KNOPPIESLAAGTE

PORTION 66

BIODIVERSITY ASSESSMENT

Ecological Assessment and Wetland Assessment for the Proposed Township Development on PTN 66 Knoppieslaagte 385 JR, Gauteng Province

Compiled by

Flori Scientific Services

MAY 2019

1 REPORT INFORMATION

PROJECT TITLE: Proposed Township Development on Portion 66 of the Farm Knoppieslaagte 385 JR, Gauteng Province.

STUDY NAME: Biodiversity Impact Assessment

COMPILED BY: Flori Scientific Services cc

AUTHOR/S: Johannes Oren Maree, MSc.; MBA; *Pr. Sci. Nat.*

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2 EXECUTIVE SUMMARY

Background

The project is the proposed establishment and development of a new township on Portion 66 of the Farm Knoppieslaagte 385 JR, Gauteng Province. The proposed township is to be called Knoppieslaagte Extension 66.

Flori Scientific Services cc was appointed as the independent consultancy to conduct a biodiversity assessment, which includes a terrestrial ecological assessment and an aquatic (wetland) assessment of the proposed development site.

Field investigations were conducted on 26 September 2018 and 30 May 2019.

Location of the study area

The study site is Portion 66 of the Farm Knoppieslaagte 385 JR. Mimosa Ave and 1st Ave form the northern and eastern boundaries of the site, respectively. Immediately north of the site is the small township development of Gerhardsville. The site is within the City of Tswane Metropolitan Municipality, Gauteng Province.

TERRESTRIAL ECOLOGY

Vegetation

The vegetation of the study area was historically Carletonville Dolomite Grassland with elements of Egoli Granite Grassland. However, historically much of the study area was cultivated, ploughed farmlands. Presently the site is not actively cultivated but the grasses are regularly cut, probably for use as cattle fodder. The effect is that there is a loss of natural grassland features. There are some examples of typical Carletonville Dolomite Grassland on the fringes, especially in the southern section, which also has some Egoli Granite Grassland characteristics. However, there are no areas of pristine grassland present on site and the area can at best be described as moderately degraded grassland with patches of severely degraded to transformed grassland.

Priority species

Two orange listed floral species are present on site, namely *Boophane disticha, Hypoxis hemerocallidea.*

Protected trees in the study area

There are no protected trees on the study site.

AQUATIC ECOLOGY

Watercourses in the study area

There are no watercourses in the study area, including freshwater pans (wetlands) and distinctive drainage lines.

Drainage areas

The table below is a summary of the drainage areas in which the study site is situated (Table 1).

Table 1: Summary of drainage area

Level	Category
Primary Drainage Area (PDA)	A
Quaternary Drainage Area (QDA)	A21B
Water Management Area (WMA) – Previous / Old	Crocodile (West) & Marico (WMA 3)
Water Management Area (WMA) – New (as of Sept. 2016)	Limpopo (WMA 1)
Catchment Management Agency (CMA)	Limpopo (CMA 1)
Priority Quaternary Catchment	No
Rivers or streams	No
Wetlands (including pans)	No
NFEPA Rivers present	No
NFEPA Wetlands present	No
Fish FEPA	No
Rehab FEPA	No
Fish Corridor	No
Wetland Vegetation Region	Dry Highveld Grassland (Group 5)

Sensitivity analyses

The ecological sensitivity of the study area is determined by combining the sensitivity analyses of both the floral and faunal components. The highest calculated sensitivity unit of the two categories is taken to represent the sensitivity of that ecological unit, whether it is floristic or faunal in nature (Table 2). According to the analyses there are no high sensitivity areas, high sensitivity habitats, or 'No-Go' zones.

Table 2: Ecological sensitivity analysis

Ecological community	Floristic sensitivity	Faunal sensitivity	Ecological sensitivity	Development Go-ahead
Degraded Grassland	Medium	Medium \ Low	Medium	Go-But

Fatal flaws

There are no fatal flaws. There are no 'No-Go' zones.

Priority areas

Priority areas include formal and informal protected areas (nature reserves); important bird areas (IBAs); RAMSAR sites; National fresh water ecosystem priority areas (NFEPA) and National protected areas expansion strategy (NPAES) areas. The study site is situated within the outer edges of the Magaliesberg IBA, but within no other priority areas.

The study area is situated within demarcated CBA and ESA areas.

The study area is not on or within 500 m of any demarcated ridges.

Sensitivity map of the study area

The sensitivity map of the study area is shown in the figure below (Figure 1).

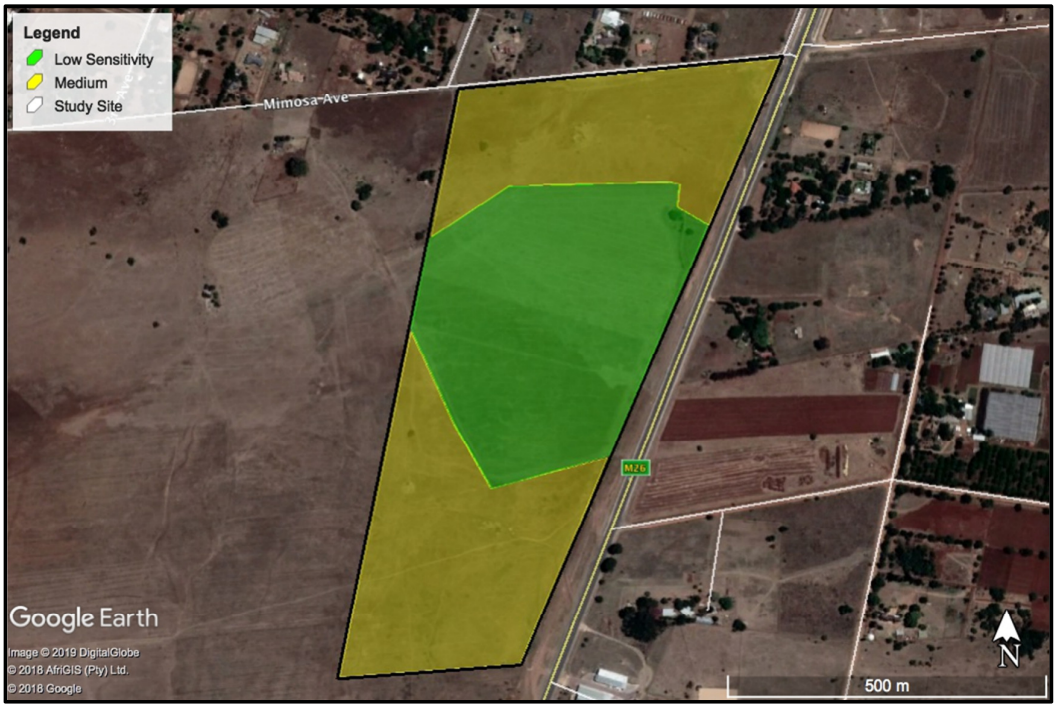

Figure 1: Sensitivity map

Review and Approval

Name	Title	Signature	Date
Johannes Maree	Ecologist & Author (Flori Scientific Services)		**04/06/2019**
Faith Makena	EAP (Lokisa Environmental Consulting)		
Elaine Minnaar	Lead EAP (Lokisa Environmental Consulting)		

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3 ACRONYMS

CBA	Critical Biodiversity Areas
CMA	Catchment Management Agencies
DEA	Department of Environment Affairs
DWA	Department of Water Affairs (Old name for DWS)
DWS	Department Water and Sanitation
EIS	Ecological Importance & Sensitivity
EMC	Environmental Management Class
HGM	Hydrogeomorphic
IBA	Important Bird Area(s)
IUCN	International Union for Conservation of Nature
MAP	Mean Annual Precipitation
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy
ODL	Orange data listed (fauna or flora species)
PES	Present Ecological State
PDA	Primary Drainage Area
QDA	Quaternary Drainage Area
RDL	Red data listed (fauna or flora species)
RDSIS	Red Data Sensitivity Index Score
REC	Recommended Ecological Category (or Class)
REMC	Recommended Ecological Management Category (or Class)
RVI	Riparian Vegetation Index
SANBI	South African National Biodiversity Institute
SWSA	Strategic Water areas of South Africa
WMA	Water Management Areas
WUL	Water Use Licence
WULA	Water Use Licence Application

4 BACKGROUND

4.1 Project overview

The project is the proposed establishment and development of a new township on Portion 66 of the Farm Knoppieslaagte 385 JR, Gauteng Province. The proposed township is to be called Knoppieslaagte Extension 66.

Flori Scientific Services cc was appointed as the independent consultancy to conduct a biodiversity assessment, which includes a terrestrial ecological assessment and an aquatic (wetland) assessment of the proposed development site.

Field investigations were conducted on 26 September 2018 and 30 May 2019.

4.2 Purpose of the Study

The project involves the development of a new township and / or mixed development project. The project triggers various environmental requirements, such as the clearing of areas of natural vegetation of >5ha, which therefore requires the need for an environmental impact assessment (EIA) process or basic impact assessment (BA) process. Part of the EIA / BA process includes the need for specialist studies such as an ecological impact assessment and / or wetland impact assessment. The purpose of the study is therefore to determine if any ecological or watercourse (including wetlands) sensitive habitats or red data listed fauna and flora are present. If so, to highlight and assess the potential impacts the project might have on these environments and to recommend mitigating measures where and if necessary.

4.3 Quality and age of base data

The latest data sets were used for the report in terms of background information for veldtypes, ecosystems, threatened ecosystems, red data listed (RDL) fauna and flora species, priority areas (including protected areas, strategic expansion areas, wetlands, watercourses, etc. The data used is of high quality and was sourced from the same data sets that are nationally used and approved by all consultants and governmental organisations. These include the South African National Biodiversity Institute, which is the standard for all EIAs and specialist studies and assessments conducted in South Africa.

The source, data and age of data included the following:

- Threatened ecosystems: Latest datasets were obtained from the SANBI website (www.bgis.sanbi.org).
- RDL species: Red List of South Africa Plants (latest update) – (www.redlist.sanbi.org).
- Veldtypes and ecosystems: Mucina & Rutherford, 2006, 2010. Updated 2012.
- SANBI data sets – latest updated website data (www. bgis.sanbi.org).
- Plants of Southern Africa: 2012 - (www.posa.sanbi.org).
- Gauteng Conservation Plan (C-Plan) version 3.3.

4.4 Assumptions and Limitations

The assumptions and limitations for the assessment are as follows:

- All information regarding the proposed project and related activities as provided by the Client are taken to be accurate;
- The site is relatively small and uniform in habitat and the two site visits are therefore considered to be sufficient for this project;
- Precise buffer zones, regulated zones, etc. or exact GPS positions cannot be made using generalised corridors or kml files on Google Earth. However, the buffer zones drawn are accurate to within 2-3m;
- Standard and acceptable methodologies as required and used in South Africa were used.
- The latest data sets were used in terms of obtaining and establishing background information and desktop reviews for the project. The data sets were taken to be accurate, but were verified and refined during field investigations.

5 METHODOLOGY

5.1 Desktop assessment

A literature review was conducted regarding the main vegetation types and fauna of the general region and of the specific study area. The primary guidelines used were those of Mucina & Rutherford (eds) (2006), Low & Rebelo (1996) and Acocks (1988). Background data regarding soils, geology, climate and general ecology were also obtained from existing datasets and relevant organisations. These are useful in determining what species of fauna and flora can be expected or possibly present within the different habitats of the study area.

Lists of plant species for the relevant 1:50 000 base map grid references within which the proposed project is situated, were obtained from the database of the South Africa National Biodiversity Institute (SANBI). The lists represent all plant species that have been identified and recorded within the designated grid coordinates. The main aim was to determine if any protected species or Red Data species were know to occur in the study area or in the immediate vicinity of the study area.

Red data and protected species listed by the National Environmental Management: Biodiversity Act (Act No. 10 of 2004), as well as in other authoritative publications were consulted and taken into account. Alien invasive species and their different Categories (1, 2 & 3) as listed by the Conservation of Agricultural Resources Act (Act No. 43 of 1983) and the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) were also consulted.

5.2 Field surveys

During field surveys, cognisance was taken of the following environmental features and attributes:

- Biophysical environment;
- Regional and site specific vegetation;
- Habitats ideal for potential red data fauna species
- Sensitive floral habitats;
- Red data fauna and flora species;
- Fauna and flora species of conservation concern; and
- Watercourses and water bodies.

Digital photographs and GPS reference points of importance where recorded and used throughout the report when and where necessary.

5.3 Floristic Sensitivity

The methodology used to estimate the floristic sensitivity is aimed at highlighting floristically significant attributes and is based on subjective assessments of floristic attributes. Floristic sensitivity is determined across the spectrum of communities that typify the study area. Phytosociological attributes (species diversity, presence of exotic species, etc.) and physical characteristics (human impacts, size, fragmentation, etc.) are important in assessing the floristic sensitivity of the various communities.

Criteria employed in assessing the floristic sensitivity vary in different areas, depending on location, type of habitat, size, etc. The following factors were considered significant in determining floristic sensitivity:

- Habitat availability, status and suitability for the presence of Red Data species
- Landscape and/or habitat sensitivity
- Current floristic status
- Floristic diversity
- Ecological fragmentation or performance.

Floristic Sensitivity Values are expressed as a percentage of the maximum possible value and placed in a particular class or level, namely:

- High: 80 – 100%
- Medium/high: 60 – 80%
- Medium: 40 – 60%
- Medium/low: 20 – 40%
- Low: 0 – 20%

High Sensitivity Index Values indicate areas that are considered pristine, unaffected by human influences or generally managed in an ecological sustainable manner. Nature reserves and well-managed game farms typify these areas. Low Sensitivity Index Values indicate areas of poor ecological status or importance in terms of floristic attributes, including areas that have been negatively affected by human impacts or poor management.

Each vegetation unit is subjectively rated on a sensitivity scale of 1 to 10, in terms of the influence that the particular Sensitivity Criterion has on the floristic status of the plant community. Separate Values are multiplied with the respective Criteria Weighting, which emphasizes the importance or triviality that the individual Sensitivity Criteria have on the status of each community.

Ranked Values are then added and expressed as a percentage of the maximum possible value (Floristic Sensitivity Value) and placed in a particular class or level, namely:

- High: 80% – 100%
- Medium/high: 60% – 80%
- Medium: 40% – 60%
- Medium/low: 20% – 40%
- Low: 0% – 20%

5.4 GO, NO - GO Criteria

The sensitivity analyses are also expressed in terms of whether the "Go Ahead" has or has not been given for development in a specific area or ecological unit, with regards to the ecological sensitivity along with mitigating measures. The criteria are directly linked to all the other analyses used in the study and can be expressed as follows:

- GO: Areas of low sensitivity

These would typically be areas where the veld as been totally or mostly transformed.

- GO-SLOW: Areas of medium/low sensitivity

These would typically be areas where large portions of the veld has been transformed and/or is highly infested with alien vegetation and lacks any real faunal component. Few mitigating measures are typically needed, but it is still always wise to approach these areas properly and slowly.

- GO-BUT: Areas of medium sensitivity and medium/high sensitivity

These are areas that are sensitive and should generally be avoided if possible. But, with the correct implementation of mitigating and management measures can be entered if need be.

- NO-GO: Areas of high sensitivity

These are areas of high sensitivity and should be avoided at all cost. In these areas mitigating measures are typically futile in limiting impacts.

The Precautionary Principle is applied throughout this investigation.

5.5 Floral Assessment – Species of Conservation Concern

Baseline data for the quarter degree grids in which the study area is situated were obtained from the SANBI database and were compared to the Interim Red Data List of South African Plant Species (Raimondo D. *et.al*., 2009) to compile a list of Floral Species of Conservation Concern (which includes all Red Data flora species) that could potentially occur within the study area.

A snapshot investigation of an area presents limitations in terms of locating and identifying Red Data floral species. Therefore, particular emphasis is placed on the identification of habitats deemed suitable for the potential presence of Red Data species by associating available habitat to known habitat types of Red Data floral species. The verification of the presence or absence of these species from the study area is not perceived as part of this investigation as a result of project limitations.

5.6 Faunal Sensitivity

Determining the full faunal component of a study area during a short time scale of a few field trips can be highly limiting. Therefore, the different habitats within the study area and nearby surrounding areas were scrutinised for attributes that are deemed to be suitable for high diversity of fauna, as well as for Red Data species. Special consideration was given to habitats of pristine condition and high sensitivity.

Areas of faunal sensitivity were calculated by considering the following parameters:

- Habitat status – the status or ecological condition of the habitat. A high level of habitat degradation will often reduce the likelihood of the presence of Red Data species.
- Habitat linkage – Movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to surrounding habitats and adequacy of these linkages are evaluated for the ecological functioning of Red Data species within the study area
- Potential presence of Red Data species – Areas that exhibit habitat characteristics suitable for the potential presence of Red Data species are considered sensitive.

The same Index Values, Sensitivity Values and Categories used for the floral sensitivity ratings are used for the faunal sensitivity ratings. The same Go, No-Go

criteria and ratings used for the flora component are also used for the faunal component.

5.7 Faunal Assessment – Species of Conservation Concern

Literature was reviewed and relevant experts contacted to determine which faunal species of conservation concern (which include all Red Data species) are present, or likely to be present, in the study area. A snapshot investigation of an area presents limitations in terms of locating and identifying Red Data fauna species. Particular emphasis was therefore placed on the identification of habitat deemed suitable for the potential presence of Red Data fauna species by associating available habitat to known habitat types of Red Data species. The verification of the presence or absence of these species from the study area is not perceived as part of this investigation as a result of project limitations.

5.8 Fauna Red Data Sensitivity Index Score (RDSIS)

Field investigations limited to a few days can seldom, if ever, be comprehensive in terms of identifying all faunal species, let alone Red Data Listed (RDL) Species and/or priority species. Included is the reality that many faunal species are highly mobile and might be moving in and out of an area, which makes observing these species sometimes incidental and fortunate, depending largely on time and chance. Added to this are the species that are primarily nocturnal in nature.

For the above reasons, the Red Data Sensitivity Index Scoring (RDSIS) method for fauna is widely used by specialists involved in EIAs, specialist studies, etc. The RDSIS methodology provides a calculated indication for the potential of certain red data or priority species occurring in the study area. The index is based on historical data, present presence of ideal habitat and food sources, general inferences on the landuses of the region and the Specialist's knowledge and experience.

5.8.1 Probability of Occurrence (POC)

Known distribution range (D), habitat suitability of the site (H) and availability of food sources (F) on site is determined for each of the species. Each of these variables is expressed a percentage (where 100% is a perfect score). The average of these scores provides a POC score for each species.

The POC is calculated as follows:

POC = (D+H+F) / 3

The POC value is then categorised as follows:

- 0-20% = Low
- 21-40% = Low / Medium
- 41-60% = Medium
- 60-80% = Medium/High
- 81-100% = High

5.8.2 Total Species Score (TSS)

Species with a POC score of more than 60% (Medium/High) are considered when applying the RDSIS. A weighting factor is assigned to the different IUCN categories providing species with a higher conservation status, a higher score. This weighting factor is then multiplied with the POC to calculate the total species score (TSS) for each species.

The weighting assigned to each category rating is as follows:

Status Category	Abbreviation	Weighting
Data deficient	DD	0,2
Rare	RA	0,5
Near Threatened	NT	0,7
Vulnerable	VU	1,2
Endangered	EN	1,7
Critically Endangered	CR	2,0

The TSS is calculated as follows:
TSS = (IUCN weighting x POC) where POC is > 60%.

5.8.3 Average Total Species & Average Threatened Taxa Score

The average of the Total Species (TSS) potentially occurring on the site is calculated. The average of all the Threatened Taxa (TT) (Near threatened, Vulnerable, Endangered and Critically Endangered) TSS scores are also calculated. The average of these two scores (Av.TSS and Av.TT) is then calculated in order to add more weight to threatened taxa with POC higher than 60%.

The average is calculated as follows:
Average = (Av.TSS [TSS / Total Species] + Av.TT [TT TTS / No. of species]) / 2

5.8.4 Red Data Sensitivity Index Score (RDSIS)

The average score obtained above and the sum of the percentage of species with a POC of >60% of the total number of Red Data Listed species listed for the area is then calculated. The average of these two scores, expressed as a percentage, gives the RDSIS for the area investigated.

The RDSIS is calculated as follows:

RDSIS = (Average + [Spp. with POC >60% / Total No. of Spp*100]) / 2

The RDSIS Category ratings are categorised as follows:

RDSIS Score	Category Rating
0 – 20%	LOW
21 – 40%	LOW / MEDIUM
41 – 60%	MEDIUM
61 – 80%	MEDIUM / HIGH
81 – 100%	HIGH

5.9 Biodiversity Impact Assessment

The impact assessment takes into account the nature, scale and duration of the effects on the natural environment and whether such effects are positive (beneficial) or negative (detrimental).

A rating/point system is applied to the potential impact on the affected environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each issue the following criteria are used and points awarded as shown:

- Extent: National - 4; Regional – 3; Local – 2; Site – 1.
- Duration: Permanent – 4; Long term – 3; Medium term – 2; Short term – 1.
- Intensity: Very high – 4; High – 3; Moderate – 2; Low – 1.
- Probability of Occurrence: Definite – 4; Highly probable – 3; Possible – 2; Impossible – 1.

5.10 Criteria for the classification of an impact

Nature

A brief description of the environmental aspect being impacted upon by a particular action or activity is presented.

Extent (Scale)

Considering the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact.

- Site: Within the construction site
- Local: Within a radius of 2 km of the construction site
- Regional: Provincial (and parts of neighbouring provinces)
- National: The whole of South Africa

Duration

Indicates what the lifetime of the impact will be.

- Short-term: The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase.
- Medium-term: The impact will last for the period of the construction phase, where after it will be entirely negated.
- Long-term: The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter.
- Permanent: The only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.

Intensity

Describes whether an impact is destructive or benign.

- Low: Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.
- Medium: Effected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way.
- High: Natural, cultural and social functions and processes are altered to extent that they temporarily cease.
- Very high: Natural, cultural and social functions and processes are altered to extent that they permanently cease.

Probability

Probability is the description of the likelihood of an impact actually occurring.

- Improbable: Likelihood of the impact materialising is very low.
- Possible: The impact may occur.
- Highly probable: Most likely that the impact will occur.
- Definite: Impact will certainly occur.

Significance

Significance is determined through a synthesis of impact characteristics. It is an indication of the importance of the impact in terms of both the physical extent and the time scale and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Using the scoring from the previous section, the significance of impacts is rated as follows:

- Low impact: 4-7 points. No permanent impact of significance. Mitigating measures are feasible and are readily instituted as part of a standing design, construction or operating procedure.
- Medium impact: 8-10 points. Mitigation is possible with additional design and construction inputs.
- High impact: 11-13 points. The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.
- Very high impact: 14-16 points. The design of the site may be affected. Intensive remediation as needed during construction and/or operational phases. Any activity, which results in a “very high impact”, is likely to be a fatal flaw.

Status

Status gives an indication of the perceived effect of the impact on the area.

- Positive (+): Beneficial impact.
- Negative (-): Harmful or adverse impact.
- Neutral Impact (0): Neither beneficial nor adverse.

It is important to note that the status of an impact is assigned based on the *status quo.* That is, should the project not proceed. Therefore not all negative impacts are equally significant. The suitability and feasibility of all proposed mitigation measures will be included in the assessment of significant impacts. This will be achieved through the comparison of the significance of the impact before and after the proposed mitigation measure is implemented.

6 RECEIVING ENVIRONMENT

6.1 Study Site Location

The study site is Portion 66 of the Farm Knoppieslaagte 385 JR. Mimosa Ave and 1st Ave form the northern and eastern boundaries of the site, respectively. Immediately north of the site is the small township development of Gerhardsville. The site is within the City of Tswane Metropolitan Municipality, Gauteng Province (Figure 2). The study site is approximately 36,1 ha in size.

6.2 GPS Coordinates of the Main Landmarks

The GPS coordinates of the main landmarks within the project area are as follows:

- Study site location (approximate centre): 25°51'37.31"S; 28° 1'56.02"E.
- Intersection (Mimosa Ave & 1st Ave): 25°51'21.84"S; 28° 2'11.37"E.
- Quaternary Degree Square (QDS): 2528CC (Centurion).
- Quaternary Drainage Area (QDA): A21B.

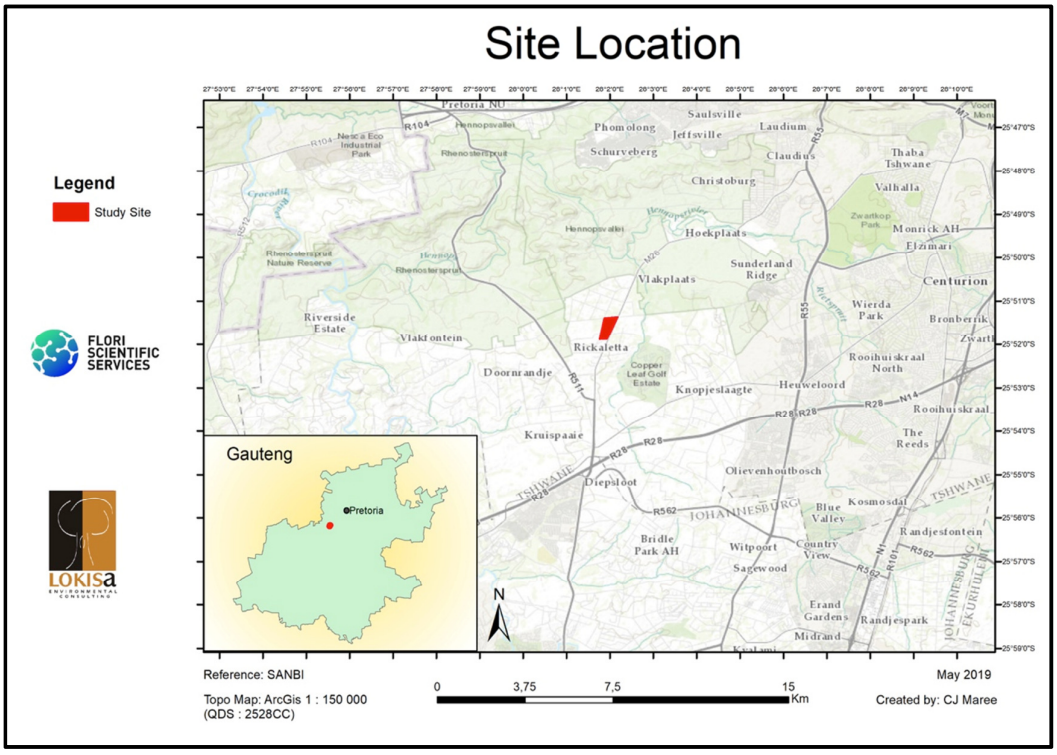

Figure 2: Site location

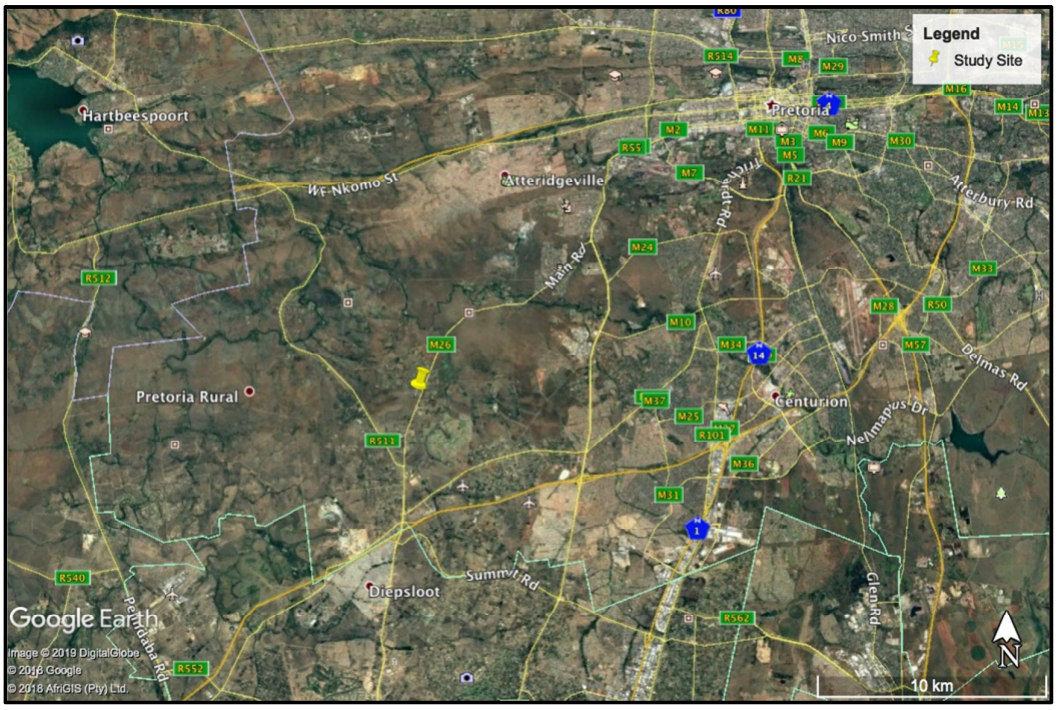

Figure 3: Site location (Google Earth)

6.3 Topography

The topography of the general region and study area is flat to undulating plains and occasional hilly terrain, with ridges, valleys, ravines or rocky outcrops present throughout the region. The study site itself is an open flat plain with slight undulation and no ridges, valleys or distinctive rocky outcrops (koppies).

The average height above sea level of the study area is 1 410m, with a minimum of approximately 1 395m and a maximum of approximately 1 427m. The average gradient (slope) across the north-south length of the study site is medium / low at 3%. The general downward slope across the site and surrounding area is from south to north and from west to east. There is a slight narrow embankment or mound in the northern area of the study site, where the gradient rises very slightly and then drops down again. This embankment appears to be a mix of natural topography and soils or rocks that might have also been moved over the years of cultivating and working the lands on site.

6.4 Geology and Soils

The geology of the study site and representative veldtype is primarily that of dolomite and chert of the Malmani Subgroup (Transvaal Supergroup), supporting mostly

shallow Mispah and Glenrosa soil forms typical of the Fa land type, dominating the landscapes of this unit. Deeper red to yellow apedal soils (Hutton and Clovelly forms) occur sporadically, representing the Ab land type (Mucina & Rutherford, 2006). Land types are mainly Ab and Fa (Mucina & Rutherford, 2006).

The general description of the soils on site are red and yellow soils with low to medium base status. The class of the soils is that of freely drained, structurless soils (www.bgis.sanbi.org).

Table 3: Description of the Land Types found in the Region

Ab	Red-yellow apedal, freely drained soils (Red, dystrophic and/or mesotrophic) Dominantly (> 40%) red, freely drained, apedal (= structureless) soils. Normally associated with high rainfall areas, where soils are subjected to moderate (= mesotrophic) to intense (= dystrophic) leaching of nutrients from the soil profile. Soils are thus mostly low in base elements (K, Ca, Mg, Na). A broad range of textures may occur.
Fa	GLENROSA AND/OR MISPAH FORMS (other soils may occur); lime rare or absent in the entire landscape. Generally shallow soils consisting of a topsoil directly underlain by weathered rock (Glenrosa form) or hard rock (Mispah form), sometimes with surface rock and steep slopes. Found in moister areas or areas with acidic parent materials, where little lime exists.

6.5 Climate

The study area is situated within the summer rainfall region of South Africa and within the medium rainfall band of 600+ mm to 800 mm per annum (Figure 4). The general climate of the study site is similar to that of Pretoria.

Climatic registers show that Pretoria normally receives about 573 mm of rain per year, with most rainfall occurring during summer. The area normally receives the lowest rainfall (0 mm) in June and the highest (110 mm) in January. The average midday temperatures for Pretoria range from 18,3 °C in June, to 27,5 °C in January. The region is the coldest during July when temperatures drop on average to around 1,7 °C during the night. Frost is not uncommon in the area of the study site during the cold, winter months, but not frequent (www.saexplorer.co.za). The study site is situated within the temperate interior climatic zone, but relatively close to the cold interior zone of South Africa (Figure 5).

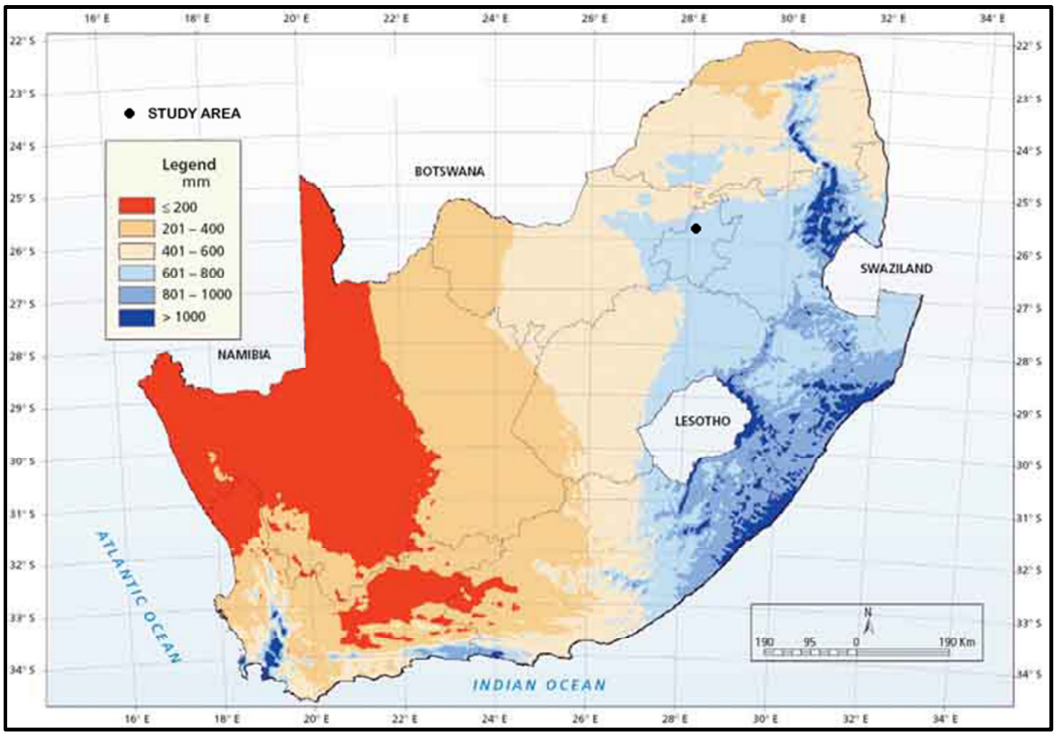

Figure 4: Rainfall averages for South Africa

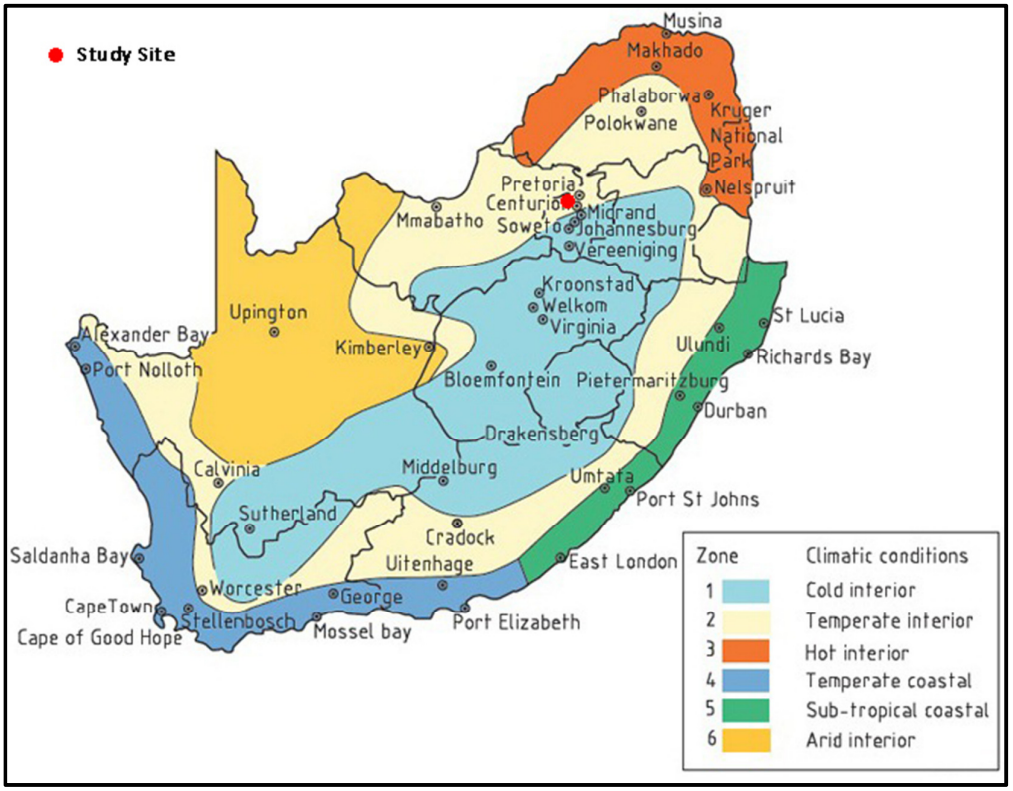

Figure 5: Broad climatic zones of South Africa

6.6 Landcover

The landcover (or landuse) of the study area is that of open, moderately to highly degraded grassland, with no significant development or infrastructure at present. Immediately north of the study area is the small, township of Gerhardsville. The area is mainly smallholdings, with a golf course estate to the south east. Although the overall urbanisation of the region is low it is seeing increasing development and urban encroachment.

7 TERRESTRIAL ECOLOGY

7.1 Vegetation

South Africa is divided up into nine Biomes. The study area is situated within the northern reaches of the Grassland Biome (Figure 6). Grassland vegetation types are dominated by a single, lower layer of grasses, with the occurance of a middle layer of shrubs and upper layer of trees being rare to absent, except in a few localised habitats such as koppies (rocky outcrops) and rocky ridges.

The Grassland Biome can be naturally subdivided into dry and moist grassland regions. Grassland veldtypes with a rainfall of 600mm+ per annum tend to be dominated by sour, andropogonoid grasses. While in veldtypes with an average rainfall of below 600mm per annum, the sweet chloridoid grasses tend to be more common. Dry and moist grassland types are further divided primarily on the basis of rainfall, with 500-700mm being the broad boundary. Historically, such as with the classification of veld types by JPH Acocks (1952) and AB Low & AG Rebelo (1998), these grasslands have been divided into sweet grasses (sweetveld) and sour grasses (sourveld) based primarily on agriculutral or grazzing criteria. In high rainfall areas (moist grasslands) sour grasses tend to dominate, while in low rainfall areas the sweet grasses (which are more palatable for livestock) tend to dominante. Grasslands (like any other vegetation type) are also influenced and shaped by numerous environmental factors such as temperature, soils, fire and altitude.

Mucina and Rutherford (eds) (2006) subdivided the Grassland Biome into four main bioregions. Namely, Dry Highveld Grasslands; Drakensberg Grasslands; Mesic Highveld Grasslands; and Sub-Escarpment Grasslands. These subdivisions of the Grassland Biome are based on gradients of altitude (height above sea-level) and moisture (rainfall). Altitude has a strong influence on climatic variables and an increase in altitude usually corresponds with an increase in rainfall and a decrease in temperature. The study site is situated within the Dry Highveld Grassland Bioregion, albeit on the edge between the Dry and Mesic Highveld Grasslands (Figure 7).

The study site is situated within the original extent of the veldtype of Carletonville Dolomite Grassland (Figure 8). According to maps it appears that the southern extreme of the study site is within Egoli Granite Grassland (which a mesic grassland veldtype). However, during field investigations it appears that the site is more representative of Dolomite than Granite grassland (although there are some common

features and species of both present). The two adjacent grassland veldtypes are very similar in many aspects and it is therefore not surprising that both Acocks (1953) and Low & Rebelo (1996) saw the two as one and the same. Table 4, shows the vegetation classification or hierarchy of the study site, while Table 5 gives a comparison of veldtype names commonly used in the literature.

Table 4: Vegetation classification of the study site

Category Description	Classification
Biome	Grassland
Bioregion	Dry Highveld Grassland
Vegetation Types	Carletonville Dolomite Grassland

Table 5: Comparison of veldtype names

Mucina & Rutherford (2006)	Low & Rebelo (1996)	Acocks (1953)
Carletonville Dolomite Grassland	Rocky Highveld Grassland	Bankenveld
Egoli Granite Grassland	Rocky Highveld Grassland	Bankenveld

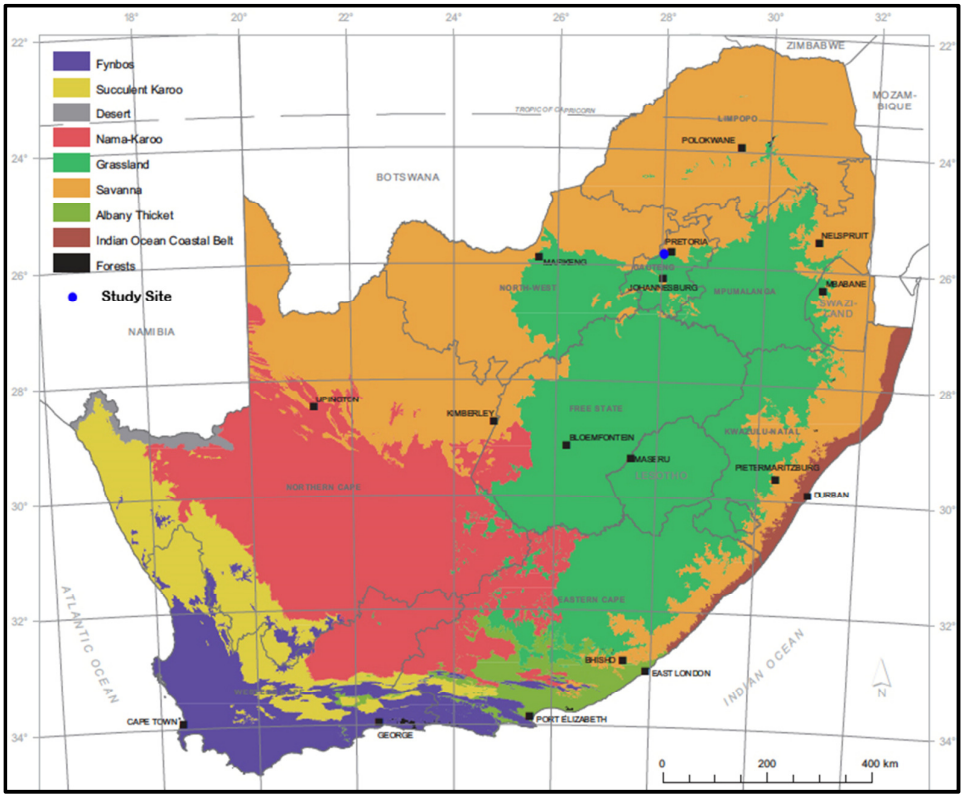

Figure 6: Biomes of South Africa

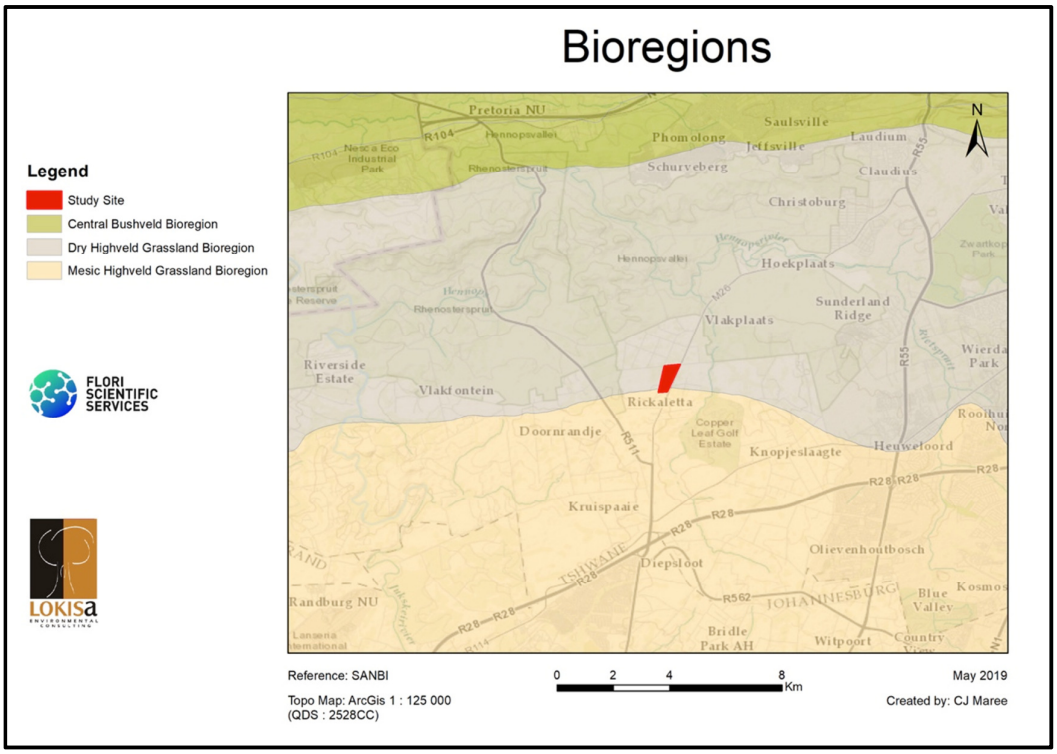

Figure 7: Bioregions

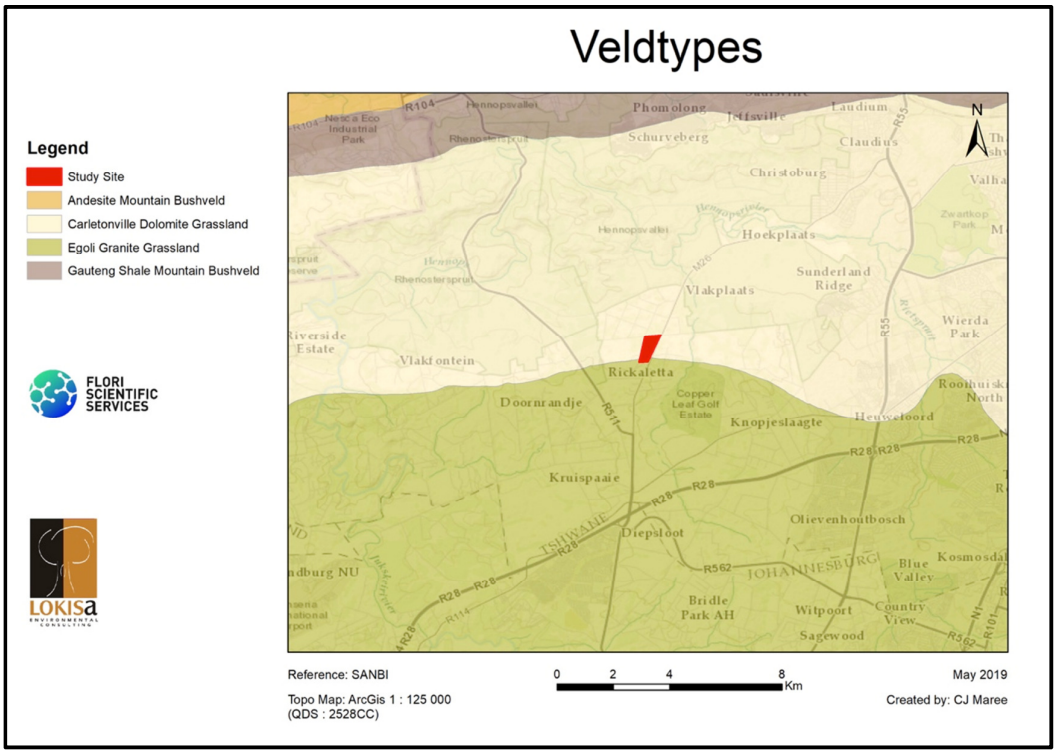

Figure 8: Veld types

Carletonville Dolomite Grassland is characterised by slightly undulating plains dissected by prominent rocky chert ridges. Species-rich grasslands forming a complex mosaic pattern dominated by many species.

Egoli Granite Grassland is characterised by moderately undulating plains and low hills supporting tall, usually *Hyparrhenia hirta* dominated grassland, with some woody species on rocky outcrops (koppies) or rock sheets. The rocky habitats show a high diversity of woody species, which occur in the form of scattered shrub groups or solitary small trees.

7.1.1 Vegetation of the study area

The vegetation of the study area was historically Carletonville Dolomite Grassland with elements of Egoli Granite Grassland. However, historically much of the study area was cultivated, ploughed farmlands. It would appear from site investigations that the levels of cultivation were moderate and not for intense, high commercial production. Presently the site is not actively cultivated but the grasses are regularly cut, probably for use as cattle fodder. The effect is that there is a loss of natural grassland features. There are some examples of typical Carletonville Dolomite Grassland on the fringes, especially in the southern section, which also has some Egoli Granite Grassland characteristics. However, there are no areas of pristine grassland present on site and the area can at best be described as moderately degraded grassland with patches of severely degraded to transformed grassland.
The list of dominant species observed during field investigations and known to occur on the site and immediate area are found listed in the appendices.

7.1.2 Priority Floral Species

No Red Data Listed (RDL) floral species (endangered, threatened or vulnerable) were observed during field investigations. Two orange data listed floral were observed during field investigations. Namely, *Boophane disticha and Hypoxis hemerocallidea.* Both have a status of declining.

7.2 Conservation status

The conservation status of Carletonville Dolomite Grassland is Least Threatened (LT) (www.bgis.sanbi.org). Egoli Granite Grassland, on the other hand, is a threatened veldtype, with a threat status of endangered (EN) (www.bgis.sanbi.org) (Table 6).

Table 6: Veldtype status

Veldtype	Status	Information
Carletonville Dolomite Grassland	Least threatened (LT) Or Least Concern (LC)	Only a small extent conserved in statutory reserves (Sterkfontein Caves—part of the Cradle of Humankind World Heritage Site, Oog Van Malmanie, Abe Bailey, Boskop Dam, Schoonspruit, Krugersdorp, Olifantsvlei, Groenkloof) and in at least six private conservation areas. Almost a quarter already transformed for cultivation, by urban sprawl. Erosion very low (84%) and low (15%) (Mucina & Rutherford, 2006).
Egoli Granite Grassland	Endangered (EN)	Only about 3% conserved in statutory reserves (Diepsloot and Melville Koppies Nature Reserves) and a number of private conservation areas including Motsetse and Isaac Stegmann Nature Reserves, Kingskloof Natural Heritage Site, Melrose and Beaulieu Bird Sanctuaries as well as the Walter Sisulu National Botanical Garden. More than two thirds of the unit has already undergone transformation mostly due to urbanisation, cultivation or by building of roads. Current rates of transformation threaten most of the remaining unconserved areas. There is no serious alien infestation in this unit, although species such as *Eucalyptus grandis*, *E. camaldulensis* and *E. sideroxylon* are commonly found. Erosion is moderate and very low (Mucina & Rutherford, 2006).

The Biodiversity Act (Act 10 of 2004) provides for listing of threatened or protected ecosystems, in one of four categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or protected. The main purpose for the listing of threatened ecosystems is an attempt to reduce the rate of ecosystem and species destruction and habitat loss, leading to extinction. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems (SANBI).

Table 7: Ecosystem Status: Simplified explanation of categories used

STATUS	% Transformed	Effect on Ecosystem
Least Threatened (LT)	0-20% (<20% loss)	No significant disruption of ecosystem functions
Vulnerable (VU)	20-40% (>20% loss)	Can result in some ecosystem functions being altered
Endangered (EN)	40-60% (>40% loss)	Partial loss of ecosystem functions
Critically Endangered (CR)	>60% or BT Index for that specific veldtype	Species loss. Remaining habitat is less than is required to represent 75% of species diversity

Source: South African National Spatial Biodiversity Assessment Technical Report. Volume 1: Terrestrial Component. 2004. SANBI. Mucina & Rutherford (eds) (2010).

Note: BT stands for the Biodiversity Threshold and is an index value that differs for each veldtype. In other words, because the composition, recovery rate, etc. differs for each veldtype there will be a different threshold (in this case percentage transformed) at which species become extinct and ecosystems breakdown. That is, at which point the veldtype is critically endangered. For the grassland vegetation units discussed the index value (BT) is broadly given as 60% and greater.

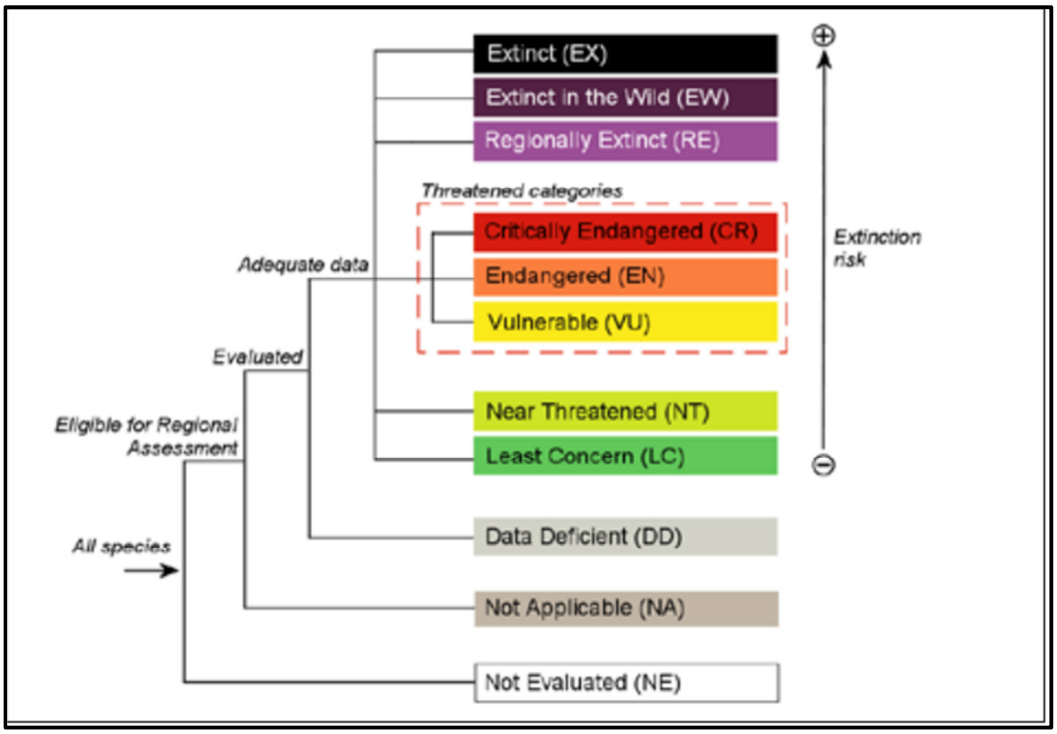

Figure 9: Structure of categories used at the regional level

7.3 Plants identified during field investigations

The dominant plant species identified during field investigations are listed in the appendices. Field investigations were limited to a few days only and plant lists can therefore not be considered comprehensive.

No Red Data List (RDL) floral species were observed during field investigations. Two orange data listed species were observed, namely, *Boophane disticha and Hypoxis hemerocallidea.* Both have a status of declining.

Most of the study area is degraded grassland and old cultivated lands, with common grasses and a few common herbs. There are no sensitive habitats or distinctive habitats present that would potentially be suitable for many of the RDL and ODL species of the Gauteng Province.

7.3.1 Alien plants identified in the Study Area

A few different alien plant species were identified in the study area. However, there are no major areas or patches of infestation of alien species. Alien species are typcially scattered across the area, with a higher degree of concentration in disturbed areas. The alien plant species encountered in the open veld of the study area are recorded, along with their category rating, in Table 8. The categories are as set out in the Conservation Act of Agricultural Resources Act, 1983 (CARA) (Act 43 of 1983).

Table 8: Alien plants identified in the study area

Botanical Name	Common Name	Category
Bidens pilosa	Blackjacks	-
Caesalpinia decapetala	Mauritius thorn	1
Conyza canadensis	Horseweed fleabane	-
Datura ferox	Large thorn apple	1
Datura stramonium	Common thorn apple	1
Malva verticillata	Mallow	-
*Melia a*zedarach	Syringa	1b
Opuntia ficus-indica	Prickly pear	1
Oxalis corniculata	Sorrel	-
Ricinus communis	Castor oil plant	2
Solanum elaeagnifolium	Silverleaf bitter apple	1
Tagetes minuta	Khakibos, kahki weed	-

Verbena bonariensis	Vervain	-
Xanthium strumarium	Large cocklebur	-

7.4 Protected tree species identified in the study area

No protected tree species were observed in the study area during field investigations.

7.5 Fauna

No wild fauna was observed on site during field investigations with the exception of a few common bird species. No active burrows or holes were observed either and no animal tracks.

7.5.1 Mammals

No mammals were observed during field investigations. However, due to the openness of the site, with low to medium levels of surrounding urbanisation it is likely that some common rodent species will be present. It is fairly unlikely that any priority or RDL mammal species are permanently present on the site.

7.5.2 RDSIS for mammals in the study area

The Red Data Sensitivity Index Score (RDSIS) was calculated for the study area using the methodology described above in the chapter on Methodology. The Red Data List (RDL) of Mammal species for the Gauteng Province is shown in the table below, along with their IUCN threat status (Table 9). The IUCN Red List of Threatened Species was consulted via their official website (www.iucnredlist.org).

Table 9: RDL Mammal Species for the Gauteng Province

Scientific Name	Common Name	GDARD Status	IUCN Status
Neamblysomus julianae	Juliana's Golden Mole	VU	EN
Mystromys albicaudatus	White-tailed Mouse	EN	EN
Atelerix frontalis	SA Hedgehog	NT	LC
Lutra maculicollis	Spotted-necked otter	NT	NT
Miniopterus schreibersii	Schreiber's long-fingered bat	NT	NT
Myotis tricolor	Temminck's hairy bat	NT	LC
Rhinolophus blasii	Blasius's/Peak-Saddle Horseshoe Bat	VU	LC
Rhinolophus clivosus	Geoffroy's Horseshoe bat / Wing-gland bat	NT	LC

Rhinolophus darlingi	Darling's Horseshoe Bat	NT	LC
Rhinolophus hildebrandtii	Hildebrandt's Horseshoe Bat	NT	LC

VU = Vulnerable, EN = Endangered, NT = Near Threatened, LC = Least Concern

The Probability of Occurrence (POC) is the probability of the animal/s occurring in the study area. The calculated POC of the mammal species is calculated by taking the animal's historical distribution, present habitat availability and present food source into account. The calculated POC for the priority mammal species are shown in the table below (Table 10).

Table 10: Probability of Occurrence (POC): Mammals

Scientific Name	Common Name	IUCN Status	POC (%)	POC Value
Atelerix frontalis	Hedgehog	NT	47	Medium
Lutra macuicollis	Spotted-necked otter	NT	13	Low
Miniopteris schreibersi	Schreibers's long-fingered bat	NT	57	Medium
Myotis tricolor	Temminck's hairy bat	LC	50	Medium
Mystomys albicaudatus	White tailed mouse	EN	53	Medium
Neamblysomus julianae	Juliana's Golden Mole	EN	13	Low
Rhinolophus blasii	Blasius's/Peak-Saddle Horseshoe Bat	LC	30	Low/Medium
Rhinolophus clivosus	Geoffroy's Horse bat	NT	57	Medium
Rhinolophus darlingi	Darling's Horseshoe Bat	LC	30	Low/Medium
Rhinolophus hildebrandtii	Hildebrandt's Horseshoe Bat	LC	47	Medium

The Red Data Sensitivity Index Score (RDSIS) for the study area's potential Red Data Listed (RDL) mammals yielded an average score of 10,1%, indicating a 'Low' index score of importance or occurrence with regards to RDL mammal species within the study area and immediate vicinity. All species with a Probability of Occurrence (POC) of 60% or more have an increased probability of either permanently or occasionally inhabiting the study area. The species with a POC of 100% are those species that were observed during field investigations. Table 11, below, is a summary of the main calculated indices for the RDSIS for the study area in terms of RDL Mammal Species. The spreadsheet showing the more detailed calculations in

determining the RDSIS can be found in the appendices. The rating levels and descriptions are found in the chapter on Methodology and in the table below (Table 12).

Table 11: RDSIS for Mammals for the study area

RED DATA SENSITIVITY INDEX SCORE (RDSIS)	
Average Total Species Score	40,3%
Average Threatened Taxa Score	0%
Average of the combined Total Species and Threatened Taxa Scores	20,2%
% of Species with a Probability of Occurrence of >60%	20%
RDSIS for the Study Site	**10,1%**
RDSIS Category for Study Site	**LOW**

Table 12: RDSIS Rating & Description (Mammals)

RDSIS Rating	Description
0-20	Low
21-40	Low/Medium
41-60	Medium
61-80	Medium/High
81-100	High

7.5.3 Avifuana

A few common bird species were observed during field investigations such as laughing dove (*Streptopelia sensegalensis*), cape turtle dove and feral pigeon (*Columba livia*). Due to the medium openness of grassland and farm areas and the relative closeness of the Swartbooispruit and Magaliesberg Mountains, there is the likelihood that certain priority birds, especially raptors, might occasionally traverse the study area. However, due to the closeness of major urban areas, the lack of ideal habitats and the frequent movement of people and vehicles through the area, it is unlikely that any of these priority birds will successfully nest and breed on the study site.

7.5.4 RDSIS for avifauna in the study area

The Red Data Sensitivity Index Score (RDSIS) for birds was calculated for the study area using the methodology described above in the chapter on Methodology. The IUCN Red List of Threatened Species was consulted via their official website (www.iucnredlist.org). The species with a probability of occurrence (POC) of 100% are those species that were observed during field investigations. The Red Data

Sensitivity Index Score (RDSIS) for the study area's potential Red Data Listed (RDL) birds yielded an average score of 8,2%, indicating a 'Low' index score of potential occurrence or importance of the site in regards to RDL bird species. Table 13, below, is a summary of the main calculated indices for the RDSIS for the study area. The spreadsheet showing the more detailed calculations in determining the RDSIS can be found in the appendices.

Table 13: RDSIS for avifauna in the study area

RED DATA SENSITIVITY INDEX SCORE (RDSIS)	
Average Total Species Score	32,5%
Average Threatened Taxa Score	0%
Average of the combined Total Species and Threatened Taxa Scores	16,3%
% of Species with a Probability of Occurrence of >60%	0%
RDSIS for the Study Site	**8,2%**
RDSIS Category for Study Site	**LOW**

7.5.5 Reptiles

No reptiles were observed during field investigations. Lizards tend to prefer rocky habitats and there are no rocky outcrops (koppies), rocky ridges or areas of large rock sheets within the study area. The likelihood is rare that any priority lizard species will be present in the study area. Snakes tend to be more mobile and adaptable to various and altered environments. It is possible that some common snake species will be found on site from time to time. These include common brown house (*Lamprophis capensis*), red-lipped herald (*Crotaphopeltis hotamboeia*) and rinkhals (*Hemachatus haemachatus*). However, it is highly unlikely that any priority snake species are present on the site or the immediate adjacent areas. There is one RDL snake species for the Gauteng Province (Table 14). The striped harlequin snake is naturally rare and seldom seen. The species inhabits deserted termite mounds and is found mostly in moist savanna and grassland. There was also no ideal habitat present on site for the possible presence of Rock Python (*Python natalensis*).

Table 14: RDL Snake species for the Gauteng Province

Scientific Name	Common name	GDARD Status	IUCN Status
Homoroselaps dorsalis	Striped Harlequin Snake	NT	NT

7.5.6 Invertebrates

Invertebrates such as spiders, scorpions and butterflies are important faunal groups, but are difficult to fully assess in a short time period. During field investigations specific attention was given to priority species such as Mygalomorphae arachnids (Trapdoor and Baboon spiders) and red data butterflies. Fortunately, the nature and scope of the project is such that it will have little negative impact on these species. No priority species were observed. According to the Gauteng: State of the Environment Report (2011), spiders and scorpions are no longer included in the list of conservation priorities for the Province due to the lack and paucity of data on spiders and the wide distribution of scorpions. Conservation efforts are now more focused on specific species, as opposed to faunal groups.

Currently there are three invertebrate species of conservation concern in Gauteng, which qualify for IUCN Red List status, namely two butterflies (the Highveld blue (*Lepidochrysops praeterita*) and the Heidelberg copper (Chrysoritis aureus)) and a scarab beetle (*Ichnestoma stabbiai*). However, an additional four butterfly species are proposed as Red List Species. These are *Aloeides dentatis dentatis, Orachrysops mijburghi, Metisells meninx* and *Platylesches dolomitica*. Table 15, below lists the RDL invertebrate species for Gauteng Province and whether they are likely to be present in the study area or not.

Table 15: RDL Invertebrate species for the Gauteng Province

Scientific Name	Common name	GDARD Status	Present in study area
Lepidochrysops praeterita	Highveld Blue Butterfly	VU	Unlikely
Chrysoritis aureus	Heidelberg Copper	VU	Unlikely
Ichnestoma stobbiai	Stobbia's Fruit Chafer Beetle	VU	Unlikely
Aloeides dentatis dentatis	Roodepoort Copper Butterfly	VU	Unlikely

7.5.7 Faunal species of conservation concern

During field investigations no faunal species of conservation concern were encountered. The general habitats present in the study area are not ideal for most priority species, in particular mammals and birds. However, continued high density urbanisation and other human encroachments on the natural environment in the region continues to reduce the possibility of priority and other species populating the area or moving through the area. Table 16, below, is a summary of the red data

status of species in the Gauteng Province. Table 17, below, lists some of the national threatened species and their likelihood of occurring in the study area.

Table 16: Summary of Red Data Status of species in Gauteng

Group	Tot. Sp. in SA	No. in Gauteng (% in Gauteng)	% Threatened in Gauteng (No.)	IUCN Red Data Category				
				CR	EN	VU	NT	DD
Plants	20 457	2 160 (11%)	1,1% (23)	0	8	13	20	1
Mammals	296	130 (44%)	7,7% (10)	3	3	6	12	10
Birds	694	473 (68%)	3,6% (17)	1	0	16	22	0
Reptiles	363	92 (25%)	0	0	0	0	0	0
Amphibians	111	22 (20%)	0	0	0	0	1	0
Butterflies	820	211 (26%)	0	0	1	4	1	0

Table 17: Priority Faunal Species most likely to occur in the area

Species	Common Name	Red Data Status	Preferred Habitat	Habitat Restrictions	Present in Study area
Frogs					
Pyxicephalus adspersus	Giant bullfrog	Threatened	Grassland; savanna	Temporary floodplains, pans	No
Mammals					
Atelerix frontalis	SA hedgehog	Near threatened	Most, broad	Broad	Unlikely
Manis temmincki	Pangolin (Scaly anteater)	Vulnerable	Grassland, savanna	Woody savanna, ants, termites	No
Mellivora capensis	Honey badger (Ratel)	Near threatened	Most, broad	Broad	No
Cloeotis percivali	Short-eared trident bat	Critically endangered	Savanna	Caves and subterranean habitat	No
Pipistrellus rusticus	Rusty bat	Near threatened	Most, broad	Woody savanna, large trees	No
Snakes					
Python	Rock python	Vulnerable	Ridges,	Rocky areas;	No

natalensis			wetlands	open water	

The maps below show the Quarter Degree Squares (QDS) (Quadrants) that are hotspots for priority butterflies, snakes and lizards in South Africa (Figure 10, Figure 11 & Figure 12). The study site is situated within hotspots for snakes and lizards (reptiles). However, during site investigations it is clear that there are minimal ideal habitats for lizard species and strong doubt that due to the years of cultivation and farming on the study site and surrounding area that priority snakes are likely to commonly occur. However, it is more than likely that a few common snake species might occur on the study site. The main area of the hotspot, in which the study site occurs, is more likely the ridges, kloofs and mountain ranges situated approximately 5 km north west of the study site.

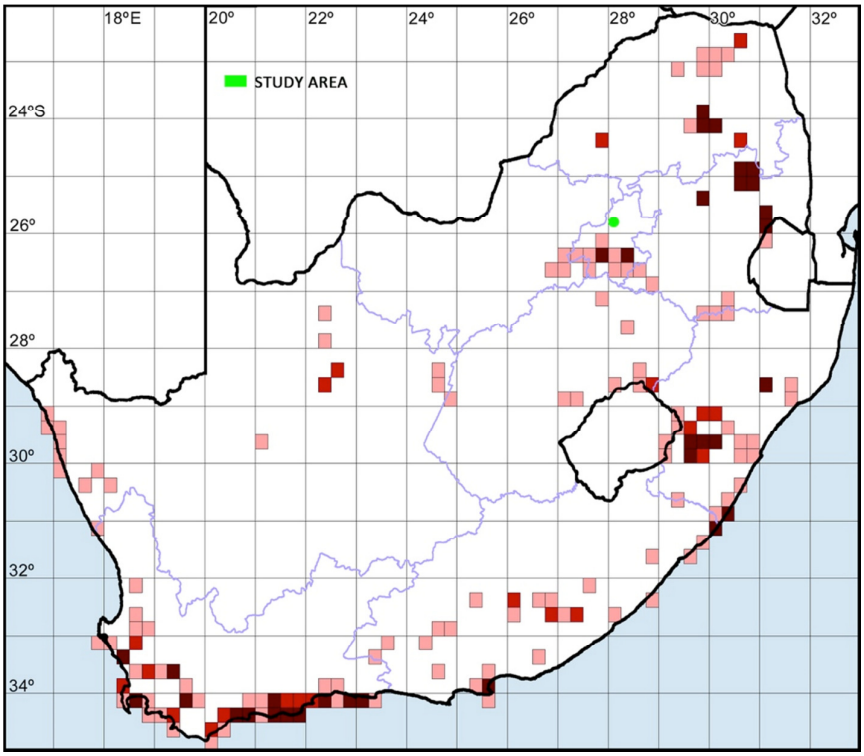

Figure 10: Butterfly Hotspots

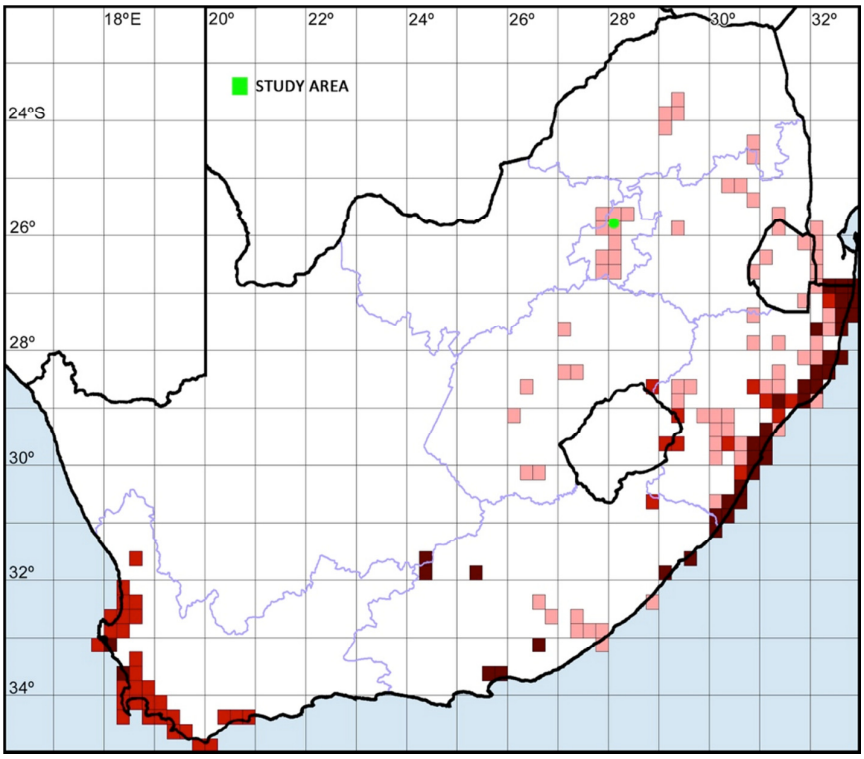

Figure 11: Snake Hotspots

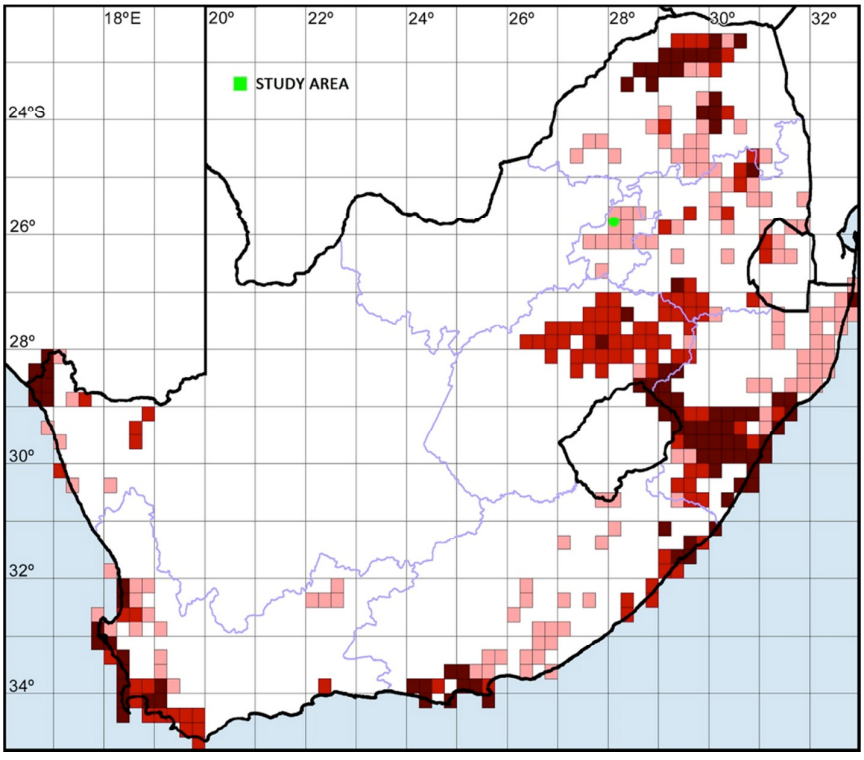

Figure 12: Lizard Hotspots

8 AQUATIC ECOLOGY

The aquatic ecology focuses on the open waterbodies within the study area. These watercourses include wetlands, rivers, streams, pans, lakes and manmade dams. In reality a pan is actually a type of wetland and must be approached as such. The focus is to delineate watercourses and limit any impact the project might have on these watercourses.

8.1 Wetlands

'Wetland' is a broad term and for the purposes of this study it is defined according the parameters as set out by the Department of Water & Sanitation (DWS) in their guideline (A practical field procedure for identification and delineation of wetlands and riparian areas, 2005). The classification of wetlands (which is a type of watercourse) is summarised below (Figure 13).

According to the DWS document and the National Water Act (NWA) a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*."

Furthermore, the guidelines stipulate that wetlands must have one or more of the following defining attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of water loving plants (hydrophytes); and
- A high water table that results in saturation at or near surface, leading to anaerobic conditions developing in the top 50cm of the soil.

During the site investigations the following indicators were used to determine whether an area needed to be defined as a wetland or not, namely:

- Terrain unit indicator;
- Soil form indicator;
- Soil wetness indicator; and
- Vegetation indicator.

Hydrogeomorphic types		Description	Source of water maintaining the wetland[1]	
			Surface	Sub-surface
Floodplain		Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel		Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/ ***
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans)		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source: * Contribution usually small

*** Contribution usually large

*/ *** Contribution may be small or important depending on the local circumstances

*/ *** Contribution may be small or important depending on the local circumstances.

 Wetland

Figure 13: Classification of wetlands

8.2 Riparian zones

Riparian vegetation is typically zonal vegetation closely associated with the course of a river or stream and found in the alluvial soils of the floodplain. According to the National Water Act (NWA) riparian habitat is defined as including "*The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or*

flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas."

It is important to note that the NWA states that the riparian zone has a floral composition distinct from those of adjacent areas. The NWA also defines riparian zones as areas that "c*ommonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands display more diffuse flow and are lower energy environments*."

8.3 Rivers and streams

A stream or river is a watercourse that is characterised by a very distinct channel. Most, but not all streams and rivers have an associated floodplain and / or riparian zone. Although wetlands and rivers are both watercourses, the legal implications differ in terms of development, buffer zones, etc.

8.4 Watercourses in the study area

There are no watercourses in the study area, including rivers, streams, distinctive drainage lines, wetlands or freshwater pans (which is a type of wetland). The closest major watercourse is the Hennops River and the Swartbooispruit (stream) (Figure 14). The Swartbooispruit is situated between 1 km and 1,2km due east of the study site. The stream flows north and is a tributary of the larger Hennops River. There are a few small wetland areas situated mainly along the course of the Swartbooispruit, but there are none within the study area, or any within a 500 m radius of the outer boundaries of the study area. Figure 15, below, shows the extent of delineated NFEPA / Gauteng FEPA wetlands in the region.

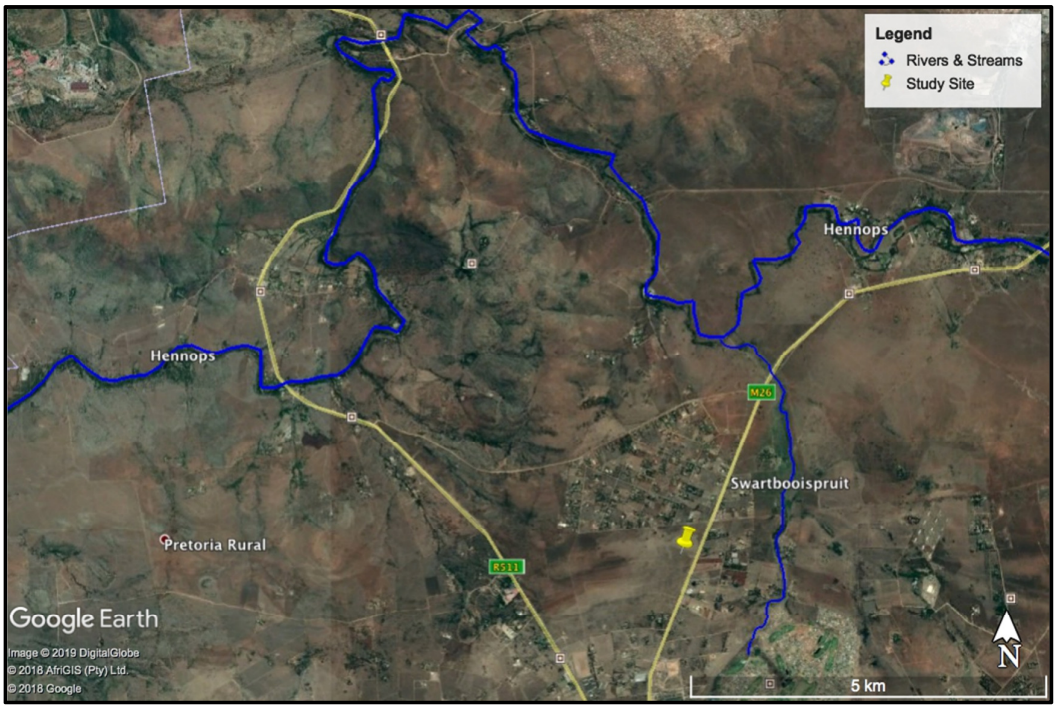

Figure 14: Main watercourses in the area

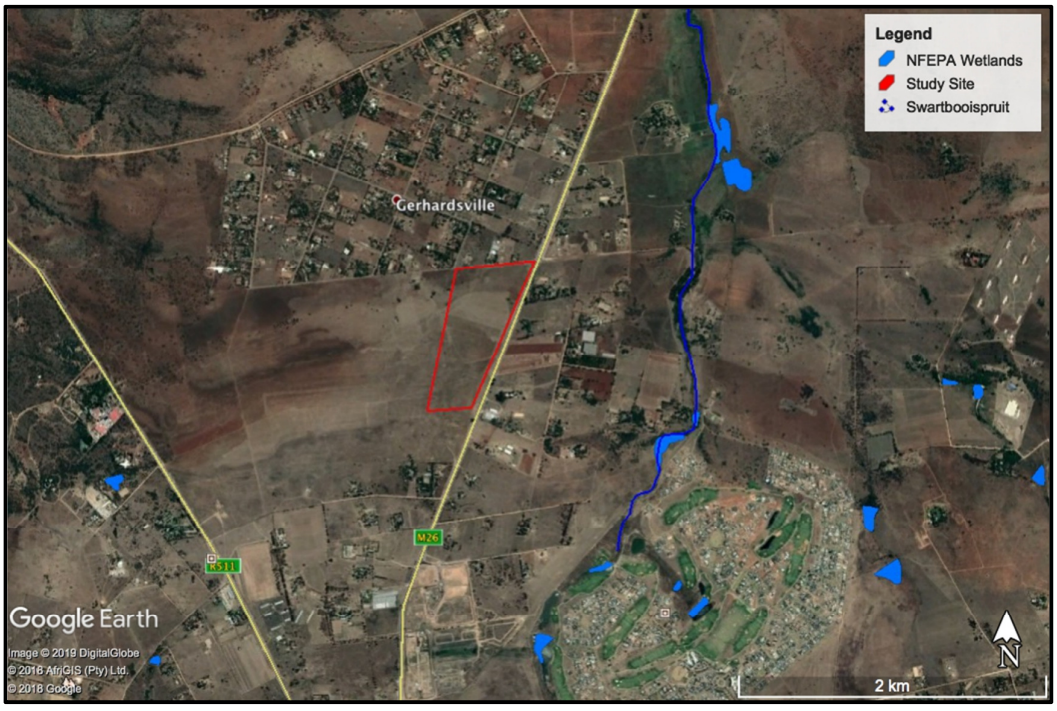

Figure 15: NFEPA wetlands in the area

8.5 Classification of watercourses in the study area

There are no watercourses in the study area, including drainage lines. Normally identified watercourses are classified along different hydrogeomorphic (HGM) types or units, up to Level 4, in terms of various levels as refined for South Africa by Kleynhans, *et. al*. (2005) and used in the Classification System for Wetlands user manual – SANBI Series 22 (Ollis *et. al.* 2013). See tables below (Table 18). This in addition to the classification system used above (Figure 13).

Table 18: Classification levels 1 - 4

LEVEL 1 System	LEVEL 2 Regional setting (Ecoregion)	LEVEL 3 Landscape Unit	LEVEL 4 HGM Unit	
			HGM Type	Landform
Inland	SA Ecoregions according to DWS and/or NFEPA	• Valley floor • Slope • Plain • Bench	River	• Mountain headwater stream • Mountain stream • Transitional stream • Upper foothill • Lower foothill • Lowland • Rejuvenated foothill • Upland floodplain
			Channeled valley bottom wetland	
			Unchannelled valley bottom wetland	
			Floodplain Wetland	
			Depression	• Exorheic • Endorheic • Dammed
			Seep	• With channel outflow (connected) • Without channel outflow (disconnected)
			Wetland flat	

8.6 Delineated Watercourses

There are no watercourses in the study area and therefore none could be delineated, or classified.

8.7 Drainage areas

South Africa is geographically divided up into a number of naturally occurring Primary Drainage Areas (PDAs) and Quaternary Drainage Areas (QDAs) (Figure 16). The different areas are demarcated into Water Management Areas (WMAs) and fall under the authority of different Catchment Management Agencies (CMAs). Until recently there were 19 WMAs and 9 CMAs. Figure 17 shows the extent of the old (or previous) Water Management Areas (WMAs). As of September 2016, these were revised and there are now officially only 9 WMAs, which correspond directly in demarcation to the 9 CMAs (Figure 18) (Government Gazette, 16 September 2016. No.1056, pg. 169-172).

The study area is situated within the Primary Drainage Area (PDA) of A and the Quaternary Drainage Area (QDA) of A21B (Figure 19). The study area is within the Limpopo Water Management Area (WMA 1) and under the jurisdiction of the Limpopo Catchment Management Agency (CMA 1) (Figure 18).

The study site is also not situated within a priority quaternary drainage catchment, in terms of guidelines and legislation from both the Department of Water & Sanitation (DWS) and the Gauteng Department of Agriculture & Rural Development (GDARD). According to GDARD the following are priority quaternary catchments, namely A21F, A21G, B31A, B31B, B31C, B20E, B20F, B20H, B20J, C21A, C21B & C21C.□

The table below gives a summary of the catchment areas and management areas for the study site (Table 19). In terms of water ecology the study area is situated within the wetland vegetation ecoregion of Central Sandy Bushveld Group 3 (Figure 20).

Table 19: Summary of Catchment areas for the study site

Level	Category
Primary Drainage Area (PDA)	A
Quaternary Drainage Area (QDA)	A21B
Water Management Area (WMA) – Previous / Old	Crocodile (West) & Marico (WMA 3)
Water Management Area (WMA) – New (as of Sept. 2016)	Limpopo (WMA 1)
Catchment Management Agency (CMA)	Limpopo (CMA 1)
Priority Quaternary Catchment	No
Rivers or streams	No
Wetlands (including pans)	No

NFEPA Rivers present	No
NFEPA Wetlands present	No
Fish FEPA	No
Rehab FEPA	No
Fish Corridor	No
Wetland Vegetation Region	Dry Highveld Grassland (Group 5)

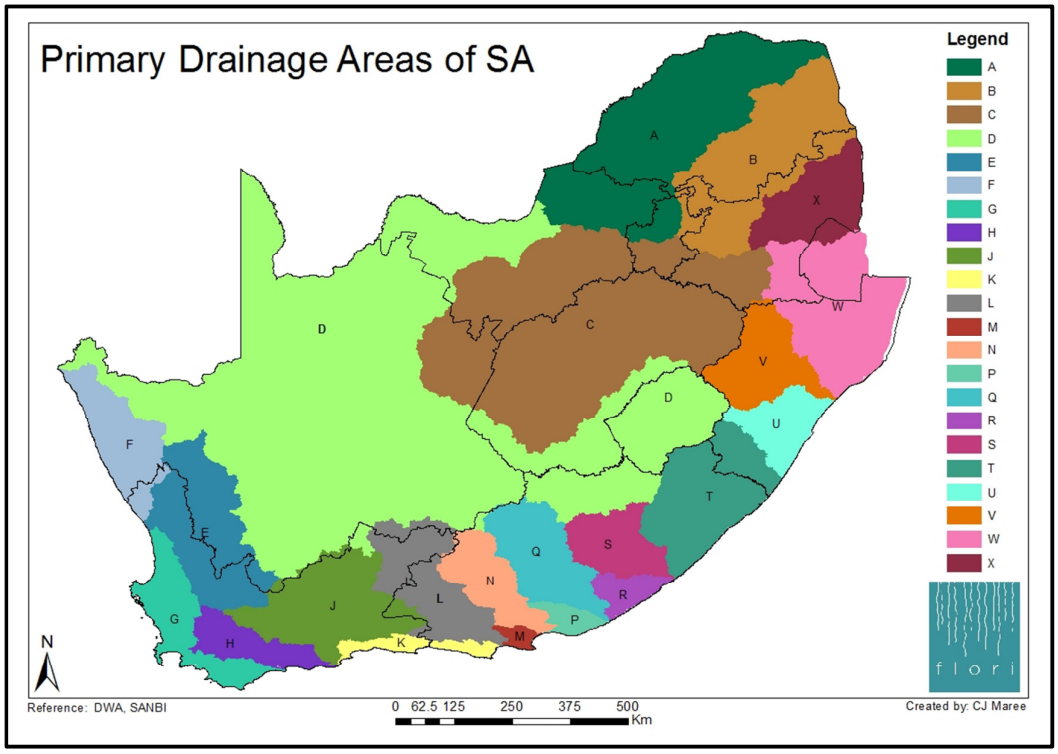

Figure 16: Primary drainage areas of South Africa

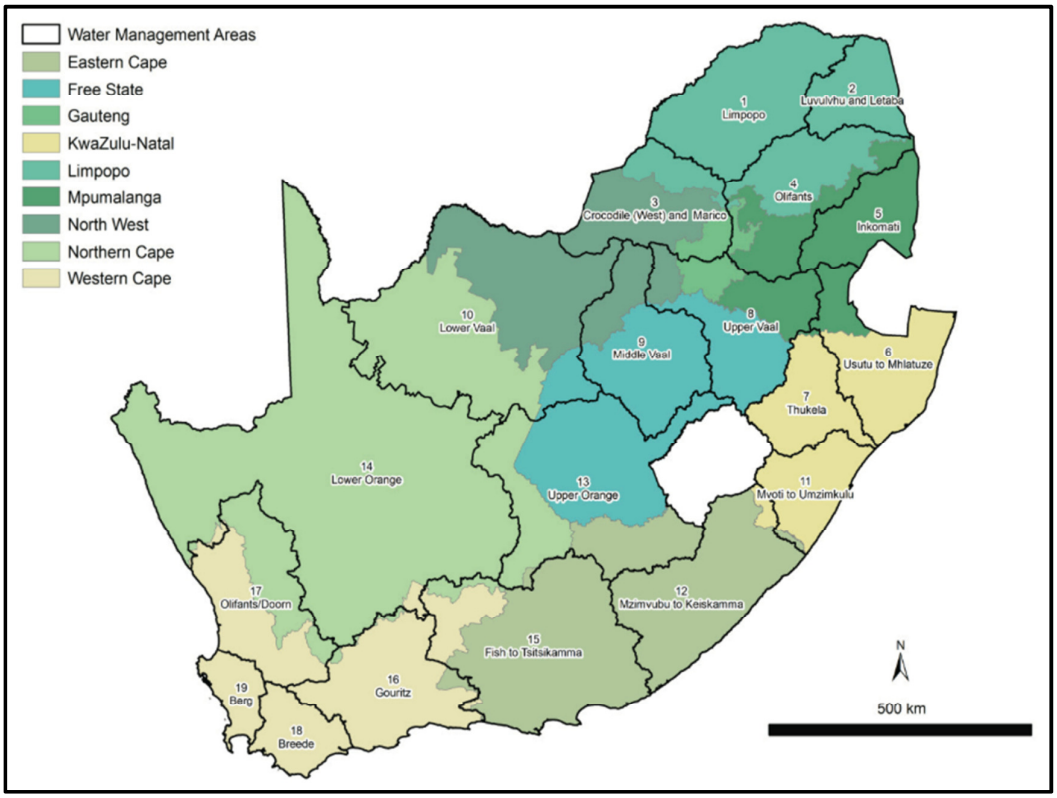

Figure 17: Old WMAs of South Africa

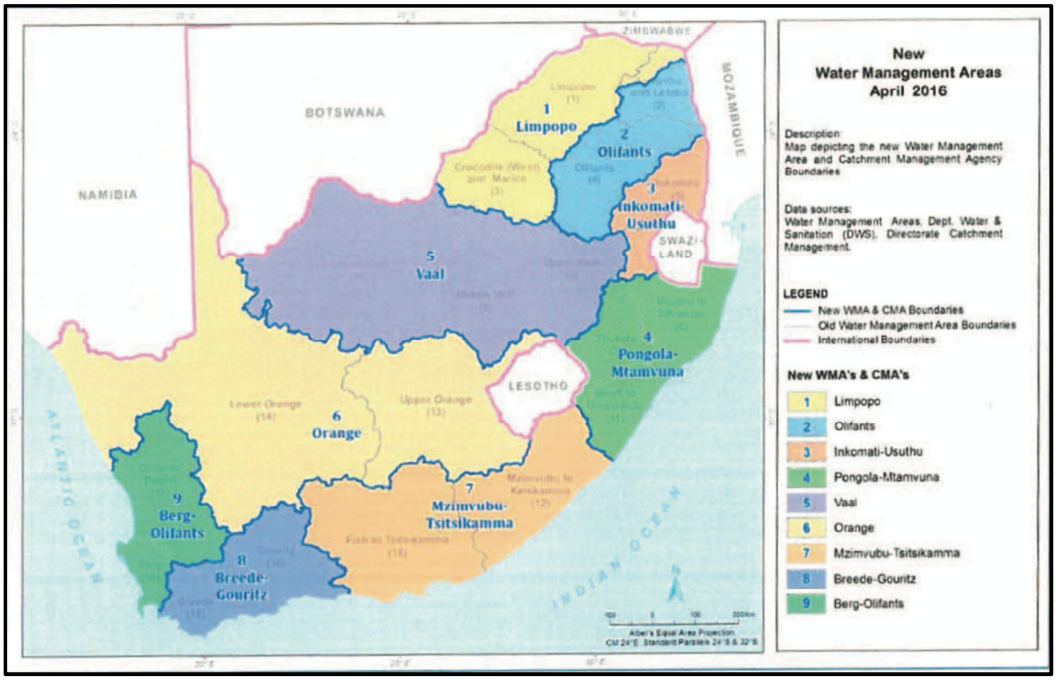

Figure 18: New WMAs & CMAs of South Africa

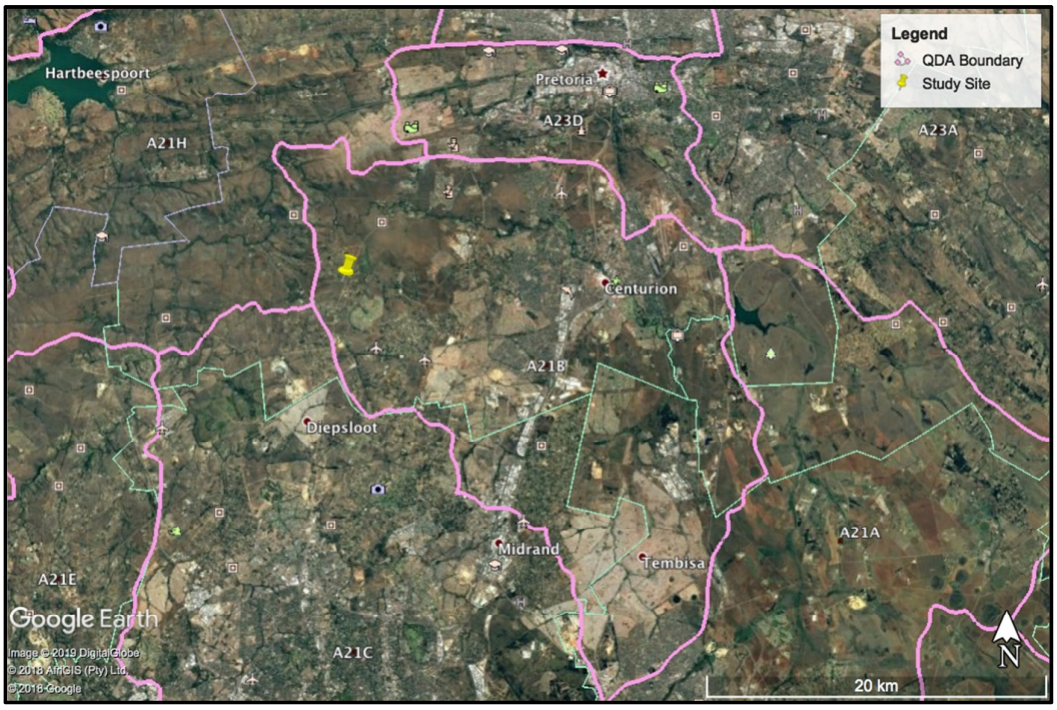

Figure 19: Quaternary drainage areas (QDAs)

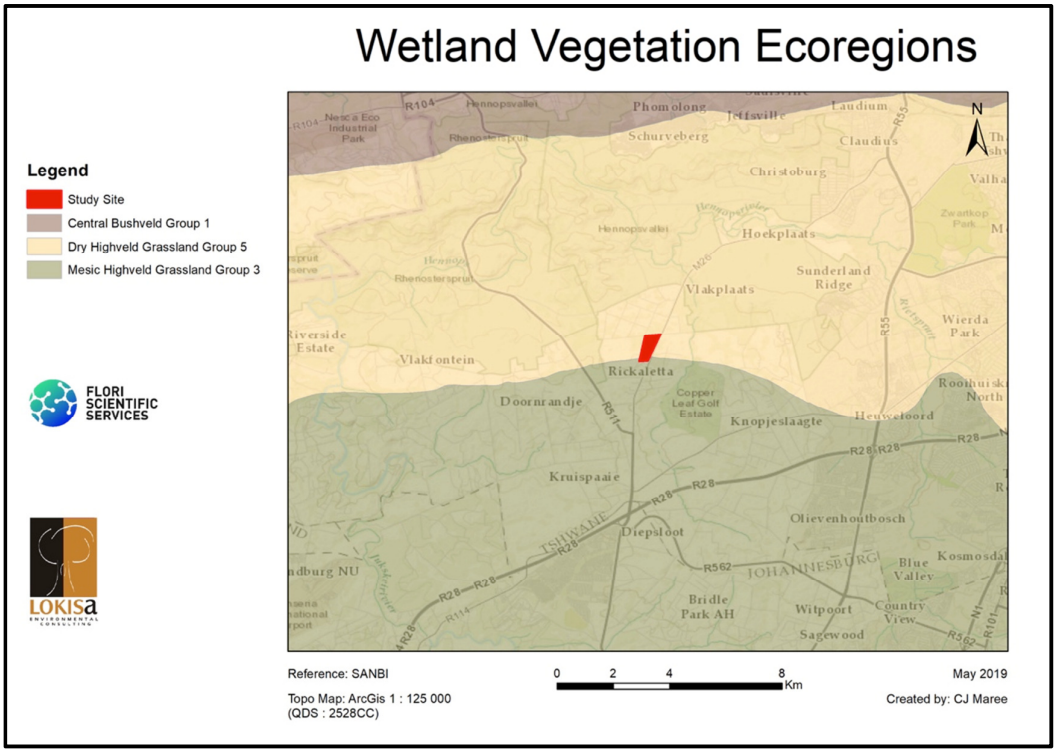

Figure 20: Wetland Vegetation Ecoregion

8.8 Strategic water source areas (SWSA) of South Africa

The Strategic Water Source Areas of South Africa (SWSA) are those areas that supply a disproportionate amount of mean annual runoff compared to the actual size of the geographical area. These areas are important because they have the potential to contribute significantly to the overall water quality and supply of the country, supporting growth and development needs that are often a far distance away. These areas make up 8% of the land area across South Africa, Lesotho and Swaziland but provide 50% of the water in these countries.

The study area is not situated within any Strategic Water Source Areas of South Africa (SWSA) (Figure 21).

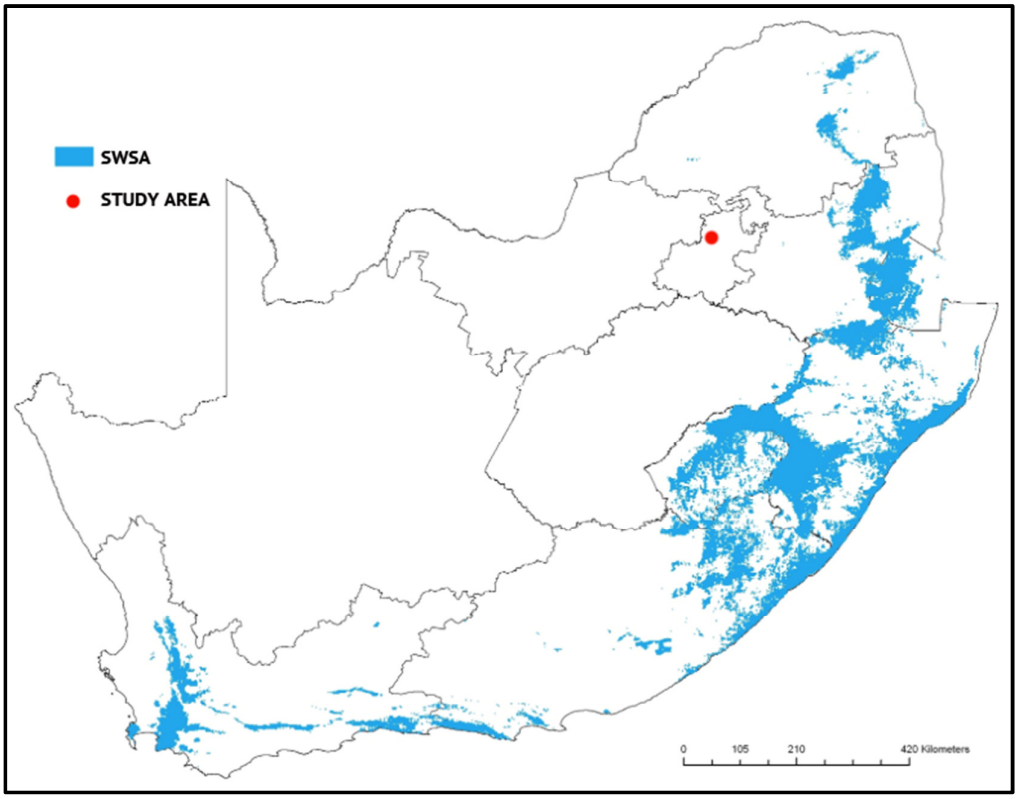

Figure 21: SWSA of South Africa

8.9 Methodology: Present Ecological State

The Present Ecological State (PES) is the current (present) ecological condition (state) in which the watercourse is found, prior to any further developments or impacts from the proposed project. The PES ratings of watercourses found in the study area are just as important to determine, as are the potential impacts of the

proposed development. The PES of a watercourse is assessed relative to the deviation from the Reference State (also known as the Reference Condition).

The reference state is the original, natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES Method (DWA, 2005) was used to establish the present state (integrity) of the unnamed drainage line in the study area. The methodology is based on the modified Habitat Integrity approach of Kleynhans (1996, 1999).

Table 20 shows the criteria used for assessing the habitat integrity (PES) of wetlands and other watercourses, along with Table 21 describing the allocation of scores to the various attributes. These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland.

Table 20: Habitat assessment criteria

Rating Criteria	Relevance
Hydrology	
Flow modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural lands. Changes in flow regime (timing, duration, frequency), volumes, and velocity, which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.
Permanent inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
Water quality	
Water Quality Modification	From point or diffuse sources. Measured directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural

	rates of erosion, accretion or infilling of wetlands and change in habitats.
Geomorphology & Hydraulics	
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities, which reduce or changes wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Over utilisation of Biota	Overgrazing, over fishing, over harvesting of plant material, etc.

Table 21: Scoring guidelines for habitat assessment

Scoring guidelines per criteria	
Natural / unmodified	5
Mostly natural	4
Moderately modified	3
Largely modified	2
Seriously modified	1
Critically modified (totally transformed)	0

Table 22 provides guidelines for the determination of the Present Ecological Status Category (PESC), based on the mean score determined for the assessments. This

approach is based on the assumption that extensive degradation of any of the wetland attributes may determine the PESC (DWA, 2005).

Table 22: Wetland integrity categories

Category	Mean Score	Description
A	>4	Unmodified, natural condition.
B	>3 to 4	Largely natural with few modifications, but with some loss of natural habitats.
C	>2,5 to 3	Moderately modified, but with some loss of natural habitats.
D	2 to 2,5	Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
E	>0	Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
F	0	Critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

The integrity of watercourses with a category rating of F,E & D were deemed to be Low. Category rating of C was deemed to be Medium, while Category ratings of B & A were deemed to be High.

8.10 PES of watercourses in the study area

No watercourses are present within, or immediately adjacent to, the study area. Therefore, no PES determinations could be done or is required.

8.11 Methodology: Ecological Importance & Sensitivity

Ecological importance and sensitivity (EIS) looks at the importance of the wetland, watercourse or water ecosystem in terms of biodiversity and maintenance. The determination is not just based on the identified watercourse in isolation, but also its' importance in terms of supplying and maintaining services to the larger catchment and water systems up and downstream.

The ecological sensitivity (ES) part of the EIS looks at how sensitive the system is to changes in services and environmental conditions. The Recommended Environmental Management Class (REMC) is the recommended state to which the watercourse should be returned to or maintained at. The EIS categories and descriptions are outlined in the table below (Table 23). A high REMC relates to ensuring a high degree of sustainability and a low risk of ecosystem failure occurring. A low REMC would ensure marginal sustainability, but with a higher risk of

ecosystem failure. The REMC is based on the results obtained from assessing the ecosystem or watercourse in terms of EIS, PES and function. The ideal would be that with realistic recommendations and mitigating actions, to return the system to a certain level of functionality and original state.

Table 23: EIS Categories and Descriptions

EIS Categories	Median Range	Category
Wetlands that are considered ecologically important and sensitive on a **national or international** level. The biodiversity of these wetlands is usually very sensitive to flow & habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	Very high 3 - 4	A
Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	High 2 - 3	B
Wetland that are considered to be ecologically important and sensitive on a **provincial or local** scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	Moderate 1 - 2	C
Wetlands that are not ecologically important and sensitive on any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	Low 0 - 1	D

8.12 EIS of watercourses in the study area

No watercourses are present within, or immediately adjacent to, the study area. Therefore, no EIS determinations could be done.

8.13 Drivers of ecological change on the watercourses

The main drivers of ecological change on the water environment and ecosystems in the region are:

- High (and increasing) levels of urbanisation, eventhough in the area of the study site the levels of urbanisation are low;
- Urban encroachment on the natural riparian zones and main channels;
- In-channel dams in the main watercourses in the area; and
- General pollution, dumping and destruction of watercourses by local residents and industries.

9 SENSITIVITY ASSESSMENT

The sensitivity assessment identifies those areas and habitats within the study site that have a high conservation value and that may be sensitive to disturbance. All watercourses, including seasonal streams and drainage lines are always deemed to be sensitive, even if they are badly degraded. Rocky ridges and rocky outcrops (koppies) are also considered to be sensitive. Areas or habitats have a higher conservation value (or sensitivity) based on their threatened ecosystem status, presence or ideal habitats for priority species (including Red Data species), species-richness, distinctive habitats, etc.

The study site is predominantly that of an intertwined mix of open, degraded grassland and old cultivated lands, some of which are presently mowed on a regular basis for cattle fodder. The only habitat present can therefore be described as degraded grassland, as it cannot be separated out from the old cultivated lands. The floral and faunal sensitivity analyses for the study area are shown in the tables below (Table 24 & Table 25).

9.1 Floristic Sensitivity Analysis

Table 24: Floristic sensitivity analysis

Criteria	Distinctive habitats in the study area
	Degraded Grassland
Red Data Species	3
Habitat Sensitivity	3
Floristic Status	5
Floristic Diversity	5
Ecological Fragmentation	7
Sensitivity Index	46%
Sensitivity Level	Medium
Development Go Ahead	Go-But

GO-BUT: These are areas that are medium sensitive and should generally be avoided if possible. But, with the correct implementation of mitigating and management measures can be entered if need be.

9.2 Faunal Sensitivity Analysis

Table 25: Faunal sensitivity analysis

Criteria	Distinctive habitats in the study area
	Degraded Grassland
Red Data Species	3
Habitat Sensitivity	4
Faunal Status	3
Faunal Diversity	3
Ecological Fragmentation	7
Sensitivity Index	40%
Sensitivity Level	Medium / Low
Development Go Ahead	Go-Slow

GO-SLOW: These would typically be areas where large portions of the veld has been transformed and/or is highly infested with alien vegetation and lacks any real faunal component. Few mitigating measures are typically needed, but it is still always wise to approach these areas properly and slowly.

9.3 Ecological Sensitivity Analysis

The ecological sensitivity of the study area is determined by combining the sensitivity analyses of both the floral and faunal components. The highest calculated sensitivity unit of the two categories is taken to represent the sensitivity of that ecological unit, whether it is floristic or faunal in nature (Table 26). According to the analyses there are no high sensitivity areas, high sensitivity habitats, or 'No-Go' zones.

Table 26: Ecological sensitivity analysis

Ecological community	Floristic sensitivity	Faunal sensitivity	Ecological sensitivity	Development Go-ahead
Degraded Grassland	Medium	Medium \ Low	Medium	Go-But

9.4 Priority areas

Priority areas include formal and informal protected areas (nature reserves); important bird areas (IBAs); RAMSAR sites; National fresh water ecosystem priority areas (NFEPA) and National protected areas expansion strategy (NPAES) areas. The study site is situated within the outer edges of the Magaliesberg IBA, but within no other priority areas (Figure 22).

GDARD's Conservation Plan (C-Plan v.3.3) shows that the study site is situated within an ecological support area (ESA) and a critical biodiversity area (CBA). The CBA is a CBA – Important (Figure 23). The area in which the study site is situated is however not pristine grassland or open natural habitat, but is mostly degraded grassland, cultivated farmlands and old farmlands.

The study area is not situated within or close to any demarcated Gauteng ridges (Figure 24).

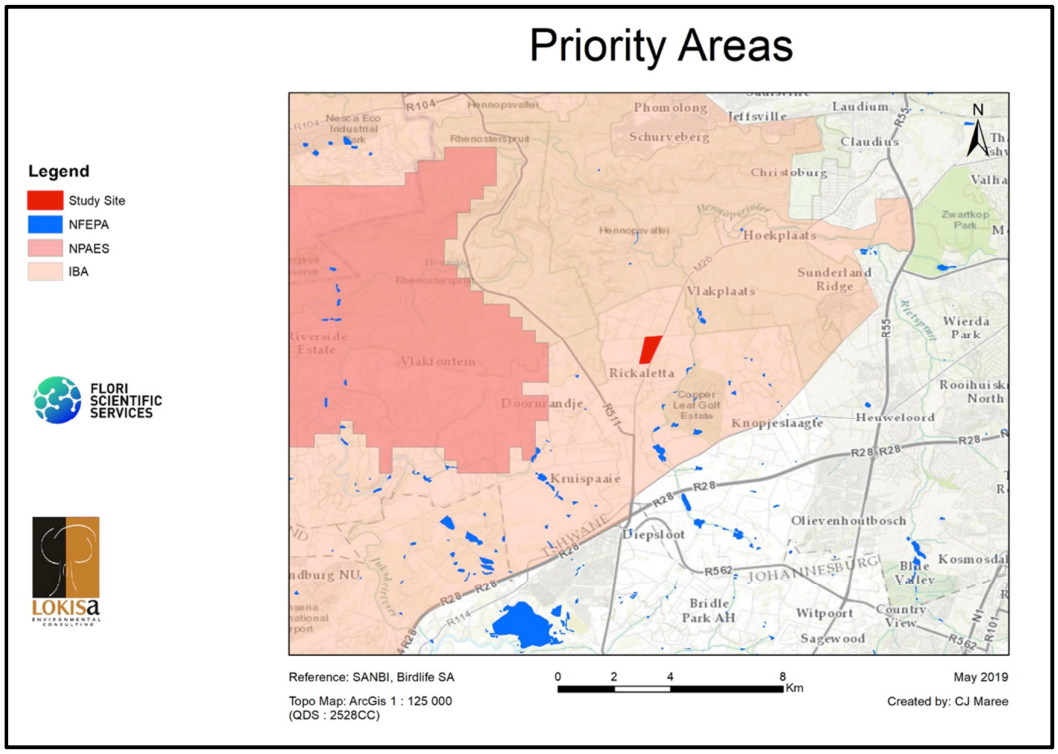

Figure 22: Priority areas

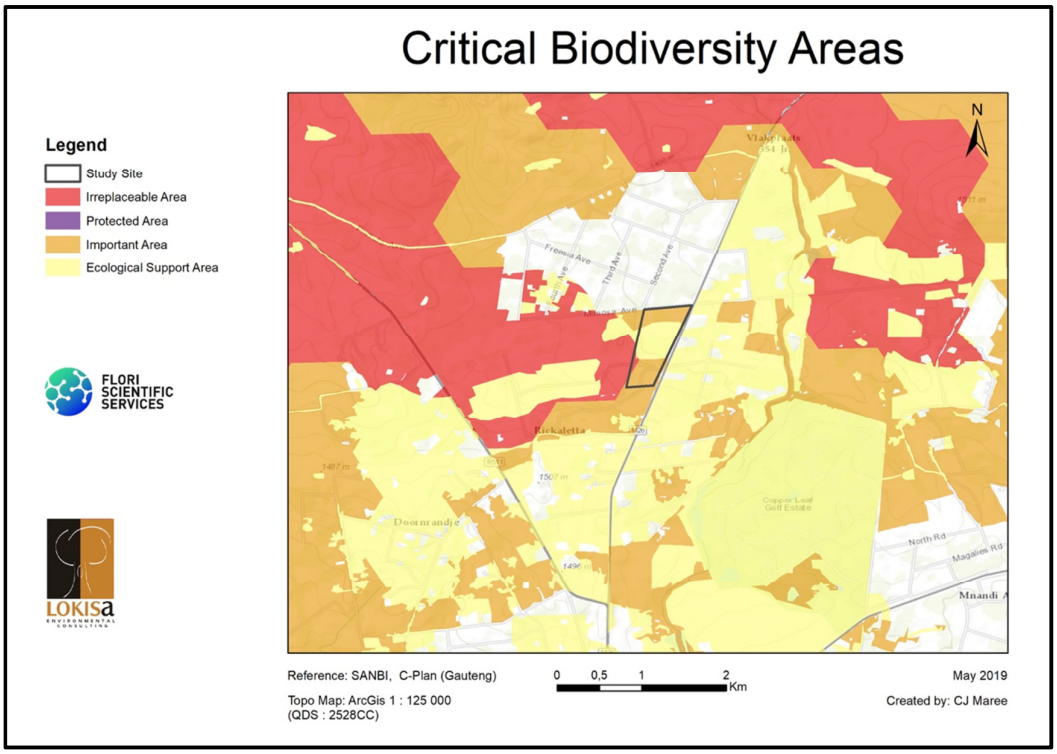

Figure 23: CBAs & ESAs

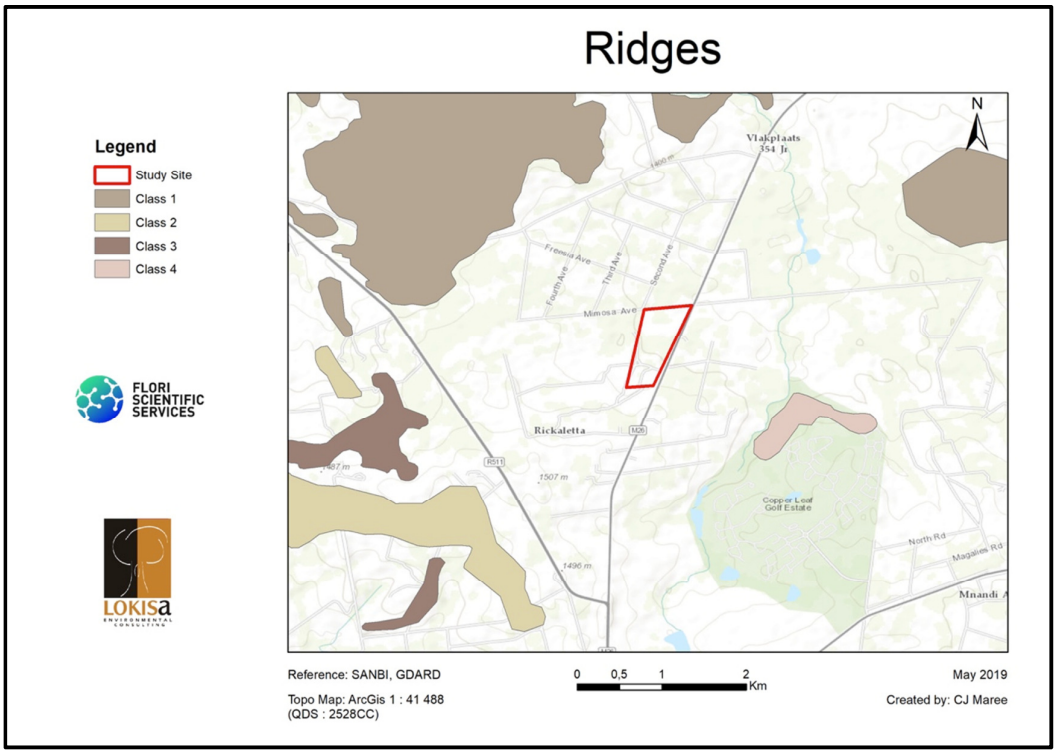

Figure 24: Ridges in the region

9.5 Gauteng Environmental Management Framework

The Gauteng Environmental Management Framework (EMF) is a legal instrument in terms of the Environmental Management Regulations Framework (2010). The objective of the EMF is to protect Critical Biodiversity Areas (CBAs) and properly integrate Ecological Support Areas (ESAs) as defined in the C-Plan, within urban and rural areas. The study area was assessed in terms of the EMF (2014 & 2018), with focus on biodiversity, current land use, hydrology and other environmental factors. An environmental sensitivity assessment was conducted and sensitivity delineations done in terms of Conservation status, Conservation priorities, Ridges, Surface hydrological features and current land use. EMF Zones 1 & 5 have been updated in terms of Government Gazette 41473, Notice 164 of 2 March 2018.

According to the Management Zones of the EMF the study site is situated within Zone 3 (High control zone outside of Zone 1 or high control zone) and Zone 4 (Normal control zone).

9.6 Sensitive areas identified during field investigations

No high sensitive areas or 'No-Go' zones were identified during field investigations. All of the above information and data sets are taken into account when determining the sensitivity of the study site, including CBAs, ESAs, priority areas, ideal habitats for priority species (fauna and flora), watercourses, ridges, koppies (rocky outcrops), presence of RDL and ODL species, threat status of the veldtype in which the study site is situated, etc. The sensitivity map below gives the extent of the demarcated sensitivity levels (Figure 25).

Most of the study area was previously cultivated land. A small ditch (not quite a farm dam) appears to have been dug to impound surface stormwater run-off. This area is not sensitive or natural and currently has to highest level of weed infestation, including syringa trees. This area may be levelled in required. A mound or small low rise is present in the northern section of the site. This is not a ridge or rocky ridge (koppie) although there are some surface rocks present. It appears to be a mix of natural contours and dumped soil (probably during the levelling of farmlands as well as to assist in the channeling of surface stormwater (Figure 26).

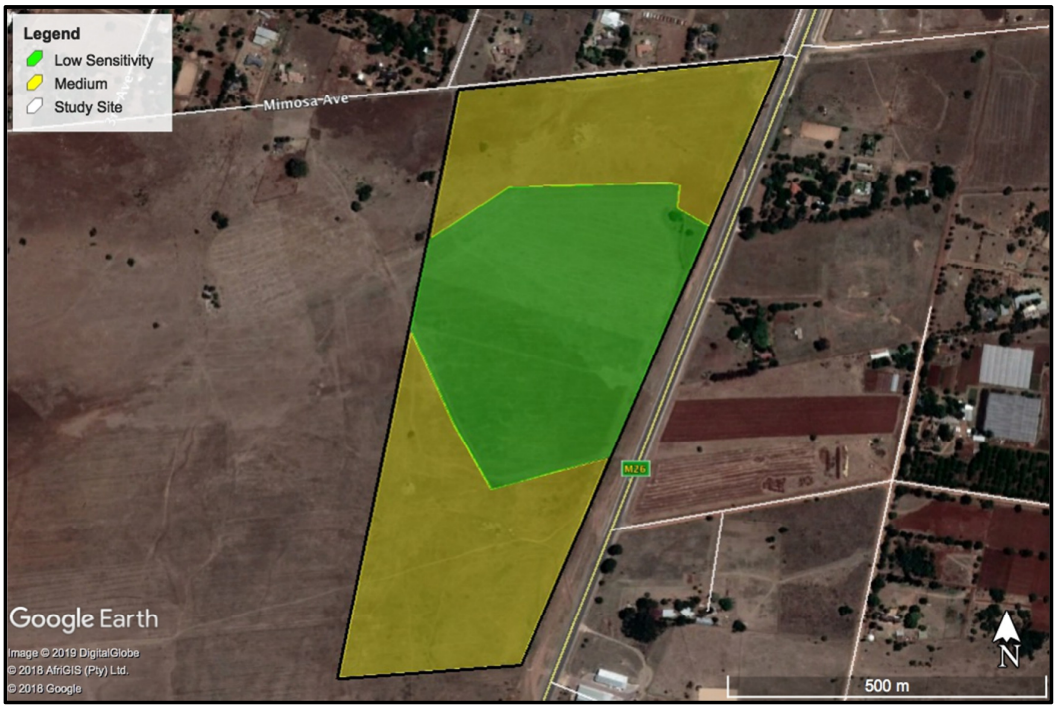

Figure 25: Sensitivity map

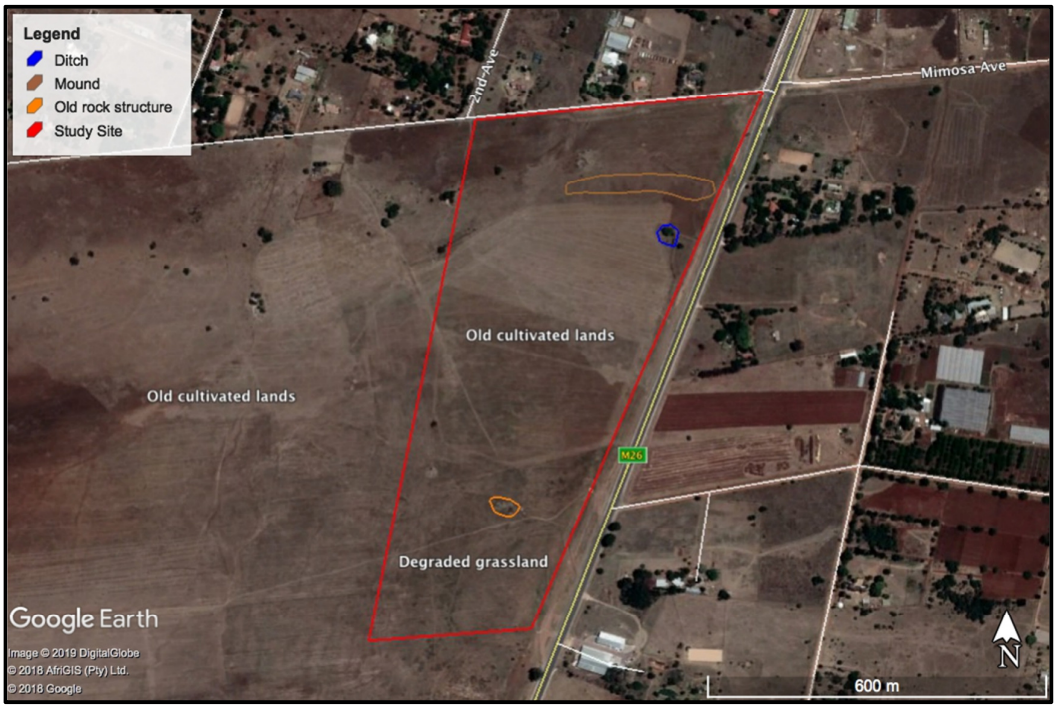

Figure 26: Environmental and current landuse map

10 THE GO, NO-GO OPTION

10.1 Classification criteria

The term ‘fatal flaw’ is used in the pre-application planning and screening phases of a project to evaluate whether or not an impact would have a ‘no-go’ implication for the project. In the scoping and impact assessment stages, this term is not used. Rather impacts are described in terms of their potential significance.

A potential fatal flaw (or flaws) from a biodiversity perspective is seen as an impact that could have a "no-go" implication for the project. A ‘no-go’ situation could arise if residual negative impacts (i.e. those impacts that still remain after implementation of all practical mitigatory procedures/actions) associated with the proposed project were to:

a) Conflict with international conventions, treaties or protocols (e.g. irreversible impact on a World Heritage Site or Ramsar Site);

b) Conflict with relevant laws (e.g. clearly inconsistent with NEMA principles, or regulations in terms of the Biodiversity Act, etc.);

c) Make it impossible to meet national or regional biodiversity conservation objectives or targets in terms of the National Biodiversity Strategy and Action Plan (BSAP) or other relevant plans and strategies (e.g. transformation of a ‘critically endangered’ ecosystem);

d) Lead to loss of areas protected for biodiversity conservation;

e) Lead to the loss of fixed, or the sole option for flexible, national or regional corridors for persistence of ecological or evolutionary processes;

f) Result in loss of ecosystem services that would have a significant negative effect on lives (e.g. loss of a wetland on which local communities rely for water);

g) Exceed legislated standards (e.g. water quality), resulting in the necessary licences/approvals not being issued by the authorities (eg. WULA);

h) Be considered by the majority of key stakeholders to be unacceptable in terms of biodiversity value or cultural ecosystem services.

10.2 Potential Fatal Flaws for the Project

There are no fatal flaws and the project may go ahead. There are no 'No-Go' areas within the study site. However, mitigating measures still need to be implemented.

11 IMPACT ASSESSMENT

The impacts of the activities related to the proposed project were rated. There are existing and potential impacts and mitigating measures are recommended to help reduce the sum of the negative impacts. The rated impacts of the proposed project before and after the implementation of mitigating measures are shown in the table below (Table 27). The impact assessments focus on the construction phase (development) of the project.

11.1 Existing Impacts

Existing negative impacts on the study area and surrounding areas include low to high levels of urbanisation (to the immediate north and south east of the site), over-utilisation of natural resources, cultivated lands, regular cutting of grass for fodder, some illegal dumping of rubbish, and general infrastructure such as roads and power lines.

11.2 Potential Impacts

The potential impacts of the proposed project activities are medium- to high-level negative impacts for the medium- to long-term. The medium- to long-term negative impacts of the project include the removal and loss of vegetation, the loss of ecosystem integrity and the loss of natural habitat, even if degraded grassland.

11.3 Assessment of total potential impacts

The calculated total potential impacts the proposed development project may have on the natural environment, with specific recommended mitigating measures, are summarised in the table below (Table 27).

Table 27: Assessment of Impacts (Total)

CONSTRUCTION PHASE		
Impact Rating	**Mitigating Measures**	**Sensitivity**
Before Mitigation: HIGH Extent: Local: 2 Duration: Permanent: 4 Intensity: High: 3 Probability: Definite: 4 Status: Negative Cumulative Effect: Medium Total: 13	Any temporary storage, lay-down areas or accommodation facilities to be setup in existing disturbed areas. No temporary facilities or portable toilets to be setup within 100m of any watercourse (There are however no watercourses on the study area). Ensure as small a footprint as possible during the	**MEDIUM** **(After mitigation)**

After Mitigation: MEDIUM Extent: Site: 1 Duration: Long-term: 3 Intensity: High: 3 Probability: Highly Probable: 3 Total: 10	construction phase. All excess materials brought onto site for construction purposes to be removed after construction. Disturbed dug up areas to be reshaped and re-contoured to original contours and to blend in with surrounding topography. Re-seeding of bare areas with local indigenous grasses to be part of the rehabilitation plan. No exotic species to be used for rehabilitation.	

11.4 Assessment of individual potential impacts

Below are the impact assessments for the individual potential impacts the project and related activities may have on the ecological environment of the study site and immediate surround. There are no potential positive impacts arising from the project.

Potential Impact 1: Loss of natural vegetation (negative)

The establishment of a township development will result in the removal and loss of vegetation.

	Impact Criteria						
	Extent	**Duration**	**Intensity**	**Probability**	**Total Score**	**Significance**	**Cumulative effect**
Pre-Mitigation	Site: 1	Permanent 4	High 3	Definite 4	12	High	Medium
Post-Mitigation	Site 1	Long-term 1	High 3	Definite 4	9	Medium	Medium

Mitigating Measures:

- A site-specific rehabilitation plan is required.
- Part of the rehabilitation plan must include the planting of new locally indigenous trees along street avenues.
- Where possible, large existing trees (although few) should be kept and worked into the final layout design. However, the existing alien trees, such as syringa should be removed.
- Open public spaces must be created and locally indigenous trees planted (if not existing) in those open spaces.

Potential Impact 2: Erosion (negative)

Erosion is always a real potential negative impact in projects of this nature. Fortunately the area is mostly flat, with a low erosion potential.

	Impact Criteria						
	Extent	**Duration**	**Intensity**	**Probability**	**Total Score**	**Significance**	**Cumulative effect**
Pre-Mitigation	Site: 1	Short-term: 1	Moderate 2	Possible 2	6	Low	Low
Post-Mitigation	Site 1	Short-term: 1	Low: 1	Possible 2	5	Low	Negligible

Mitigating Measures:

- Erosion potential to be monitored at all times during the construction phase. Any erosion to be corrected immediately.
- Proper stormwater management systems to be installed and maintained.

Potential Impact 3: Loss of RDL faunal and floral species (negative)

No RDL species were observed during field investigations, so although there is always the potential of loss of RDL species the potential impact is low.

	Impact Criteria						
	Extent	**Duration**	**Intensity**	**Probability**	**Total Score**	**Significance**	**Cumulative effect**
Pre-Mitigation	Site: 1	Short-term: 1	Moderate: 2	Possible: 2	6	Low	Low
Post-Mitigation	Site: 1	Short-term: 1	Low: 1	Improbable: 1	4	Low	Negligible

Mitigating Measures:

- Care should be taken not to interact with any wild animals encountered.
- Any active nests or burrows must first be cordoned off until the ECO and/or a specialist has had time to come to site to evaluate the situation and advise accordingly.
- Under no circumstances may any wild animals be killed or captured by contractors.
- Any unusual plants encountered during the construction phase should be photographed and sent to the ECO and / or botanist for identification and status. If in the unlikely event the plant is a RDL species the specialist should advise action accordingly.

Potential Impact 5: Increase in invasive weeds (negative)

The disturbance of soils, such as digging and excavating always has the real potential negative impact in creating a favourable environment for invasive alien weeds. The extent of invasive weeds in the study site is low, but there is also the reality that seeds may be imported from other areas as well.

	Impact Criteria						
	Extent	**Duration**	**Intensity**	**Probability**	**Total**	**Significanc**	**Cumulativ**

					Score	e	e effect
Pre-Mitigation	Local: 2	Medium-term: 3	Moderate: 2	Possible: 2	9	Medium	Low
Post-Mitigation	Site: 1	Short-term: 2	Low: 1	Possible: 2	6	Low	Low

Mitigating Measures:

- A weed control programme should be implemented to monitored and remove any invasive weeds during and after the construction phase.
- Proper rehabilitation and re-seeding of the disturbed areas and bare soils with locally indigenous grasses will greatly reduced the probability of invasive weeds from seriously colonising the site.
- The key to controlling of invasive weeds is proper construction and then more importantly the proper and regular maintenance by local municipal authorities.

12 MITIGATION OF IMPACTS

The following mitigating measures are recommended to help reduce the potential negative impacts of the project on the natural environment. The implementation of recommended mitigating measures are necessary if the conclusions and assessments of the report are to remain pertinent. The main mitigating measures have been mentioned above. The mitigating measures below also include, obvious and best practice measures.

12.1 Construction Phase

- Only existing roads to be used by vehicles during construction. Roads to be rehabilitated after construction by contractors.
- Dust suppression to be conducted during construction due to close proximity to urban areas.
- No indigenous trees to be cut down unnecessary.
- Disturbed surface areas in the construction phase to be rehabilitated. No open trenches to be left. No mounds of soils created during construction to be left.
- All construction material, equipment and any foreign objects brought into the area by contractors to be removed immediately after completion of the construction phase.
- Proper rubbish/waste bins to be provided. These to be emptied weekly and the waste to be removed to an official waste disposal site.
- Bare areas to be rehabilitated with locally indigenous grass species.
- Indigenous trees to be planted in open public spaces.
- Stormwater management plan to be compiled and implemented.

12.2 Operation & Maintenance Phases

Maintenance of the township development should be regularly and routinely undertaken by the cllient/ owners and local authorities. However, this seldom happens. Regular maintenance should include the control of invasive weeds, maintenance of public open spaces, maintenance of trees and the maintenance and cleaning of stormwater systems.

13 APPENDICES

13.1 List of floral species identified on site

Trees & Shrubs

Acacia karroo, Acacia robusta, Searsia (=Rhus) leptodictya, Searsia lancea.

Shrubs & Herbaceous plants

Acalypha angustata, Barleria macrostegia, Chamaecrista mimosoides, Chamaesyce inaequilatera, Crabbea angustifolia, Helichrysum nudifolium, Ipomoea ommaneyi, Justicia anagalloides, Kohautia amatymbica, Kyphocarpa angustifolia, Pollichia campestris, Senecio coronatus, Vernonia oligocephala, Asparagus cooperi, Aloe greatheadii.

Grasses

Aristida congesta (d), *Brachiaria serrata* (d), *Cynodon dactylon* (d), *Digitaria tricholaenoides* (d) *Eragrostis chloromelas* (d), *Eragrostis racemosa* (d), *Eragrostis curvula, Heteropogon contortus* (d), *Hyparrhenia hirta, Setaria sphacelata* (d), *Themeda triandra* (d).

(d) = Dominant.

Aquatic species

None.

Red Data species present

None.

Protected trees

None

Priority Species (Species of conservation concern)

Boophane disticha, Hypoxis hemerocallidea.

13.2 Photographs

Photo 1: Study Site. Looking south / southwest. Old cultivated lands in foreground, where the grass is now routinely cut for fodder.

Photo 2: Rock strewn area in northeast of site where the soils are shallow. Some of the rocks have historically been moved from cultivated lands. But some lay on a slight mound (not a rocky outcrop)

Photo 3: Study site. Grass cut on old cultivated lands and open grasslands for fodder.

Photo 4: Open degraded grassland on study site

Photo 5: Stormwater drain system in northeast corner of site (Mimosa St & 1st Ave intersection)

Photo 6: Old broken down structure in the southern area of the study site

Photo 7: Aloe plants growing in the rocky area. Although not a priority species these can easily be lifted and transplanted into the open public space

Photo 8: Large syringa tree on site that is an invasive alien and may be removed

Photo 9: Trees in photo are alien species and may be removed. Looking south along the eastern boundary (1st Ave) of the study site

13.3 RDSIS Score sheet for mammals

RED DATA SENSITIVITY INDEX SCORE (RDSIS): MAMMALS
Project: Knoppieslaagte Ptn 66

1. Red Data Listed Species potentially occuring in the study area

Scientific Name	Common Name	IUCN Status	Distribution Range (D)	Habitat (H)	Availability of Food (F)	POC (%)	POC Value
Atelerix frontalis	Hedgehog	NT	80	20	40	47	Medium
Lutra macuicollis	Spotted-necked otter	NT	10	10	20	13	Low
Miniopteris schreibersi	Schreibers's long-fingered bat	NT	100	20	50	57	Medium
Myotis tricolor	Temminck's hariy bat	LC	50	40	60	50	Medium
Mystomys albicaudatus	White tailed mouse	EN	80	30	50	53	Medium
Neamblysomus julianae	Juliana's Golden Mole	EN	0	20	20	13	Low
Rhinolophus blasii	Blasius's/Peak-Saddle Horseshoe Bat	LC	30	10	50	30	Low/Medium
Rhinolophus clivosus	Geoffroy's Horshoe bat	NT	100	20	50	57	Medium
Rhinolophus darlingi	Darling's Horseshoe Bat	LC	30	10	50	30	Low/Medium
Rhinolophus hildebrandtii	Hildebrandt's Horseshoe Bat	LC	80	10	50	47	Medium
					Average TSS	**40,3**	

Total Species Score (Only use species with a POC >60%)

Scientific Name	Common Name	IUCN Status	POC	TSS
-	-	-	-	0
-	-	-	-	0
			Average TT Score	**0**

Status Category	TSS Weighting
DDT	0,2
R	0,5
NT	0,7
VU	1,2
EN	1,7
CR	2

Average Total Species Score

Average TSS	40,3
Average TT Score	0
Average Score	20,2

RED DATA SENSITIVITY INDEX SCORE (RDSIS)

Average Total Species Score		40,30%	
Average Threatened Taxa Score		0,00%	
Average (TSS + TT)		20,20%	
% Speices >60% POC		0%	
RDSIS for Study area		**10,1**	**LOW**

POC range	Description
0-20	Low
21-40	Low/Medium
41-60	Medium
61-80	Medium/High
81-100	High

RDSIS Rating	Description
0-20	Low
21-40	Low/Medium
41-60	Medium
61-80	Medium/High
81-100	High

Status Category	Abbreviation	Weighting
Data deficient	DDT	0,2
Rare	R	0,5
Near Threatened	NT	0,7
Vulnerable	VU	1,2
Endangered	EN	1,7
Critically Endangered	CR	2

13.4 RDSIS score sheet for birds

RED DATA SENSITIVITY INDEX SCORE (RDSIS): BIRDS
Project: Knoppieslaagte Ptn 66

1. Red Data Listed Species potentially occuring in the study area

Scientific Name	Common Name	IUCN Status	Distribution Range (D)	Habitat (H)	Availability of Food (F)	POC (%)	POC Value
Alcedo semitorquata	Half-collared Kingfisher	LC	10	0	25	12	Low
Anthropoides paradiseus	Blue Crane	VU	50	20	30	33	Low/Medium
Circus ranivorus	African Marsh-Harrier	LC	40	30	50	40	Low/Medium
Eupodotis caerulescens	Blue Korhaan	NT	70	30	50	50	Medium
Eupodotis senegalensis	White-bellied Korhaan (Bustard)	LC	25	30	50	35	Low/Medium
Gorsachius leuconotus	White-backed Night Heron	LC	10	0	25	12	Low
Gyps coprotheres	Cape Vulture	EN	100	20	30	50	Medium
Mirafra cheniana	Melodious Lark	NT	50	20	50	40	Low/Medium
Podica senegalensis	African Finfoot	LC	10	0	20	10	Low
Sagittarius serpentarius	Secretarybird	VU	70	20	40	43	Medium
Tyto capensis	African Grass-Owl	LC	50	20	60	43	Medium
					Average TSS	**0,3**	

Total Species Score (Only use species with a POC >60%)

Scientific Name	Common Name	GDARD*	POC	TSS
-	-	-	0	0
-	-	-	0	0
-	-	-	0	0
			Average TT Score	**0**

Status Category	TSS Weighting
DDT	0,2
R	0,5
NT	0,7
VU	1,2
EN	1,7
CR	2

Average Total Species Score

Average TSS	32,5
Average TT	0
Average Score	16,3

*IUCN status is usually used, but for birds used local GDARD status to improve sensitivity

RED DATA SENSITIVITY INDEX SCORE (RDSIS)

Average Total Species Score		32,5%
Average Threatened Taxa Score		0,00%
Average (TSS + TT)		16,30%
% Speices >60% POC		0%
RDSIS for Study area		**8,2**

LOW

POC range	Description
0-20	Low
21-40	Low/Medium
41-60	Medium
61-80	Medium/High
81-100	High

RDSIS Rating	Description
0-20	Low
21-40	Low/Medium
41-60	Medium
61-80	Medium/High
81-100	High

Status Category	Abbreviation	Weighting
Data deficient	DDT	0,2
Rare	R	0,5
Near Threatened	NT	0,7
Vulnerable	VU	1,2
Endangered	EN	1,7
Critically Endangered	CR	2

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15 DECLARATION

DECLARATION OF INDEPENDENCE

I, **Johannes Oren Maree** , do hereby declare that I :

- Act as an independent ecologist, wetland specialist and environmental specialist in compiling this report;
- Do not have any financial interests, or stand to gain in any way whatsoever in the undertaking of this activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- Do not have, nor will have, any vested interest in the proposed activity proceeding;
- Have no, neither will engage in, conflicting interests in the undertaking of this activity;
- Undertake to disclose, to the competent authority, any material information that has, or may have, the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2014; and
- Will provide the competent authority with access to all information at my disposal regarding the investigations, studies and application, whether such information is favourable to the applicant or not.

The South African Council for Natural Scientific Profession (SACNASP) certifies that in terms of Section 20(3)(a) of the Natural Scientific Professions Act, 2003 (Act 27 of 2003), that Mr. J.O. Maree is registered as a Professional Natural Scientist.
Reg. No: 400077/91

Private Bag X5401; Silverton; Pretoria; 0127
Tel: (012) 841 - 1057

SIGNATURE: _____

NAME OF COMPANY: **Flori Scientific Services cc**

DATE: ___24 May 2019 ____