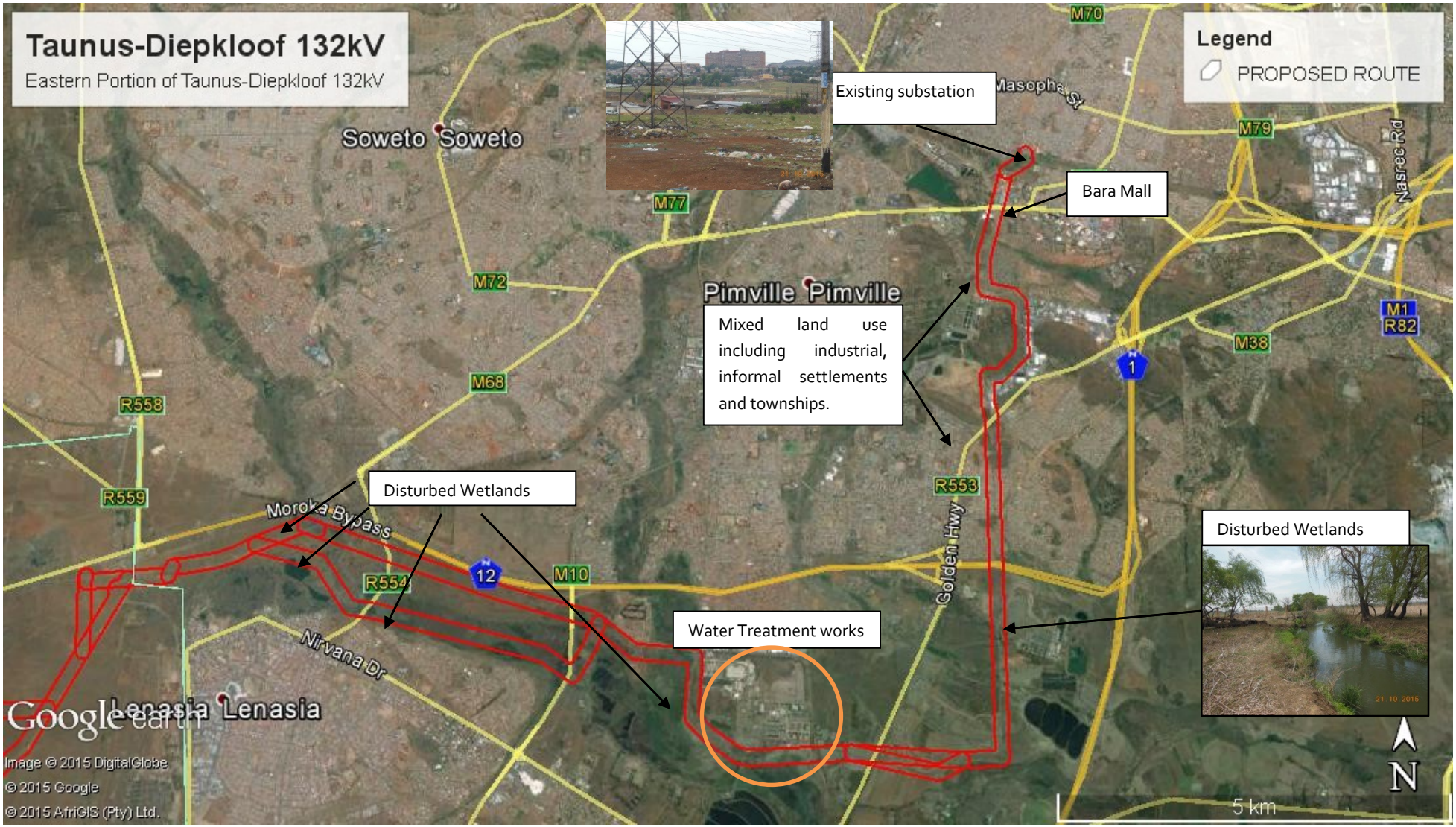


Figure 8: Land uses and transformed vegetation along the eastern portion of the Tanus Diepkloof 132 kV route Google Earth image, 2015

3.2 Vegetation groupings delineated

The proposed Tanus Diepkloof 132 KV line traversed semi-natural grassland, bushveld and wetland vegetation, as well as large portions of transformed land that included pastures and fallow lands.

The broad vegetation groups comprised:

1. Secondary and historically disturbed grassland,
2. Disturbed Mountain Bushveld,
3. Moist grassland and wetland, and
4. Transformed land (pasture, fallow lands and built up areas including roads and railways).

Each broad vegetation grouping s geographically represented in Figure 6 and discussed below. The various types of transformed vegetation are discussed but grouped under Transformed in Figure 9. Figure 9 includes a 100m buffer on either side of the proposed route. The plant species (indigenous and exotic) that were observed within each vegetation group at the time of the field survey are listed in Appendix B.

3.2.1 Secondary and Historically Disturbed Grasslands

Secondary grasslands develop where the original, primary (undisturbed) grassland vegetation was removed (e.g. by cultivation). After such disturbances cease, pioneer grassland species, as well as weedy plants, colonise the disturbed areas leading to a secondary grassland state with a lower species diversity as opposed to the primary (climax) state prior to any disturbances. Where grasslands were historically disturbed although no cultivation took place (e.g. compaction of the soils), the result could also resemble a secondary grassland state with limited species diversity. Primary grasslands are species rich ecosystems, which once disturbed, are difficult, if not impossible to restore.

Historic aerial images (Google Earth, 2015), as well as topographic maps indicated that cultivation took place within grasslands along western and half of the southern portion of the Taunus-Diepkloof 132kV line (Figure 7). A recent fire event was evident and vegetative cover was still relatively sparse due to dumping and the lack of rain. This vegetation group contained a high frequency of the grasses *Hyparrhenia hirta* (common thatching grass) and *Aristida congesta* (three-awn), as well as some *Eragrostis curvula* (weeping love grass) and dominant patches of *Cynodon dactylon* (couch grass) (Photograph 10). The indigenous invasive shrub *Seriphium plumosum* (*bankrupt bush),* which is known to proliferate in overgrazed or mismanaged veld (van Wyk & Malan, 1997), was also present. Numerous interspersed forbs were present in this vegetation group. The dominant forb was *Felicia muricata* as well as the weed *Tagetes minuta* (khaki weed) (Photograph 1).

The secondary grassland did contain patches with alien invasive trees *Acacia mearnsii, Melia azedarach* and *Eucalyptus camaldulensis.* The grass layer in these patches were less developed than in the remainder of the vegetation group.

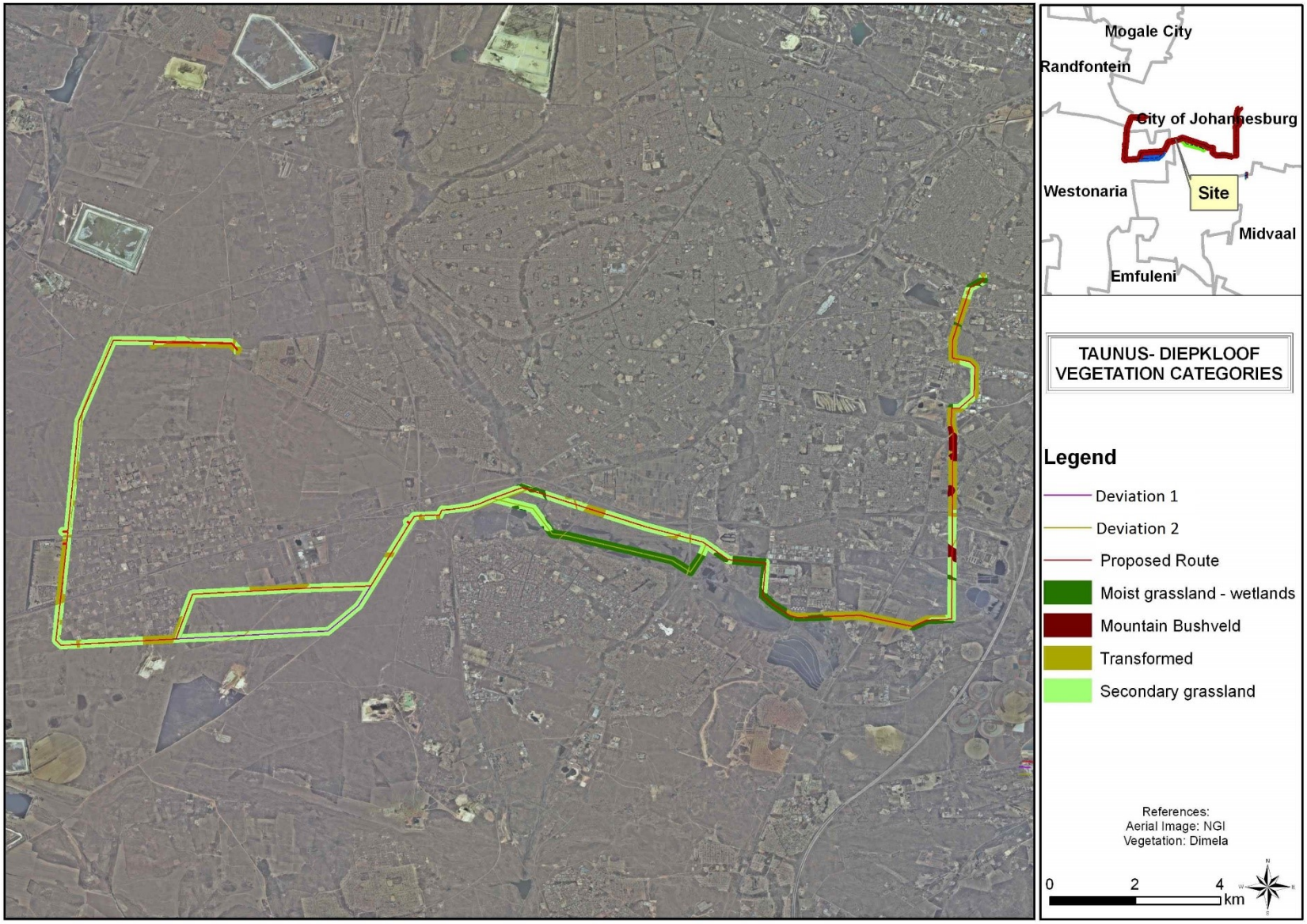


Figure 9: Vegetation groups delineated along the proposed Taunus-Diepkloof 132kV line (100m on either side of the route was mapped)

Photograph 1: Secondary grassland on the western portion and south of the proposed Tanus-Diepkloof line

The species diversity was higher than expected due to the level of pressure from various disturbances. The vegetation group contained 15 grass species, 40 forbs and one indigenous tree species (Appendix B).

Plant species of conservation concern: Due to historic disturbances, no threatened or protected plants were expected to occur and none was recorded in the secondary grassland. However, species such as *Hypoxis hemerocallidea* (African potato) may persist in the historically disturbed grassland. *Boophone disticha* was present within this vegetation group.

Alien invasive plant species: There was 21 alien invasive plant species present in this vegetation unit. The weedy *Tagetes minuta* (khaki weed) was common and one of the dominant species present. *Datura stramonium, Melia azedarach, Verbena bonariensi* and *Sesbania punica* all category 1 b weeds were present as well.

3.2.2 Disturbed Mountain Bushveld

This vegetation group was limited to slightly elevated areas, "koppies" and hills on the eastern section of the proposed routes. The large rocky boulders present in this vegetation group created the micro-climate for the woody species to establish themselves. One of the major threats to this vegetation unit is the dumping of building rubble and domestic wastes. There are numerous foot paths traversing this vegetation group in. The bushveld was open canopied with more senior tree species. Recruitment of new woody species was limited due to the high level of disturbance observed as a result of mainly anthropogenic activities. The portion of this vegetation unit on the eastern portion in close proximity to the Rand Water Works was in relatively good condition and the tree layer was clearly dominant. North of this portion the vegetation groups tree canopy was very open and the grass layer as well as alien invasive species competed with the woody layer to establish dominance (Photograph 2).

The most common woody species included *Vachellia karroo, Senegalia caffra and Searsia lancea.* The grass layer contained mainly *Hyparrhenia hirta* (common thatching grass) *Andropogon schirensis (*stab grass), *Brachiaria serrata* (saw-tooth grass) and *Cynodon dactylon* (couch grass).

Photograph 2: Mountain bushveld with a good woody layer present and *Tagetes minuta* present on the left indicated by the red circle. Severe dumping was present in this vegetation group surrounded by mainly grassland and invasive species.

At the time of the site visit, 9 woody species, 10 grass species, 25 forbs, 1 ferns were recorded in sampled areas.

Plant species of conservation concern: The rocky ridge section provided suitable habitat to the near threatened succulent *Lithops leslei* (Figure 6). This area can also provide suitable habitat to at least two more species of conservation concern (see section 3.3.2).

Alien invasive plant species: Due to the high level of disturbance justifies the presence of 17 invasive species in this vegetation group. Some of the invasive species include garden escapees such as *Morus alba* (mulberry). The dominant invasive species in this vegetation group was *Tagetes minuta, Datura stramonium* and *Bidens pilosa*.

3.2.3 Moist grassland

Moist grasslands were present between the R558 and R553 of the proposed Tanus-Diepkloof 132 kV line. Moist grassland was also present in the Rand water treating facility on the eastern portion of the proposed line. Additionally moist grassland were also present on the northern most tip of the eastern portion of the power line, one to the south of Bara Mall and the other to the south of the existing substation to the north of Bara Mall. All of the aforementioned sections of moist grassland are associated with the Klip River and its tributaries.

Prior to crossing the R553 the Klip River was channelled. The river banks were disturbed and mostly covered by *Pennisetum clandestinum* (Kikuyu). The invasive tree species *Salix babylonica* was present along these river banks. Patches of *Tyhpa capensis* (bulrush) was present in the marginal and non-marginal zones. The invasive aquatic weed *Nasturtium officinale* (water cress) was present within the marginal zone of the river (Photograph 3).

Photograph 3: Upstream and downstream view. *Salix babylonica* is prominent along the river banks. The right picture indicates the sparse vegetative cover on the river banks. The left picture indicates the high grazing pressure and the presence of *Pennisetum clandestinum* along with patches of uncovered soil.

Moist grasslands to the north and south of Bara mall. The level of disturbance was significantly higher when compared to the moist grasslands situated to the south of the Tanus-Diepkloof 132 kV line. Species composition was still similar and these moist grassland has a channel present described above. Rehabilitation efforts were observed in the moist grassland to the north of Bara Mall (Photograph 4).

Photograph 4: Channelled moist grassland to the south of Bara Mall. To the right wetland rehabilitation structures present in the moist grassland to the north of Bara Mall.

The moist grassland had patches were the channel was not evident due to dense stands of *Phragmites australis* (common reed). These stands were extremely dense and outcompeted any other species forming monospecific stands. On the edges of these dense stands *Tyhpa capensis* (bulrush), *Juncus effuses* (soft rush) and *Pycreus macranthus* were present. Invasive species were prominent along the edges of the dens reed stands including the following 1b species *Campuloclinium macrocephalum* and *Ricinus communis var communis* (castor oil). Domestic waste and rubble dumping were evident along the moist grasslands (Photograph 5).

Photograph 5: Dense stands of *Phragmites australis*. A more disturbed part of the moist grassland with dense stands of *Phragmites australis* and rubble in the foreground.

At the time of the site visit 4 sedges, 3 grasses, 6 forbs and 13 invasive or weedy species were recorded in the moist grassland. The moist grassland corresponds with Eastern Freshwater Wetlands vegetation type that is considered as Endangered, as well as with the C-plan important areas as per Figure 4 (GDARD, 2011).

Plant species of conservation concern: Although some threatened or protected species (e.g *Kniphofia tyhoides*) were expected to occur within this moist grassland, the species were not recorded in walked transects and sample plots.

Alien invasive species: A number of declared invasive species were recorded in the moist grassland and included: *Trifolium repens* (white clover), *Persicaria lapathifolia (*knot weed), *Cirsium vulgare* (scotch thistle), *Verbena bonariensis Salix babylonica (weeping willow) Verbena bonariensis and the grass Pennisetum clandestinum* (kikuyu).

3.2.4 Transformed

The transformed areas consisted of areas that comprised degraded and highly disturbed vegetation with little ecological function and a high degree of alien invasive plant species, or areas comprising monocultures (e.g. maize and pasture) and built-up areas. All of the transformed areas situated in the eastern portion of the Tanus-Diepkloof 132 kV line correspond fall within Ecological Support as well as ImportantAreas of the Gauteng C-plan. These areas are of low vegetation sensitivity, but are suitable habitat to fauna species of conservation concern.

Pasture:

Large parcels of land were historically ploughed and planted as pasture (Photograph 6). The pasture comprised *Eragrostis curvula*. Within the *Eragrostis*-pasture, indigenous grasses such as *Hyparrhenia hirta* (common thatching grass) were also recorded, with a limited number of indigenous forbs that colonised the pasture. Invasive weeds included *Tagetes minuta* (khaki weed) and *Bidens pilosa* (black jack). The area was recently cut which made the identification of other species troublesome.

Fallow and degraded lands:

Historically cultivated land with red soils were observed south of the N12 on the western portion of the Tanus-Diepkloof 132 kV line. At the time of the site visit, the grass cover was poor, consisting mainly of the pioneer species *Cynodon dactylon* (couch grass) .The forb layer was dominated by the weed *Tagetes minuta* (khaki weed) present (Photograph 6).

Photograph 6: Recently cut *Eragrostis* pasture on the left. Fallow and degraded lands on the right.

Plant species of conservation concern: No plants of conservation concern were recorded in the transformed land and due to past and current impacts, none are expected to occur.

Alien invasive plant species: Due to the transformed state of this group, a high number of alien invasive species were recorded (Appendix B).

3.3 Review of Plants of Conservation Importance

3.3.1 Threatened or Protected Plant Species (TOPS)

Chapter 4, Part 2 of the National Environmental Management: Biodiversity Act (No. 10 of 2004), (NEMBA) provides for listing of plant and animal species as threatened or protected. If a species is listed as threatened, it must be further classified as Critically Endangered, Endangered or Vulnerable. These species are commonly referred to as TOPS listed. The Act defines these classes as follows:

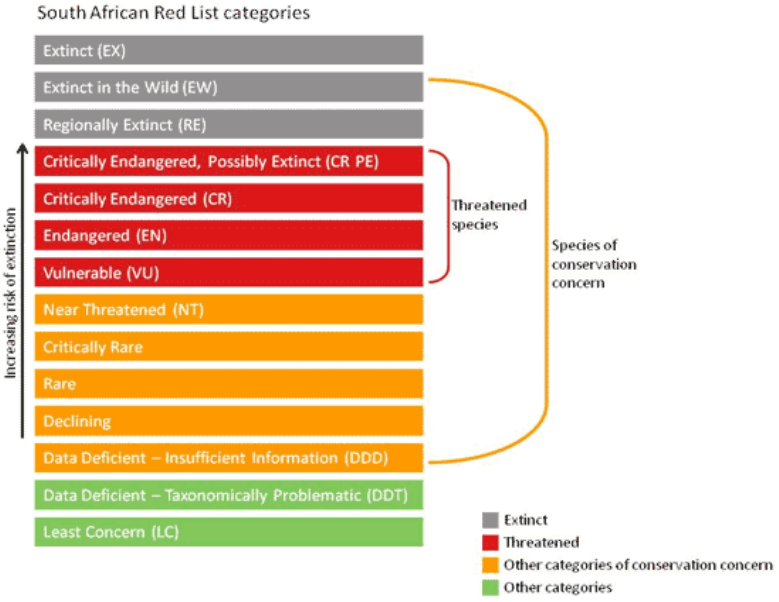
- Critically endangered species: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- Endangered species: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- Vulnerable species: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- Protected species: any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category will include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Certain activities, known as 'Restricted Activities', are regulated on listed species using permits by a special set of regulations published under the Act. Restricted activities regulated under the act are keeping, moving, having in possession, importing and exporting, and selling. The first list of threatened and protected species published under NEMBA was published in the government gazette on the 23rd of February 2007 along with the Regulations on Threatened or Protected Species.

At the time of this assessment, no TOPS listed species was recorded within the proposed development footprint.

3.3.2 Red and Orange listed plant species

In addition to the TOPS list, the Threatened Species Programme of the South African National Biodiversity Institute (SANBI) published the Red List of South African Plants (Raimondo *et al*, 2009). An online version provides up to date information on the national conservation status of South Africa's indigenous plants (SANBI, 2015). In addition, the Gauteng province provides a list of red and orange listed plant species within the Province (Gauteng Department of Agriculture and Rural Development). These are referred to as Plants of Conservation Concern and are those plants that are important for South Africa's conservation decision making processes and include all plants that are Threatened or that due to ongoing decline, could become Threatened in the near future (Figure 10). These plants are also referred to as Red Listed (Critically endangered, Endangered and Vulnerable) and Orange Listed (Near Threatened, Critically Rare, Rare, Declining and Data deficient) plants (Figure 10).



(Source: http://redlist.sanbi.org/redcat.php)

Figure 10: Threatened species and species of conservation concern

A list of plants of conservation concern was compiled using information from the South African National Biodiversity Institute's (SANBI) checklist (SANBI, 2009), Raimondo *et al*, (2009) and information received from GDARD (GDARD, 2015). A list of seven (7) plants of conservation concern that were previously recorded in the quarter degree square that the site is situated in, or may potentially occur are given in Appendix C, as well as their likelihood of occurrence.

Of the species listed in Appendix C, one Declining plant species, *Boophone distichia* (poison bulb), was confirmed to occur in the secondary and historically disturbed grassland. The locality of this species are indicated in Appendix C and geographically represented in Figure 11. This individual plant is in the direct path of the powerline and should be removed prior to the commencement of any construction activities.

3.4 Provincially protected plants

A number of provincially protected plants are listed in the Transvaal Nature Conservation Ordinance Act No. 12 of 1983. These plants are not to be removed, damaged, or destroyed without permit authorisation from Gauteng Department of Agriculture and Rural Development (GDARD).

No provincially protected plants were observed in the walked transects and sample plots.

3.5 Alien Invasive Plant Species

Declared weeds and invader plant species have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems. Therefore, it is important that these plants are controlled and eradicated by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species (Henderson, 2001).

The National Environmental Management: Biodiversity Act (NEMBA) is the most recent legislation pertaining to alien invasive plant species. In August 2014 the list of Alien Invasive Species was published in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (Government Gazette No 78 of 2014). The Alien and Invasive Species Regulations were published in the Government Gazette No. 37886, 1 August 2014. The legislation calls for the removal and / or control of alien invasive plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within close proximity to a watercourse.

Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

> Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
> Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
> Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
> Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a

gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

The alien plant species identified on the study site are listed in Appendix B. Note that according to the regulations, a person who has under his or her control a category 1b listed invasive species must immediately:

(a) notify the competent authority in writing

(b) take steps to manage the listed invasive species in compliance with

(i) section 75 of the Act;

(ii) the relevant invasive species management programme developed in terms of regulation 4; and

(iii) any directive issued in terms of section 73(3) of the Act.

Ten category 1b species were recorded and must therefore be removed by implementing an alien invasive plant management programme in compliance of section 75 of the Act as stated above. The species were *Arundo donax, Datura stramonium, Cirsium vulgare, Melia azedarach, Gleditsia triacanthos, Solanum mauritianum, Verbena bonariensis, Sesbania punica, Pennisetum clandestinum* and *Campuloclinium macrocephalum.*

4. VEGETATION IMPORTANCE AND SENSITIVITY

It has been clearly demonstrated that vegetation not only forms the basis of the trophic pyramid in an ecosystem, but also plays a crucial role in providing the physical habitat within which organisms complete their life cycles (Kent & Coker 1992). Therefore, the vegetation of an area will largely determine the ecological sensitivity thereof.

The vegetation sensitivity assessment aims to identify whether the vegetation within the study area is of conservation concern and thus sensitive to development as it is amongst others:

- Situated in a listed ecosystem or threatened vegetation unit;
- Habitat or potential habitat to threatened plants, protected plants or protected trees;
- Situated within ecologically sensitive features such as rocky areas, ridges, wetlands or riparian areas; and
- Untransformed and un-fragmented natural vegetation.

4.1 Sensitivity ratings

In order to determine the sensitivity of the vegetation groups in the study area, weighting scores and criteria as in Appendix A were applied. The results of the scoring places the vegetation in either of the sensitivity classifications as listed in Table 2 below. Vegetation with a low score is not considered to be sensitive. Vegetation with a score of 7 were considered as medium-low, while a score of 13 were regarded as medium to high.

Table 2: Weighting scores

Scoring	13-18	7-12	1-6
Sensitivity	High	Medium	Low

4.2 Sensitivity Analysis

As per Table 3 below, the result of the sensitivity assessment indicated that moist grassland scored the highest and include some sensitivities to the proposed development as discussed below and geographically represented in Figure 11.

Table 3: Sensitivity scoring of vegetation groups delineated along the proposed routes

Vegetation group	Conservation Status of regional Vegetation unit	State of vegetation	Legislated protection	Plants of conservation concern	Ecological Function	Conservation Importance	Total Score out of max of 18
Moist grassland	2	1	3 *Watercourse, Cplan Important area*	1	3	3	**13 High**
Disturbed mountain bushveld	1	1 Depending on the area	2 *Situated in C-plan Important area, semi-natural grassland*	1	1	1	**7 Medium** Although considered medium-low (see 4.2.2)
Secondary & disturbed grassland	1 disturbed	1	0 / 2 *Small portions are situated in C-plan ESA's, while majority is not*	1	1	1	**5 / 7 Medium-low**
Transformed	N/A	**0**	2 *Situated in C-plan ESA's*	**0**	**1**	**0**	**3 Low**

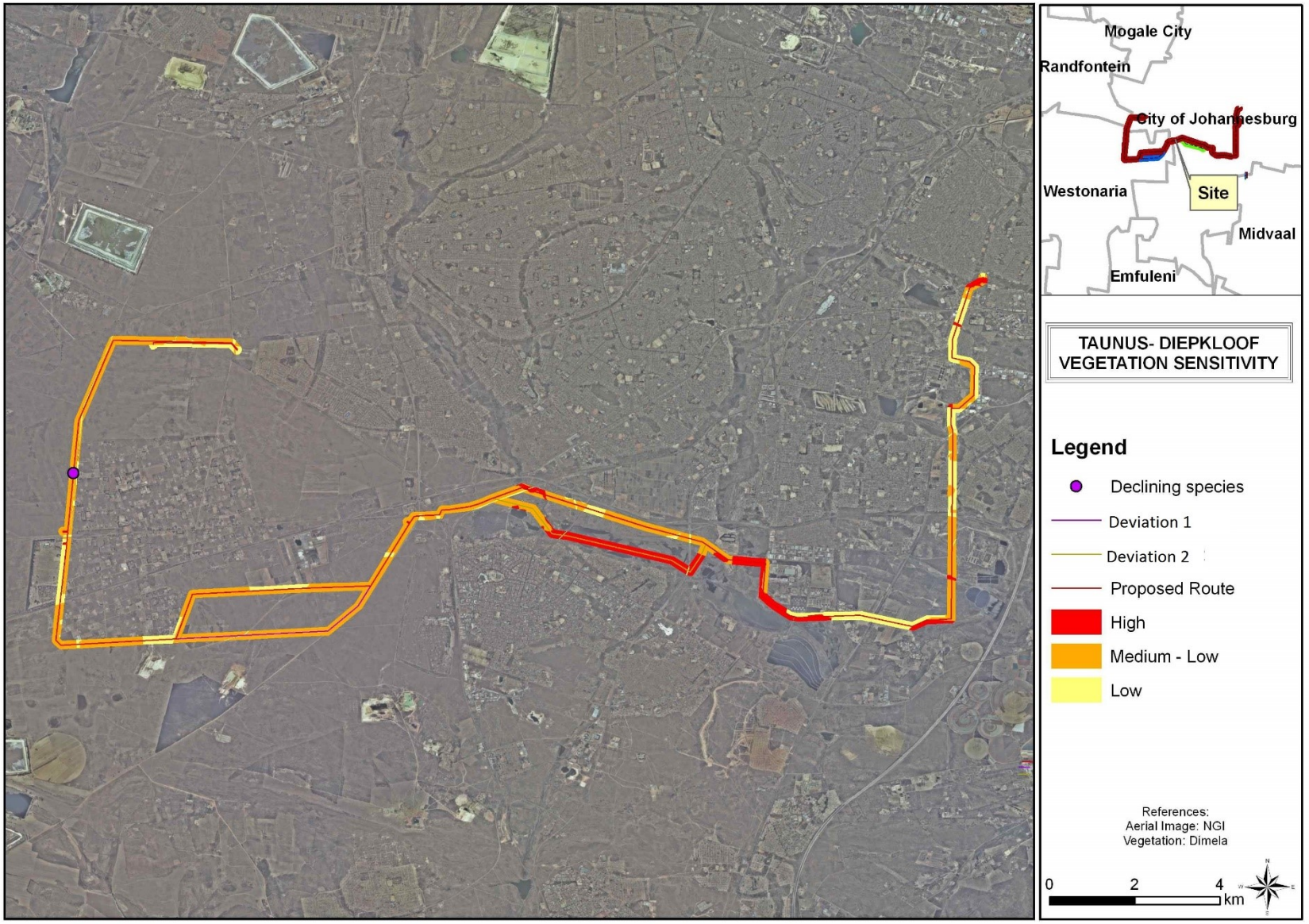


Figure 11: Vegetation sensitivity along the proposed powerline routes

4.2.1 Vegetation of high sensitivity

Moist grassland

Moist grassland vegetation helps maintain the hydrology of the area and slows the flow of water, both by physically blocking the passage of water, and by absorbing the water into its root systems. This moderates the impacts of flooding on downstream and surrounding areas. Moist grasslands (wetland areas) are protected by national legislation and are essential to maintain ecological corridors for the movement and survival of species within a landscape fragmented by cultivation and urbanisation. In addition, the hydrological processes associated with the wetlands and are closely associated with the intactness of the vegetation within and surrounding these moist grasslands. The moist grassland is situated within an Important area of the Gauteng C-plan.

The moist grassland are watercourses which are rated highly sensitive as all watercourses in South Africa (albeit degraded) are protected by the National Water Act (Act 10 of 1998). Riparian land in particular, is very valuable as it is the most fertile and productive part of a landscape (Land for Wildlife, 2002). Although vegetation associated with some of the moist grasslands were disturbed with a degree of alien vegetation, the vegetation is highly functional in preventing soil erosion and degradation of surrounding vegetation, as well as downstream watercourses.

4.2.2 Vegetation of medium to low sensitivity

Mountain bushveld

Although this vegetation group is present on the class 3 ridge portion, as well as important conservation areas according to C-plan, the vegetation group was found to be severely degraded. No provincially protected plant species were observed during time of the site visit. Species diversity was not high and there was a vast number of alien invasive species present. Habitat loss for plant species occurred in this vegetation group due to trampling, grazing as well as rubble and rubbish dumping. Sensitive and protected plants may have been lost due to the loss of habitat. Therefore, although this vegetation scored 7, the line will traverse already disturbed areas and it is therefore regarded as being of medium to low sensitivity to the proposed development.

Secondary and disturbed grassland

This vegetation grouping comprised mainly of land that was historically cultivated or disturbed and typically included a higher frequency of pioneer species, a low diversity of indigenous species and a low basel cover. It is assumed that cultivation removed plant species of conservation concern from these areas. Only one individual of a Declining species was noted in this vegetation group.

4.2.3 Vegetation with a low sensitivity

Transformed

The transformed areas had limited to no natural habitat remaining and therefore are of low sensitivity to the proposed Tanus-Diepkloof 132 kV line (Figure 11).

5. IMPACT ASSESSMENT AND MITIGATION

Mankind depends on the natural environment for a large number of ecological services provided for by ecosystems, ecological processes and plant species in general. However, any development activities in natural systems will impact on the surrounding natural environment and usually in a negative way. In order to limit or negate these impacts, the source, extent, duration and intensity of the possible impacts needs to be identified. Once the significance of the impacts is understood, the development could both adequately plan for and mitigate these impacts to a best practise and acceptable level. However, if the impacts are significant, especially in already threatened ecosystems and vegetation units, and no adequate mitigation measures could reduce or avert these impacts, then the development should not be allowed to proceed.

5.1 Impact statement

The greatest impact of the proposed development on vegetation is expected to occur in the disturbed moist grasslands. Due to the transformed and disturbed state of the remainder of the vegetation, the impacts are envisaged to be minimal. The most significant impact is expected to occur during the construction phase. While the excavation of soil for the base of pylons would remove vegetation, the vegetation could be replanted after the construction and its re-establishment monitored to ensure that the soil and vegetation rehabilitated. The greatest threat to the rehabilitation of the land disturbed by construction (in the mountain bushveld, secondary grassland, moist grassland and transformed vegetation), are the potential of invasive plant species to colonise the disturbed soil and spread into adjacent natural areas. If remedial measures and monitoring is properly employed, the vegetation that will be disturbed during construction could rehabilitate well over time, and long term impacts on vegetation and faunal habitats could thus be minimal.

Furthermore, the presence of proximate access roads and dirt roads, will greatly reduce the impacts if the existing roads and already disturbed areas are employed during construction. The greatest threat to the rehabilitation of the disturbed areas, are the potential of invasive plant species to colonise the disturbed soil and spread into adjacent natural areas. If remedial measures and monitoring are properly employed, the vegetation that will be disturbed during construction could rehabilitate well over time, and long term impacts on vegetation could be minimal.

Prior to the commencement of the construction activities it is recommended that all building rubble and domestic wastes should be removed from the footprint area of the proposed Tanus-Diepkloof line. Not only are these piles of rubble and rubbish harmful to the health of the workers whom will be constructing the proposed line but it also limits the habitat for vegetation to grow and re-establish. During rehabilitation, waste skips should be placed on intersections with main roads for the community to dispose of their wastes and allow the re-establishment of vegetation in the footprint area.

5.2 Route and substation locality preferences

Powerline route

The preferred route is considered the most feasible option if the individual of *Boophone disticha* is removed and relocated prior to the commencement of any construction activities. Deviation 1 is also seen as a viable option but it transverses more Important areas in terms of GDARD's C-Plan and therefore the preferred route is more viable. Deviation 2 however, is the least viable option as this alternative is situated in the moist grassland and wetland vegetation group which is considered sensitive (Figure 11). The area of high sensitivity compared to that of limited to low sensitivity per route is given in Table 4 below. This tables confirmed the finding that the Preferred route are supported from a vegetation perspective, while Deviation 2 will have the most impact on sensitive areas.

Table 4: Area (in hectares) of sensitivity per proposed route.

Vegetation and sensitivity Category	Deviation 1 (Ha)	Deviation 2 (Ha)	Proposed route (Ha)
Moist Grassland (high)	**68.49**	**134.03**	**68.49**
Mountain Bushveld (medium low)	*21.85*	*21.85*	*21.85*
Secondary Grassland (medium low)	*489.00*	*435.70*	*478.61*
Transformed (low)	*199.69*	*201.91*	*237.47*
Total of Medium-low and low per route	**710.54**	**659.46**	**737.93**

Substations alternatives

Due to transformed state of the vegetation at the preferred substation site, as well as the alternative site, no long term impact on natural vegetation is likely to occur. However, both sites included signs of elevated soil moisture. The wetland assessment report needs to be consulted with regards to the functionality of these transformed / artificial moist grasslands and which site would have the least impact on hydrology.

5.3 Impact Assessment Criteria

The possible impacts, as described in the next section, were assessed based on the Significance Rating Matrix below. The Significance of the impact is calculated as follows and rating significance is explained in Table 5 and Table 6.

Significance = Consequence *(Magnitude+ Duration+ Extent + Reversibility)* **X Probability**

wherein the following meaning applies:

- The *Magnitude* of the impact is quantified as either:
    - Low: Will cause a low impact on the environment;
    - Moderate: Will result in the process continuing but in a controllable manner;
    - High: Will alter processes to the extent that they temporarily cease; and

- Very High: Will result in complete destruction and permanent cessation of processes.

- The *Duration* (Exposure) which indicates whether:
  - The impact will be of an immediate nature;
  - The impact will be of a short tem (Between 0-5 years);
  - The impact will be of medium term (between 5-15 years);
  - The impact will be long term (15 and more years); and
  - The impact will be permanent.

- *Reversibility/ Replaceability.* This refers to the degree to which the impact can be reversed or the lost resource can be replaced.

- The *Probability*: which shall describe the likelihood of impact occurring and will be rated as follows:
  - Extremely remote: Which indicates that the impact will probably not happen;
  - Unusual but Possible: Distinct possibility of occurrence;
  - Can Occur: there is a possibility of occurrence;
  - Almost Certain: Most likely to occur; and
  - Certain/ Inevitable: Impact will occur despite any preventative measures put in place.

Table 5: Significance rating matrix

RANKING	MAGNITUDE	REVERSIBILITY	EXTENT	DURATION	PROBABILITY
5	Very high/ don't know	Irreversible	International	Permanent	Certain/inevitable
4	High		National	Long term (impact ceases after operational life of asset	Almost certain
3	Moderate	Reversibility with human intervention	Provincial	Medium term	Can occur
2	Low		Local	Short term	Unusual but possible
1	Minor	Completely reversible	Site bound	Immediate	Extremely remote
0	None		None		None

Table 6: Description of significance rating

RANKING	65-100	64-36*	35-16*	15-5	1-4
SIGNIFICANCE	Very High	High	Moderate	Low	Minor

* The score of 36 was regarded as medium-high and 16 was regarded as medium-low

5.4 Impacts Assessment

Table 7 & 8 list the activities that could impact on the vegetation as a result of the construction of the powerline and construction of the substations, as well as impacts that may be associated with the operation and maintenance thereof. The construction (Table 7) and operational (Table 8) impacts are assessed and suitable mitigation measures are given in Section 5.5.

Table 7: Assessment of impacts associated with the construction of the powerline

Impact	Source	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without mitigation	With mitigation
1. Destruction of vegetation, although disturbed, will result in further deterioration	• Clearing of and damage to vegetation in construction footprint for or by –towers -access roads -construction camps - vehicle / machinery traffic - trampling by workers (stepping on small plants) • Illegal disposal and dumping of construction material such as cement or oil, as well as maintenance materials during construction; • Edge effects e.g. heavy vehicles turning in adjacent areas; and	Moderate (3) Low (2) Only if moist grasslands can be avoided	Reversible (3) Reversible (3)	Site bound (1) Site bound (1)	Short term (2) Short term (2)	Almost certain (4) Unusual but possible (2)	36 16	Moderate	Moderate-Low

Impact	Source	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without mitigation	With mitigation
	• Storage of structures within vegetation								
2. Exposure of the soil to erosion and subsequent sedimentation of proximate moist grassland	• Removal of vegetation in proximity to the moist grassland, without proper rehabilitation or failure of rehabilitation • Access roads, especially on slopes, channels rainfall and causes erosion	Moderate (3) Low (2)	Irreversible (5) Reversible (3)	Local (2) Site bound (1)	Long term (4) Short term (2)	Can occur (3) Unusual but still possible (2)	42 16	High	Moderate to low
3. Destruction of plants of conservation concern	• Construction of the preferred route will destroy the one *Boophone distichia* (poison bulb) individual • Construction activity where these plants occur e.g. moist grassland or remnant natural veld	Moderate (3) **Low** (2)	Irreversible (5) Reversible (3)	Local (2) Site bound (1)	Perm (4) Short term (2)	Can occur (3) Unusual but possible (2)	42 16	High	Moderate to low
4. Spread of alien invasive vegetation	• Contaminated construction vehicles and tools; and • Alien invasive species spread from current infestation into disturbed soils	High (4) Low (2)	Reversible (3) Reversible (3)	Provincial (3) Site (1)	Long term (4) Short term (2)	Can occur (3) Unusual but can occur (2)	42 16	High	Moderate to low
5. Soil	• The movement of heavy	High	Reversible	Site bound	Medium	Can occur	33	Moderate	Moderate

Impact	Source	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without mitigation	With mitigation
compaction (*rocky grassland and moist grasslands*)	machinery will result in soil compaction that could modify habitats, destroy vegetation and inhibit re-vegetation • Soil compaction will increase runoff and could result in erosion of proximate watercourses and moist grassland	(4) Low (2)	(3) Reversible (3)	(1) Site bound (1)	term (3) Short term (2)	(3) Unusual but can occur (2)	16		to low
6. Disturbance / impacts to moist grassland loss of stabilising vegetation	• Construction activities within the moist grasslands; • Removal or damage to natural vegetation; and • Edge effects on moist grasslands and watercourse	High (4) Low (2)	Reversible (3) Reversible with human intervention (3)	Local (2) Site (1)	Long term (4) Short term (2)	Almost certain (4) Can occur (2)	52 16	High	Moderate to low
Potential positive impact									
7. Improve growing conditions for indigenous species	• Removal of rubble from the footprint and servitude areas • Rehabilitation of the disturbed footprint								

Table 8: Assessment of impacts associated with the operation of the powerline and substation

Impact	Source	Magnitude	Reversibility	Extent	Duration	Probability of occurrence	Ranking	Significance	
								Without mitigation	With mitigation
8. Erosion and bare soils	• Lack of rehabilitation or failed rehabilitation • Maintenance vehicles disturbing rehabilitated areas • Failure of rehabilitation of the construction footprint	Moderate (3) Low (2)	Reversible (3) Reversible (3)	Local (2) Site (1)	Long term (3) Short term (2)	Can occur (3) Unusual but can occur (2)	33 16	Moderate	Moderate to low
9. Deterioration of vegetation	• Maintenance vehicles driving within natural or rehabilitated vegetation	Moderate (3) Low (2)	Reversible (3) Reversible with human action (3)	Local (2) Site (1)	Long term (3) Short term (2)	Can occur (3) Unusual but can occur (2)	33 16	Moderate	Moderate to low
10. Possible invasion by exotic vegetation	• Alien vegetation spreading into disturbed soil, especially in the absence of successful rehabilitation	Moderate (3) Low (2)	Reversible (3) Reversible (3)	Local (2) Site (1)	Short term (2) Short term (2)	Almost certain (4) Unusual but can occur (2)	44 16	High	Moderate to low

5.5 Mitigation Measures

A: Construction

5.5.1 Destruction of natural vegetation

The powerline construction will inevitably require the removal of the current, stabilising. Areas where structures are stored would flatten vegetation that could be detrimental to the persistence thereof. In addition, the illegal disposal of construction material such as oil, cement etc. could further deteriorate the vegetation along the route.

Mitigation Measures

- The work area (e.g. area to be disturbed) in the moist grassland and mountain bushveld must be kept to a minimum.
- A temporary fence or demarcation must be erected around the construction area (include the servitude, construction camps, areas where material is stored and the actual footprint of the development) to prevent access to adjacent, vegetated environs.
- Prohibit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the construction area (particularly to the moist grassland).
- No open fires are permitted.
- Formalise access roads and where possible, make use the existing roads rather than creating new routes through naturally vegetated areas.
- No activities should take place during rainy events and at least 2 days afterwards.
- Maintain site demarcations in position until the cessation of construction work.
- After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land must be left in a condition as close as possible to that prior to construction.

5.5.2 Exposure to erosion

The removal of surface vegetation, whether natural or disturbed, will expose the soils, which in rainy events could wash down into proximate moist grasslands, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive plant species will spread easily into these eroded soils.

Mitigation Measures

- Do not allow erosion to develop on a large scale before taking action.
- Where possible, no construction / activities should be undertaken within the moist grasslands. The extent of wetland conditions should be verified by a wetland specialist and no activities should take place within these areas without that a Water Use License was granted by the Department of Water Affairs (DWA) for these activities.
- Make use of existing roads and tracks where feasible, rather than creating new routes through vegetated areas.

- Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005).
- Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. The grassland can be removed as sods and re-established after construction is completed.
- Colonisation of the disturbed areas by plants species from the surrounding natural vegetation must be monitored to ensure that vegetation cover is sufficient within one growing season. If not, then the areas need to be rehabilitated with a grass seed mix containing species that naturally occur within the study area.
- Protect all areas susceptible to erosion (especially the sloped rocky grassland) and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.

5.5.3 Removal / Destruction of protected plants and plants of conservation concern

In addition, construction activities to the preferred route will necessitate the relocation of the one *Boophone distichia* (poison bulb) (Declining species) that was recorded in secondary grassland. No other plants of conservation concern were recorded. Although, a small possibility exist that some of these species may be uncovered during construction.

Mitigation Measure

- Where possible, construction activities must be restricted to previously disturb (Secondary grasslands) and transformed areas.
- Some pylons need to be places within the sensitive rocky grassland/moist grassland. However, all other construction related activities in these areas must be limited to absolutely necessary.
- The Declining *Boophone distichia* (poison bulb) should be relocated to suitable habitat outside of the disturbed footprint or within a substation locality where it can be monitored. This should be discussed with the GDARD, prior to removal.
- The ECO should be notified if any bulbous species are uncovered. The species should be identified by a suitably qualified person, who will also advise to correct action to be taken.

5.5.4 Potential increase in invasive vegetation

The proposed development area include a large number of alien invasive plant species. The seed of alien invasive plant species that occur on and in the vicinity of the construction areas could spread into the disturbed and stockpiled soil. Also, the construction vehicles and equipment were likely used on various other sites and could introduce alien invasive plant seeds or indigenous plants not belonging to this vegetation unit to the construction site.

Mitigation Measures

- Alien invasive species, in particular category 1 species that were identified within the study area should be removed from the development footprint and immediate surrounds, prior to construction or soil

disturbances. By removing these species, the spread of seeds will be prevented into disturbed soils which could thus have a positive impact on the surrounding natural vegetation.

- All alien seedlings and saplings must be removed as they become evident for the duration of construction.
- All construction vehicles and equipment, as well as construction material should be free of plant material. Therefore, all equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. This should be verified by the ECO.

5.5.5 Soil compaction

The movement of heavy machinery over vegetated areas will result in soil compaction that will modify habitats, destroy vegetation and inhibit re-vegetation. Soil compaction as a result of vehicles and traffic, could lead to a decrease of water infiltration and an increase of water runoff. Such areas are more likely to be colonised by pioneer, alien invasive plant species, than indigenous species. This will further transformed the vegetation of the area.

Mitigation Measures

- Vehicles and machinery may not veer from the dedicated roads.
- Once construction is complete, obsolete roads should be obliterated by breaking the surface crust and erecting earth embankments to prevent erosion, while the natural species composition should be re-established.
- It is advised that environmental audits be undertaken by an independent party during this construction period, especially in sensitive areas.

5.5.6 Disturbance / impacts to moist grassland, loss of stabilising vegetation

Destruction of the vegetation within and in proximity to the moist grasslands will impact on its hydrological function. Polluted water or sediment reaching moist grasslands will have detrimental effects on the vegetation and hydrology downstream. Soil erosion could lead to increased sedimentation and turbidity, which could then reduce water storage capacity, smother vegetation, and decrease oxygen concentration. In addition, the lack of natural vegetation could drastically reduce water holding capacity and the subsequent loss of the ecological function of the moist grassland vegetation as catchment to the downstream watercourses. This could have a cumulative impact on plants within these areas, as well as downstream from the study area.

Mitigation measures:

- The wetland boundary and recommend protective buffer zone as reported on by the wetland assessment should be adhered to.
- Project engineers should compile a method statement, outlining the construction methodologies. The required mitigation measures to avoid the impacts on the moist grasslands should be contained within the method statement. The method statement must be approved by the ECO and be available on site for reference purposes.

- Make use of existing roads and tracks where feasible, rather than creating new routes through moist grassland areas.
- Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover.
- An ecologically sound, storm water management plan must be implemented during construction and ensure that the stormwater management of the completed development is adequate to prevent deterioration of the moist grasslands and the watercourse.
- Do not allow stormwater to be canalised.
- Prevent contamination of rainwater on construction camps and sites.
- Place and maintain erosion control barriers as appropriate to prevent sedimentation into the watercourse and moist grasslands.
- Trucks and equipment should only be washed in dedicated areas and the dirty water is not allowed to discharge into the watercourse or surrounding natural vegetation.

5.5.7 Positive impact: removal of rubble

The vegetation along the proposed routes are largely disturbed. Dumping has significantly contributed to the degradation of the natural vegetation in the area. By clearing the servitude and construction footprint from rubble, and discouraging continues dumping in the area, the rehabilitation will be more successful and growing conditions for indigenous species improved

Mitigation measures

- Prior to construction, remove rubble from the construction footprint, servitude and adjacent areas.
- Ensure that the area remain litter free during construction and operation (e.g. providing skips, consult with municipality).
- Ensure rehabilitation is successful and monitor for at least three years after rehabilitation.

B: Operational

5.5.8 Erosion and bare soils

After construction, a lack of rehabilitation or failed rehabilitation will result in bare soils that are susceptible to erosion. Furthermore, maintenance vehicles could disturb rehabilitated areas which could lead to soil erosion, habitat modification, trampling of vegetation as well as the destruction of protected plants and plants of conservation concern.

Mitigation measures

- Leave as much natural vegetation as intact as possible during construction.
- Do not disturbed soil unnecessary during maintenance. Ensure that maintenance work does not take place haphazardly, but according to a fixed plan.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.

- After maintenance, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land must be left in a condition as close as possible to that prior to construction and maintenance.
- Monitor rehabilitation and ensure that alien invasive species are dealt with in accordance to the Environmental Management Plan.
- If monitoring finds that indigenous vegetation from the surrounding grasslands are not colonising the site, implement a re-vegetation plan to ensure that grass species that naturally occur in the area, are sowed in order to re-establish indigenous plant cover.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Monitor rehabilitation and delay the re-introduction of livestock (where applicable) to all rehabilitated areas until an acceptable level of re-vegetation has been reached.
- Maintenance workers may not trample natural vegetation and work should be restricted to previously disturbed footprint. In addition, mitigation measures as set out for the construction phase should be adhered to.

5.5.9 Deterioration of natural vegetation

Maintenance vehicles driving within vegetated areas (including secondary vegetation), not impacted on during the construction, will lead to the destruction of naturally occurring vegetation and compaction of soils and subsequent erosion or colonisation by alien invasive plant species. In addition, failed rehabilitation could lead to soil erosion during rainfall events and flooding.

Mitigation Measures

- Ensure that maintenance work does not take place haphazardly, but according to a fixed plan.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Maintenance workers may not trample natural vegetation and work should be restricted to previously disturbed footprint. In addition, mitigation measures as set out for the construction phase should be adhered to.
- Introduce adequate sedimentation control measures at watercourse crossings and when excavation or disturbance within moist grasslands takes place.
- Address erosion donga crossings, applying soil erosion control and bank stabilisation procedures as specified by the ECO.
- Do not allow erosion to develop on a large scale before effecting repairs. When in doubt, seek advice from the ECO.
- Repair all erosion damage as soon as possible and in any case not later than six months before the termination of the Maintenance Period to allow for sufficient rehabilitation growth.

5.5.10 Possible increase in alien and invasive plants

If rehabilitation of the indigenous vegetation along the powerline route as well as around the disturbed footprint of the substation site are unsuccessful or is not enforced, exotic and invasive vegetation may invade the area.

Mitigation measures

- Implement an alien invasive plant monitoring and management plan whereby the spread of alien and invasive plant species into the areas disturbed by the construction are regularly removed and re-infestation monitored.

6. CONCLUSION

The eastern portion of the Taunus-Diepkloof 132kV line falls within a critical ecosystem and a small portion of a class 3 ridge. However all four major vegetation groups identified during the survey all had significantly high levels of disturbance present. The wetland or moist grassland comprised mainly of dense stands of *Phragmites australis.* Only one Declining species was identified within the proposed Taunus-Diepkloof 132kV line, as well as adeviations and substations. This can be attributed to the high level of disturbance associated with these vegetation groups.

The preferred Taunus-Diepkloof 132kV line does not pose any significant threat to the vegetation and are supported from a vegetation perspective. The preferred route and Deviation 1 are considered as feasible option if all of the mitigation measures and recommendations are adhered to. Deviation 2 traverse a large section of the sensitive moist grassland vegetation group and is not considered a feasible option. Due to transformed state of the vegetation at the preferred substation site, as well as the alternative site, no long term impact on natural vegetation is likely to occur. However, both sites included signs of elevated soil moisture. The wetland assessment report needs to be consulted with regards to the functionality of these transformed / artificial moist grasslands and which site would have the least impact on hydrology.

In conclusion, the proposed development could proceed provided that the mitigation measures a set out in this report is implemented as a minimum to limit the potential impacts on vegetation during construction and operation of the developments.

7. REFERENCES

Bromilow, C, (2010): Problem Plants of Southern Africa. Third edition, first impression Briza Publications, Pretoria.

Department of Water Affairs and Forestry (2005): Environmental Best Practice Specifications: Construction for Construction Sites, Infrastructure Upgrades and Maintenance Works. Version 3

Gauteng Department of Agriculture and Rural Development (GDARD) (2012a): Requirements for Biodiversity Assessment Version 2. GDACE, South Africa. June 2012

GDARD, (2012b): Red List Plant Species Guidelines. Compiled 26 June 2006 with minor edits in January 2012

Gauteng Department of Agriculture and Rural Development (GDARD), (2011): Gauteng Conservation Plan Version 3 ArcGIS Spatial data

GDARD, (2015): Red list species information as received from Lorraine Mills per email on the 15th of October 2015

Golding, J.S. (ed), (2002): South African plant red data list. Southern African Botanical Diversity Network (SABONET) Rep. No.14

Government Gazette No 32689, (2009): Draft National List of Threatened Ecosystems in terms of the National Environmental Management Act, 2004 (Act 10 of 2004). Department of Environmental Affairs Notice 1477 of 2009 in Government Gazette No 32689, 6 November 2009.

Henderson, L., (2001): Alien Weeds and Invasive Plants. A complete guide to declared weeds and invaders in South Africa. Plant Protection Research Institute Handbook No. 12. Agricultural Research Council, South Africa.

Mucina, L. & Rutherford, M.C. (2006): The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia 19. South African National Biodiversity Institute*, Pretoria.

SANBI, (2009): Plants of Southern Africa. POSA version 3. June 2009. http://posa.sanbi.org. (Accessed in April 2015)

SANBI, (2015): Threatened Species Programme. Red List of Southern African Plants. http://redlist.sanbi.org/? (Accessed November 2015).

Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Manyama P.A., (eds) (2009): Red List of South African plants 2009. *Strelitzea* 25, South African National Biodiversity Institute.

Van Oudtshoorn, F., (2002): A Guide to Grasses of Southern Africa. Briza Publications,

Van Wyk, B., Van Oudshoorn B., & Gericke N., (2005): Medicinal Plant of South Africa. Briza Publications, Pretoria.

8. GLOSSARY

Alien species Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity

Azonal Water-logged and salt-laden habitats require specially adapted plants to survive in these habitats. Consequently the vegetation deviates from the typical surrounding zonal vegetation and are considered to be of azonal character (Mucina & Rutherford, 2006)

Biodiversity Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of

	ecosystems
Biome	A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.
Buffer zone	A collar of land that filters edge effects.
Conservation	The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.
Conservation concern (Plants of..)	Plants of conservation concern are those plants that are important for South Africa's conservation decision making processes and include all plants that are Threatened (see **Threatened**), Extinct in the wild, Data deficient, **Near threatened,** Critically rare, Rare and **Declining**. These plants are nationally protected by the National Environmental Management: Biodiversity Act. Within the context of these reports, plants that are provincially protected are also discussed under this heading.
Conservation status	An indicator of the likelihood of that species remaining extant either in the present day or the near future. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.
Community	Assemblage of populations living in a prescribed area or physical habitat, inhabiting some common environment.
Critically Endangered	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Data Deficient	There is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. However, "data deficient" is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.
Declining	A taxon is declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Threatened or Near Threatened, but there are threatening processes causing a continuous decline in the population (Raimondo *et al*, 2009).
Ecological	Corridors are roadways of natural habitat providing connectivity of various patches

Corridors	of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible
Ecosystem	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space
Edge effect	Inappropriate influences from surrounding activities, which physically degrade habitat, endanger resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution
Endangered	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future
Endemic	Naturally only found in a particular and usually restricted geographic area or region
Exotic species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
Forb	A herbaceous plant other than grasses.
Habitat	Type of environment in which plants and animals live
Indigenous	Any species of plant, shrub or tree that occurs naturally in South Africa
In Situ	"In the place" In Situ conservation refers to on-site conservation of a plant species where it occurs. It is the process of protecting an endangered plant or animal species in its natural habitat. The plant(s) are not removed, but conserved as they are. Removal and relocation could kill the plant and therefore in situ conservation is preferred/ enforced.
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas
Mitigation	The implementation of practical measures to reduce adverse Impacts
Near Threatened	A Taxon is Near Threatened when available evidence indicates that that it nearly meets any of the five IUCN criteria for Vulnerable, and is therefore likely to qualify for a threatened category in the near future (Raimondo *et al*, 2009).
Plant community	A collection of plant species within a designated geographical unit, which forms a relatively uniform patch, distinguishable from neighboring patches of different vegetation types. The components of each plant community are influenced by soil type, topography, climate and human disturbance. In many cases there are several soil types within a given plant community (Gobbat *et al*, 2004)

Protected Plant	According to Provincial Nature Conservation Ordinances or Acts, no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority. These plants are protected by provincial legislation.
Threatened	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities
Red Data	A list of species, fauna and flora that require environmental protection - based on the IUCN definitions. *Now termed Plants of Conservation Concern*
Species diversity	A measure of the number and relative abundance of species
Species richness	The number of species in an area or habitat
Suffrutex	Low-growing woody shrub or perennial with woody base, sometimes referred to as underground trees
Threatened	Threatened Species are those that are facing a high risk of extinction, indicated by placing in the categories Critically Endangered (CR), Endangered (E) and Vulnerable (VU) (Raimondo *et al,* 2009)
Transformation	The removal or radical disturbance of natural vegetation, for example by crop agriculture, plantation forestry, mining or urban development. Transformation mostly results in a serious and permanent loss of biodiversity and fragmentation of ecosystems, which in turn lead to the failure of ecological processes. Remnants of biodiversity may survive in transformed landscapes
Vegetation Unit	A complex of plant communities ecologically and historically (both in spatial and temporal terms) occupying habitat complexes at the landscape scale. Mucina and Rutherford (2006) state: "Our vegetation units are the obvious vegetation complexes that share some general ecological properties such as position on major ecological gradients and nutrient levels, and appear similar in vegetation structure and especially floristic composition".
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but meets any of the five IUCN criteria for Vulnerable and are therefore facing a high risk of extinction in the wild in the future(Raimondo *et al*, 2009)

APPENDIX A: METHODOLOGIES

The study was undertaken on the 20th and 21st of October 2015. The assessment entailed a literature review which included short listing plants of conservation concern that could potentially occur along the route, a field survey, the analysis of data collected and reporting.

Literature Review:

The description of the regional vegetation relied on literature from Mucina & Rutherford (2006). Plant names follow Van Wyk & Van Wyk (1997), Van Wyk & Malan (1997), Pooley (1998), Henderson (2001), Van Oudtshoorn (2002) and Bromilow (2010). The study was undertaken in accordance with the Requirements for Biodiversity Assessments Version 2 (GDARD, 2012a).

Field survey:

The field survey focussed on identifying natural and untransformed vegetation, unique features that could indicate local sensitivities such as threatened and protected plants, as well as sensitive ecological features such as wetlands, ridges and rivers that are essential for the maintenance of ecosystems and ecological processes. Where access allowed, random transects were walked within the proposed development footprint and immediate surroundings (Figure 12). In order to identify species and variation within the vegetation community, transects concentrated on moving through environmental gradients encountered within the site and surrounds. This was continued until few or no new species were encountered. Any additional information on any other feature thought to have ecological significance within the site was also recorded. Plant identification and vegetation description relied on species recorded in the sampling points along the walked transects.

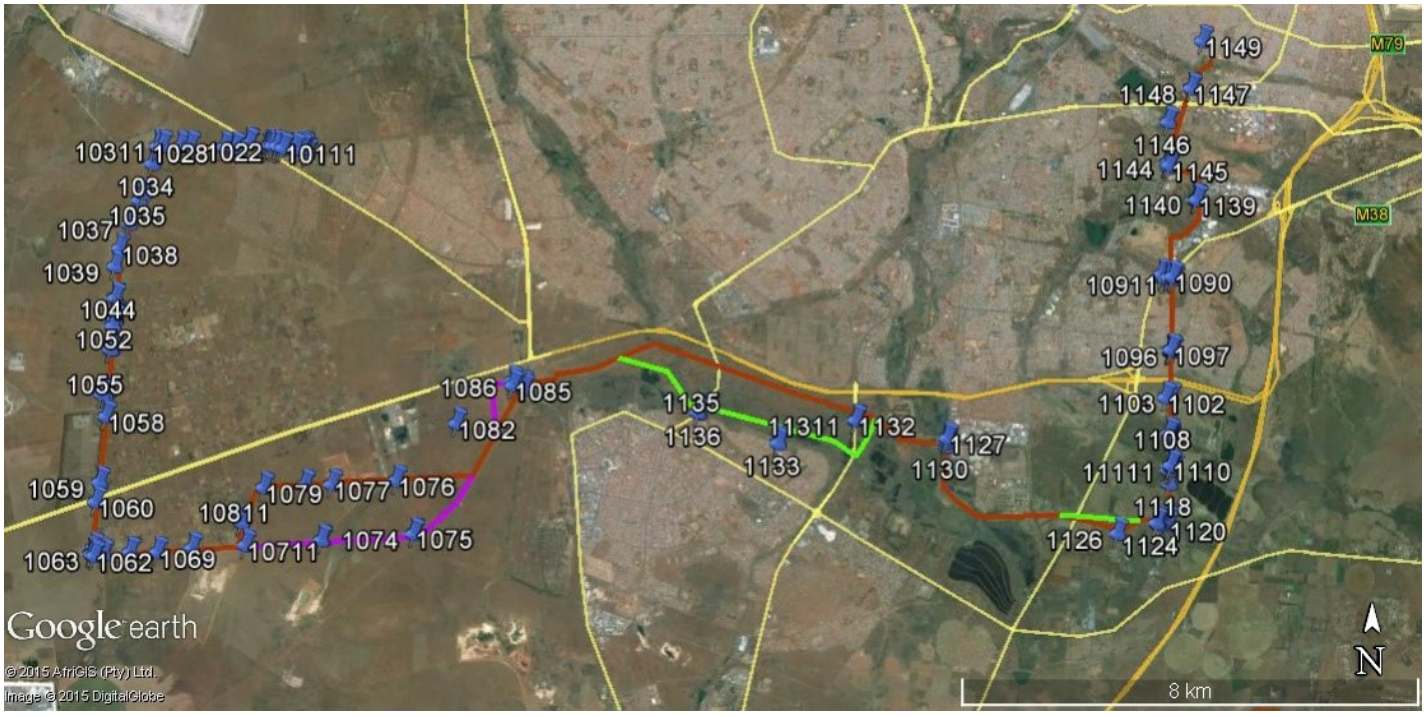


Figure 12: Sample point map (Google Earth imagery)

Vegetation Sensitivity

The following criteria and weighting was used to determine the vegetation sensitivity, function and conservation importance:

1. The status of the regional vegetation that is expected to occur on the study site, only where natural vegetation is still remaining.

Conservation status*	**Scoring**
Critically Endangered	3
Endangered	2
Vulnerable	1
Least threatened	0

*This scoring is not applicable (N/A) for areas devoid of natural vegetation.

2. Whether the study area is situated within a Listed Ecosystem in terms of Section 52 of the National Environmental Management: Biodiversity Act (Act 10 of 2004) or in a vegetation that is classified as Vulnerable or Endangered.

Listed Ecosystem*	**Scoring**
Primary state	3
Sub-climax state	2
Secondary state	1
No natural vegetation remaining	0

3. Whether the vegetation or ecological feature is protected by legislation:

Listed Ecosystem*	**Scoring**
National legislation	3
Provincial policies and guidelines	2
Municipal or other protection	1
No legislated protection	0

4. The presence of suitable habitat for plants of conservation concern as well as the actual occurrence thereof.

Suitable habitat / presence	**Scoring**
Confirmed presence of red listed species (Threatened)	3
Confirmed presence of Orange listed (Near threatened, Declining), and Suitable habitat and some likelihood of occurrence of Threatened species	2
Suitable habitat but unlikely to occur	1
No suitable habitat	0

5. Ecological Function: areas important to ecological processes such as ecological corridors, hydrological processes and important topographical features such as ridges.

Ecological function	Scoring
High: Sensitive vegetation communities with low inherent resistance or resilience towards disturbance factors; vegetation that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.	3
Medium to high: Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with a high degree of connectivity with other ecological systems OR disturbed vegetation connected to an ecological and protected system e.g. ridge, wetland or river	2
Medium: Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree or limited connectivity with other ecological systems	1
Low: Degraded and highly disturbed vegetation with little ecological function	0

6. Conservation Importance: indication of the necessity to conserve areas based on factors such as the importance of the site on a national and/or provincial scale and on the ecological state of the area (degraded or pristine). This is determined by the presence of a high diversity, rare or endemic species and areas that are protected by legislation.

Ecological importance	Scoring
High: Ecosystems with high species diversity and usually provide suitable habitat for a number of threatened species. OR protected ecosystems e.g. wetlands, riparian vegetation etc. These areas should be protected	3
Medium to high: Ecosystems with intermediate levels of species with the possible occurrence of threatened species	2
Medium: Ecosystems with intermediate levels of species diversity without any threatened species.	1
Low: Areas with little or no conservation potential and usually species poor (most species are usually exotic).	0

APPENDIX B: SPECIES LIST

List of plants observed at the time of the site visit (20-21 October 2015).

1 – recorded in the vegetation grouping
D – Declining
NT-Near Threatened
P - Provincially protected

Species	Common name	Habitat notes	Mountain Bushveld	Secondary Grassland	Moist grassland	Transformed
Grasses						
Andropogon schirensis	Stab Grass	Rocky slopes in well-drained soils, often in moist places.	1			
Brachiaria serrata	Saw-tooth grass	Rocky, undisturbed places	1			
Cynodon dactylon	Couch grass	Most soils, usually in disturbed areas. Increaser II grass, palatable	1	1		1
Eragrostis racemosa	Narrow Heart Love Grass	Various habitats, mostly sandy or rocky moist soils. Increaser II	1	1		
Heteropogon contortus	Spear Grass	Rocky, sloped land and common on disturbed road reserves. Increaser II grass. Palatable in early summer	1			
Hyparrhenia hirta	Common Thatching Grass	Well drained, rocky soil in open grassland and disturbed areas. Increaser I grass	1	1		1
Hyperrhenia tamba	Blue Thatching Grass	Road reserves and where water accumulates, also next to rivers or outer edge of wetlands	1			
Melinis repens	Natal Red Top	Disturbed grassland. Increaser II grass.	1	1		
Aristida adscesionis	Annual Three-awn	Disturbed land such as road reserves. Increaser II		1		
Aristida congesta	Tassel Three-awn	Disturbed, overgrazed or farmed land. Increaser II grass		1		
Chloris virgata	Feather-top Chloris	Disturbed, moist areas, mostly clay soils and on edge of pans. Increaser II		1		
Eragrostis curvula	Weeping Love Grass	Mostly occurs in disturbed areas / sown as pasture. Increaser II grass		1		1
Eragrostis lehmanniana	Lehmann's Grass	Sandy soil, mostly in disturbed land. Increaser II grass		1		

Species	Common name	Habitat notes	Mountain Bushveld	Secondary Grassland	Moist grassland	Transformed
Eragrostis plana	Tough Love Grass	Disturbed areas, mostly in moist patches. Increaser II grass		1		
Hyperthelia dissoluta	Yellow Thatching Grass	Sandy bushveld areas, open grassland and disturbed areas.		1		
Pogonarthria squarrosa	Herringbone Grass	Disturbed places, sparsely distributed in natural, open grassland. Sub climax grass that colonise disturbed sandy soils. Not palatable, Increaser II	1	1		
Themeda triandra	red grass	Undisturbed or disturbed open grassland. Decreaser Grass	1	1		
Aristida congesta subsp *barbicollis*	Spreading Three-awn	Disturbed areas such as fallow lands and road reserves. Not palatable, Increaser II		1		
Setaria sphacelata var *spacelata*	Common Bristle Grass	Rocky slopes or in moist soils		1		
*Pennisetum clandestinum**	Kikuyu	Disturbed, moist areas.			1	1
Phragmites australis	Common Reed	Grows close to water sources such as rivers and wetlands.			1	
Imperata cylindrica	Cotton Wool Grass	Mostly in moist soils			1	
Total number of grass species = 21			**10**	**15**	**3**	**4**
Forbs/ shrubs						
Acalypha angustata	Copper Leaf	Grassland, rocky grassland	1			
Albuca cf *setosa*	Fibrous Slime Lily / Slangkop	Plains, rocky areas	1			
Aloe greatheadii		Rocky outcrops, rocky grassland. Often forming dense stands in overgrazed areas.	1			
Asparagus intricatus		Open woodland, dry rocky hillsides	1			
Asparagus sauveolens	Bushveld Asparagus	Bushveld and thicket, rocky grassland	1		1	
Berkheya radula	Boesmanrietjie	Moist grassland and vlei's	1		1	
*Bidens bipinnata**	Basterkakiebos/Black Jack	Weed in disturbed places	1	1		
Chaetacanthus costatus		Grassland, often rocky hillsides	1			
Commelina benghalensis **(M)**	Benghal Wondering Jew	Bushveld, grassland	1			

Species	Common name	Habitat notes	Mountain Bushveld	Secondary Grassland	Moist grassland	Transformed
Cotula podocephala		Roadsides and disturbed grasslands	1			
Dipcadi species		Between rocky outcrops	1	1		
Erythrina zeyheri	Ploegbreuker	Grassland frequently in moist vleis with clay soil	1			
Felicia muricata		Grassland, proliferating in overgrazed/disturbed places	1	1		1
Geigeria burkei	Vermeerbos	Common in overgrazed and disturbed areas	1			
Hermannia depressa	Rooi-opslag / Creeping Hermannia	Grassland, also in trampled and overgrazed areas	1			
Hibiscus microcarpus		Grassland	1			
Hypoxis rigidula **(M)**	Kaffirtulp	Grassland	1			
Indigofera comosa		Grassland and rocky ridges	1	1		
Kohautia caespitosa		Grassland and bushveld	1	1		
Ocimum obovatum subsp *obovatum* **(M)**		Grassland	1			
Pentharrhinum insipidum	African heartvine	Forest margins, woodland	1		1	
Solanum panduriforme	Poison Apple	Disturbed places, often under trees (probably an indigenous specie)	1	1		1
Tribulus terrestris	Common Devil's Thorn / Dubbeltjie	Spreading weed in disturbed places	1	1	1	1
Polydora (Vernonia) poskeana		Bushveld, often weed in disturbed places	1	1		
Waltheria indica	Meidebossie	Grassland and Bushveld, often in disturbed areas.	1			1
Bulbine abyssinica		Rocky grassland Widespread		1		
Dimorphotheca spectabilis	Bloubietou	Grassland		1		
Chamaecrista mimosoides **(M)**	Fishbone Cassia	Grassland/bushveld		1		
Cleome maculata		Grassland, often a weed of disturbed sandy places		1		
Cleome monophylla	Spindlepod	Grows in disturbed places		1		
Comelina africana		Widespread		1		
Cucumis cf *zeyheri* **(M)**		Grassland and bushveld		1		

Species	Common name	Habitat notes	Mountain Bushveld	Secondary Grassland	Moist grassland	Transformed
Eriosema burkei		Grassland		1		
Gomphocarpus fructicosus	Milkweed	Grassland, often along roadsides and abandoned cultivated fields.		1		
Helichrysum nudifolium **(M)**	Hottentot's tea	Grassland		1		
Helichrysum rugulosum **(M)**		Grassland, often in vlei's or patches in disturbed areas		1		
Helichrysum setosum	Yellow everlasting	Rocky grassland		1		
Heliotropium amplexicaule		Naturalised weed in grassland and disturbed areas		1		
Kohautia amatymbica		Grassland, often appearing after fire.		1		
Nidorella anomala		Grassland, often occurring in groups in moist areas.		1		
Pollichia campestris	Waxberry	Grassland		1		
Rhynchosia monophylla		Moist grassland, often in clay.		1		
Senecio affinis		Grassland.		1		
*Solanum retroflexum**	Black Nightshade	Disturbed places, often under trees (probably an indigenous specie)		1		
Sphenostylis angustifolia **(M)**	Wild Sweetpea	Clumps of bush, bushveld and rocky ridges		1		
Boophone disticha (P) (D) (M)	Poison Bulb	Grassland, often in rocky places		1		
Elephantorrhiza elephantina (suffrutex)	Elephant's root	Grassland		1		
Felicia mossamedensis	Yellow Felicia	Sandy areas		1		
Gazania krebsiana	Botterblom	Grassland, widespread in other habitats		1		
Gnidia capitata	Kerrieblom	Grassland		1		
Helichrysum sp				1		
Helichrysum coriaceum	Vaalteebossie	Grassland and rocky hillsides		1		
Hilliardiella (was Vernonia) oligocephala (M)	Bitterbossie	Grassland		1		
Hypoxis iridifolia		Grassland		1		
Ledebouria cooperi (M)		Grassland, often in moist places		1		

Species	Common name	Habitat notes	Mountain Bushveld	Secondary Grassland	Moist grassland	Transformed
Ledebouria revoluta		Grassland, bushveld		1		
Nemesia fructicans	Wildeleeubekkie	Shallow soils on exposed rock, also in disturbed areas		1		
Euphorbia striata	MilkGrass	Infrequently scattered in grassland, often in seepage lines			1	
Rhanunculus multifidus **(M)**	Buttercup	Damp grassland, near streams			1	
Seriphium plumosum	Bankruptbush	Grassland, often proliferating in overgrazed areas.		1		1
Total number of forb/shrub species = 59			25	41	6	5
Trees						
Acacia (Vachellia) karroo (M)	Sweet Thorn	Widespread, often proliferate in overgrazed areas	1	1		
Celtis africana	Stinkwood	Wooded areas or bush clumps, usually on dolomite	1		1	
Acacia (Senegalia) caffra (M)	Common Hook-thorn	Grassland, bushveld, often on rocky ridges	1			
Euclea crispa subsp crispa	Blue Guarri	Rocky slopes, kloofs, along rivers and forest margins	1			
Gymnosporia buxifolia	Common Spike Thorn	Widespread, often as pioneer in disturbed places	1			
Searsia lancea	Sour Karee	Grassland and bushveld	1			
Searsia pyroides (Rhus pyroides)	Common Wild Currant	Mountain grassland, bushveld, grassland - wide range of habitats	1		1	
Ximenia caffra	Sourplum	Bushveld as well as coastal bush	1			
Ziziphus zeyheriana	Dwarf Buffalo-thorn	Grassland	**1**			
Total number of tree species = 9			**9**	1	2	0
Sedges						
Cyperus sexangularis	Matjiesgoed	Along the edge of streams, rivers and pans, often in water, occasionally found growing in drier areas.			1	
Juncus effusus	Soft Rush	Wetland, swampy areas and streambeds			1	
*Typha capensis**	Bulrush	Grows in marshy areas and along watercourses.			1	
Pycreus macranthus		Marshes vleis and seasonal swamps			1	
Total number of sedge species = 4			**0**	**0**	**4**	**0**

Species	Common name	Habitat notes	Mountain Bushveld	Secondary Grassland	Moist grassland	Transformed
Climbers Ferns or Mosses						
Pentarrhinum insipidum	Donkieperske	Grassland and clumps of bush, often twining in fences. It is an aggressive grower and in slightly disturbed areas exhibits invasive tendencies.	1	1		
Pellaea calomelanos **(P)**	Hard Fern	Grassland, often in moist or rocky places.	1			1
Total number of climbers and ferns species = 2			**2**	**1**	**0**	**1**
Alien and invasive species						
Argemone ochroleua	Mexican Poppy (White)	Category 1 (CARA)	1	1	1	1
Arundo donax	Giant Reed	Category 1b	1			1
Bidens pilosa	Blackjack	Widespread, naturalised weed.	1	1	1	
Conyza bonariensis	Flax-leaf Fleabane	Annual weed in fallow land	1			
Datura stramonium (M)	Thorn-apple / Olieboom	Category 1b	1	1	1	
Gleditsia triacanthos	Honey Locust	Category 1b	1			
Melia azedarach	Syringa	Category 1b (3 in urban areas)	1	1		1
Morus alba	Mulberry	Invader, Category 3 (CARA)	1	1		
Opuntia ficus-indica	Sweet Prickly Pear	Category 1b	1			
*Oxalis corniculata**	Creeping Sorrel	Weed in disturbed places	1			
Populus spp	Poplar	Invader	1			
Shinus molle	Pepper Tree	Not listed	1			
Solanum mauritianum	Bugweed	Category 1b	1			1
Verbena bonariensis	Wild Verbena	Category 1b (NEMBA)	1	1		
Verbena tenuisecta	Fine-leaved Verbena	Common in disturbed places	1			
Plantago lanceolata	Narrow-leaved Plantain	Introduced weed, usually in disturbed places	1	1		1
Tagetes minuta	Khaki Weed	Weed in disturbed places. Has become naturalised and due to the vast amount of seed set, difficult to control	1	1	1	1

Species	Common name	Habitat notes	Mountain Bushveld	Secondary Grassland	Moist grassland	Transformed
Acacia mearnsii	Black Wattle	Category 2 invader (NEMBA)		1		1
Cirsium vulgare	Scotch Thistle	Category 1b (NEMBA)		1		1
Eucalyptus camaldulensis	Red River Gum	Category 1b in riparian areas. On site these species did not occur within riparian areas or watercourses		1		1
Pinus spp.	Pines	Invaders. Category 2, transform landscape and reduce carrying capacity		1		
Pyracantha angustifolia	Yellow Firethorn	Invades high altitude grasslands		1		
Richardia brasilliensis		A weed from S America, naturalised in disturbed places		1	1	1
Sesbania punica	Red Sesbania	Category 1b		1		
Sisymbrium thellungii	Wild Mustard	Often a weed in disturbed places		1		
Solanum pseudocapsicum	Jerusalem Cherry	Weed originally from Europe and Asia and now naturalised in RSA		1		
Solanum seaforhianum	Potato Creeper	Creeper, invading wooded areas		1		
Sonchus oleraceus	Sowthistle	Weed, widespread in cultivated areas		1		
Gomphrena celosiodes	Prostrate Globe Amaranth	Cosmopolitan Weed		1		1
Agave spp	Agave/Sisal	Special effects weed		1		
Campuloclinium macrocephalum	Pom-Pom Weed	Invasive weed, Category 1b			1	1
Nasturtium officinale (was Rorippa nasturtium-aquaticum)	Watercress	Live in water, but rooted in soil Category 2			1	
Persicaria lapathifolia	Spotted Knotweed	Invasive weed			1	
Populus x canescens *	Grey Poplar	Declared invader of moist areas Category 2 (CARA)			1	1
Ricinus communis vat communis	Castor Oil	Category 2 that invade moist areas, roadsides and waste lands			1	
Rumex crispus	Curly Dock	Invades ditches and moist, waste places			1	

Species	Common name	Habitat notes	Mountain Bushveld	Secondary Grassland	Moist grassland	Transformed
Salix babylonica	Weeping Willow	Category 2 Invader per the CARA legislation, although this specie is not listed in the NEMBA list. The spreading root mass can reduce the depth of waterways thereby increasing the risk of flooding			1	
Trifolium repens	White Clover	Weed of disturbed (damp) places, often forming dense colonies and replacing indigenous grass			1	
Total number of alien and invasive species = 37			17	21	13	13

APPENDIX C: PLANTS OF CONSERVATION CONCERN

Plants of conservation which could occur in proximity to the proposed development due to the presence of suitable habitat and/or distribution records. The likelihood of each plant species occurring is printed in *italics*, while those that were confirmed to occur is printed in ***bold italics***

QDS – Quarter degree square

Species	Conservation Status	Habitat notes and likelihood of occurrence	Flowering time
Habenaria mossii	Endangered	Occurs in grassland on dolomite. In black or sandy soil. *No suitable habitat present and therefore unlikely to occur.*	March-April
Cineraria longipes	Vulnerable	This specie occurs in grassland amongst rocks and along seepage areas and exclusively on basalt koppies on south facing slopes in association with the fern *Pteridium*. The species has previously been recorded within the Kliprivіersberg. *The level of disturbance on the rocky outcrops were high. This assessment not undertaken during this species flowering period and it is thought to be unlikely to occur..*	March-May
Dioscorea sylvatica	Vulnerable	Wooded places with fair to reasonably good rainfall (e.g. moister bushveld areas, coastal bush and wooded mountain kloof) *The level of disturbance on the rocky outcrops were high and are not considered to be prime habitat for this sepcies..*	Oct-Jan
Lithops lesliei subsp. *lesliei*	Near threatened	Primary habitat appears to be the arid grasslands in the interior of South Africa where it usually occurs in rocky places, growing under the protection of surrounding forbs and grasses. This plant is well camouflaged in brown shale on hilltops and difficult to spot when not in flower. *This assessment was undertaken outside of this species flowering period and the area surveyed does not provide suitable habitat*	March-June
Boophone disticha	Declining	Rocky grasslands, but particularly in proximity or on rocky outcrops.	Oct-Jan

<table>
<tr><th>Species</th><th>Conservation Status</th><th>Habitat notes and likelihood of occurrence</th><th>Flowering time</th></tr>
<tr><td></td><td></td><td>Confirmed to occur in secondary grassland vegetation group along the proposed powerline route at the following coordinates:
<table>
<tr><th>Lat</th><th>long</th></tr>
<tr><td>-26.293760°</td><td>27.742598</td></tr>
</table></td><td></td></tr>
<tr><td>Hypoxis hemerocallidea</td><td>Declining</td><td>Occurs in a wide range of habitat; appears to be drought and fire tolerant and can tolerate some disturbance.

Not found during site visit however the entire length of the powerline and alternatives was not walked. The level of disturbance in the wetland as well as secondary grassland vegetation was severe. The disturbance level may exceed the level of tolerance of this plant species and it is considered unlikely to occur.</td><td>Sept-March</td></tr>
<tr><td>Lepdidium mossii</td><td>Data deficient - D</td><td>unknown - known from a locality in Nancefield and the Free State

The proposed development is situated in the vicinity of Nancefield, one of the few localities where this species has been recorded. However, not enough is known about the distribution, specific habitat or current population status of this species.</td><td>unknown</td></tr>
</table>

APPENDIX D: LOCALITIES OF PLANTS OF CONSERVATION CONCERN

Species	Conservation status	Coordinates	
		Lat	Long
Boophone distichia	Declining	-26.293760°	27.742598°

APPENDIX E: SPECIALIST CV

Curriculum Vitae and abbreviated Company Profile

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February 2014

Drafted by

Antoinette Eyssell

Pr Sci Nat (400019/11) Ecological Science

1. EMPLOYMENT RECORD

I am currently self-employed and am the sole proprietor of Dimela Eco Consulting. I have been working in the field of environmental impact assessment since 2007 (7 years) (Table 1).

Table 1: Employment record: Environmental Assessments

Time frame	Title	Company
Nov 2011 - current	Sole proprietor, vegetation specialist	Dimela Eco Consulting
Sep 2007 – Nov 2011	Terrestrial Ecologist, specialising in vegetation	Strategic Environmental Focus (SEF)

Prior to working in the environmental impact assessment field, my main work experience was gained at the Pretoria National Botanical Gardens where I have developed much of my knowledge on indigenous pants.

Table 2: Employment record: Other

Time frame	Title	Company
Aug 2003 – Sep 2007	Snr Environmental Education Officer	Environmental Education Centre, Pretoria National Botanical Garden, South African National Biodiversity Institute (SANBI)
Jun – Jul 2003	Horticultural Trainer	17 Shaft Training Centre, Johannesburg
May 1997 – Mar 2002	Horticulturist	Pretoria National Botanical Garden (then NBI, now SANBI)

2. QUALIFICATIONS

- M.Sc Environmental Science, University of Pretoria (2010)
  Dissertation: *Land cover change and its effect on future land uses*
- B. Sc (Hons) Horticulture, University of Pretoria (1999-2000)
  Dissertation: *Horticultural uses of the indigenous Barleria species*
- B. Sc (Agriculture) Horticulture, University of Pretoria (1993-1996)

3. PROFESSIONAL MEMBERSHIP: SACNASP

Registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professionals (SACNASP)

SACNASP Reg no 400019/11

4. SPECIALIST WORK EXPERIENCE

Dimela Eco Consulting is an independent consultancy which offers a range of services pertaining to the integration of vegetation, vegetation ecology, protected plants and other ecological concerns into the development and land use process. In support of sustainable development, green infrastructure and socially responsible progress, Dimela Eco Consulting provides clients with quality, unbiased and reliable reports to

help minimise the impact on the receiving natural environment and to inform effective decision making by providing the following services:

- Vegetation assessments;
- Vegetation overviews or scans;
- Strategic ecological assessments, including wetland input;
- Wetland assessments in conjunction with Limosella Consulting;
- Mitigation measures to reduce impacts on the natural environment;
- Ecological management and biodiversity action plans (including alien vegetation management);
- Specialist input: ecological conditional requirements for Green Star rating;
- Ground-truthing of vegetation related data; and
- Review of ecological reports.

In addition, Antoinette Eyssell has 4 years' experience in Environmental Education and Greening Projects at the South African National Biodiversity Institute (SANBI) (2003-2007). In this time, she mentored four students over two year period as part of an intership programme. She currently writes the ecology feature for the bimonthly Supernova Kids Magazine and welcome opportunities to stay involved in environmental education and related community programmes. Since January 2012, Antoinette assists with the administration, project management, report review and vegetation assessments for Limosella Consulting. Limosella Consulting is an independent consultant that specialises in wetland assessments, but also include a wide range expertise such as fauna, flora and aquatic assessments.

The table below list some of the past project experience.

PROJECT NAME	INDUSTRY / CLIENT	DATE	ADDITIONAL INFORMATION
Vegetation Assessment for Solar Panels	Schmidsdrift, Northern Cape	January 2012	Delineation of vegetation communities, determine vegetation sensitivities and survey for plants of conservation concern. Report on potential impacts and mitigation measures to limit impacts.
Protected tree identification	Kranspoort road upgrade	March 2012	Identify and record localities, species and numbers of protected trees along an area earmarked for road upgrade.
Ground-truth final ESKOM route alignment	Dhuva-Minerva route deviation	March-April 2012	Walk proposed route alignment and identify sensitive vegetation issues and pylon positions that might need to be moved.
Vegetation base line study and input into Biodiversity Action Plan	Kumba Iron Ore (Anglo)	April-May 2012	Undertake a gap analysis and review of existing information and update by assessing the vegetation during the summer months and suggesting monitoring plots, information to e collected and areas where sensitive vegetation should avoided and managed.
Vegetation assessment	Rietfontein Open Cast	April 2012	Delineation of vegetation communities, determine vegetation sensitivities and survey for plants of conservation concern. Report on potential impacts and mitigation measures to limit impacts.
Vegetation assessment	Eskom: Perseus to Gamma	October 2012	Survey the proposed route options and compare the floral assemblages that are expected to occur within the area to the actual vegetation found to be present

PROJECT NAME	INDUSTRY / CLIENT	DATE	ADDITIONAL INFORMATION
			along the route options. Map the localities of plants of conservation concern that was identified during the field survey or suitable habitat where these plants could potentially occur. Assess impacts and determine route alignment that is likely to have the least impact on sensitive vegetation
Vegetation assessment and EMP input	Vierfontein Colliery	January 2013	Assess the current impacts of the open cast mine on the vegetation and provide input into the EMP to conserve and limit impact on conservation worthy vegetation that persist on the site
Diepsloot Eskom line and substation, Johannesburg (Gauteng	Envirolution	March 2013	Survey the preferred and alternative route alignments and compare the floral assemblages that are expected to occur within the area to the actual vegetation found to be present along the routes. Map the vegetation / habitat types according to structurally distinct vegetation units as well as transformed areas, as well as the localities of threatened plant species. Recommend mitigation measures to aid the conservation of vegetation during construction and operation and indicate the route that will have the least impact on the vegetation.
Komati Power Station – Coal stockyard *Vegetation opinion*	Envirolution	May 2013	• Assess the potential plant species and vegetation communities that could be impacted by the proposed increase in capacity of the coal stockyard; and • •Recommend mitigation measures to avoid or limit the potential negative impacts that the proposed activity could have on the surrounding vegetation.
Droogenfontein - open cast mine Vegetation assessment	CEMS	October 2013	Assess the vegetation on land proposed for an open cast mine and indicate sensitive vegetation groupings and plants of conservation concern.
Masa Ngwedi 750kV and 400kV lines (Limpopo and North West Provinces) Section D & E *Vegetation Input for EMP*	Mandara Consulting	November 2013	Walk down with specific reference to plants of conservation concern that could occur along the proposed powerline route. A report detailing the pylons in proximity to intact and likely sensitive vegetation as well as measures to aid conservation / rehabilitation of this vegetation along the powerline routes as input into the EMP; and localities of plants of conservation concern will be mapped and used to apply for permits for the removal/destruction/pruning of these species where they might be impacted on by the powerline.
Meteor	Nsovo	February	• Survey the preferred and alternative route

PROJECT NAME	INDUSTRY / CLIENT	DATE	ADDITIONAL INFORMATION
substation, as well as the 88kV line between the Pulsar, Meteor and Sonland substations, Sebokeng area, Gauteng	Environmental Consulting	2014	alignments and substation locality; • Compare the floral assemblages that are expected to occur within the area to the actual vegetation found to be present along the routes; • Map the vegetation / habitat types according to structurally distinct vegetation units as well as transformed areas; • Map the localities of plants of conservation concern that was identified during the field survey or suitable habitat where these plants could potentially occur; • Assess the possible impacts that the proposed powerline an substation could have on the vegetation; • Recommend mitigation measures to aid the conservation of vegetation during construction and operation; and • Indicate the route that will have the least impact on the vegetation

Lorainmari den Boogert

Resume Summary

Contact: +27 722 006244
Email: lorain@iggdrasilscientific.com
Languages: English, Afrikaans, Dutch
Nationality: South African (8506040029082)

Career Highlights

DIRECTOR, ECOLOGIST
Iggdrasil Scientific Services **Jan 2012 – Present**
A medium sized enterprise specialising in ecological assessments, covering fauna, flora, wetland and aquatic ecosystems.

PLANT ECOLOGIST
GEM – Science, South Africa **Oct 2010 – Jan 2012**
A medium sized enterprise providing comprehensive geological and environmental consulting service for the mining industry.

JUNIOR ENVIRONMENTAL CONSULTANT
Bokamoso Environmental Consultants, SA **Jan 2010 – Oct 2010**

PROJECT RESEARCH ASSISTANT
Abiotic Research Group, Alterra, Wageningen, The Netherlands **Jan 2009 – Jun 2009**

BOTANY DEMONSTRATOR
University of Pretoria, Plant Sciences, SA **Jul 2008 – Nov 2008**

FIELD ASSISTANT
University of Pretoria, Zoology, SA **Nov 2007 – Feb 2007**

PROJECT RESEARCH ASSISTANT
University of Pretoria, Zoology, SA **Jan 2006 – Aug 2006**

Education and Training

Degrees

- **Master of Science Plant Science** **2010**
  Wageningen University, The Netherlands and University of Pretoria, SA
- **Bachelor of Science (Honours) Plant Science (Cum Laude)** **2008**
  University of Pretoria, SA
- **Bachelor of Science Ecology** **2007**
  University of Pretoria, SA

Certificates and Accreditations

- **SASS5 Accreditation (Freshwater Aquatic Zoology)** **2014 and 2011**
  Department of Water Affairs, SA
- **Dutch as a professional language** **2011**
  CNaTV, Belgium

Additional Courses

- Inventory and survey methods for invasive plants, Online Course, Department of land resource of environmental Sciences, Montana State University, Bozeman, Montana. (2009)
- A rapid method for water quality assessment, Nepid Consultants, Sabie (2011)
- EIA water use authorisation and waste management activity licences, Carin Bossman Sustainable Solutions, Pretoria (2011)
- Tools for wetland assessment, Rhodes University, Grahamstown (2011)
- Groundwater hydraulics, hydrochemistry and pollution, groundwater modelling, groundwater management, Institute for Groundwater Studies, University of the Free State (2014).

Selected Project Experience

*** Full project list available upon request.**

Vegetation Reports:

African Transboundary River Basin Support Programme Case of the Orange – Senqu River in Botswana, Lesotho, Namibia and South Africa

Vegetation specialist for the Vaal River survey for 2015.

Construction:

Plant Ecological Report for the Tanus – Diepkloof Power line, Soweto, Gauteng.
Plant Ecological Report for the proposed decommissioning of the Kloof Slag Dump – Samancor, Midellburg Mpumalanga.
Vegetation Survey for Portion 1 of the Farm Doornkloof 391. Delmas, Mpumalanga.
Vegetation Survey for the Proposed Resedential Development at Erasmia, Gauteng.
Vegetation Survey for the Proposed Longmore Bridge, Pretoria, Gauteng.
Vegetation Survey for the Proposed Township: Clayville X 10, Johannesburg, Gauteng.
Vegetation Survey for the Proposed Filling Station, Newcastle, KwaZulu – Natal.
Vegetation Survey for the Bails Bridge, Centurion, Gauteng.

Vegetation Survey for the Proposed Hatfield Heights, Pretoria, Gauteng.
Vegetation Survey for Portion 37 of the farm Elandsfontein 334 IQ, Gauteng, South Africa.
Vegetation Assessment for Stoorpark, Thswane, Gauteng.

Solar:

Plant Ecological Report For the proposed alternative energy plant on Metsimatala also known as Groenwater 453, Groenwater, Northern Cape.
Plant Ecological Report For the proposed alternative energy plant !Xun & Khwen, Kimberley, Northern Cape.

Mining:

Bi-annual VEGRAI monitoring of 18 mines during the dry and wet season from 2012-2015. The mines fall under a consolidated holding company. Mines are situated in Natal and Mpumalanga. in Mpumalanga and KwaZulu-Natal.
Vegetation Survey for the Proposed Vlakvarkfontein Colliery, Mpumalanga.
Vegetation Survey for the Proposed Buffelskloof Iron Ore Mine, Mpumalanga.
Background Biodiversity Report for the Wakkerstroom Area, KwaZulu – Natal.
Vegetation Survey for the Proposed Onbekend Colliery, Mpumalanga.
Vegetation Survey for the Proposed Roodepoort Colliery, Mpumalanga.
Vegetation Survey for the Proposed Boschpoort Colliery, Mpumalanga.
Vegetation Survey for the Proposed Welstand Colliery, Mpumalanga.
Vegetation Survey for the Proposed Welgemeend Colliery, Mpumalanga.
Vegetation Survey for the Proposed Vaalwater Colliery, Mpumalanga.
Vegetation Survey for the Proposed Pegasus, Mpumalanga.

Game Farms

Vegetation Assessment for Tuli Roan and Sable Trust, Botswana
Vegetation Assessment for the farm of Mazunga, Gravelotte, Limpopo.
Vegetation Assessment for the Knopfontein Farm, Vaalwater, Limpopo.

Conference Presentations

- **Presentation on: The Vegetation ecology of Seringveld Conservancy, Cullinan South Africa 2010**
  South African Association of Botanist's Annual Conference, Potchefstroom
- **Presentation on: A comparison between Ellenberg and Wamelink Biological indicator values 2009**
  Wageninen Abiotic Research Group, Alterra Annual Conference, Wageningen, The Netherlands
- **Presentation on: The effect of the higher energy flow in the Ash River System, Bethlehem, SA 2003**
  Stockholm International Youth Science Seminar, Sweden
- **Presentation on: The youth of South Africa would like to see underground water pollution addresses in light of the international summit for sustainable development 2003**
  Water institute of South Africa, Annual Conference, Durban

Achievements

- Board member of the South African Botanical Society Pretoria Branch
- Selected for an exchange program to the University of Wageningen as part of my MSc studies.
- Overall Winner and gold medalist of the Eskom Expo for Young Scientist, representing south Africa in the Stockholm Sweden at the Stockholm international youth seminar
- Winner of the South Africa youth water prize of the department of water affairs and represented South Africa at the international youth water prize during world water week in Stockholm Sweden.

Membership & Associations

- South African Council of Natural Scientific Professions - Registered Professional Scientist (Pri.Sci.Nat: 400003/13),
- South African Association for Botanists,
- South African Botanical Society,
- South African Society for Aquatic Scientist,
- Department of Water Affairs SASS5 practitioners,

** References available upon request.