Clover Hill Club Access Road and Bridge

BIODIVERSITY ASSESSMENT

Ecological Assessment and Aquatic (Wetland) Assessment for the Proposed Upgrading of the Access Roads and Bridge leading to Clover Hill Club, Gauteng Province

Compiled by

Flori Scientific Services

AUGUST 2018

1 PROJECT INFORMATION

PROJECT TITLE: **Proposed Upgrade of the Road and Bridge at Clover Hill, Gauteng Province**

STUDY NAME: Biodiversity Impact Assessment

COMPILED BY: Flori Scientific Services cc

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DATE OF REPORT: 3 August 2018

REPORT STATUS: Final Draft (edited 12 September 2018)

REPORT NUMBER: CH/AR_01

2 EXECUTIVE SUMMARY

Background

The project entails the proposed upgrading of the access road and bridge leading to the Clover Hill Club at the Bronkhorstspruit Dam. The existing gravel road will be upgraded to a surfaced road of approximately 871m in length, with a proposed road reserve of 16 metres. The upgraded road will consist of two lanes of 3,4 metres each, two bicycle lanes of 0,6 metres each, a 1 metre paved walkway in one direction and a 1 metre gravel shoulder in the other. The upgraded bridge will consist of a reinforced concrete voided slab. Both shoulders will be paved as walkways at the bridge section.

The City of Tshwane's Department of Roads and Transport, has appointed Tshepega Engineering to undertake engineering consulting services for the upgrading of the access road and a bridge. TGM Environmental Services cc is the appointed lead Environmental Authorised Practitioner (EAP) on the project. Flori Scientific Services cc was appointed as the independent consultancy to conduct a biodiversity assessment, which includes a terrestrial ecological assessment and a wetland assessment for the proposed project.
Field investigations were conducted on the 13 April and 31 May 2018.

Location of the study area

The study site is located along the western / northwestern side of the Bronkhorstspruit Dam. The study site is the main access road to the Clover Hill Club, which runs for approximately 871m, from just short of the Club's entrance gate northwards to Kilimanjaro Street. A bridge over a watercourse forms part of the access road and study site. The site is within the City of Tswane Metropolitan Municipality, Gauteng Province.

TERRESTRIAL ECOLOGY

Vegetation

The study site is situated within the original extent of Gold Reef Mountain Bushveld (northern section) and Rand Highveld Grassland (southern section). The vegetation of the study site is a mix of degraded and transformed bushveld and grassland. The southern, lower section of the site is more grassland looking, while the northern section, close to and below the ridges is more bushveld looking. The study site consists predominantly of an existing gravel road, which is a totally transformed area.

Along the rocky areas, foothills and ridges the vegetation is badly disturbed and seriously invaded by blackwattle and other alien trees. The watercourse is also very badly invaded by alien trees such as blackwattle, poplar and syringa. This at first might initially give the appearance of a well-wooded area, but unfortunately it is mostly highly invasive alien weed species that actually need to be removed and controlled. Cultivated farmlands, orchards and housing developments have also transformed all of the grassland in the southern section. There are no areas of pristine grassland or bushveld within the study area.

AQUATIC ECOLOGY

Watercourses in the study area

There is one watercourse in the study area, which is a small, semi-perennial stream that flows down off the ridge and into the Bronkhorstspruit Dam. There are no wetlands or perennial rivers in the study area. The stream is small and not perennial, but it is situated within a fairly large and significant kloof (ravine) that is narrow upstream and in the ridge area (west of bridge and road), but then opens up into a wide area almost immediately downstream of the study site (east of the bridge and road).

Drainage areas

The table below is a summary of the drainage and catchment areas in which the study site is situated.

Level	Category
Primary Drainage Area (PDA)	B
Quaternary Drainage Area (QDA)	B20C
Water Management Area (WMA) – Previous / Old	Olifants
Water Management Area (WMA) – New (as of Sept. 2016)	Olifants (WMA 2)
Sub-Water Management Area	Upper Olifants
Catchment Management Agency (CMA)	Olifants (CMA 2)
Priority Quaternary Catchment	No
Wetland Vegetation Ecoregion	Mesic Highveld Grassland Group 4 Central Bushveld Group 1

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. According to the ecological analysis there are no actual high sensitivity areas, high sensitivity habitats, or 'No-Go' zones, as shown in the table below. This gives a 'real-state' look at the envrionment in question. However watercourses are, by default, considered to have a sensitivity rating of 'High' and for this project need to be approached as such. Ridges are also sensitive habitats and also need to be approached with caution.

Ecological sensitivity analysis

Ecological community	Floristic sensitivity	Faunal sensitivity	Ecological sensitivity	Development Go-ahead
Ridge	Medium/High	Medium/High	Medium/High	Go-But
Watercourse	Medium	Medium	Medium	Go-But
Grassland	Low	Low	Low	Go

Priority areas

The study area does not fall within any national 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 along the edge of a Critical Biodiversity Area (CBA – Irreplaceable) and crosses through an Ecological Support Area (ESA).

The northern section of the study site is also within a ridge area (Class 2).

Fatal flaws

There are no fatal flaws.

Sensitivity map of the study site

The entire study site is seen as having a sensitivity rating of 'Low', except for the demarcated watercourse and ridge areas (figure below) that are demarcated as 'High'.


N
Legend
Ridge
Watercourse
Google Earth
Image © 2018 DigitalGlobe
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© 2018 Google
200 m

3 REVIEW AND APPROVAL

Name	Title	Signature	Date
Johannes Maree	Ecologist & Author (Flori Scientific Services)		**03/08/2018**
Delia de Lange	Lead EAP (TGM Environmental Services)		

3.1 Acknowledgements

The author would like to acknowledge and thank TGM Environmental Services, City of Tswane Roads and Transport Department, Tshepega Engineering and other roleplayers for their assistance with project information and responding to queries related to the project.

4 EXPERTISE AND EXPERIENCE OF THE SPECIALIST

The expertise and experience of the specialist that conducted the investigations and compiled the report are as follows:

Name of Specialist: Johannes Oren Maree

Position: Ecologist and Wetland Specialist.

- 2 Masters degrees (MSc & MBA).
- Diplomas in both business and public speaking.
- SAQA accreditation and qualifications in training, assessing & service provision (AgriSeta).
- The specialist is registered with the South African Council for Natural Scientific Professions (SACNASP) since 1991. Registration number: 400077/91
- 21 years experience in technical and managerial positions.
- 18 years experience in project management and consultancy.
- 18 years experience in writing of articles, books, training material, training & presentations, proposals.
- 12 years direct experience in EIAs.
- Has conducted hundreds of field investigations and compiled hundreds of technical speciaist reports for EIAs, including ecological assessments (fauna & flora), wetland assessments and avifauna impact assessments.
- Studies include working on linear and modular projects.
- Projects involved in include power lines, roads, quarries, housing developments, mines and wind farms.

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5 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
EAP	Environmental Authorised Practitioner
EIS	Ecological Importance & Sensitivity
EMC	Environmental Management Class
GDARD	Gauteng Department of Agriculture and Rural Development
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
PES	Present Ecological State
PDA	Primary Drainage Area
QDA	Quaternary Drainage Area
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

6 BACKGROUND

6.1 Project overview

The project entails the proposed upgrading of the access road and bridge leading to the Clover Hill Club at the Bronkhorstspruit Dam. The existing gravel road will be upgraded to a surfaced road of approximately 871m in length, with a proposed road reserve of 16 metres. The upgraded road will consist of two lanes of 3,4 metres each, two bicycle lanes of 0,6 metres each, a 1 metre paved walkway in one direction and a 1 metre gravel shoulder in the other. The storm water drainage infrastructure associated with the upgraded road will include storm water pipes, side kerbs, natural channels and where necessary, concrete lined drains and cross culverts. The upgraded bridge will consist of a reinforced concrete voided slab. Both shoulders will be paved as walkways at the bridge section.

The City of Tshwane's Department of Roads and Transport, has appointed Tshepega Engineering to undertake engineering consulting services for the upgrading of the access road and a bridge. TGM Environmental Services cc is the appointed lead Environmental Authorised Practitioner (EAP) on the project. Flori Scientific Services cc was appointed as the independent consultancy to conduct a biodiversity assessment, which includes a terrestrial ecological assessment and a wetland assessment for the proposed project.
Field investigations were conducted on the 13 April and 31 May 2018.

6.2 Purpose of the study

The project involves the upgrade and rehabilitation of an access road to the Clover Hill Club. Part of the road upgrade includes a bridge, which crosses over a watercourse along the route. The project triggers various environmental requirements which includes the need for an EIA. Part of the EIA includes the need for specialist studies such as an ecological impact assessment and wetland impact assessment. The purpose of the study is therefore to determine if any ecological or wetland (watercourse) 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.

6.3 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).
- GDARD Conservation Plan (C-Plan version 3.3).

6.4 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 accurate;
- Field investigations were undertaken on 13 April and 31 May 2018;
- Buffer zones and GPS positions as delineated in Google Earth maps in the report are accurate to within 2 – 3 metres;
- Standard and acceptable methodologies as required in EIAs and used by Specialists 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 (ground-truthing);
- Equipment used: Standard soil augers; hand-held Garmin GPS instrument; EC & pH hand-held meters; IPhone 7 for photographs, MacBook Pro and Epson PC Laptops; Google earth maps, 1:50 000 South African topographical maps.

- Computer packages used: MS Word; MS Excel; Adobe Photoshop, ARC GIS; Google Earth; Garmin Base Maps; and
- No alternative sites were investigated.

7 METHODOLOGY

7.1 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.

7.2 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.

Photographs and GPS reference points of importance where recorded furing field investigations and have been used throughout the report where pertinent.

7.3 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%

7.4 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.

7.5 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.

7.6 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.

7.7 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.

7.8 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; Improbable – 1.

7.9 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.

8 RECEIVING ENVIRONMENT

8.1 Study Site Location

The study site is located along the western / northwestern side of the Bronkhorstspruit Dam. The study site is the access road to the Clover Hill Club, which runs for approximately 871m, from just short of the Club's entrance gate northwards to Kilimanjaro Street. A bridge over a watercourse forms part of the access road and study site. The Bronkhorstspruit Dam is situated approximately 9,5km southwest of the town of Bronkhorstspruit and 9km south of the N4 national route. The study site is within the City of Tswane Metropolitan Municipality, Gauteng Province (Figure 1 & Figure 2).

8.2 GPS Coordinates of the Main Landmarks

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

- Access Road (At Kilimanjaro St junction): 25°53'23.95"S; 28°41'7.33"E.
- Access Road (100m from Clover Hill Club entrance gate): 25°53'39.78"S; 28°40'43.92"E.
- Bronkhorstspruit Dam: 25°53'55.83"S; 28°41'31.08"E.
- Bronkhorstspruit: 25°48'38.63"S; 28°44'20.13"E.
- 1:50 000 map grid references: 2528DC.

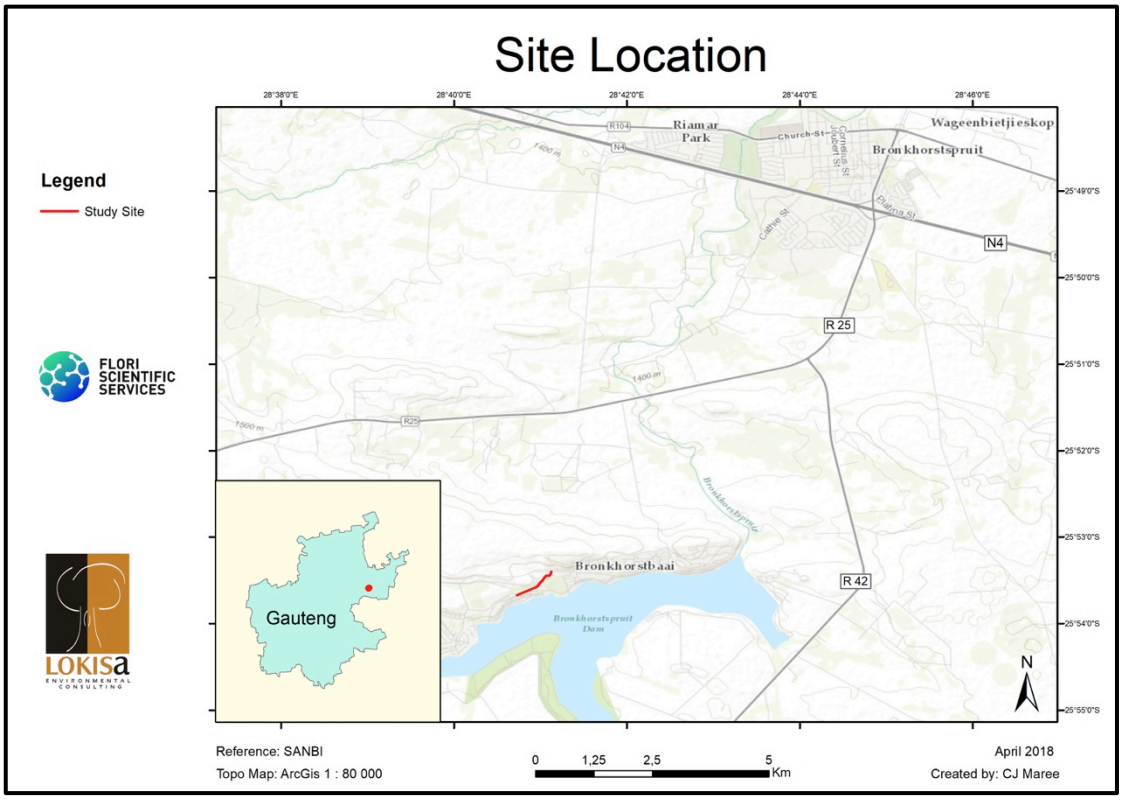

Figure 1: Study site location

Figure 2: Study site location (Google Earth)

8.3 Topography

The topography of the area is that of lowlands, hills and mountains with moderate to high relief (Barnard, 2000). The area has distinctive lowlands with parallel hills and ridges. The study site is situated along a moderate to steep sloping gradients from north to south. That is, from Kilimanjaro Street, downwards to the Clover Hill Club. There are ridges, rocky outcrops (koppies) and ravines within, or adjacent to, the study area. The average height above sea level of the study area is approximately 1 463m, with a minimum of approximately 1 451m and a maximum of approximately 1 477m (Figure 3). The average gradient (slope) varies from 4,4% to 1,9% across the length of the study site.

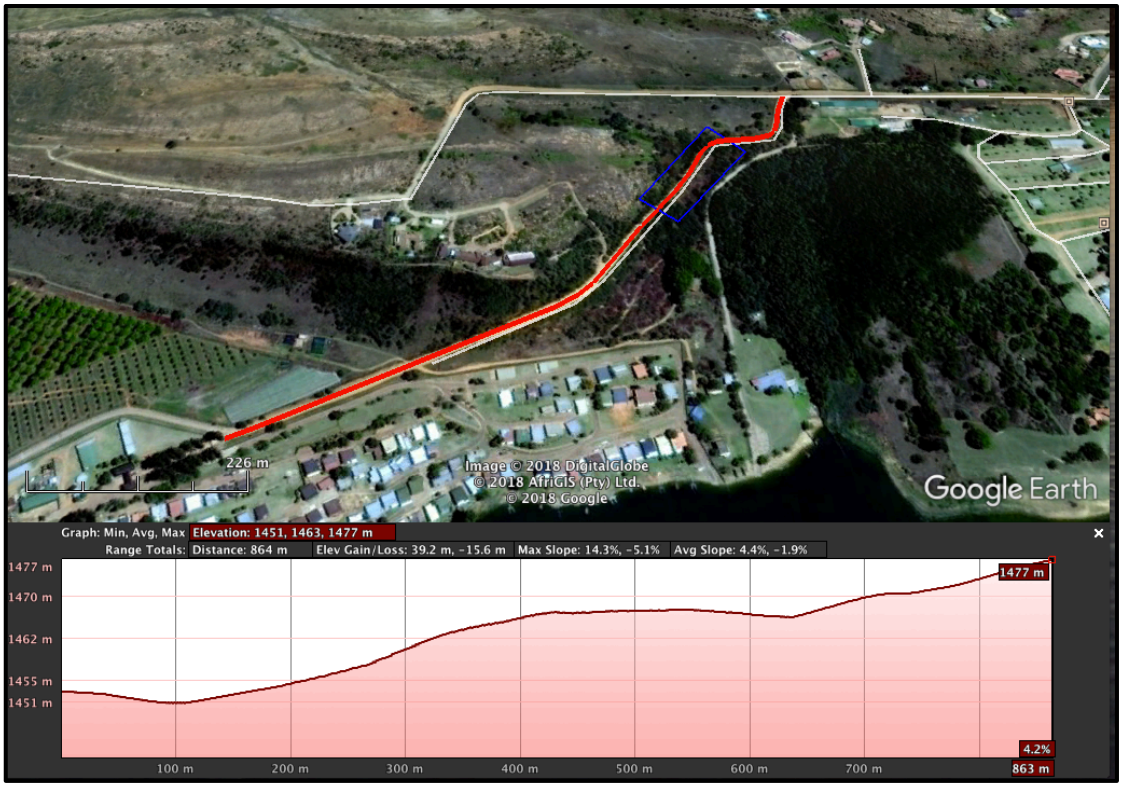

Figure 3: Topography of the study site

8.4 Geology and Soils

The geology of the area is quartzite ridges of the Witwatersrand Supergroup and the Pretoria Group, supporting soils of varying quality (shallow Glenrosa and Mispah forms especially on rocky ridges). Land types are mainly Ba, Bc, Bb and Ib (Mucina & Rutherford, 2006). The soils of the study site are freely drained, structureless soils. The colour of the soils is yellow-red with a low base status.

Table 1: Description of the Land Types found in the Region

Ba & Bb	Plinthic catena: Upland duplex and margalitic soils rare (Dystrophic and/or mesotrophic; red and/or yellow soils). Mainly red (Ba) or yellow (Bb), apedal (= structureless) soils, moderately (mesotrophic) to highly (dystrophic), leached (low to moderate fertility status), with a wide textural range, mostly sandy loam to sandy clay loam. Soils contain a greyish subsoil layer (plinthic) where iron and manganese accumulate in the form of mottles, due to a seasonally fluctuating water table. With time these mottles may harden (or even cement) to form concretions. These plinthic layers will cause restricted water infiltration and root penetration. In drier areas, however, they may help to hold water in the soil that plants can use.
Bc	Plinthic catena: Upland duplex and margalitic soils rare (Eutrophic; red and/or yellow soils). Mainly red, apedal (= structureless) soils, which are eutrophic (= high base status). They have a moderate to high fertility status and a wide textural range, mostly sandy loam to sandy clay loam. Soils contain a greyish subsoil layer (plinthic) where iron and manganese accumulate in the form of mottles, due to a seasonally fluctuating water table. With time these mottles may harden (or even cement) to form concretions. These plinthic layers will cause restricted water infiltration and root penetration. In drier areas, however, they may help to hold water in the soil that plants can use.
Ib	Miscellaneous land classes (Rock areas with miscellaneous soils). Areas where 60-80% of the surface is occupied by exposed rock and stones/boulders and the slopes are usually steep. The rest of the area comprises mostly shallow soils, directly underlain by hard or weathered rock.

8.5 Climate

The study area is situated within the summer rainfall region of South Africa and within the medium rainfall band of 600+mm to 800mm per annum (Figure 4). The general climate of the study site is fairly similar to that of Bronkhorstspruit town, although variations in temperature are probably quite likely, due to the site's close proximity to the dam and location below the ridgeline.

Bronkhorstspruit is within the summer rainfall region of South Africa and normally receives about 570mm per year. The area receives the lowest rainfall (0mm) in June and the highest (106mm) in January. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Bronkhorstspruit range from 17,8°C in June to 26,7°C in January. The coldest month is July, when average night temperatures are around 1,6°C (www.saexplorer.co.za).

The study site is situated on the outer edge of the cold interior climatic zone of South Africa (Figure 5).

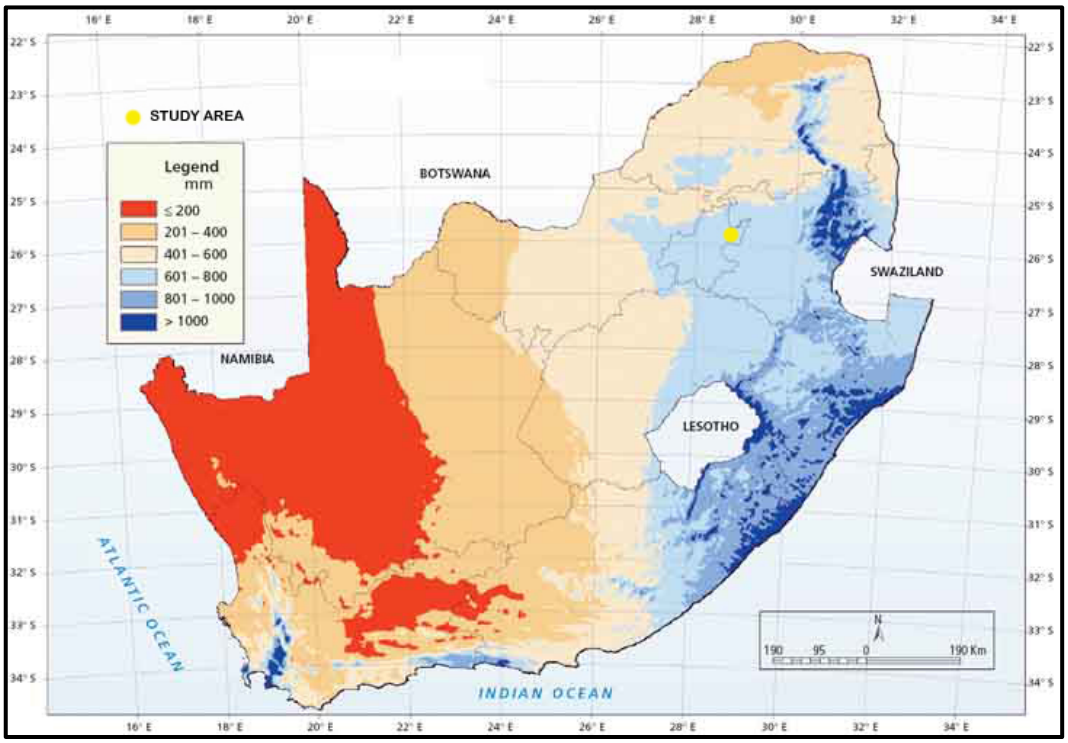

Figure 4: Rainfall regimes for South Africa

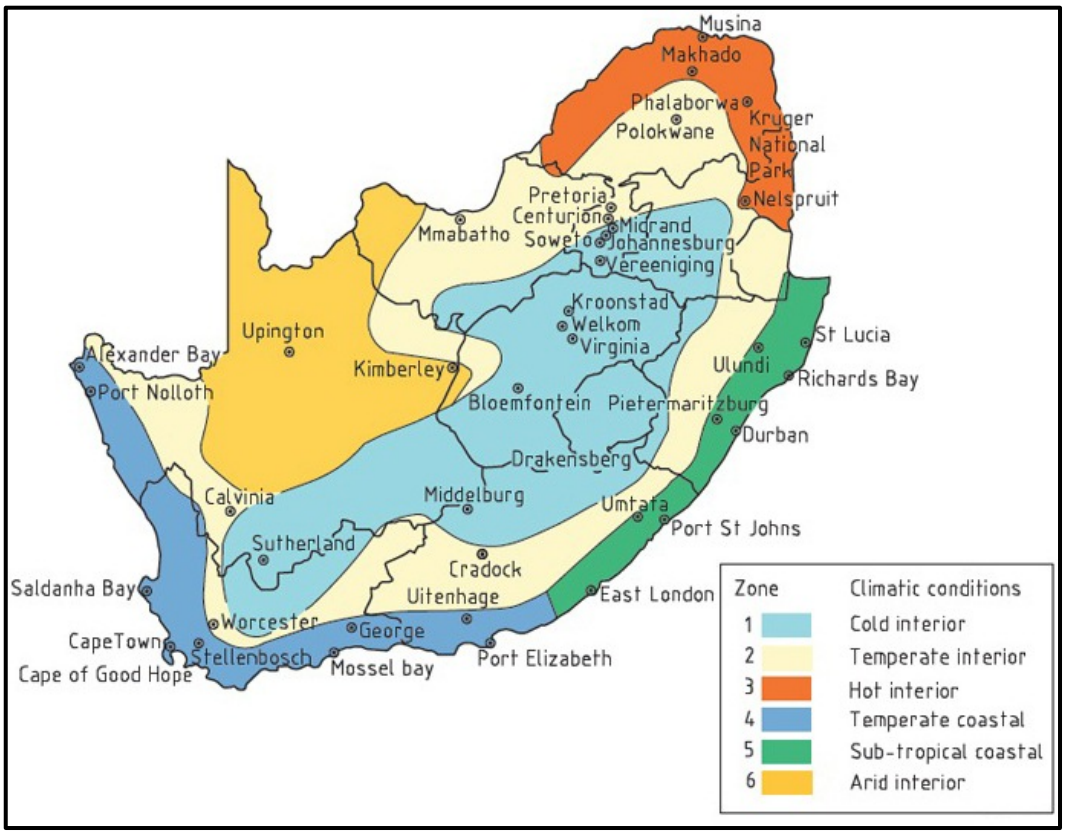

Figure 5: Broad climatic zones of South Africa

9 TERRESTRIAL ECOLOGY

9.1 Vegetation

South Africa is divided up into nine Biomes. The study area is situated predominantly in the Grassland Biome, but a section of Savanna Biome, along the mountains and ridges of the area protrudes into the Grassland Biome. The northern half of the study site is situated within this part of the Savanna Biome (Figure 6). The study site is within the Mesic Highveld Grassland Bioregion and the Central Bushveld Bioregion (Figure 7).

The grassland vegetation types of South Africa are dominated by a lower layer of grasses, with the occurance of middle layers of shrub or upper layers of trees being rare, except in a few localised habitats such as koppies (rocky outcrops), riverines and ridges. The Grassland Biome is subdivided into dry and moist grassland habitats or 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 rainfall, the sweet chloridoid grasses tend to be more common. Dry and moist grassland types are 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 were subdivided 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 and wild animals) tend to dominante. However, grasslands (like any vegetation type) are also influenced and shaped by numerous other environmental factors such as temperature, soils and altitude. Mucina & Rutherford (2006) have subdivided the Grassland Biome into four bioregions. Namely, Dry Highveld Grasslands; Drakensberg Grasslands; Meisic Highveld Grasslands; and Sub-Escarpment Grasslands. The major 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.

Savanna vegetation types (veldtypes) tend to have a mix of a lower grassy layer, middle shrub layer and an upper woody layer. The mix and ratio of the three layers

varies from veldtype to veldtype within the Savanna Biome. The Savanna Biome is subdivided into six bioregions, namely, Central Bushveld; Mopane; Lowveld; Sub-Escarpment Savanna; Eastern Kalahari Bushveld; and Kalahari Duneveld. The study site is situated within the Mesic Highveld Grassland Bioregion.

According to the vegetation classification of Mucina & Rutherford (2006) the study site is situated within the original extent of Gold Reef Mountain Bushveld (in the north and along the ridges) and Rand Highveld Grassland (in the south) (Figure 8). The veldtype, in the grassland area, in which the site is situated has also recently been more finely defined as Bronkhorstspruit Highveld Grassland. Table 2, below shows the vegetation hierarchy of the study site.

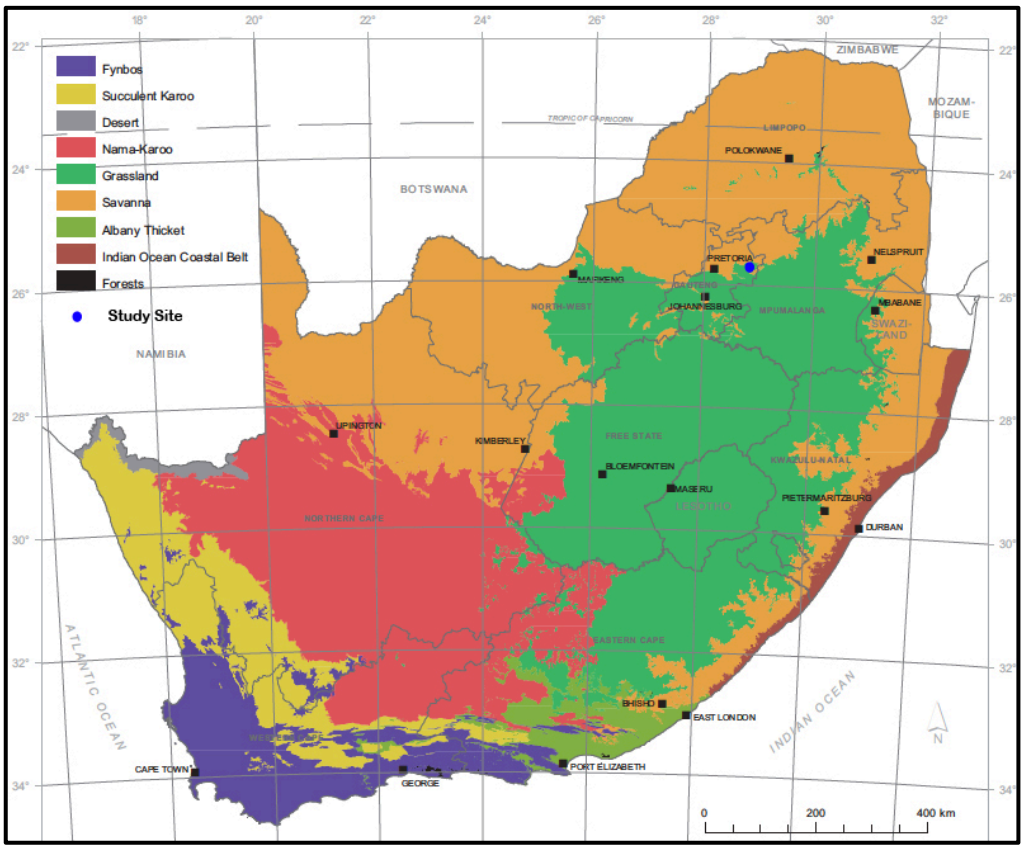

Figure 6: Biomes of South Africa

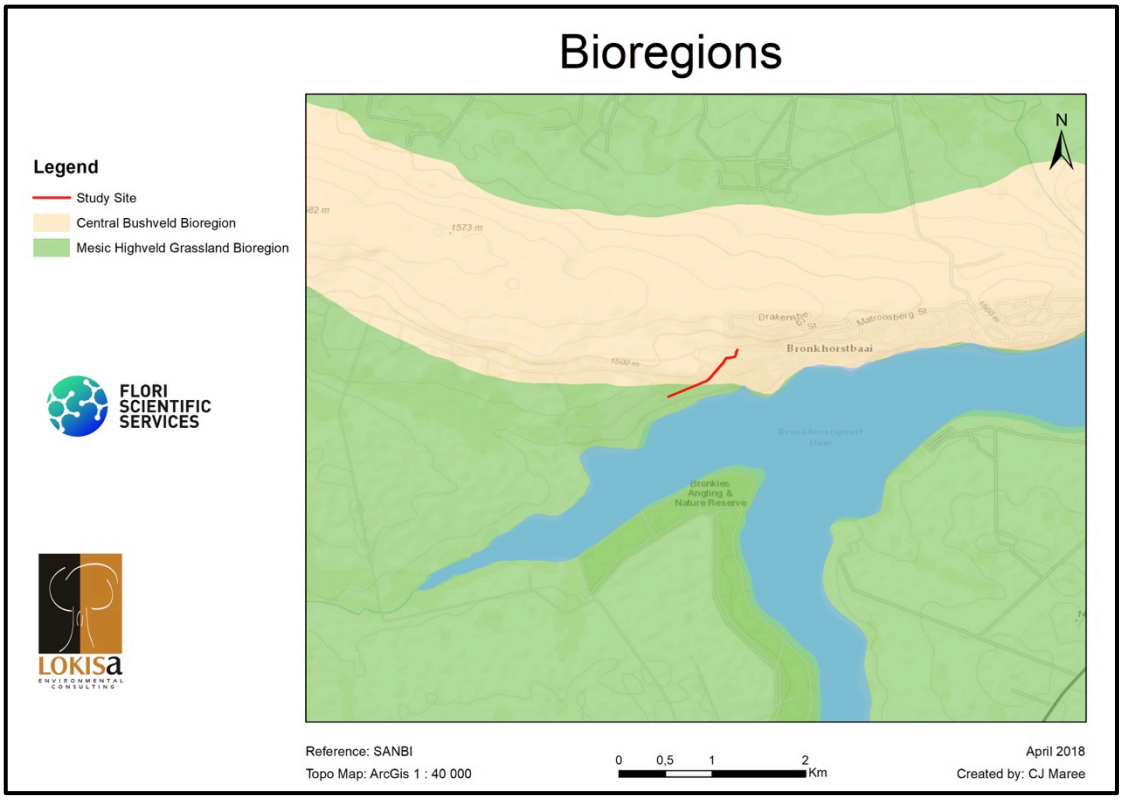

Figure 7: Bioregions

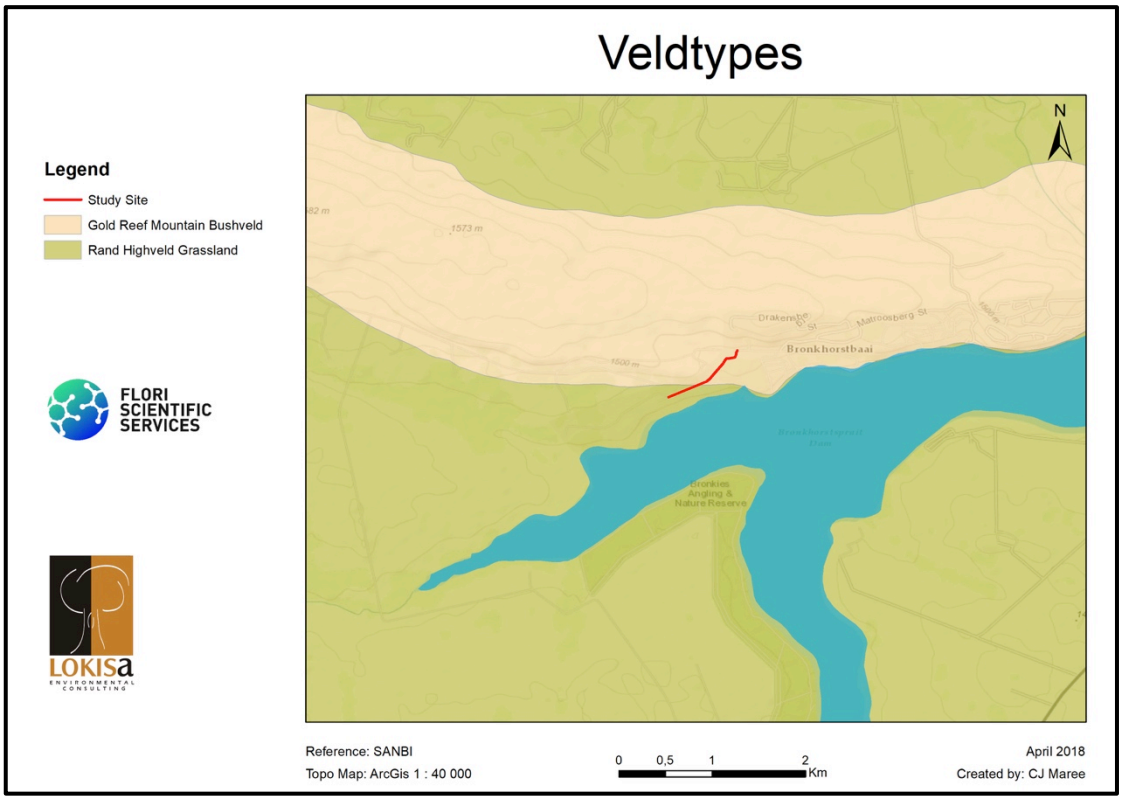

Figure 8: Veldtypes

Table 2: Hierarchy of vegetation of the study site

Category Description	Classification
Biome	Bushveld & Grassland
Bioregion	Central Bushveld & Mesic Highveld Grassland
Vegetation Types	Gold Reef Mountain Bushveld & Rand Highveld Grassland (Bronkhorstspruit Highveld Grassland)

Rand Highveld Grassland is characterised by a highly variable landscape with extensive sloping plains and a series of parallel ridges slightly elevated over undulating surrounding plains. The vegetation is typically that of species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. Most common grasses on the plains belong to the genera *Themeda*, *Eragrostis*, *Heteropogon* and *Elionurus*. High diversity of herbs, many of which belong to the Asteraceae (daisy family), is also a typical feature across the vegetation unit. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra* subsp. *caffra*, *Protea welwitschii*, *Acacia caffra* and *Celtis africana being dominant*, accompanied by a rich suite of shrubs among which the genus Searsia (=*Rhus)* (especially *Searsia magalismonata*) is most prominent (Mucina & Rutherford, 2006).

Golf Reef Mountain Bushveld is characterised by rocky hills and ridges usually orientated in a west-east direction, with more dense woody vegetation often on the south-facing slopes associated with distinct floristic differences (e.g. a predominance of *Acacia caffra* on the southern slopes). Tree cover elsewhere is variable. Tree and shrub layers are often continuous, while grasses dominant the lower, herbaceous layer (Mucina & Rutherford, 2006).

9.1.1 Vegetation of the study area

The vegetation of the study site is a mix of degraded and transformed bushveld and grassland. The southern, lower section of the site is more grassland looking, while the northern section, close to and below the ridges is more bushveld looking. The study site consists predominantly of an existing gravel road, which is a totally transformed area. Along the rocky areas, foothills and ridges the vegetation is badly disturbed and seriously invaded by blackwattle and other alien trees. The watercourse is also very badly invaded by alien trees such as blackwattle, poplar and

syringa. This at first might initially give the appearance of a well-wooded area, but unfortunately it is mostly highly invasive alien weed species that actually need to be removed and controlled. In some areas along the side of the access road wattle trees have been cut down and removed. Cultivated farmlands, orchards and housing developments have also transformed all of the grassland in the southern section. There are no areas of pristine grassland or bushveld within the study area.

9.1.2 Priority Floral Species

No Red Data species (endangered, threatened or vulnerable) were observed in the actual study area during field investigations. No Orange Data species or species or conservation concern were observed during field investigations either. According to the South African National Biodiversity Institute's (SANBI) Botanical Database of Southern Africa (BODATSA) (2016), possible Red data or Orange data species occuring in the general region include:

- *Searsia gracillima* (Rhus) (Near Threatened)
- *Boophone disticha* (Declinging)
- *Crinum bulbispermum* (Declining)
- *Hypoxis hemerocallidea* (Declining)

A Delospermum specie was recorded north of the study site in the area of the ridges and koppies. It is possible that it could have been *Delospermum leendertziae* (Near Threatened) which is found in that region. The habitat preference of the species is steep, south-facing slopes of quartzite in mountain grassveld and it is possible that a few plants may be found in the southern facing ridges that are west of the study site (road and bridge area) (Riamondo *et. al.*, 2009; www.redlist.sanbi.org).

The study site itself is highly transformed, but some of the ridges and rocky outcrops in the immediate vicinity may well have Red and Orange listed floral species.

9.2 Conservation status

The conservation statuses of the veldtypes and a short description of their statuses are shown in the table below (Table 3). According to the SANBI website (www.bgis.sanbi.org) and under the biodiversity summary of the Kungwini Municipality area (in which the study site is located), Rand Highveld Grassland is considered vulnerable (VU) and Gold Reef Mountain Bushveld is least threatened (LT). The grassland is a threatened ecosystem, but not the bushveld. Table 4, below, gives a basic description of each of the status categories, while Figure 9 shows the categories in a hierarchical format (IUCN Redlist, 2010). The southern section of the

study site (the gravel road) is situated within the original extent of Rand Highveld Grassland. However, the grassland in this area has been all but totally transformed by farming practices such as cultivation and orchards, as well as by housing and other developments of the Clover Hill Club.

Table 3: Veldtype status

Veldtype	Status	Information
Gold Reef Mountain Bushveld	Least Threatened (LT) or Least Concern (LC)	About 22% is statutorily conserved mainly in the Magaliesberg Nature Area and much smaller proportions in the Rustenberg, Wonderboom and Suikerbosrand Nature Reserves. At least an additional 1% is conserved in other reserves bringing the total conserved very close to the ideal target of 24%. About 15%+ has been transformed mainly by cultivation and urban and built-up areas. Some areas with dense stands of the alien *Melia azedarach* but which is often associated with drainage lines or alluvia (i.e. azonal vegetation) embedded within this unit. Erosion is very low to low (Mucina & Rutherford, 2006, 2010).
Rand Highveld Grassland	Vulnerable (VU)	Poorly conserved (only 1%). Small patches protected in statutory reserves (Kwaggavoetpad, Van Riebeeck Park, Bronkhorstspruit, Boskop Dam Nature Reserves) and in private conservation areas (e.g. Doornkop, Zemvelo, Rhenosterpoort and Mpopomeni). About 50% of the veldtype has already been transformed, mostly by cultivation, plantations, urbanisation or dams. Cultivation may also have had an impact on an additional portion of the surface area of the unit where old lands are currently classified as grasslands in land-cover classifications and poor land management has led to degradation of significant portions of the remainder of this unit (D.B. Hoare, personal observation). Scattered aliens (most prominently *Acacia mearnsii*) occur in about 7% of this unit. Only about 7% has been subjected to moderate to high erosion levels (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 4: Ecosystem Status: Simplified explanation of categories used

STATUS	% Transformed	Effect on Ecosystem
Least Threatened (LT) / Least Concerned (LC)	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.

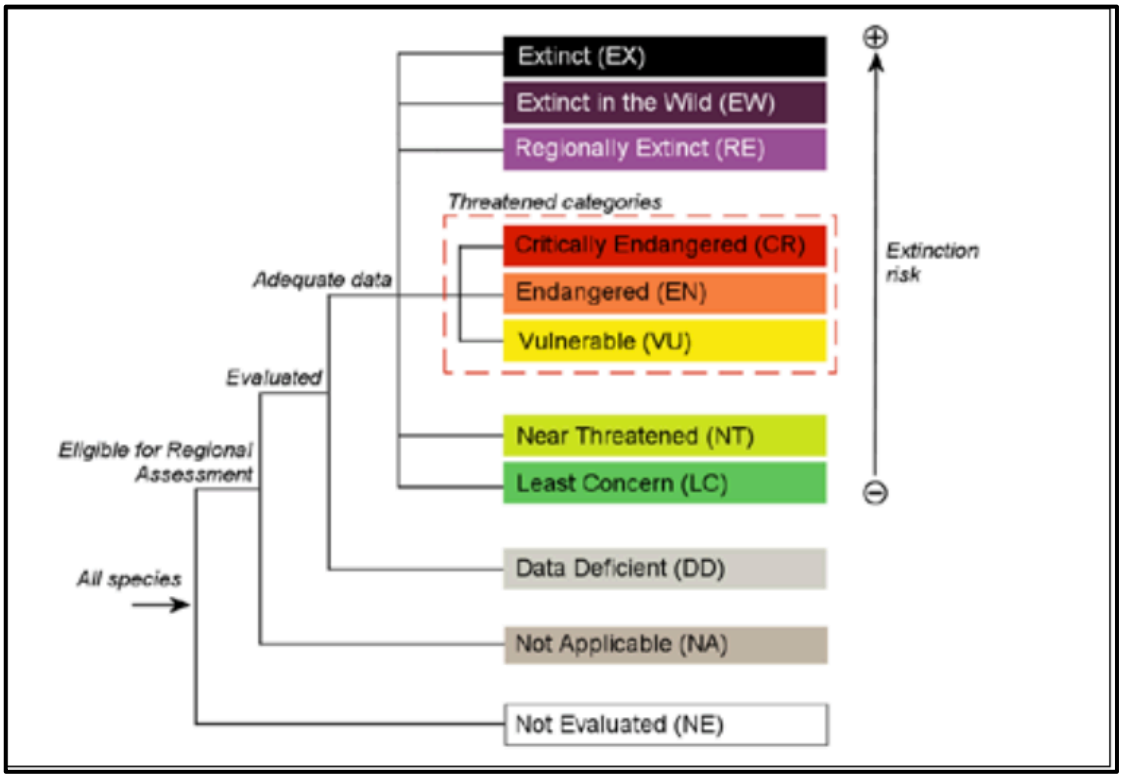

Figure 9: Structure of categories used at the regional level

9.3 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 totally complete. However, due to the transformed nature of the site, it is unlikely that many plant species were missed during field investigations.

No Red Data or Orange Data Species (Priority species) were observed within the study site during field investigations.

9.3.1 Alien plants identified in the Study Area

A few common alien plant species, that are annuals and perennials, were identified in the study area. The study area is badly infested and invaded by alien weeds species, in particular blackwattle and poplar trees. The alien plant species encountered in the study area are recorded, along with their category rating, in Table 5. The categories are as set out in the Conservation Act of Agricultural Resources Act, 1983 (CARA) (Act 43 of 1983).

Table 5: Alien plants identified in the study area

Botanical Name	Common Name	Category
Acacia mearnsii	Blackwattle	2
Argemone ochroleuca	White-flowered Mexican poppy	1
Araujia sericifera	Moth catcher	1b
Bidens pilosa	Blackjacks	-
Conyza canadensis	Horseweed fleabane	-
Datura ferox	Large thorn-apple	1
Eucalyptus spp	Gum tree	1b/2
Melia azedarach	Syringa	1b
Pinus spp.	Pine	2
Populus alba	White poplar	2
Populus x canescens	Grey poplar	2
Solanum elaeagnifolium	Silverleaf bitter apple	1
Tagetes minuta	Khakibos, kahki weed	-
Verbena bonariensis	Vervain	-

9.4 Protected tree species identified in the study area

No protected tree species were observed in the study area during field investigations. None are expected to occur.

9.5 Fauna

No large- or medium-sized mammals or other types of wild faunal species were observed during field investigations. Medium-levels of urbanisation around the dam and close to the study site, as well as farming practices limit the amount of wild animals that will be permanently present in the study area. However, the dam, stream and ridges in the area are ideal habitats for numerous wild faunal species. It is evident that there will be fairly significant movement of wildlife across and alongside the road in and between the different habitats.

Red Data faunal species most likely to be present in the general area are listed below in Table 6.

Table 6: Red Data Faunal Species likely to occur in the region

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	Not likely
Mammals					
Atelerix frontalis	SA hedgehog	Near threatened	Most, broad	Broad	Possible
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	Possibly (in terms of hunting in the area at night)
Pipistrellus rusticus	Rusty bat	Near threatened	Most, broad	Woody savanna, large trees	No
Snakes					
Python natalensis	Southern African python	Vulnerable	Ridges, wetlands	Rocky areas; open water	No

* Although bulfrog is not considered a red data species anymore it is still been listed as a priority and protected species.

The maps below show the quadrants that are hotspots for priority faunal species of butterflies, snakes and lizards in South Africa (Figure 10, Figure 11 & Figure 12). The study site is not within any hotspots. The ideal 'hotspots' within the QDS would be more that of ridges, kloofs and other rocky areas which form ideal habitats for lizards in particular. There are no such ideal habitats on the study site. Common snake species such as rinkals (*Hemachatus haemachatus*), Red-lipped herald (*Crotaphopeltis hotamboeia*), brown house snake (*Lamprophis capensis*) and the poisonous puff adder (*Bitis arietans*) are common in the general area and would possibly be found on occasion in the study area.

9.5.1 Mammals

No large- or medium-sized mammals were observed during field investigations, with the exception of some common bird species and a few signs of mongoose, hares and field mice. Some rodent species are more than likely to be present, although not observed during field investigations, except for signs such as droppings. Due to the closeness of rocky outcrops, ridges and the dam, numerous small- to medium-sized mammals will be found in the area.

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 7). The IUCN Red List of Threatened Species was consulted via the official website (www.iucnredlist.org). Table 8, below, gives a brief description of the the preferred habitat of the RDL mammal species and the likelihood of them nesting, roosting and breeding (i.e. present) in the study area.

Table 7: 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 / Rat	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

Table 8: Presence of RDL Mammals in Study Area

Common Name	Preferred Habitat	Found in Study Area
Juliana's Golden Mole	Rocky Highveld Grassland; Sandy soils.	No
White-tailed Mouse	Grassland, Fynbos & Karoo vegetation	Unlikely
SA Hedgehog	Wide variety of habitats, including semi-arid and sub-temperate habitats. Animals have generally been recorded from scrub brush, western Karoo,	Possible

	grassland and suburban gardens.	
Spotted-necked otter	Found in lakes and larger rivers throughout much of Africa.	Unlikely
Schreiber's long-fingered bat	Mainly caves, mine-shafts. Also roost in crevices & holes of trees.	Possible
Temminck's hairy bat	Open woodland & bushveld. Cave-roosting, preferring damp caves.	No
Blasius's/Peak-Saddle Horseshoe Bat	Bushveld, Mainly caves, sometimes old, dark buildings.	No
Geoffroy's Horseshoe bat / Wing-gland bat	Bushveld, Mainly caves, sometimes old, dark buildings.	No
Darling's Horseshoe Bat	Bushveld, Mainly caves, sometimes old, dark buildings.	No
Hildebrandt's Horseshoe Bat	Bushveld, caves, will utilise tree hollows.	No

9.5.2 Avifuana

A few common bird species were observed during field investigations such as laughing dove (*Streptopelia sensegalensis*), cape turtle dove (*Streptopelia capicola*) and feral pigeon (*Columba livia*). A number of RDL bird species will be found in the area and region due to the proximity of the Bronkhorstspruit Dam and ridges. The red data listed (RDL) bird species for the Gauteng Province and their threat statuses are listed in the table below (Table 9).

Table 9: RDL Bird species in Gauteng Province

Scientific Name	Common name	GDARD Status	IUCN Status
Gyps coprotheres	Cape Vulture	VU	EN
Anthropoides paradiseus	Blue Crane	VU	VU
Tyto capensis	African Grass-Owl	VU	LC
Circus ranivorus	African Marsh-Harrier	VU	LC
Gorsachius leuconotus	White-backed Night Heron	VU	LC
Eupodotis senegalensis	White-bellied Korhaan	VU	LC
Podica senegalensis	African Finfoot	VU	LC
Mirafra cheniana	Melodious Lark	NT	NT
Sagittarius serpentarius	Secretarybird	NT	VU
Eupodotis caerulescens	Blue Korhaan	NT	NT
Alcedo semitorquata	Half-collared Kingfisher	NT	LC

Table 10: Presence of RDL bird species in study area

Common name	Preferred Habitat	Present in study area
Cape Vulture	Wide foraging range. Roosts & nests on cliffs	Occasionally. Most likely to forage
Blue Crane	Grasslands & grain agricultural lands	No
African Grass-Owl	Marshes / Vleis & tall grassland. Nests in tall, thick grass	Unlikely
African Marsh-Harrier	Permanent wetlands & adjacent open country	No
White-backed Night Heron	Slow moving rivers with dense over-hanging vegetation	No (not within natural range either)
White-bellied Korhaan	Open grassland and lightly wooded savanna. Prefers tall grass	Unlikely
African Finfoot	Rivers and streams with well vegetated banks and over hanging vegetation	No
Melodious Lark	Grassland & pastures	No
Secretarybird	Bushveld & open grassland	Unlikely
Blue Korhaan	Grassland	No
Half-collared Kingfisher	Wooded streams & large reed beds	Unlikely but possible

9.5.3 Reptiles

No reptiles were observed during field investigations. A number of snakes and lizards will be present in the nearby ridges and rocky outcrops. These, especially snakes will venture from time to time on to and across the road and within the watercourse (bridge area). The study site and immediate ridges are not hotspots for lizard and snake RDL species. However, care should be taken when working along the road and watercourse for snakes. The maps below show the hotspots for priority snake and lizard species for South Africa (Figure 10 & Figure 11). The study area is close to, but not within any lizard hotspots and not within, or close to, any snake hotspots. The likelihood is however, rare that any priority lizard or snake species will be present in the study area, although numerous common species will be present.

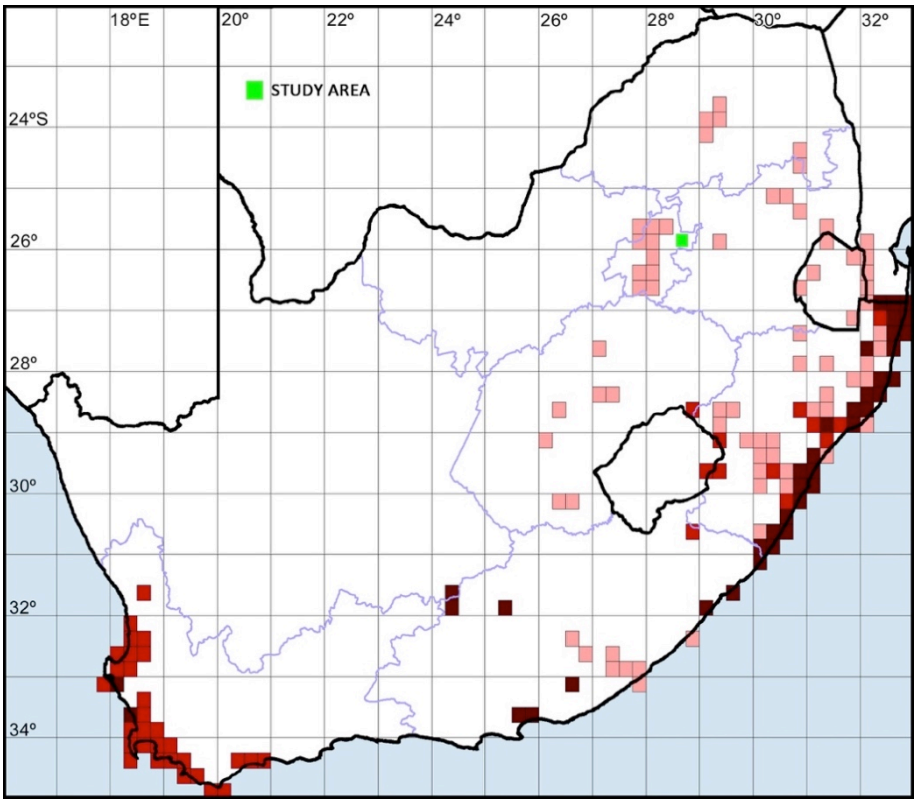

Figure 10: Snake hotspots

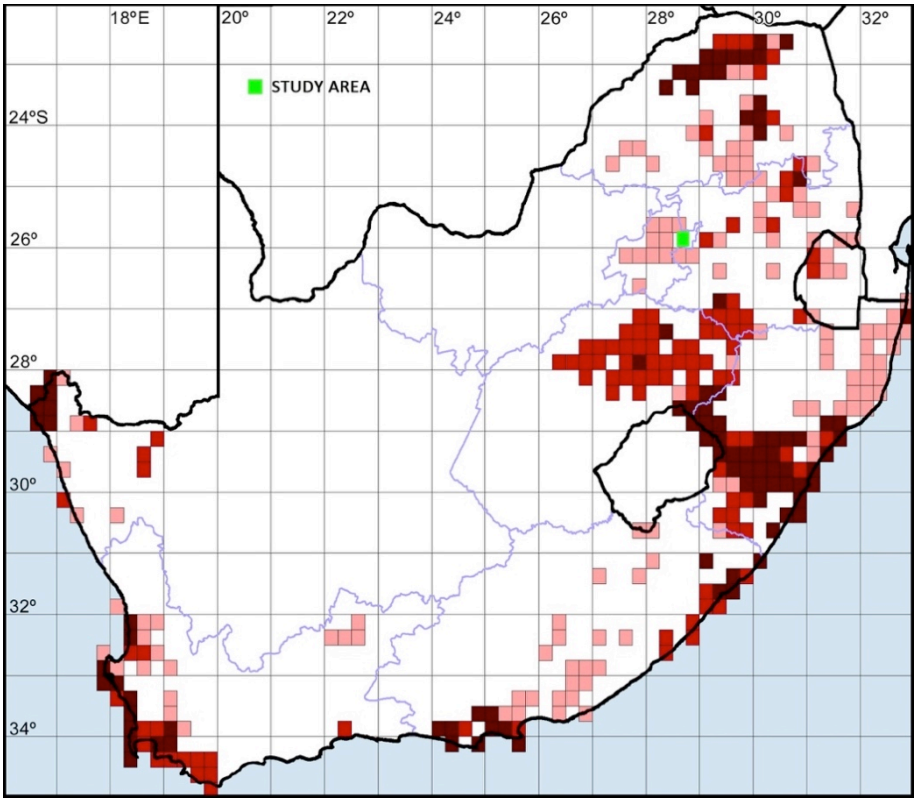

Figure 11: Lizard hotspots

9.5.4 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. No priority species were observed. Once again cognisance must be taken of the when during the year field investigations were conducted.

The map below shows the hotspots for priority butterflies and species-rich areas for South Africa (Figure 12). The study area is not within any of these known hotspots. No Red Data species are expected to occur in the study area. Butterflies usually require specific indigenous tree or shrub species on which to lay their eggs. No indigenous tree or shrub species are present on the study site.

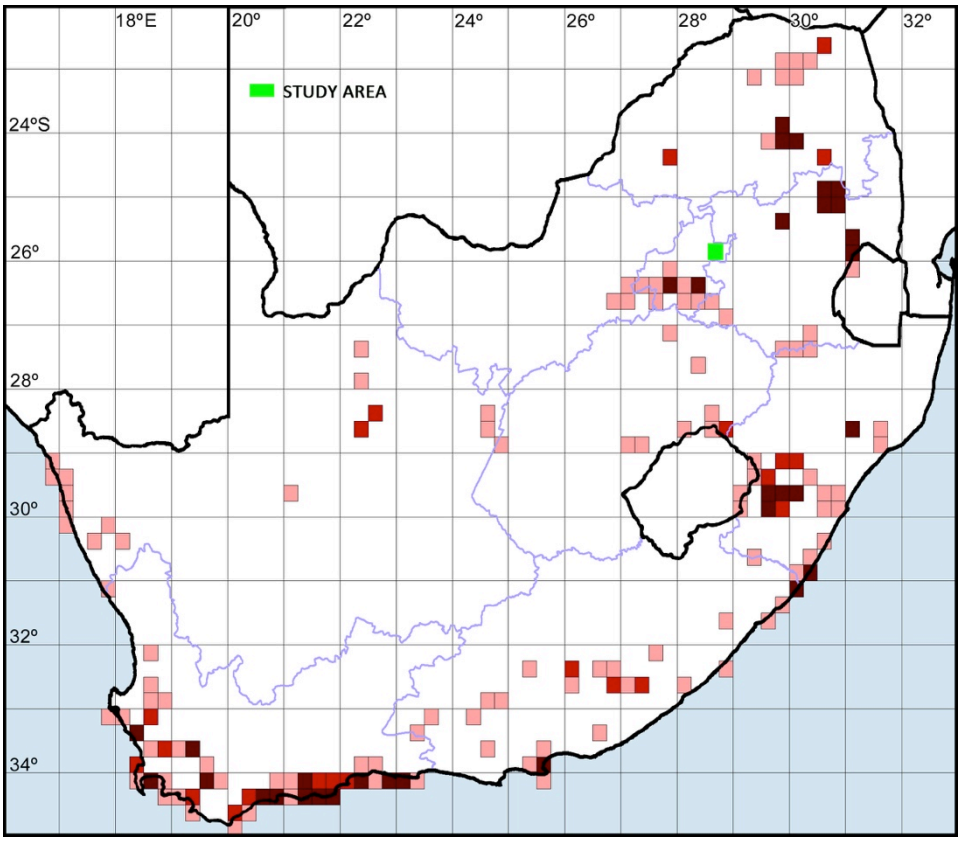

Figure 12: Butterfly hotspots

10 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.

10.1 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

10.2 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*."

10.3 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.

10.4 Watercourses in the study area

There is one watercourse in the study area, which is a small, semi-perennial stream that flows down off the ridge and into the Bronkhorstspruit Dam. It was originally a small tributary of the Bronkhorstspruit (Stream). There are no wetlands or perennial rivers in the study area. The stream is small and not perennial (flowing all year round), but it is situated within a fairly large and significant kloof (ravine) that is narrow upstream and in the ridge area (west of bridge and road), but then opens up into a wide area almost immediately downstream of the study site (east of the bridge and road). The closest large stream or river is the Bronkhorstspruit, which flows into the Bronkhorstspruit Dam and northwards through the town of Bronkhorstspruit and eventually into the Olifants River (Figure 14). The Bronkhorstspruit Dam is a significant and important water body in area. Figure 15, below, indicates the small stream in the study site. There is a small, but significant drainage line that also channels rain water from the ridge into the small stream in the area immediately west of the bridge and road.

Figure 14: Main watercourses in the area

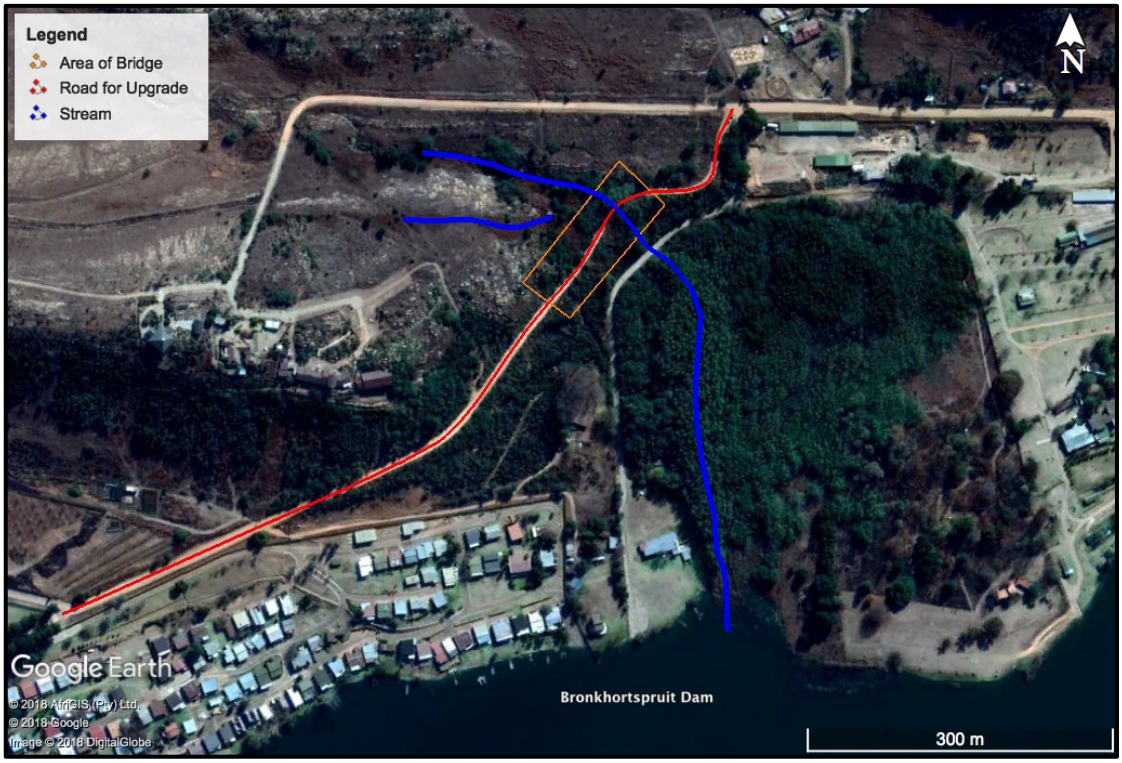

Figure 15: Watercourses in the study area

10.5 Classification of watercourses in the study area

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 table below (Table 11). This in addition to the classification system for wetlands shown above (Figure 13).

There are no wetlands (including freshwater pans) in the study area. Therefore, the wetland classification system shown in Figure 13 was not used. A small semi-perennial stream, fed from the ridges to the north, northwest and west of the study site, flows down under the road and bridge and into the Bronkhorstspruit Dam. The unnamed stream was originally a tributary of the Bronkhorstspruit (Stream), which is the main watercourse flowing into and out of the Bronkhorstspruit Dam. The small stream and Bronkhorstspruit (stream) were classified as shown in Table 12, below.

Table 11: 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	

Table 12: Classification of watercourses in the Study Site

Name	LEVEL 1 System	LEVEL 2 Regional setting (Ecoregion)	LEVEL 3 Landscape Unit	LEVEL 4 HGM Unit	
				HGM Type	Landform
Unnamed Stream	Inland	Mesic Highveld Grassland	Plain	River	Lower foothill
Bronkhorstspruit (Stream)	Inland	Mesic Highveld Grassland	Plain	River	Lowland

10.6 Delineated Watercourses

The only watercourse in the study area is a small semi-perennial stream that flows in a fairly deep and steep ravine (kloof) at the foothills of the higher ridges. The stream was delineated as shown below (Figure 16). The entire stream, riparian area and ravine were delineated as they holistically form the watercourse. Due to the extreme high levels of encroachment on the system by alien trees it is very difficult to delineate the watercourse 100% accurately.

Figure 16: Delineated watercourse

10.7 Drainage areas

South Africa is geographically divided up into a number of naturally occurring Primary Drainage Areas (PDAs) and Quaternary Drainage Areas (QDAs) (Figure 17). The different areas are demarcated into Water Management Areas (WMAs) and Catchment Management Agencies (CMAs). Until recently there were 19 WMAs and 9 CMAs. Figure 18 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 19) (Government Gazette, 16 September 2016. No.1056, pg. 169-172).

The study area is situated within the Primary Drainage Area (PDA) of B and the Quaternary Drainage Area (QDA) of B20C (Figure 20). The study area is within the Olifants Water Management Area (WMA 2) and under the jurisdiction of the Olifants Catchment Management Agency (CMA 2) (Figure 19). The site is not situated within a priority quaternary drainage catchment, in terms of guidelines and legislation from the Department of Water & Sanitation (DWS). The table below gives a summary of the catchment areas and management areas for the study site (Table 13).

Table 13: Summary of Catchment areas for the study site

Level	Category
Primary Drainage Area (PDA)	B
Quaternary Drainage Area (QDA)	B20C
Water Management Area (WMA) – Previous / Old	Olifants
Water Management Area (WMA) – New (as of Sept. 2016)	Olifants (WMA 2)
Sub-Water Management Area	Upper Olifants
Catchment Management Agency (CMA)	Olifants (CMA 2)
Priority Quaternary Catchment	No
Wetland Vegetation Ecoregion	Mesic Highveld Grassland Group 4 Central Bushveld Group 1

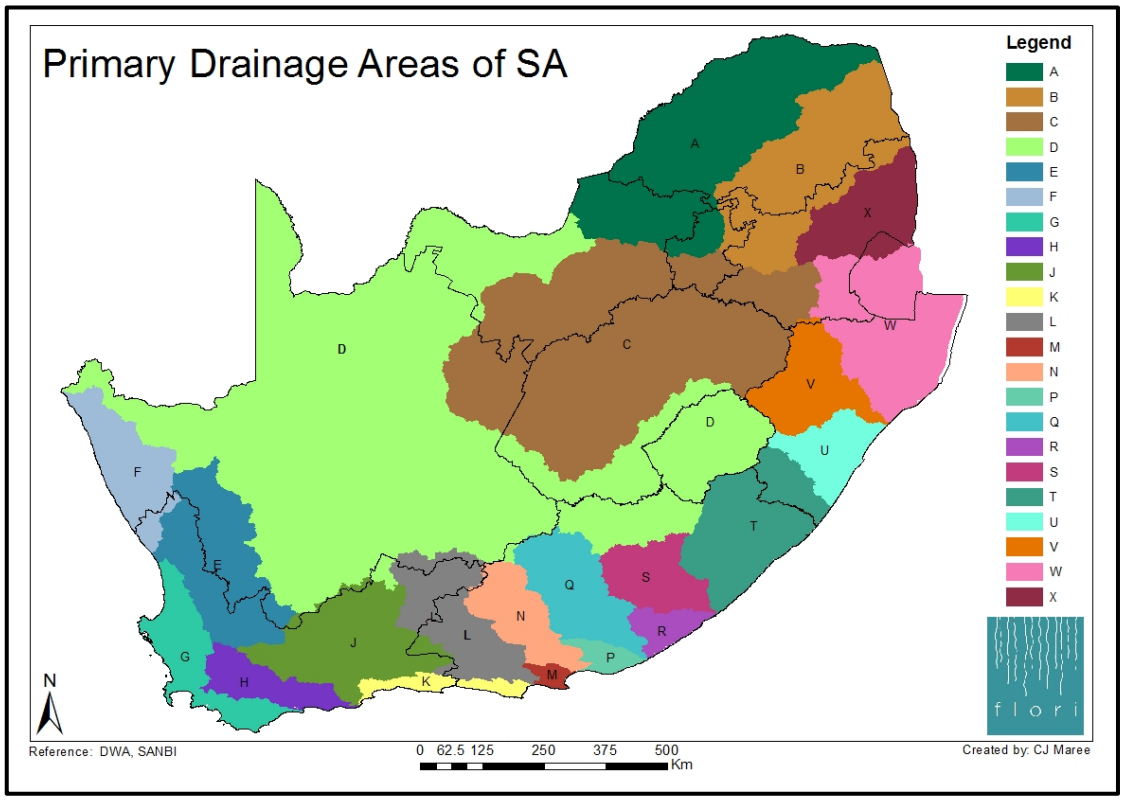

Figure 17: Primary drainage areas of South Africa

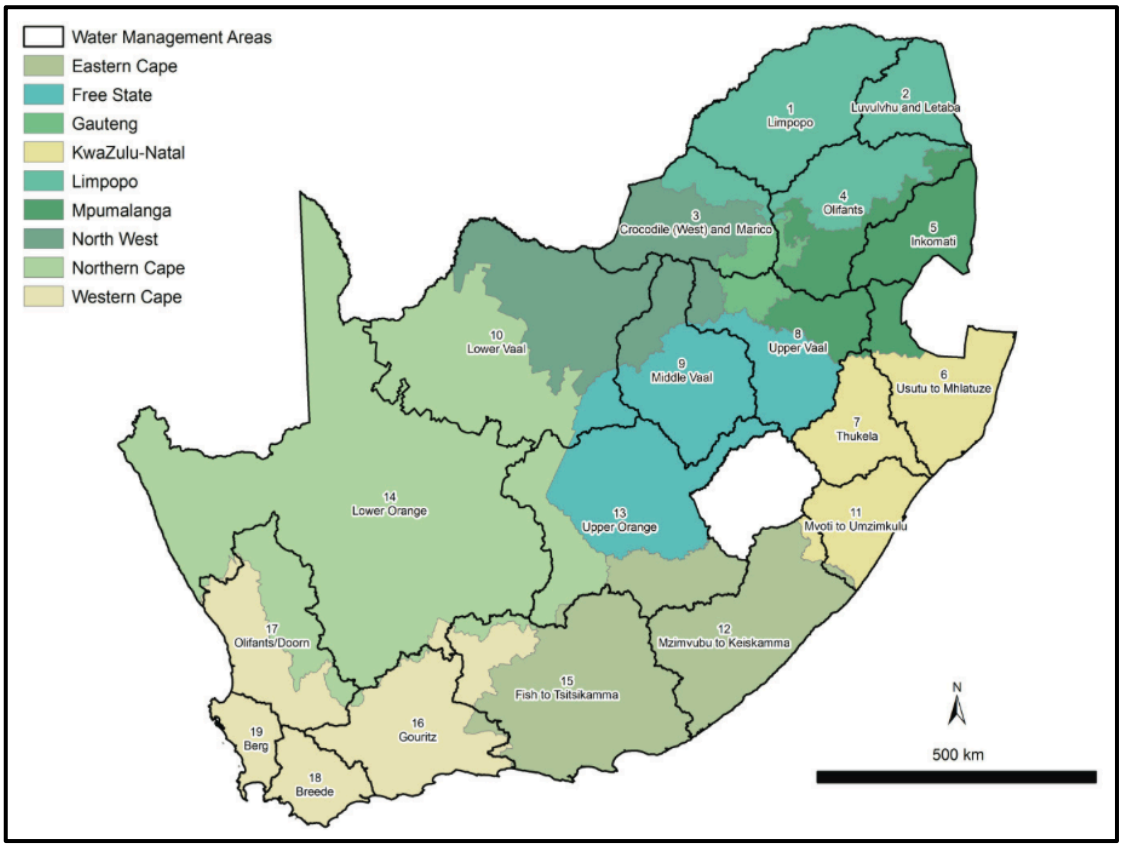

Figure 18: Old WMAs of South Africa

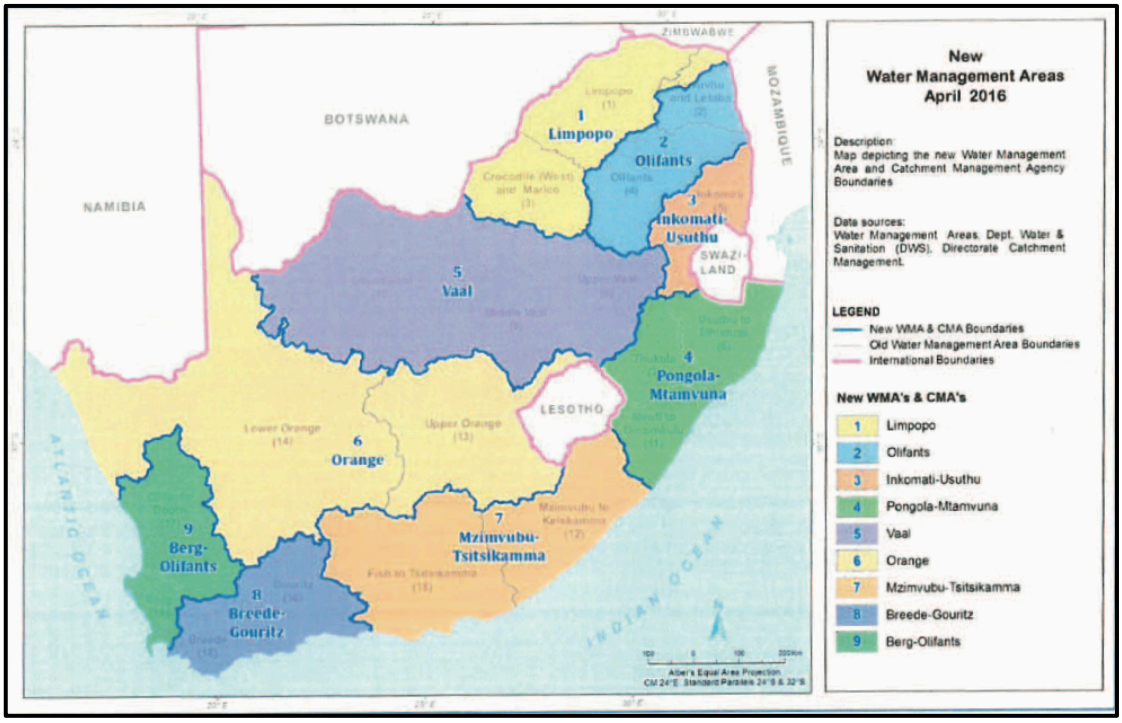

Figure 19: New WMAs & CMAs of South Africa

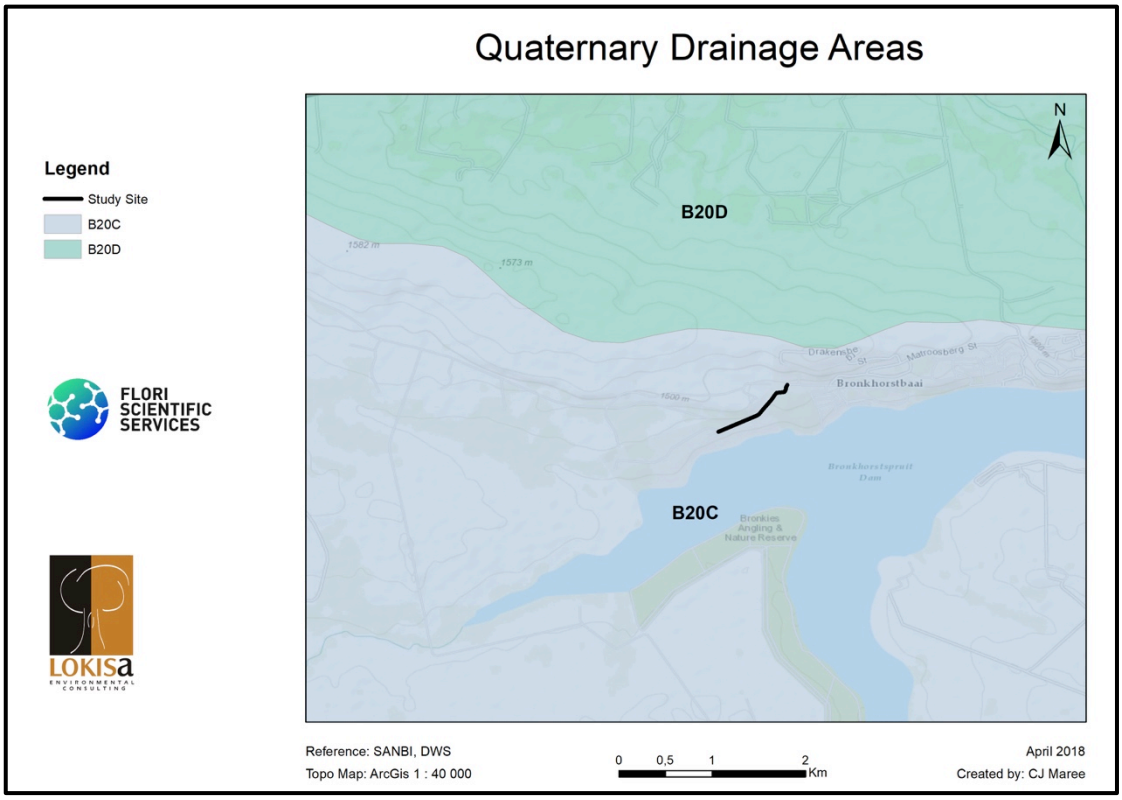

Figure 20: Quaternary drainage areas (QDAs)

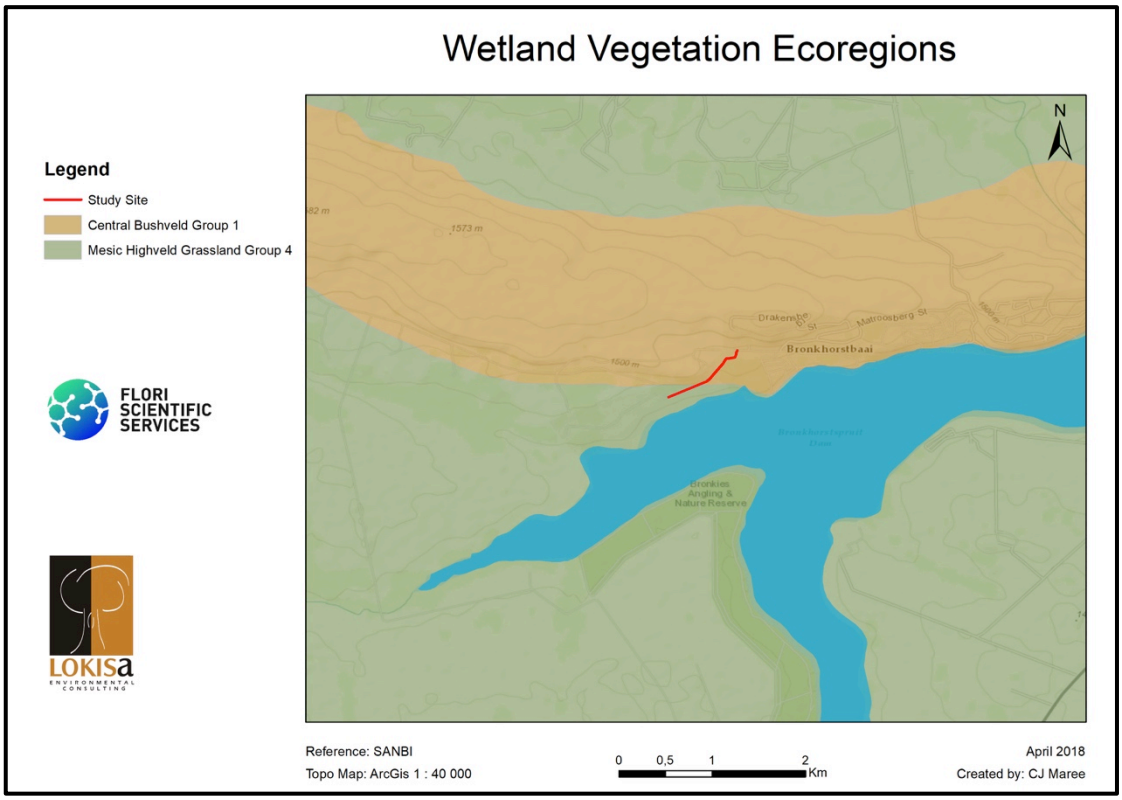

Figure 21: Wetland Vegetation Ecoregions

10.8 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 22).

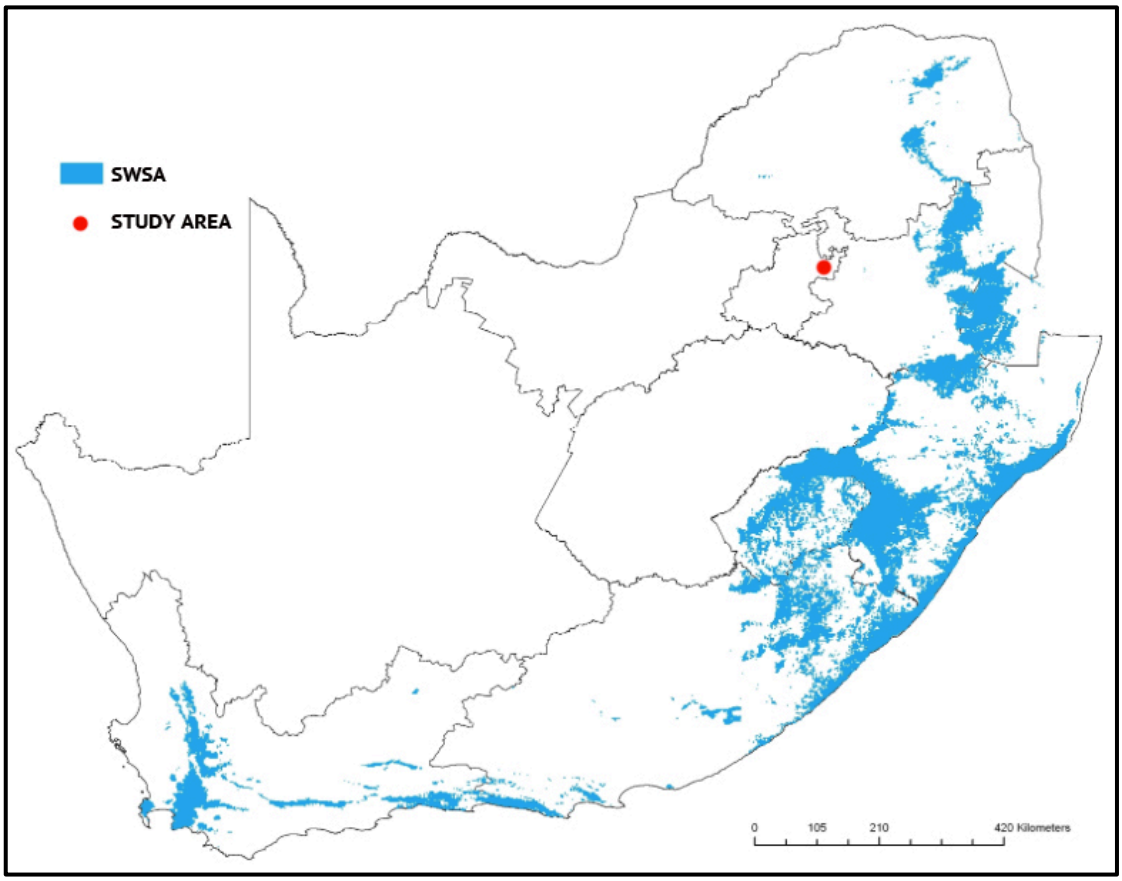

Figure 22: SWSA of South Africa

10.9 Methodology: Present Ecological State (PES)

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 14 shows the criteria used for assessing the habitat integrity (PES) of wetlands and other watercourses, along with Table 15 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 14: 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 15: 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 16 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 16: 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 are deemed to be Low. Category rating of C is deemed to be Medium, while Category ratings of B & A are deemed to be High.

10.10 PES of watercourses in the study area

The PES of the small, unnamed stream in the study area has been calculated as shown in the table below (Table 17). The determined category of 'C' (Moderately Modified) may be a bit misleading. The quality of the water is good and there are few negative impacts on the stream. The problem is that the one negative impact of alien invasive species in the system is significant and serious. This results in the PES of the stream being on the borderline between moderately and largely modified.

Table 17: PES of Watercourses in the Study Area

Criteria	Identified Watercourses
	Tributary of the Blesbokspruit
HYDROLOGY	
Flow modification	2
Permanent inundation	3
WATER QUALITY	
Water Quality Modification	3
Sediment Load Modification	2
GEOMORPHOLOGY	
Canalisation	3

Topographic Alteration	2
BIOTA	
Terrestrial Encroachment	1
Indigenous Vegetation Removal	2
Invasive Plant Encroachment	0
Alien Fauna	3
Over utilisation of Biota	2
Total:	23
Average:	2,1
Category:	**C**
Integrity (PES):	**Medium**
PES Description	**Moderately Modified**
Recommended EMC	**C**

10.11 Methodology: Ecological Importance & Sensitivity (EIS)

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 18). 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 18: 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

10.12 EIS of watercourses in the study area

The PES of the small, unnamed stream in the study area has been calculated as shown in the table below (Table 19).

Table 19: EIS of watercourses in the study area

Determinants	Stream	Confidence
PRIMARY DETERMINANTS		
1. Rare & Endangered Species	1	4
2. Populations of Unique Species	1	4
3. Species/taxon Richness	2	4
4. Diversity of Habitat Types or Features	2	4
5 Migration route/breeding and feeding site for wetland species	0	3
6. Sensitivity to Changes in the Natural Hydrological Regime	1	3
7. Sensitivity to Water Quality Changes	1	3
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	1	3
MODIFYING DETERMINANTS		
9. Protected Status	1	4
10. Ecological Integrity	2	4

TOTAL	12	-
AVERAGE	1,2	-
Overall EIS	**C**	**-**
Description	**Moderate**	**-**

10.13 Drivers of ecological change on the watercourses

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

- Urbanisation, especially along the banks Bronkhorstspruit Dam;
- Farming activities, especially cultivated lands that are extensive in the area;
- Encroachment and choking of watercourse by invasive alien tree species; and
- General pollution, dumping and destruction of watercourses across the region.

Serious and extensive encroachment and invasion by invasive alien trees is the single most significant driver of ecological change of the water environment in the study area. Historically there as been a small plantation downstream of the bridge and stream crossing. The lower area of the stream, east of the road and bridge is within the Bronkhorstspruit Nature Reserve, which is part of the dam.

11 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 natural environment within the study area is highly transformed and no pristine bushveld or grassland is present. The northern section of the site is badly invaded by alien trees and the southern section has been all but completely transformed by farming practices on the western side (cultivated lands and orchards) and urban developments on the eastern side (Clover Hill Club). The ridges to the immediate north and west of the road (study site) are moderately degraded to seriously degraded. It is however, still these ridge areas that are in reality the most sensitive in terms of fauna and flora. The floral and faunal sensitivity analyses are shown in the tables below (Table 20 & Table 21).

11.1 Floristic Sensitivity Analysis

Table 20: Floristic sensitivity analysis

Criteria	Distinctive habitats in the study area		
	Ridge	Watercourse	Grassland
Red Data Species	8	4	1
Habitat Sensitivity	9	8	1
Floristic Status	6	4	1
Floristic Diversity	6	4	1
Ecological Fragmentation	7	5	1
Sensitivity Index	72%	50%	10%
Sensitivity Level	Medium/High	Medium	Low
Development Go Ahead	Go-But*	Go-But	Go*

* For description of Development Go Ahead see Section 7.4. Go, No-Go Criteria.

11.2 Faunal Sensitivity Analysis

Table 21: Faunal sensitivity analysis

Criteria	Distinctive habitats in the study area		
	Ridge	Watercourse	Grassland
Red Data Species	7	5	1
Habitat Sensitivity	9	8	1
Faunal Status	7	4	1
Faunal Diversity	6	4	1
Ecological Fragmentation	7	5	1
Sensitivity Index	72%	52%	10%
Sensitivity Level	Medium/High	Medium	Low
Development Go Ahead	Go-But*	Go-But	Go*

* For description of Development Go Ahead see Section 7.4. Go, No-Go Criteria.

11.3 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 22). According to the ecological analysis there are no actual high sensitivity areas, high sensitivity habitats, or 'No-Go' zones, as shown in the table below (Table 22). This gives a 'real-state' look at the envrionment in question. However watercourses are, by default, considered to have a sensitivity rating of 'High' and for this project need to be approached as such. Ridges are also sensitive habitats and also need to be approached with caution.

Table 22: Ecological sensitivity analysis

Ecological community	Floristic sensitivity	Faunal sensitivity	Ecological sensitivity	Development Go-ahead
Ridge	Medium/High	Medium/High	Medium/High	Go-But
Watercourse	Medium	Medium	Medium	Go-But
Grassland	Low	Low	Low	Go

11.4 Priority areas

11.4.1 National Priority Areas

The study area does not fall within any priority areas (Figure 23), but is situated close to Bronkhorstspruit Dam which is a NFEPA watercourse / waterbody and a nature

reserve. 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.

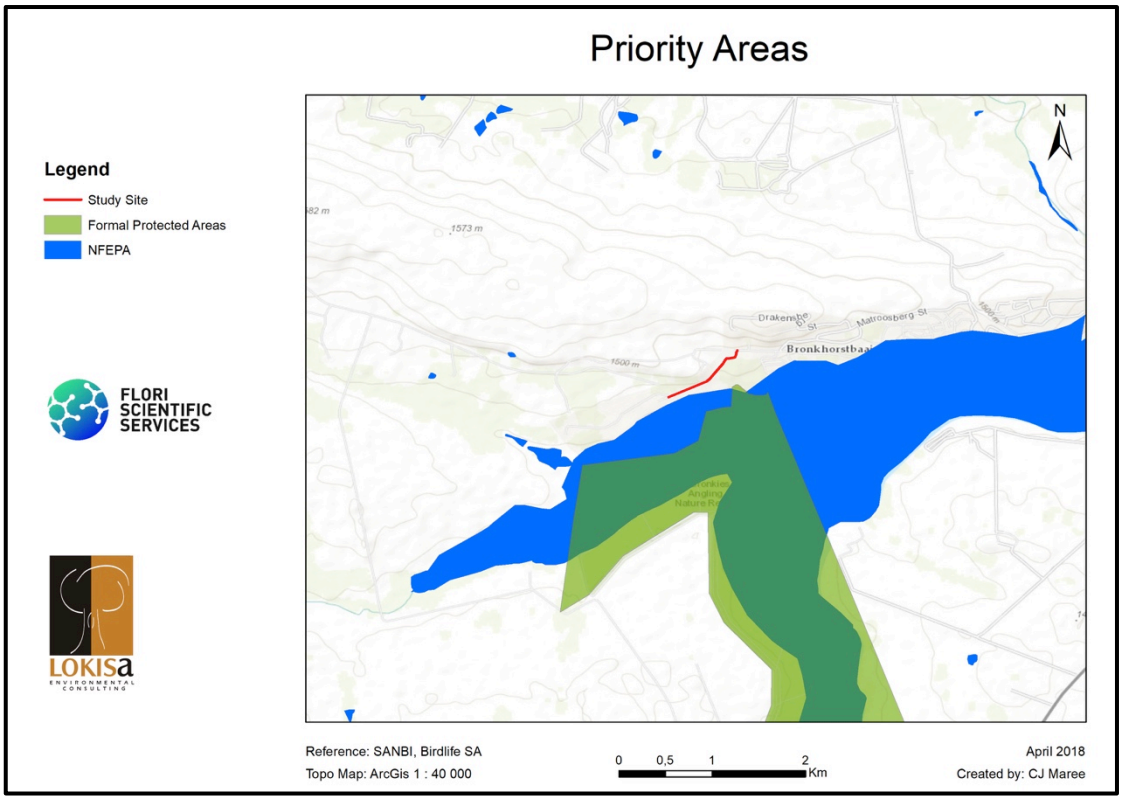

Figure 23: Priority areas

11.4.2 Critical Biodiveristy Areas (CBA) and Ecological Support Areas (ESA)

According to GDARD' conservation plan (C-Plan version 3.3) the study site is situated on the edge of a critical biodiversity area (CBA) and passes through an ecological support area (ESA). The CBA is demarcated as CBA – Irreplaceable and is the ridge area adjacent to the western boundary of the road. The ESA is the extent of the stream and riparian zone over which the road and bridge are constructed (Figure 24).

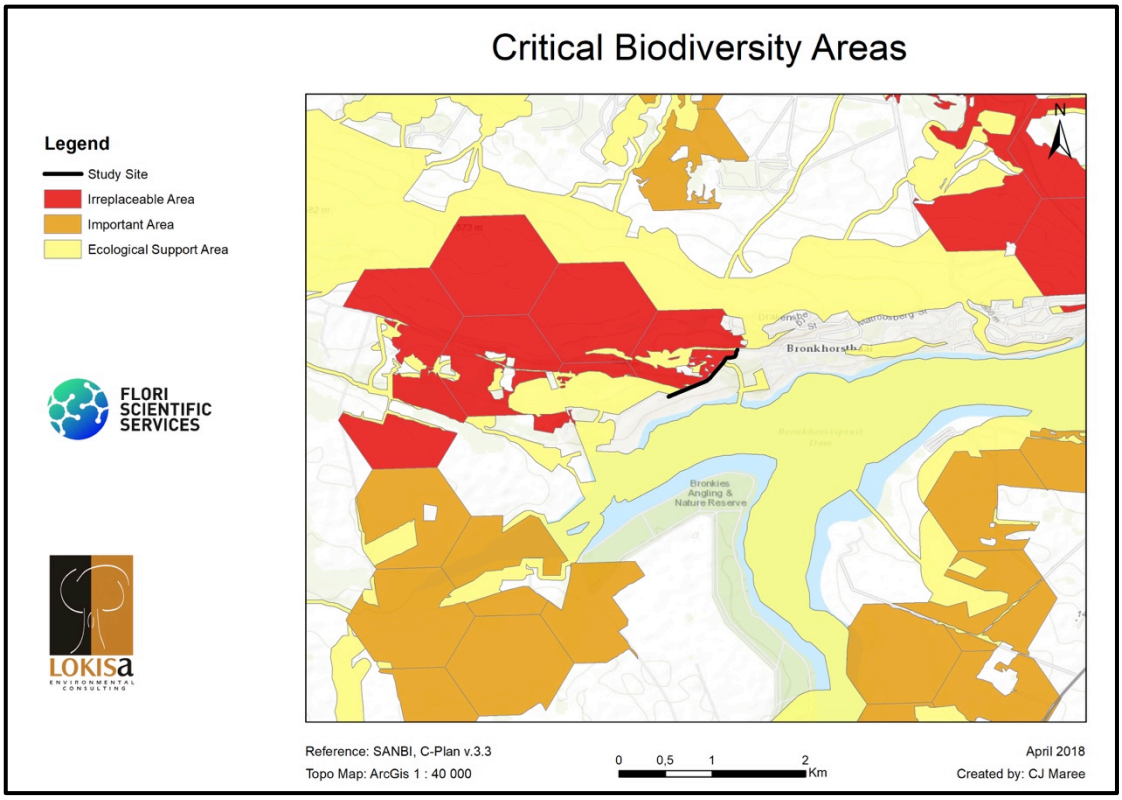

Figure 24: CBAs and ESAs

11.4.3 Ridges

Ridges within the Gauteng Province create unique, islands of biodiversity. These ridges are often bushveld type ecosystems within a grassland biome. The unique ecosystems are not just in terms of plant communities, but also in terms of faunal communities. These ridges are home to numerous lizards, snakes and invertebrate species, many of which are priority species of conservation concern.

The following extract is taken from GDARD's policies and guidelines regarding ridges (Pfab, 2001): "*In the light of the motivations presented in section 3 of this document and due to the extremely limited distribution, rarity and threatened status of the ridges in Gauteng, it is imperative that the Department adopts a strict no-go or low impact development policy for these systems. However, this policy, by necessity, will have to be adapted according to the current transformed status of some of these ridges.*"

The northern section of the study site is situated within demarcated ridges in terms of GDARD's data sets and maps (Figure 25). The ridge demarcation was verified as accurate during field investigations. Table 23, below, gives a description of the

various class categories for ridges in Gauteng. In terms of the categories the ridges in the study area would be classified as Class 2 ridges. The guidelines, which are applicable to the use and development of the Class 2 ridges, are set out below in Table 24 and need to be adhered to during the construction phase of the project (Guidelines on Gauteng Ridges (2001, updated January 2004 & April 2006). It should be noted that this GDARD guideline applies to all ridges in Gauteng, irrespective of whether a ridge is mapped in the GDARD shapefile or not.

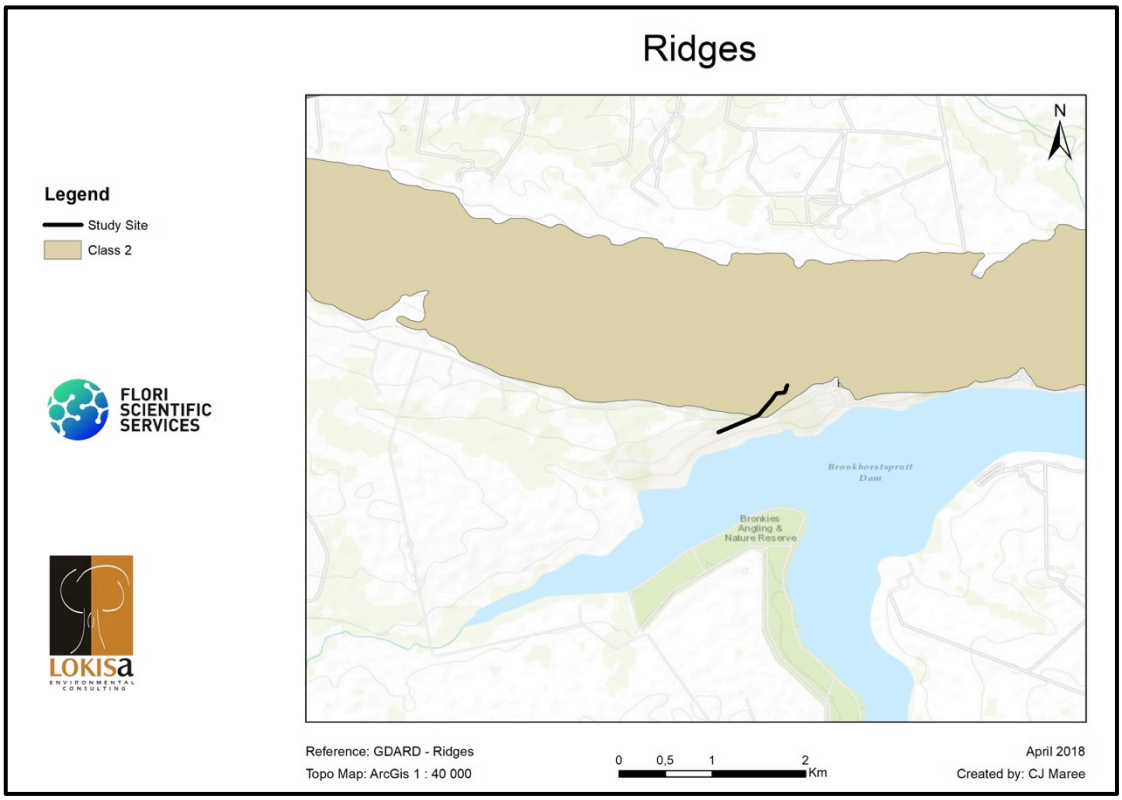

Figure 25: Ridges

Table 23: Classification of ridges in Gauteng Province

Category	Transformed	Description
Class 1	< 5%	Ridges of which **5% or less** of their surface area has been converted to urban development, quarries and/or alien vegetation. (Approximately 51% of ridges currently fall within Class 1, including the Suikerbosrand and parts of the Magaliesberg.)
Class 2	> 5% but < 35%	Ridges of which **more than 5%**, **but less than 35%,** of their surface area has been converted to urban development, quarries and/or alien vegetation. (Approximately 28% of ridges currently fall within Class 2,

		including parts of the Magaliesberg, ridges falling within the Cradle of Humankind World Heritage Site, the Klipriviersberg, the Bronberg and the Skurweberg.)
Class 3	> 35% but < 65%	Ridges of which **35% or more, but less than 65%**, of their surface area has been converted to urban development, quarries and/or alien vegetation. (Approximately 9% of ridges currently fall within Class 3, including the ridge that traverses the Northcliff, Roodepoort and Krugersdorp areas).
Class 4	65% +	Ridges of which **65% or more** of their surface area has been converted to urban development, quarries and/or alien vegetation. (Approximately 11% of ridges currently fall within Class 4, including the Melville Koppies and the Linksfield Ridge).

Table 24: Policy for Ridges as pertaining to the study area

Ridge Class	Policy Guidelines
Class 2	(a) The consolidation of properties on Class 2 ridges is supported. (b) The subdivision of property on Class 2 ridges will not be permitted. (c) Development activities and uses that have a high environmental impact on a Class 2 ridge will not be permitted. (d) Low impact development activities, such as tourism facilities, which comprise of an ecological footprint of 5% or less of the property may be permitted. (The ecological footprint includes all areas directly impacted on by a development activity, including all paved surfaces, landscaping, property access and service provision). (e) Low impact development activities on a ridge will not be supported where it is feasible to undertake the development on a portion of the property abutting the ridge.

11.5 Sensitive areas identified during field investigations

The road itself is not a sensitive area because it has been totally transformed and is an existing gravel road. This is also relevant to the bridge. The southern section of the study site, which is situated in the original extent of grassland, but that has all but been totally transformed or highly degraded is also not a sensitive area in terms of the ecological assessment. The ridge and watercourse areas are however sensitive. The northern section of the road and bridge are within demarcated ridges. The ridge is especially prominent on the western side of the road. The ridge and watercourse

have therefore been demarcated as sensitive, even though they are seriously degraded in the area of the road and road reserve. This degradation is almost entirely due to excessive invasion and encroachment by alien tree species. Along the ridge / rocky area the alien specie is almost entirely the highly invasive Australian blackwattle (*Acacia mearnsii*), while the watercourse and kloof (ravine) is a mix of pine, poplar, syringa and blackwattle on the edges. The entire study site is seen as having a sensitivity rating of 'Low', except for the demarcated watercourse and ridge areas (Figure 26, below) that are demarcated as 'High'.

Figure 26: Sensitivity map of the study area

12 THE GO, NO-GO OPTION

12.1 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.

12.2 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.

13 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 (cumulative imapcts). The rated impacts of the proposed project before and after the implementation of mitigating measures are shown in the tables below. The impact assessments focus mainly on the construction phase of the project. The operation phase is only considered in terms of ongoing, routine maintenance after clean up and rehabilitation at the end of the construction phase.

13.1 Existing Impacts

Existing negative impacts on the study area and surrounding areas include cultivation; recent establishment of pecan nut tree orchards; urban development mainly in terms of the Clover Hill Club; the existing road and bridge (study site); and extensive and serious invasion and encroachment of the ridges and watercourse by alien tree species. The dam could initially have be viewed as a negative impact, but has established and formed an important and integral part of the natural environment. In many ways it can be seen as an existing positive impact in the region.

13.2 Potential Impacts

The potential impacts arising from the proposed project and related activities are low-level negative impacts with short-term time periods mainly within the construction phase period. The medium- to long-term negative impacts of the project are fairly much neutral in terms of cumulative impacts. With proper mitigating measures and rehabilitation of the study area, the medium- to long-term impacts will be neutral, and the short-term negative impacts during the construction phase will be quickly neutralised. During the upgrade of the bridge and the road a number of alien trees and clean-up will take place as part of the construction activities. Removal of these highly invasive alien trees and opening up of the main channel of the stream are positive impacts arising from the project.

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 surroundings.

Potential Impact 1: Loss of natural vegetation (negative)

The upgrade of the road will have a small footprint not much wider than the existing road. Some vegetation may be lost along the road edge on the site. However, no pristine grassland will be lost. No RDL species will be lost and no protected trees will be lost. The site is all but transformed and the edges are seriously invaded by alien tree species so the loss of natural vegetation is low to insignificant.

	Impact Criteria						
	Extent	**Duration**	**Intensity**	**Probability**	**Total Score**	**Significance**	**Cumulative effect**
Pre-Mitigation	Site: 1	Medium-term: 2	Moderate 2	Possible: 2	7	Low	Negligible
Post-Mitigation	Site 1	Short-term: 1	Low: 1	Possible: 2	5	Low	Negligible

Mitigating Measures:

- No vegetation (even grass) to be removed unless necessary.
- No temporary lay-down areas, site offices, etc. to be set up in CBA and ESA demarcated areas, or along ridges or in watercourse and kloof.
- All disturbed and denuded areas (even within the study site) to be rehabilitated in terms of re-seeding and re-establishing of grasses. Only locally indigenous grasses may be used for rehabilitation purposes. There is no need to replant any trees.
- No new wide access roads may be created only existing roads to be used.
- Rehabilitation of denuded and work areas required after construction, but as part of the construction phase of the project.

Potential Impact 2: Loss of topsoil (negative)

During excavation activities the topsoil will be lost or mixed with other soils. Loss of more fertile topsoils will hinder the ability of vegetation to recover in denuded and disturbed areas. Only a very small excavation and construction footprint is required and will be almost exclusively within existing gravel road. There will not be any significant or meaningful loss of topsoil.

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

Mitigating Measures:

- Top 20-50 cm of soil removed must be placed separate from other soils removed deeper down (this in areas of the road reserve and not the road itself).
- During back filling of holes, etc. This same topsoil must be the final layer added and must be used in more or less the same area it was removed from.
- Returned, final layer of topsoil must not be heavily compacted.
- Mitigating measures above are given with the understanding that minimal soils outside of the road

will be moved.

Potential Impact 3: Erosion (negative)

Erosion is usually a real potential negative impact. The soils are fairly sandy and the topography moderately steep to steep. There is therefore the real potential of erosion during and after construction.

	Impact Criteria						
	Extent	**Duration**	**Intensity**	**Probability**	**Total Score**	**Significance**	**Cumulative effect**
Pre-Mitigation	Site: 1	Short-term: 1	High 3	Definite: 4	9	Medium	Medium
Post-Mitigation	Site 1	Short-term: 1	Low: 1	Possible 2	5	Low	Low

Mitigating Measures:

- Erosion to be monitored at all times during the construction phase. The risk of erosion, especially after heavy rain downpours is high. Any erosion to be corrected immediately. Special attention must also be given to both sides of the gravel road, as well as the edges of the kloof at the bridge.
- Erosion along the ridge, siltation of the watercourse, etc. must be monitored and correct immediately. Any erosion and / or siltation must be continually monitored and immediately corrected if present and if established to be a direct result of construction activities.
- A site-specific stormwater management plan must be compiled and implemented as part of the construction phase and upgrade of the road and bridge.

Potential Impact 4: Loss of RDL faunal and floral species (negative)

Loss of natural environment, including RDL fauna and flora species is always a concern with development projects. The study site is situated along high sensitive areas (ridge and watercourse). It is highly likely that some priority and other wild faunal species will visit the site periodically.

	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 ground nests or burrows found within the study site during the construction phase must first be cordoned off until the ECO and/or a specialist has had time to inspect and evaluate the situation and advise accordingly.
- Under no circumstances may any wild animals be captured or killed 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.

- A site-specific rehabilitation plan is required. It need not be a complicated or elaborate plan. All disturbed and denuded areas must be rehabilitated; soils re-contoured.

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 very high.

	Impact Criteria						
	Extent	**Duration**	**Intensity**	**Probability**	**Total Score**	**Significance**	**Cumulative effect**
Pre-Mitigation	Local: 2	Medium-term: 3	Moderate 2	Possible: 2	9	Medium	Medium
Post-Mitigation	Site: 1	Short-term: 2	Low: 1	Possible: 2	6	Low	Low

Mitigating Measures:

- A weed control programme should be implemented to monitor and remove any invasive weeds after the construction phase. The programme can form part of the routine maintenance / inspection programme of the road and bridge.
- 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.
- No chemical herbicides in spray form may be used within 50m of the stream.
- No chemical spraying of weeds may be conducted if there is any wind. There are nearby farmlands and orchards. Therefore, no chemical spraying may be conducted without first consulting with the local farmer.

Potential Impact 6: Impacts on the watercourse at the bridge crossing (negative & positive)

Potential impacts on the watercourse include erosion of stream banks, siltation, loss of riparian vegetation, etc. These are all negative potential impacts. The clearing out of invasive alien species and siltation are seen as positive potential impacts.

	Impact Criteria						
	Extent	**Duration**	**Intensity**	**Probability**	**Total Score**	**Significance**	**Cumulative effect**
Pre-Mitigation	Local: 2	Short-term: 2	Moderate 2	Possible: 2	9	Medium	Low
Post-Mitigation	Site: 1	Short-term: 2	Low: 1	Possible: 2	6	Low	Low

Mitigating Measures:

- The main channel of the stream and waterflow may not be totally blocked off during construction.
- All alien tree species may be cleared. However, care must be taken not to destabilise stream banks and steep gradients of the kloof.

- Clearing of alien trees and opening up of the chocked watercourse from these alien species will be a positive impact on the watercourse.
- Siltation will increase, but should only be short-term. Must still be monitored during construction.
- Proper rehabilitation and re-seeding of the disturbed areas and bare soils with locally indigenous grasses will greatly reduced the probability of invasive weeds, erosion and siltation of the watercourse and kloof.
- No chemical herbicides in spray form may be used within 50m of the stream.
- Aquatic monitoring of the watercourse must take place during the construction phase. The specialist must report any problems to contractors and main Client and must be remedied with promptness.

14 MITIGATION OF IMPACTS

The following general 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 in Section 13: Impact Assessment. The mitigating measures below also include obvious and best practice measures.

14.1 Construction Phase

- Only existing roads to be used by vehicles during construction phase. Roads to be rehabilitated after construction by contractors.
- Dust suppression to be conducted during construction due to close proximity to houses.
- 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.
- Stormwater management plan to be compiled and implemented.

14.2 Operation & Maintenance Phases

- Weed control should form part of the routine maintenance of the road and bridge.
- Erosion control and monitoring can also form part of the routine maintenance of the road and bridge.

15 APPENDICES

15.1 List of floral species identified on site

Trees & Shrubs

Acacia mearnsii, Canthium gilfillanii, Celtis africana, Combertum molle, Ehretia rigida, Eucalyuptus spp*, Grewia occidentalis, Gymnosporia buxifolia, Melia azedarach*, Pinus spp*, Populus alba*, Populus x canescens*, Protea caffra, Searsia lancea, Searsia leptodictya, Stoebe plumose, Vangueria infausta, Vangueria parvifolia, Ziziphus mucronata.*

** = Alien species.*

Herbaceous plants

Argemone ochroleuca, Araujia sericifera*, Bidens pilosa*, Conyza canadensis*, Conyza podocephala, Datura ferox*, Solanum elaeagnifolium*, Tagetes minuta*, Verbena bonariensis* Helichrysum nudifolium, Helichrysum rugulosum, Pentanisia angustifolia, Senecio venosus, Xerophyta retinervis, Cheilanthes hirta, Hypoxis hemerocallidea, Hypoxis rigida, Pellaea calomelanos.*

Grasses

Cynodon dactylon, Digitaria monodactyla, Eragrostis chloromelas, Heteropogon contortus, Setaria sphacelata, Themeda triandra, Trachypogon spicatus, Tristachya biseriata, Loudetia simplex (d), Panicum natalense (d), Schizachyrium sanguineum (d), Trachypogon spicatus (d), Alloteropsis semialata subsp. eckloniana, Bewsia biflora, Digitaria tricholaenoides, Diheteropogon amplectens, Sporobolus pectinatus, Tristachya biseriata, Tristachya leucothrix.

(d) = Dominant.

Red Data species present

None.

Protected trees

None.

15.2 Photographs

Photo 1: Study site (gravel road) in the area of the bridge

Photo 2: Study site (road) just south of the bridge. Looking south.

Photo 3: Ridge (rocky area) right of road and just south of bridge.

Photo 4: Road (Study site) southern section lower down near Clover Hill Club and in grassland area. Looking north.

Photo 5: Ridge area west of road. All green trees in photo are felled alien invasive blackwattle that have invaded the ridge and watercourse

Photo 6: Watercourse and kloof upstream (west) of the bridge. Trees in the photo are predominantly invasive weeds species of blackwattle and syringa

Photo 7: Bronkhorstspruit Dam & Clover Hill Club alongside study site

Photo 8: Watercourse downstream (east) of bridge. All trees in photo are invasive alien trees of poplar and blackwattle, invading and choking the watercourse

Photo 9: Study site (gravel road) with ridges to the immediate west (left in photo) and to the far north (background with water tower).

Photo 10: Stream immediately east of bridge (downstream). All trees in picture are invasive alien species (mainly blackwattle)

Photo 11: Edge of ridge next to road. This ridge along the western side of the road is seriously degraded and over run by invasive alien trees (blackwattle) all the trees in the photo are alien.

Photo 12: Study site (gravel road) at southern end at Clover Hill Club. Looking south towards Club entrance gate

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17 DECLARATION OF INDEPENDENCE

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.
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SIGNATURE: _____

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

DATE: ___20 JUNE 2018 ____