TERRESTRIAL FAUNAL, FLORAL AND WETLAND ECOLOGICAL ASSESSMENT UPDATE AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS FOR THE PROPOSED WATER SUPPLY PIPELINE UPGRADE AT THE DUVHA POWER STATION, MPUMALANGA

Prepared for

ILISO Consulting (Pty) Ltd

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EXECUTIVE SUMMARY

Based on the findings of the ecological assessment, it is the opinion of the ecologists that, from a terrestrial and aquatic ecological point of view, the proposed development be considered favorably provided that the recommended mitigation measures for the identified impacts are adhered to. In addition, it is the opinion of the ecologists that alternative 1 is the preferred alternative, as it situated within the transformed habitat unit in its entirety.

Scientific Aquatic Services (SAS) was appointed to update the full ecological assessment undertaken in 2015 for the proposed Duvha PV Plant, as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed water supply pipeline upgrade at the Duvha Power Station, Mpumalanga Province. The proposed water supply pipeline has two alternatives namely; alternative 1 and alternative 2, hereinafter collectively referred to as "study area". The study area is situated within the Duvha Power Station that is located approximately 15km east of Witbank in Mpumalanga. The study area is situated approximately 2 km west of the R575. The study area is surrounded by cultivated land and the Duvha Power Station. The ecological assessment was confined to the study area; specifically, areas that will be affected the proposed activity and did not include an ecological assessment of surrounding properties. The surrounding area was however considered as part of the desktop assessment of the area.

Specific outcomes required from this report include the following:

- To define the Present Ecological State (PES) of the terrestrial and wetland ecological resources in the vicinity of the study area;
- To delineate all wetlands or riparian zones occurring within the assessment site;
- To conduct a Species of Conservation Concern (SCC) assessment, including potential for such species to occur or to have occurred within the study area;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and any other ecologically important features; and
- To determine the environmental impacts that the construction of the development might have on floral and faunal SCC and wetland features associated with the study area, and to develop mitigation and management measures for all phases of the development.

Results of the Desktop Analysis

- According to the National Threatened Ecosystem database (2011), the study area is located within an ecosystem considered to be endangered;
- The study area falls within the Rand Highveld Grassland, and Eastern Highveld Grassland Vegetation types, which is considered to be Endangered Vegetation Types (Mucina & Rutherford, 2006);
- According to the Mpumalanga Biodiversity Sector Plan (MBSP, 2014) the study area is located within Critical Biodiversity Area (CBA) Optimal, heavily modified and moderately modified areas;
- The study area is situated within the Highveld Ecoregion and B11G quaternary catchment; and
- According to the National Freshwater Ecosystem Priority Areas Database (NFEPA, 2011) alternative 2 traverses one artificial and two natural wetlands, whereas alternative 1 does not traverse any wetlands.

FLORAL SCAN

Two habitat units were identified during the assessment, namely transformed habitat unit and wetland habitat unit.

- The transformed habitat unit is considered to be in a modified ecological condition, with significantly high levels of transformation (historic agricultural activities, vegetation cleared/ mowed as part of maintenance activities around the power station, and buildings associated

with the Eskom Duvha Power station). In addition, significant alien proliferation has taken place due to soil disturbance and overgrazing.

- The wetland habitat unit comprises an artificial wetland which formed as a result of altered topography associated with the construction of the Duvha Power station, which led to localised ponding and the establishment of facultative and obligate wetland floral species (SAS, 2015). This feature was not considered to be a natural wetland as defined in the DWAF, 2005: "A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". However, it was still assessed as it provides habitat for faunal and floral species within the Duvha power station footprint. The wetland habitat unit have been affected by edge effects from the power station, road construction, historic agriculture and general anthropogenic activities, which has negatively affected the habitat integrity of this system.
- The Probability of Occurrence (POC) of all South African National Biodiversity Institute (SANBI) floral SCC listed for the Quarter Degree Square (QDS) 2529CD was calculated.
    - During the field assessment species of *Boophane disticha* was encountered and recorded within the alternative 1 footprint. This species is known to occur within a wide range of habitats, which also includes disturbed areas;
    - *Hypoxis hemerocallidea* and *Crinum bulbispermum* are the most likely floral SCC to occur in the vicinity of the study area, especially around the artificial wetland and dam situated in close proximity to alternative 2. Due to the severe vegetation transformation associated with alternative 1, it is unlikely that these species will occur within this footprint. Thus, from a floral SCC perspective, alternative 1 is preferred. Should alternative 1 be pursued as the preferred alternative, the impact on floral SCC is anticipated to be insignificant; and
    - *B, disticha* as well as any other floral SCC, should they be encountered within the study area during any phase of the development must be removed and relocated by a qualified specialist to suitable, similar habitat in close proximity to where they have been removed from, but outside the disturbance footprint. These species could also be incorporated into the landscape plans for the development.

FAUNAL SCAN

- High levels of anthropogenic activities within the study area and its immediate vicinity, have led to transformation of natural faunal habitat;
- A number of common faunal species encountered during the field assessment include *Damaliscus pygargus phillipsi* (Blesbok), *Equus quagga* (Plains zebra), *Cynictis penicillata* (Yellow mongoose), *Orthetrum* species (Skimmer), *Musca domestica* (House fly), *Danaus chrysippus* (African Monarch), among other species, adapted to urban environments, were observed within the study area;
- No faunal SCC or suitable habitat were observed during the field assessment. In terms of conservation, the likelihood that any such species will be encountered in or near the study area is considered low, with the exception of *Tyto capensis* (African Grass Owl), *Circus ranivorus* (African Marsh Harrier), *Geronticus calvus* (Southern Bald Ibis), due to the high levels of anthropogenic activity and habitat transformation of the area; and
- The proposed development is thus deemed unlikely to pose a conservation threat to faunal species in the region.

WETLAND ASSESSMENT

The following general conclusions were drawn upon completion of the wetland assessment:

- An artificial wetland was encountered which has formed as a result of altered topography associated with the construction of the Duvha powerstation, which has led to localised ponding and the establishment of facultative and obligate wetland floral species. This feature was not considered to be a natural wetland as defined in the DWAF, 2005: "A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones'.
- From the results of the wetland ecological and socio-cultural service assessment, it is evident that the \wetland obtained an overall ecological service provision score of 1.0, which places this wetland in a moderately low class.

- The feature falls within PES Category D: largely modified. The feature has formed as a result of localised ponding due to topographic disturbances associated with the construction n of the Duvha powerstation. As a result, the feature is not as fully functional as a natural wetland would be. Furthermore, due to its anthropogenic nature, it is inherently disturbed.
- The artificial wetland feature falls within EIS Category D (Wetlands that are not ecologically important and sensitive at any scale). This wetland feature did not score a high importance in terms of diversity, habitat and wetland function as it is of anthropogenic origin and thus inherently disturbed. However, due to the high score value (critical value) of the wetland vegetation group according to the NFEPA protection stated, this increased the overall score and value of the EIS of all wetland features.

TERRESTRIAL AND WETLAND IMPACT ASSESSMENT:

The tables below summarises the findings indicating the significance of the impact on the receiving environment before mitigation takes place and the likely impact if management and mitigation takes place. In the consideration of mitigation, it is assumed that a high level of mitigation takes place but which does not lead to prohibitive costs. From the tables it is evident that prior to mitigation the impacts on floral and faunal SCC and wetland ecology are low level impacts. If effective mitigation takes place, all impacts may be reduced to very-low level impacts.

A summary of the results obtained from the impact assessment for the construction phase.

Impact	Unmanaged	Managed
1: Impact on Floral Species of Conservation Concern	Low	Low
2: Impact on Faunal Species of Conservation Concern	Low	Very-Low
3: Overall impact on the wetland feature	Low	Low

A summary of the results obtained from the impact assessment for the operational phase.

Impact	Unmanaged	Managed
1: Impact on Floral Species of Conservation Concern	Low	Low
2: Impact on Faunal Species of Conservation Concern	Very-Low	Very-Low
3: Overall impact on the wetland feature	Very-Low	Very-Low

Sensitivity

From an ecological perspective, the study area is considered to be of low sensitivity, mainly as a result of the increased level of disturbance and habitat transformation within the study area. Although *Boophane disticha* was present within the study area, this species is known to occur within a wide range of habitats, therefore adapting to habitat conditions. Due to vegetation transformation and surrounding human activities there is a very low probability that any other floral and faunal SCC will be observed within the study area. As such, any development within the study area is permissible, provided that all mitigation measures are adhered to throughout the development.

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GLOSSARY OF TERMS

Alien vegetation	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.
Indigenous vegetation	Vegetation occurring naturally within a defined
RDL (Red Data listed) species	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
SCC (Species of Conservation Concern)	The term SCC in the context of this report refers to all RDL (Red Data) and IUCN (International Union for the Conservation of Nature) listed species as well as protected species of relevance to the project.

LIST OF ACRONYMS

BGIS	Biodiversity Geographic Information Systems
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CR	Critically Endangered
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EN	Endangered
ESA	Ecological Support Areas
EW	Extinct in the Wild
GIS	Geographic Information System
GPS	Global Positioning System
IBA	Important Bird Area
IUCN	International Union for the Conservation of Nature
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential for Evaporation
MASMS	Mean Annual Soil Moisture Stress
MAT	Mean Annual Temperature
MBSP	Mpumalanga Biodiversity Sector Plan
NBA	National Biodiversity Assessment (2011)
NEMA	National Environmental Management Act (Act 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NT	Near Threatened
NWA	National Water Act
PES	Present Ecological State
POC	Probability of Occurrence
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square (1:50,000 topographical mapping references)
RDL	Red Data List
RE	Regionally Extinct
SABAP 2	Southern African Bird Atlas 2
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SAS	Scientific Terrestrial Services CC
TSP	Threatened Species Programme
VU	Vulnerable

1. INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to update the full ecological assessment undertaken in 2015 for the proposed Duvha PV Plant, as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed water supply pipeline upgrade which falls within the same study area at the Duvha Power Station, Mpumalanga Province. The proposed water supply pipeline has two alternatives namely; alternative 1 and alternative 2, hereinafter collectively referred to as “linear development” (Figures 1 & 2).

The study area is situated within the Duvha Power Station that is located approximately 15km east of Witbank in Mpumalanga, approximately 2 km west of the R575. The study area is surrounded by cultivated land and the Duvha Power Station. The ecological assessment was confined to the study area; specifically, areas that will be affected the proposed activity and did not include an ecological assessment of surrounding properties. The surrounding area was however considered as part of the desktop assessment of the area.

This report, after consideration and the description of the ecological integrity of the study area, must guide the Environmental Assessment Practitioner (EAP), regulatory authorities and developing proponent, by means of the presentation of results and recommendations, as to the ecological viability of the proposed development activities.

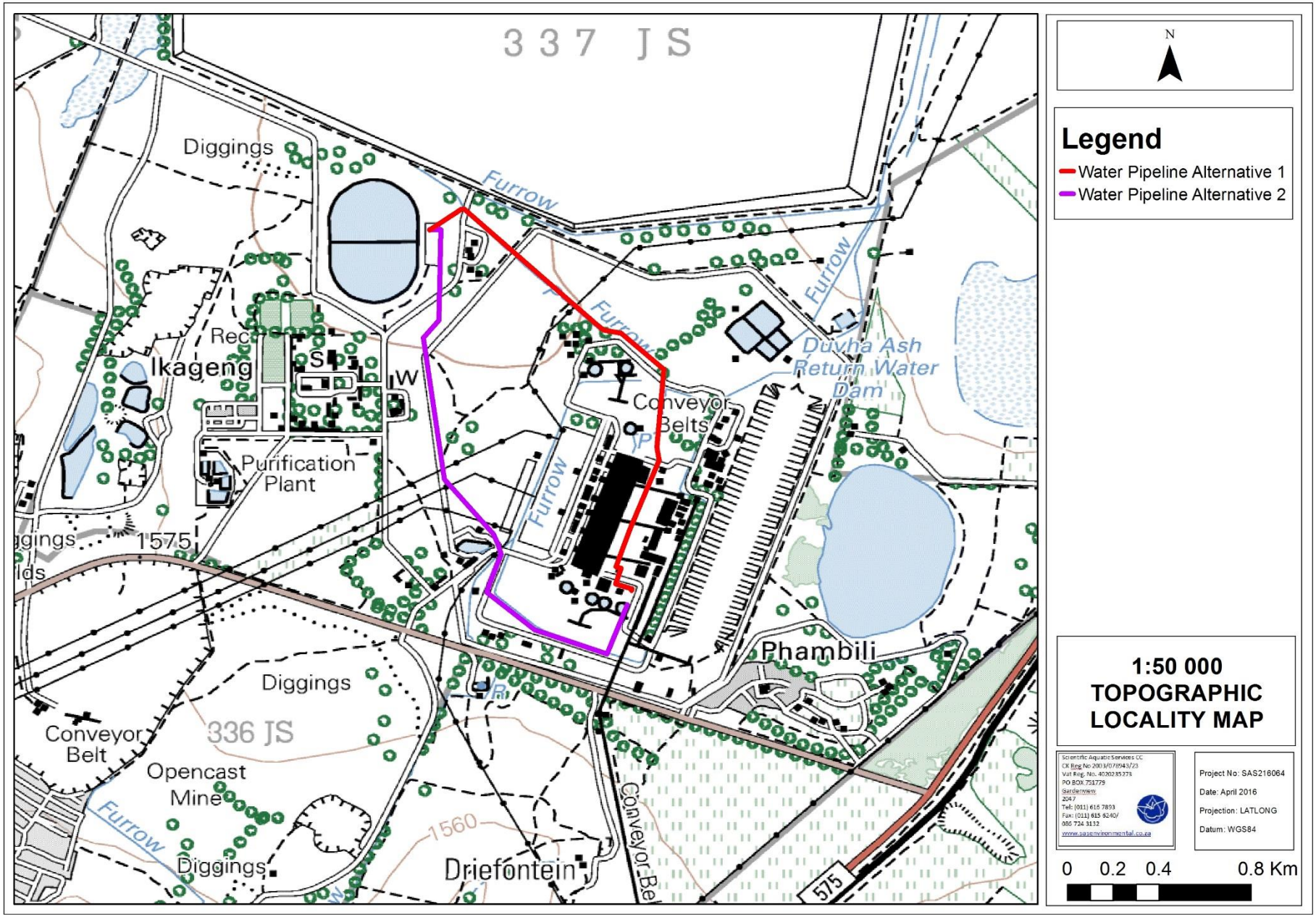


Figure 1: The study area depicted on a 1:50 000 topographical map in relation to the surrounding area.

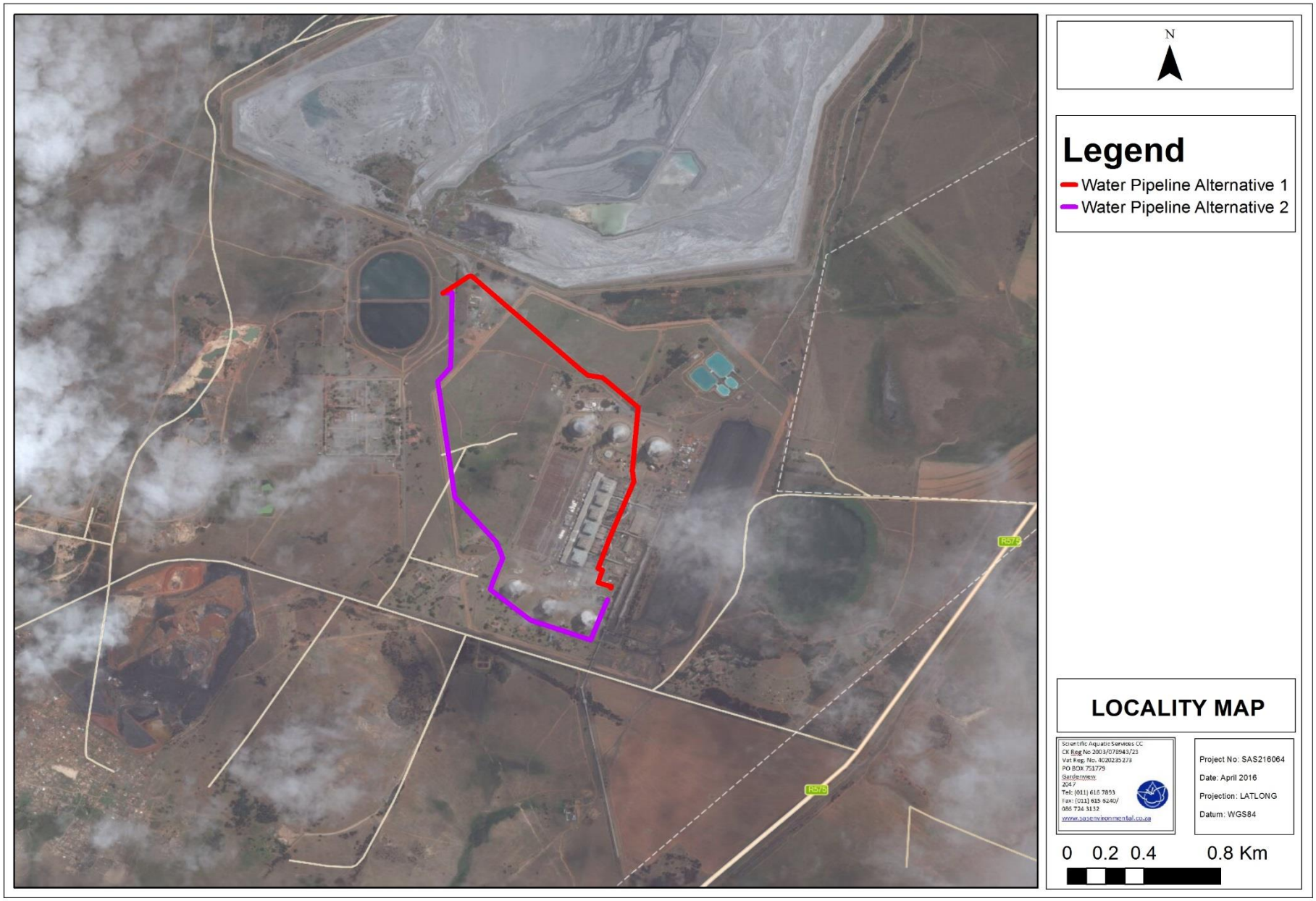


Figure 2: Digital Satellite image depicting the location of the study area in relation to surrounding areas.

1.2 Project Scope

Specific outcomes in terms of this report are outlined below:

Ecological Assessment:

- To define the Present Ecological State (PES) of the terrestrial ecological resources in the vicinity of the study area;
- To provide faunal and floral inventories of species encountered on site;
- To conduct a Species of Conservation Concern (SCC) assessment, including potential for such species to occur or to have occurred within the study area;
- To determine and describe habitats, communities and ecological state of the study area;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and any other ecologically important features, if present; and
- To determine the environmental impacts that the construction of the development might have on the terrestrial ecology associated with the study area, as well as potential impacts on the ecology due to activities related to the proposed development and to develop mitigation and management measures for all phases of the development.

Wetland Assessment:

- To define the Present Ecological State (PES) of each wetland system associated with the study area;
- To characterise the identified HGM Units according to the Classification System for Wetlands (Ollis *et al*., 2013);
- To determine the functioning of each system and the environmental and socio-cultural services that the system provide;
- To advocate a Recommended Ecological Category (REC) for each wetland feature;
- To delineate all wetlands or riparian zones occurring within the assessment site and
- To determine the environmental impacts of the proposed activity on the wetland areas associated with the study area; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving aquatic environment.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The results represented in this report are based on the baseline ecological assessment undertaken by SAS in 2015, thus the assessment undertaken in April 2016 was performed in order to update the existing data and provide an ecological opinion on the anticipated impact of the water pipeline alternatives;
- The ecological assessment is confined to the study area and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral and faunal communities have been accurately assessed and considered;
- Due to the nature and habits of most faunal taxa and the high level of surrounding anthropogenic activities, it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations were compared with literature studies where necessary;
- The wetland delineation as presented in this report is based on the full ecological assessment undertaken in 2015 and is regarded as a best estimate of the wetland boundary based on the site condition present at the time of the assessment in 2015 and verified in April 2016, and limitations in the accuracy of the delineation due to disturbances created by grazing, existing development and anthropogenic disturbances are deemed possible; and
- Wetland and terrestrial areas form transitional areas where an ecotone is formed as vegetation species change from terrestrial species to facultative and obligate wetland species. Within the transition zone some variation of opinion on the wetland boundary may occur, however if the Department of Water Affairs (DWA), 2005 method is followed, all assessors should get largely similar results.

1.4 Legislative Requirements

The following legislative requirements were considered during the assessment:

- National Environmental Management Act (NEMA) (Act 107 of 1998);
- National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004);
- Conservation of Agricultural Resources Act (CARA, Act 43 of 1983);
- National Water Act (NWA; Act 36 of 1998).

The details of each of the above, as they pertain to this study, are provided in Appendix A of this report.

2. ASSESSMENT APPROACH

2.1 General Approach

In order to accurately determine the PES of the study area and capture comprehensive data with respect to the terrestrial ecology, the following methodology was used:

- Maps, aerial photographs and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. The results of this analyses were then used to focus the field work on specific areas of concern and to identify areas where target specific investigations were required;
- A literature review with respect to habitats, vegetation types and species distribution was conducted;
- Relevant databases considered during the assessment of the study area included the South African National Biodiversity Institute (SANBI) Threatened Species Programme (TSP), the Mpumalanga Biodiversity Sector Plan (MBSP, 2014), Mucina and Rutherford (2006), National Biodiversity Assessment (NBA), Important Bird Areas (IBA) in conjunction with the South African Bird Atlas Project (SABAP2), International Union for Conservation of Nature (IUCN), and Pretoria Computer Information Systems (PRECIS);
- An initial visual on-site assessment of the study area was conducted during April 2016 in order to confirm the assumptions made during consultation of the maps and to determine the ecological status of the study area. A thorough ‘walk through’ on foot was undertaken in order to identify the occurrence of the dominant floral species and habitat diversities;
- Specific methodologies for the assessment, in terms of field work and data analysis of faunal, floral and wetland ecological assemblages are presented in Appendices B, C and D; and

- An impact assessment was undertaken including the development of mitigation measures according to the method outlined in Appendix E.

2.2 Sensitivity Mapping

All the ecological features of the study area were considered and sensitive areas / habitat were delineated with the use of a Global Positioning System (GPS). In addition, identified locations of SCC and SANBI protected species were also marked by means of a GPS. A Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps.

3. RESULTS OF THE DESKTOP ANALYSIS

3.1 Conservation Characteristics of the study area

The following table contain data accessed as part of the desktop assessment. It is important to note, that although all data sources used provide useful and often verifiable high quality data, the various databases do not always provide an entirely accurate indication of the study area's actual biodiversity characteristics.

Table 1: Summary of the conservation characteristics for the study area.

Footprint Area	NBA (2011)	Threatened Ecosystem (2011)	Vegetation Type (M&R, 2006)	Biome (M&R, 2006)	Bioregion (M&R, 2006)	SAPAD (2015)	IBA (2015)
Alternative 1 & 2	Not Protected	EN	Eastern Highveld Grassland & Rand Highveld Grassland	Grassland	Mesic Highveld Grassland	None	None

IBA = Important Bird Area; ESA = Ecological Support Area; NBA= National Biodiversity Assessment; M&R= Mucina and Rutherford; SAPAD= South Africa Protected Areas Database.

Table 2: Summary of the conservation characteristics for the study area.

Footprint Area	MBSP Terrestrial (2014)	Description	MBSP Freshwater (2014)	Description
Alternative 1 & 2	CBA Optimal	The CBA Optimal Areas are areas optimally located to meet both various biodiversity targets and other criteria defined in the analysis. Although these areas are not 'irreplaceable' they are the most efficient land configuration to meet all	Heavily Modified	All areas currently modified to such an extent that any valuable biodiversity and ecological function has been lost.

Footprint Area	MBSP Terrestrial (2014)	Description	MBSP Freshwater (2014)	Description
		biodiversity targets and design criteria.		
	Heavily Modified	All areas currently modified to such an extent that any valuable biodiversity and ecological functions have been lost.	ESA Wetlands	All non-FEPA wetlands. Although not classed as FEPAs, these wetlands support the hydrological functioning of rivers, water tables and freshwater biodiversity, as well as providing a host of ecosystem services through the ecological infrastructure that they provide.
	Moderately Modified-Old Lands	Old cultivated lands that have been allowed to recover (within the last 80 years), and support some natural vegetation. Although biodiversity pattern and ecological functioning may have been compromised, the areas may still play a role in supporting biodiversity and providing ecosystem services.	Other Natural Areas	Areas that have not been identified as priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions.

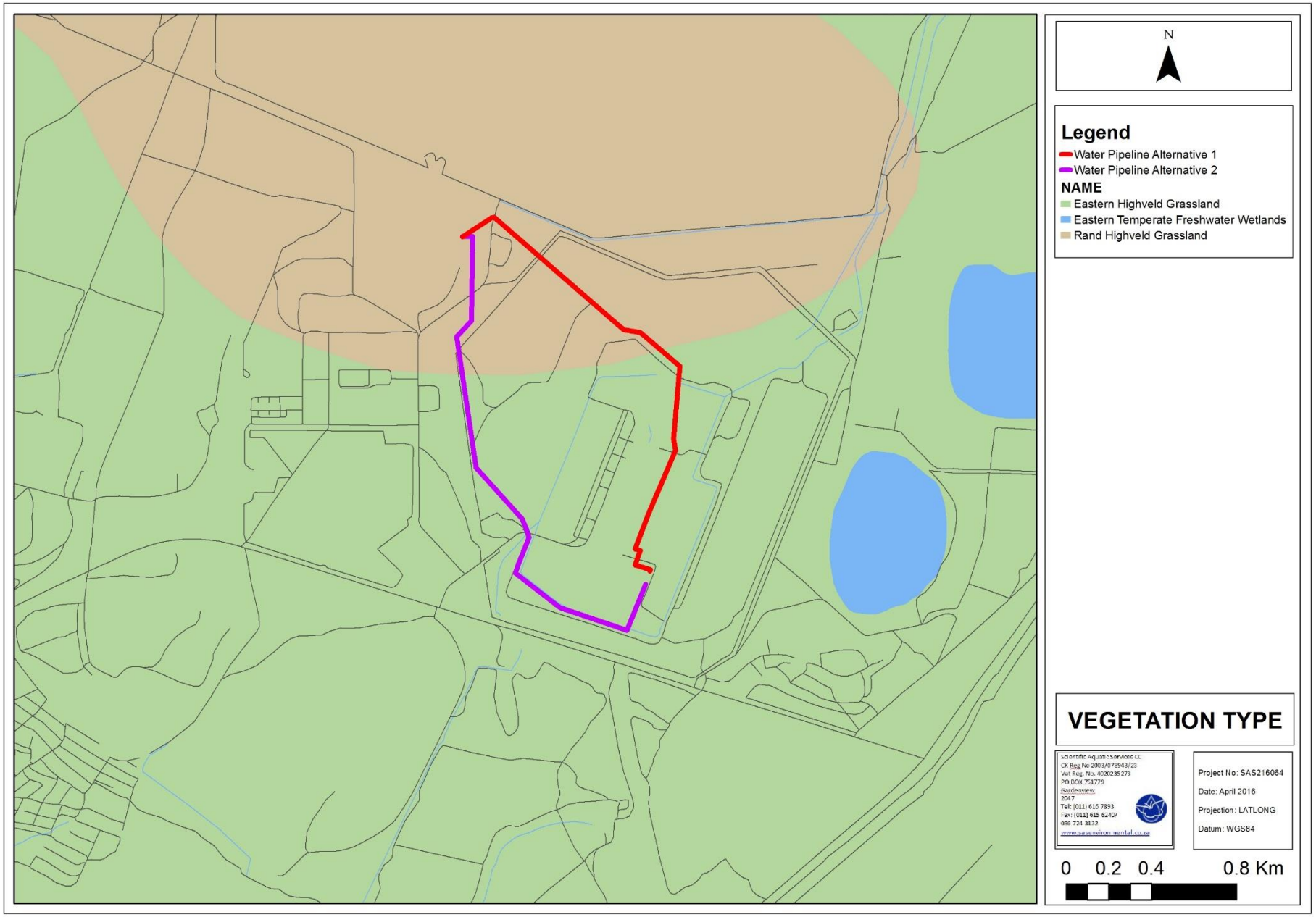


Figure 3: Vegetation types associated with the study area and surrounding area (Mucina & Rutherford, 2006).

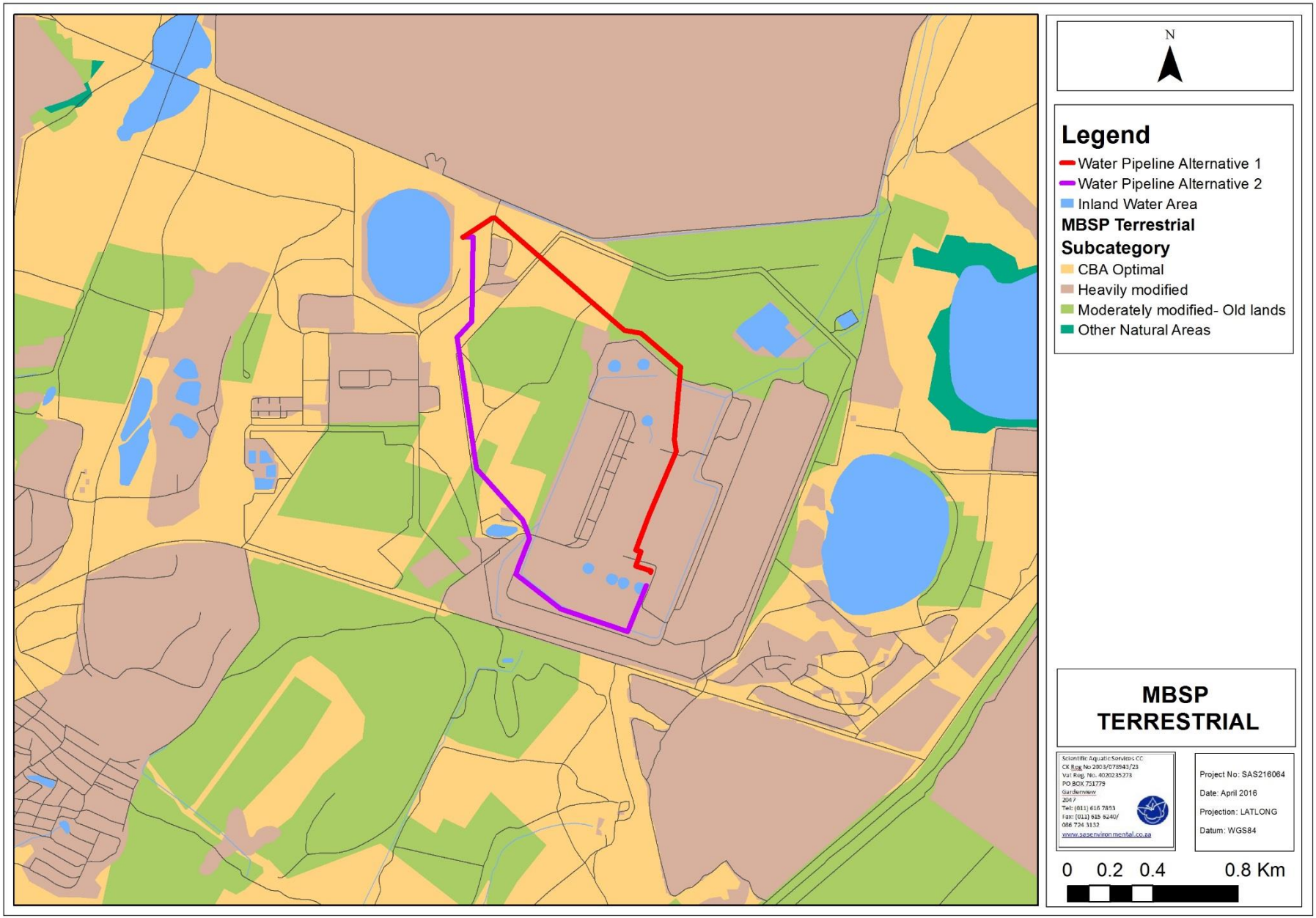


Figure 4: MBSP Terrestrial Biodiversity Assessment associated with the study area and its surroundings (MBSP, 2014).

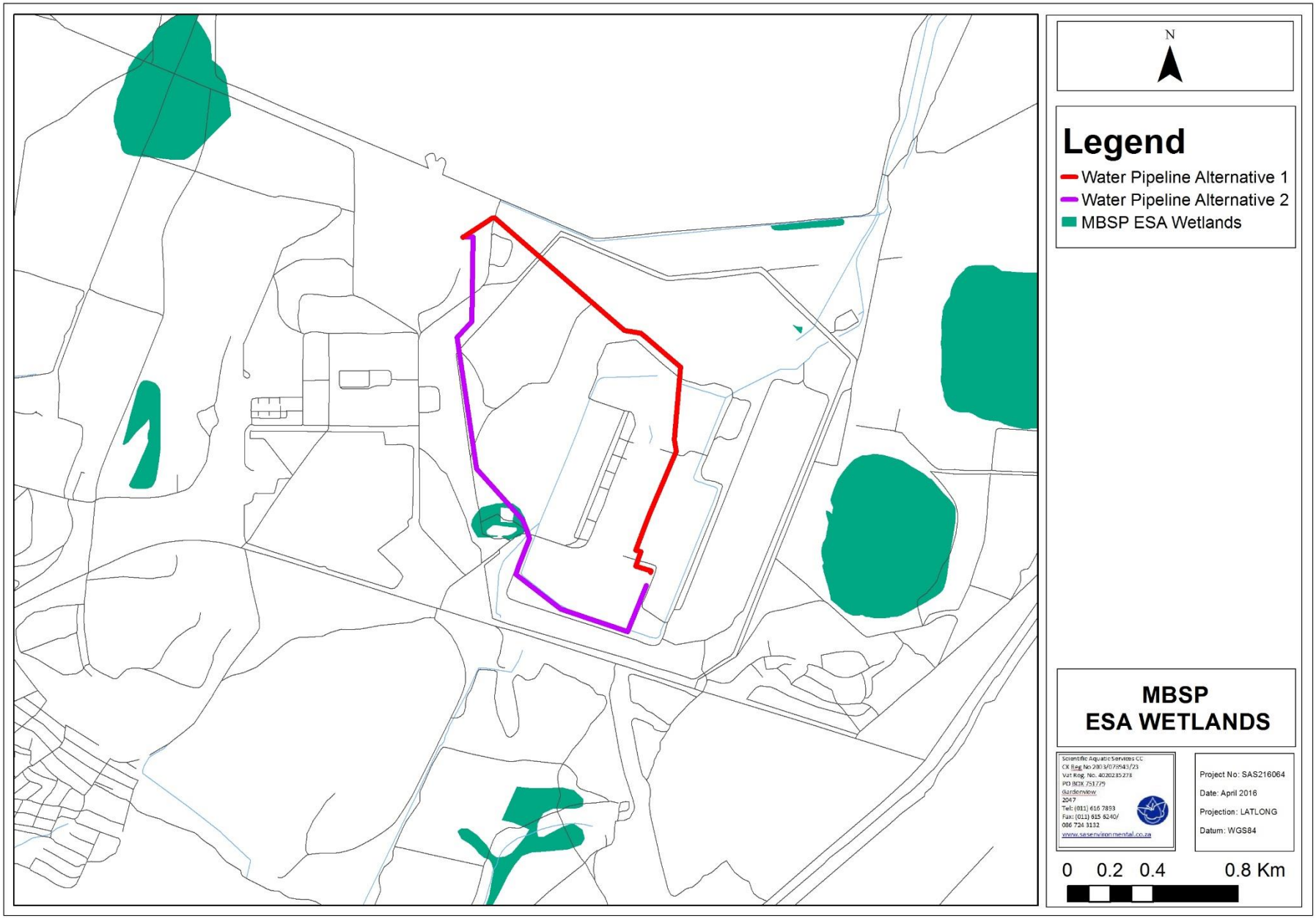


Figure 5: MBSP Freshwater Assessment indicating ESA wetlands associated with the study area and surroundings.

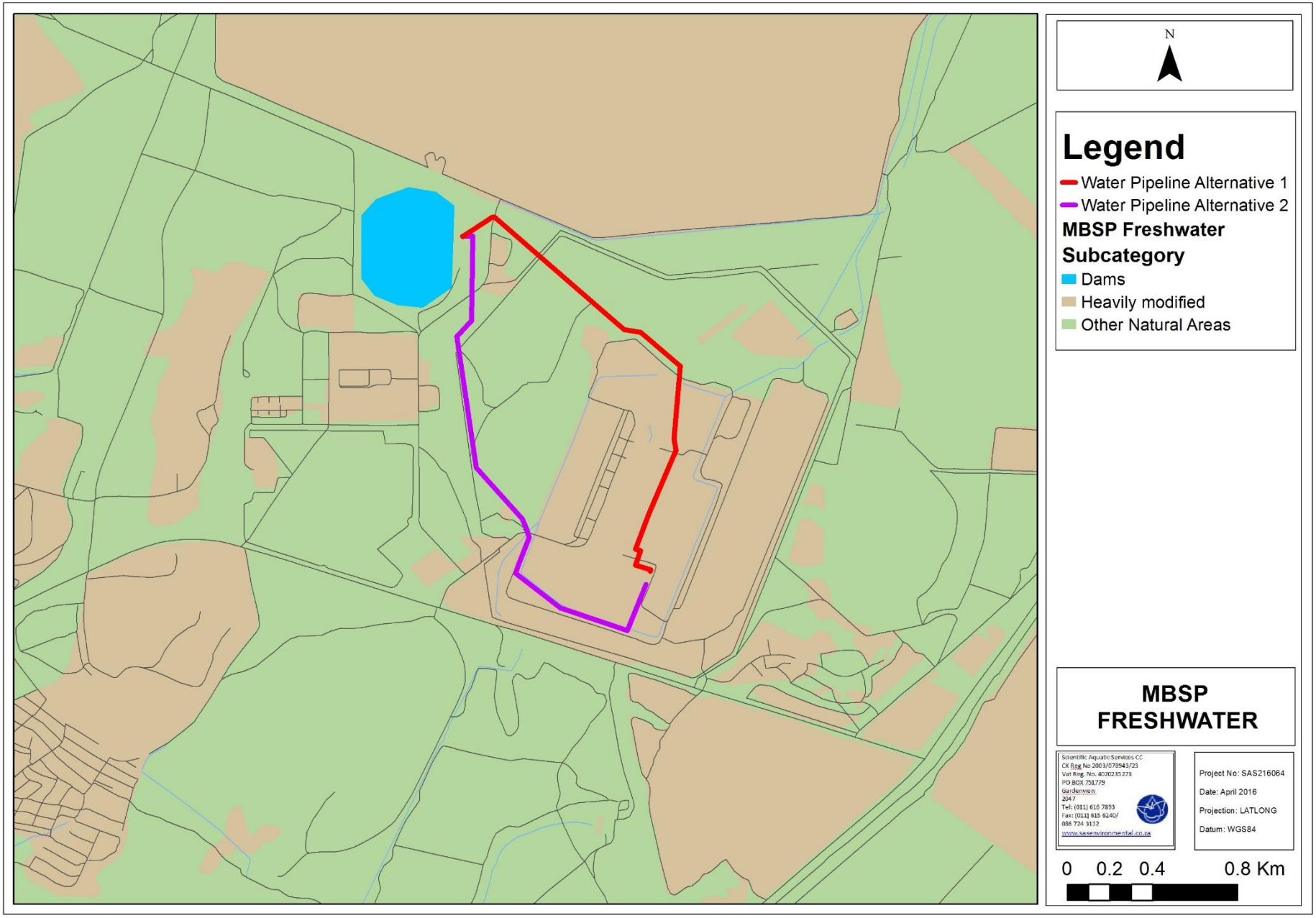


Figure 6: MBSP Freshwater Assessment indicating associated with the study area and surroundings.

3.2 Aquatic ecoregions

When assessing the aquatic ecology of any area, it is important to know within which aquatic ecoregion the study area is located. This knowledge allows for improved interpretation of data, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment.

Table 3: Aquatic Ecoregions, Quaternary Catchments and Quarter Degree Squares (QDS) of the study area.

	Catchment	Quaternary Catchment	Aquatic Ecoregion	QDS
Alternative 1 & 2	Olifants	B11G	Highveld	2529CD

QDS= Quarter Degree Square

3.3 National Freshwater Ecosystem Priority Areas (NFEPA; 2011)

The National Freshwater Ecosystem Priority Areas (NFEPA) database was consulted to define the aquatic ecology of any wetland and riverine systems that are located within or in close proximity to the study area that may be of ecological importance.

Aspects applicable to the study area is summarised in the table below:

Table 4: Aspects applicable to the study area according to the NFEPA database

	WMA	SubWMA	FEPACODE	NFEPA Wetlands	Wetveg	NFEPA Rivers
Alternative 1	Olifants	Upper Olifants	0 = No importance	None	Mesic Highveld Grassland Group 4	None
Alternative 2	Olifants	Upper Olifants	0 = No importance	One artificial and two natural wetlands traversed	Mesic Highveld Grassland Group 4	None

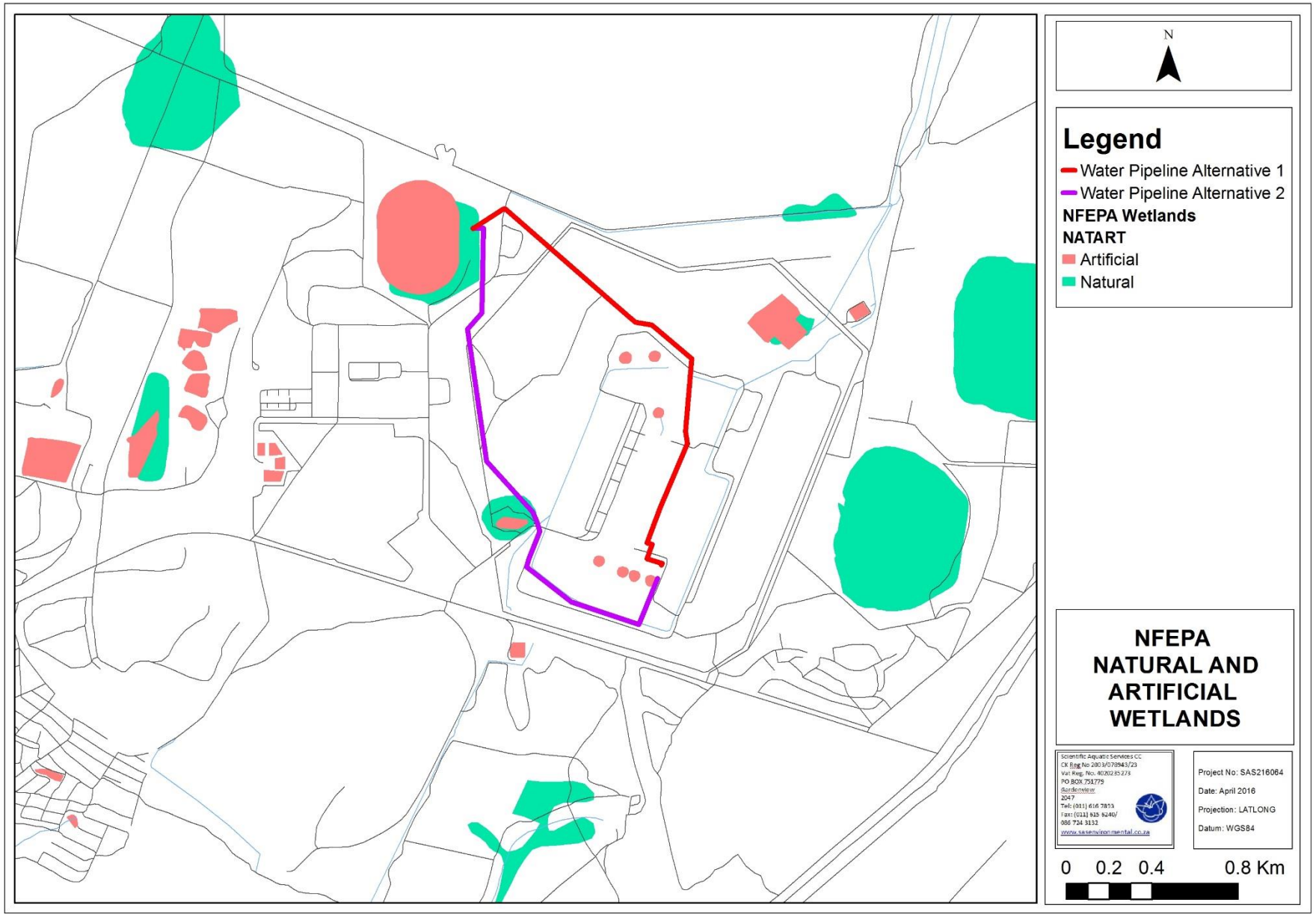


Figure 7: Wetlands associated with the study area according to NFEPA (2011).

4. RESULTS OF THE FLORAL SCAN

4.1 Habitat Units

Two habitat units were identified during the assessment, namely transformed habitat and wetland habitat, with the figure below depicting these habitat units in relation to the study area. The majority of the study area is considered to be the transformed habitat unit, and the water pipeline alternative 2 traverses the wetland habitat unit. The results of the assessment are presented in the figure and tables below.

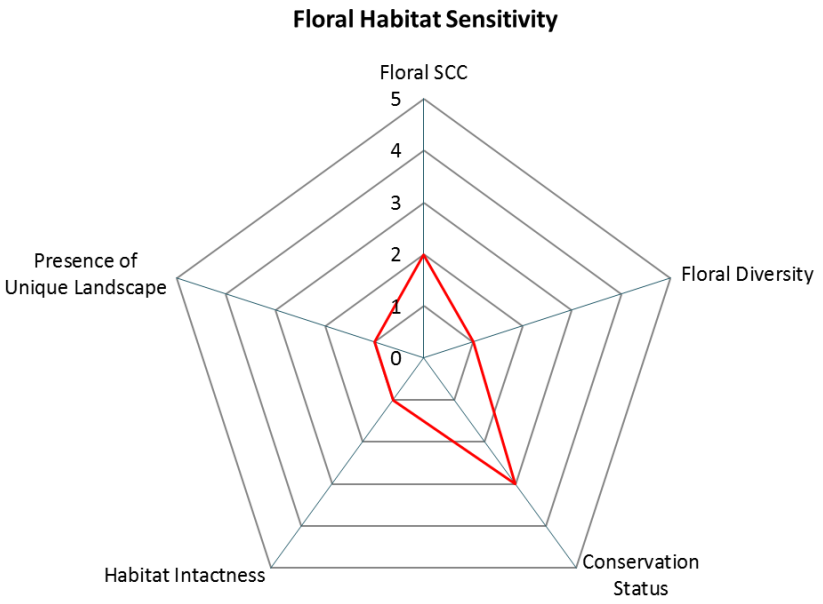
The transformed habitat unit is considered to be in a modified ecological condition, with significantly high levels of transformation (historic agricultural activities, vegetation cleared/ mowed as part of maintenance activities around the power station, and buildings associated with the Eskom Duvha Power station). In addition, significant alien proliferation has taken place due to soil disturbance and overgrazing.

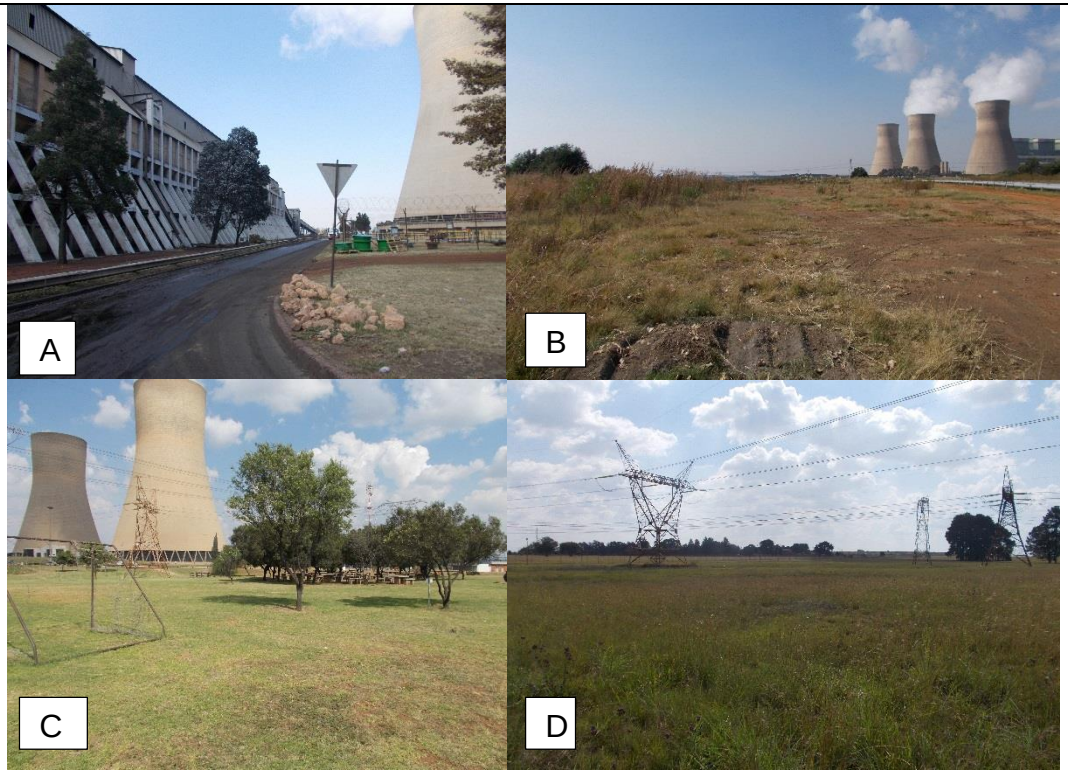
The wetland habitat unit comprises an artificial wetland which formed as a result of altered topography associated with the construction of the Duvha Power station, which led to localised ponding and the establishment of facultative and obligate wetland floral species (SAS (b), 2015). This feature was not considered to be a natural wetland as defined in the DWAF, 2005: “A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones”. However, it was still assessed as it provides habitat for faunal and floral species within the Duvha power station footprint. The wetland habitat unit has been affected by edge effects from the power station, road construction, historic agriculture and general anthropogenic activities, which has negatively affected the habitat integrity of this system.

Figure 8: Habitat units encountered within the study area.

Table 5: Summary of results of the floral assessment

Habitat Unit: Transformed Habitat Unit Wetland Habitat Unit	**Floral Habitat Sensitivity**	**Low**
	Notes on Photograph: Typical view of both habitat units associated with the study area. Photograph A to C represents the transformed habitat unit and photograph D represents the wetland habitat unit.	
Floral Habitat Sensitivity Graph:		
Floral Species of Conservation Concern (SCC)	During the field assessment one *Boophane disticha,* which is considered a medicinal floral SCC with a declining threat status (IUCN 2016), was encountered within the transformed habitat unit. Furthermore, this species is also protected under the Mpumalanga Nature Conservation Act (MNCA) of 1998. It is recommended that all *B. disticha* be rescued and relocated to nearby suitable habitat, outside of the development footprint. It is unlikely that any floral SCC will be encountered within the wetland habitat unit, since suitable	





	habitat for floral SCC listed in the QDS 2529CD is not available.		
Floral Diversity	Floral diversity was considered to be low for both habitat units. Although numerous floral species were encountered during the field assessment, alien and invasive species were dominant within the transformed habitat unit, due to historic agricultural activities and current anthropogenic activities such as edge effects from roads and power station infrastructure, vegetation clearing and encroachment by *Datura ferox* and *D. stramonium*. Transformation has occurred within the transformed habitat unit to the degree that secondary grassland conditions prevail and alien and invader species abundance is high. The floral diversity within the wetland habitat unit is low and limited to species such as *Juncus effusus, Cyperus rupestris, Eragrostis plana,* and *Hyparrhenia tamba.* For a comprehensive species list refer to Appendix F.	**General comments:** The transformed habitat unit is characterised by low ecological functioning. Dominant grass species included *Cynodon dactylon, Paspalum notatum, Eragrostis plana* and *E. chloromelas*. These species are associated with transformation and usually grow in disturbed places such as old cultivated lands and along roadsides. In addition, the transformed habitat unit has a significant build-up of moribund material due to the natural burning regime being altered, which significantly reduces forb diversity. The wetland habitat unit is considered to be extensively modified, however since it provides niche habitat for common faunal and floral species within the Duvha power station footprint, it is considered to be of importance from an ecological perspective in relation to the surrounding terrestrial areas (SAS, 2015).	**Business Case, Conclusion and Mitigation Requirements:** The wetland and transformed habitat units is of low ecological importance and sensitivity. Construction related activities would therefore have a low impact on this habitat unit, since ongoing disturbance is present within the surrounding areas of the study area. Thus, no significant impact is anticipated should the development proceed. However, to prevent unnecessary impacts to the wetland habitat unit, pipeline alternative 1 is supported from an ecological perspective.
Conservation Status of Vegetation Type/Ecosystem	Although both vegetation types are classified as Endangered, limited vegetation representative of the vegetation types remains and the transformed habitat unit is dominated by floral species associated with disturbed areas. The wetland habitat unit has been affected to varying degrees by edge effects from the power station, road construction, historic agriculture and general anthropogenic activities, which has negatively affected the habitat integrity of this system (SAS, 2015).		
Habitat integrity/Alien and Invasive species	Habitat is severely transformed and dominated by alien species such as *Datura ferox, D. stramonium,* and *Bidens pilosa,* among other species within the transformed and wetland habitat units.		
Presence of Unique Landscapes	Except for the anthropogenic wetland, no other unique landscapes were present, however the transformed habitat unit provided suitable habitat for the floral SCC *B. disticha*.		

4.2 Floral SCC Assessment

An assessment considering the presence of any plant species of concern, as well as suitable habitat to support any such species was undertaken. The SANBI PRECIS Red Data Listed plants as well as the MNCA (1998) conservation list was acquired for the Quarter Degree Square (QDS) 2529CD.

Threatened species are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is a threatened species.

SCC are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare and Declining.

The SCC listed for the area together with their calculated Probability of Occurrence (POC) are tabulated in Appendix G. Table 3 Below represent those species that obtained a POC score of 60 or more.

Table 6: Floral SCC listed for the QDS that obtained a POC score of 60% or more.

Species	Habitat	POC	Motivation
Crinum bulbispermum	Near rivers, streams, seasonal pans and in damp depressions.	60%	This species will most likely occur around the waterbodies encountered in the 30m corridor of Alternative 2 as well as within the wetland habitat unit, however it was not recorded during assessment.
Hypoxis hemerocallidea	Widespread in the eastern part of southern Africa from the Eastern Cape to Botswana and Mozambique.	60%	This species will most likely occur throughout the study area. Not recorded during assessment.

During the field assessment, *Boophane disticha* was observed within the transformed habitat unit (Figure 7). *B. disticha* is considered to be ‘declining’ as a result of its high demand for medicinal use and is also protected under the Mpumalanga Nature Conservation Act (MNCA) of 1998. If individuals or communities of this species will be disturbed by construction activities, they must be relocated to suitable, similar habitat in close proximity to where they were removed from, but outside the disturbance footprint after obtaining the relevant permits from the Mpumalanga Tourism and Parks Agency (MTPA). This rescue and relocation plan must be implemented by a suitably qualified ecologist in the correct flowering season for the abovementioned species after obtaining the relevant permits from the MTPA.

Hypoxis hemerocallidea and *Crinum bulbispermum* are the most likely floral SCC to occur in the vicinity of the study area, especially around the artificial wetland and dam situated in close

proximity to alternative 2. Due to the severe vegetation transformation associated with alternative 1, it is unlikely that these species will occur within this footprint. Thus, from a floral SCC perspective, alternative 1 is preferred. Should alternative 1 be pursued as the preferred alternative, the impact on floral SCC is anticipated to be insignificant.

Figure 9: *Boophane disticha* observed on site, within the transformed habitat unit.

Furthermore, from the species listed in 2529CD QDS (Appendix G) it is unlikely that any other floral SCC will be encountered on site, due to ongoing anthropogenic activities associated with the area which result in a lack of suitable habitat for floral SCC. However, should any SCC be observed within the study area it should be rescued and relocated by a qualified specialist to suitable habitat in close proximity to the study area.

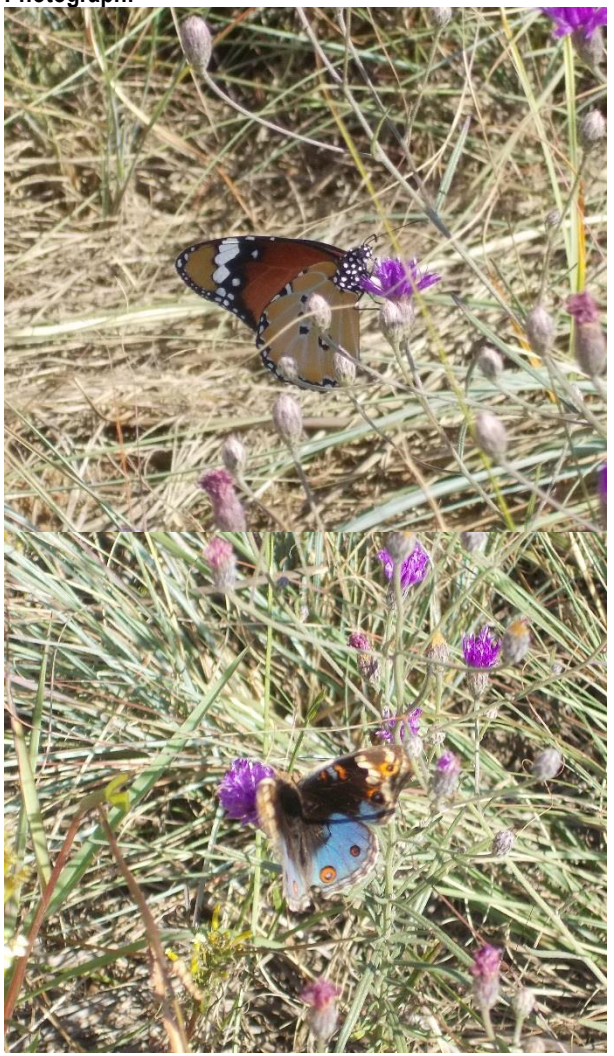
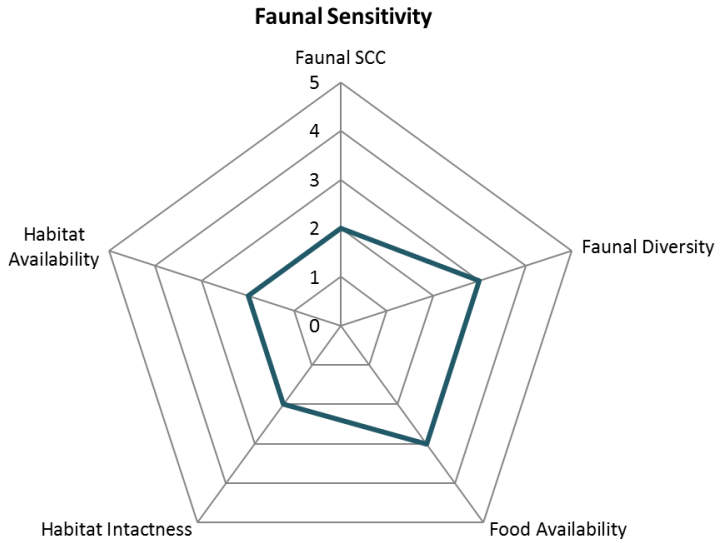
5. RESULTS OF THE FAUNAL SCAN

5.1 Habitat Description

After the site investigation it is evident that two faunal habitat units exist within the study area, namely the transformed habitat unit and the wetland habitat unit. The majority of the study area is considered to be the transformed habitat unit, and alternative 2 traverses the wetland habitat unit. Although the study area has undergone varying degrees of disturbance and transformation, the surrounding environment has suitable habitat for foraging for avifaunal and mammal species. The results of the assessment are presented in the figures and tables below.

Table 7: Summary of results of the faunal assessment

<table>
<tr><td rowspan="2">Faunal Class:

All classes</td><td>Faunal Habitat Sensitivity</td><td>Moderately Low</td><td rowspan="2">Photograph:
  </td></tr>
<tr><td colspan="2">Notes on Photograph: Danaus chrysippus (African monarch) (top) and Junonia orithya madagascariensis (Eyed pansy) (bottom) photographed during the field assessment</td></tr>
<tr><td colspan="3">Faunal Sensitivity Graph:
 
</td></tr>
<tr><td>Faunal SCC/Endemics/TOPS/</td><td colspan="3">No Faunal SCC were encountered during the field assessment. After the assessment of the study area's habitat availability and ability to support faunal SCC known to occur within the Mpumalanga Province, it was concluded that it is unlikely that any mammal, arachnid, amphibian, and invertebrate SCC will occur within the area. However, from the assessment undertaken in 2015, the avifaunal SCC Geronticus calvus (Southern Bald Ibis) was observed in the vicinity of the study area (SAS (c), 2015). However it is not anticipated that this species will utilise the study area for nesting or permanent habitation purposes.</td></tr>
</table>

Faunal Diversity	The faunal diversity within the study area was intermediate and comprised mainly of common avifaunal, invertebrate and mammal species. A number of common faunal species encountered during the field assessment include *Damaliscus pygargus phillipsi* (Blesbok), *Equus quagga* (Plains zebra), *Cynictis penicillata* (Yellow mongoose), *Orthetrum* species (Skimmer), *Musca domestica* (House fly), *Danaus chrysippus* (African Monarch), *Junonia hierta* (Yellow pansy), *Apis mellifera* (Honey bee) as well as avifaunal species such as *Streptopelia capicola (Cape turtle dove), Passer domestics (House sparrow),* and *Acridotheres tristis (Indian myna).* See Appendix F for species list.	**General comments (dominant faunal species/noteworthy records etc.):** The study area was noted to be largely disturbed in terms of faunal species abundance and diversity. The surrounding area does however provide suitable habitat for smaller mammal species and other common faunal species listed In Appendix F.	**Business Case, Conclusion and Mitigation Requirements:** The faunal habitat sensitivity of the study area is considered to be moderately low. Construction related activities would therefore have a low impact on the faunal habitat, as the habitat integrity is already considered to be highly disturbed and unlikely to support any faunal SCC.
Food Availability	Food resources are considered to be intermediate. This can be attributed to the number of seed bearing floral species present within the study area, resulting in food resources for various invertebrate, avifaunal and mammal species, therefore faunal species will be encountered within the study area.		
Habitat Intactness	Habitat intactness is considered to be moderately low. Habitat has however been degraded as a result of general habitat disturbance through anthropogenic activities associated with the power station.		
Habitat Availability	Habitat availability is considered to be moderately low. Although habitat degradation and transformation has occurred and alien floral species were present, the study area is still capable of providing habitat to a number of faunal species, albeit common and widespread species.		

5.2 Faunal SCC Assessment

During field assessments it is not always feasible to identify or observe all species within the study area, largely due to the secretive nature of many faunal species, possible low population numbers or varying habits of species. As such, and to specifically assess an area for faunal SCC, a Probability of Occurrence (POC) matrix is used, utilising a number of factors to determine the probability of faunal SCC occurrence within the study area. Species listed in Appendix H whose known distribution ranges and habitat preferences include the study area were taken into consideration.

Although no SCC were observed within the study area or surrounding areas, the possibility exists that some avifaunal SCC may utilise the study area for foraging purposes from time to time. Table 8 below lists the avifaunal SCC that have a POC>60% that may occur in the study area and surrounding area.

Table 8: Threatened faunal species with a 60% or greater Probability of Occurrence (POC) on the study area

Common Name	Scientific Name	Mpumalanga RDL status	IUCN Status	POC %
African Grass Owl	*Tyto capensis*	VU	LC	65
African Marsh Harrier	*Circus ranivorus*	VU	LC	63
Southern Bald Ibis	*Geronticus calvus*	VU	VU	100

VU = Vulnerable, LC = Least Concerned

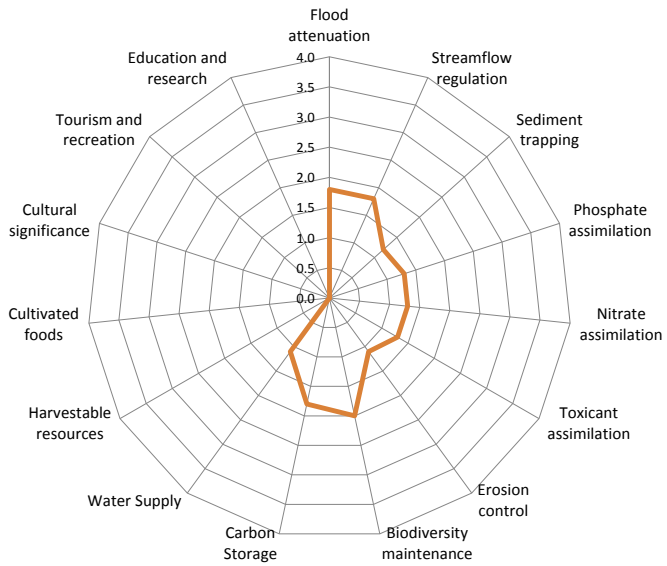
Should any faunal SCC listed in Appendix H of this report be encountered during the construction of the proposed development, all operations must be stopped immediately and a biodiversity specialist must be consulted and a suitable way forward must be sought to avoid any impacts on faunal SCC.

6. RESULTS OF WETLAND SCAN

One artificial wetland feature was identified within the footprint of alternative 2, which has formed as a result of altered topography associated with the construction of the Duvha power station, which has led to localised ponding and the establishment of facultative and obligate wetland floral species (SAS (d), 2015). This feature was not considered to be a natural wetland as defined in the DWAF, 2005: “A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones”. However, it was still assessed as it provides habitat for faunal and floral species within the Duvha power station footprint (SAS (d), 2015).

Resource: Artificial Wetland

Ecological & socio-cultural service provision graph:



HGM Unit	Channelled valley bottom wetland	**Fatal Flaw?**	**N**	**Photographs Notes**	Representative photograph of the artificial wetland traversed by alternative 2.
PES discussion	**PES Category: D** The feature has formed as a result of localised ponding due to topographic disturbances associated with the construction n of the Duvha powerstation. As a result, the feature is not as fully functional as a natural wetland would be. Furthermore, due to its anthropogenic nature, it is inherently disturbed (SAS, 2015)	**Business case, Conclusion and Mitigation Requirements:** This habitat unit is of low ecological sensitivity, however, it is not recommended that the wetland is unnecessarily disturbed as it provides niche habitat to fauna and flora associated with the study area. In this regard, it is strongly recommended that alternative 1 be considered as the preferred alternative. However, if alternative 2 is selected as the preferred alternative, it is important to limit the time of disturbance and limit the construction footprint. Furthermore, all construction related disturbance must be rehabilitated and connectivity up-and downstream of the disturbance must be reinstated.			
Ecoservice provision	**Moderately low:** The artificial wetland feature obtained a moderately low score, as it is artificial and not as fully functional as a true wetland. This feature is most important in terms of Phosphate, Nitrate and Toxicant assimilation as well as being important in terms of carbon storage and biodiversity maintenance (SAS, 2015).	**REC Category**	**Category: D**		
EIS discussion	**EIS Category: D** Wetlands that are not ecologically important and sensitive at any scale. This wetland feature did not score a high importance in terms of diversity, habitat and wetland function as it is of anthropogenic origin and thus inherently disturbed. However, due to the high score value (critical value) of the wetland vegetation group according to the NFEPA protection stated, this increased the overall score and value of the EIS of all wetland feature (SAS, 2015).				

7. SENSITIVITY MAPPING

The figure below conceptually illustrates the areas considered to be of increased ecological sensitivity. The areas are depicted according to their sensitivity in terms of the presence or potential for floral SCC, habitat intactness and levels of disturbance, threat status of the habitat type, the presence of unique landscapes and overall levels of diversity. The table below presents the sensitivity of each identified habitat unit along with an associated conservation objective and implications for development.

Table 9: A summary of sensitivity of each habitat unit and implications for development.

Habitat Unit	Sensitivity	Conservation Objective	Development Implications
Transformed Habitat Unit	Low	Historic and ongoing anthropogenic activities, such as historic agricultural activities, vegetation cleared/ mowed as part of maintenance activities around the power station, and buildings associated with the Eskom Duvha Power station, within this area have resulted in severe degradation of the habitat unit, and is therefore highly unlikely to support any faunal or floral SCC.	This habitat unit is of low ecological importance and sensitivity. Construction related activities would therefore have a low impact on this habitat unit, as no natural areas are present within this habitat unit. Thus, no significant impact is anticipated should the development proceed.
Wetland Habitat Unit	Low	The artificial wetland was allocated a 32m buffer as the feature provides important faunal and floral habitat within the Duvha power station footprint area. However, the feature itself is considered to be of low sensitivity. The National Environmental Management Act (Act 107 of 1998) stipulates that no activity can take place within 32m of a wetland without the relevant authorisation. In addition, the National Water Act (Act 36 of 1998) states that no diversion, alteration of bed and banks or impeding of flow in watercourses (which includes wetlands) may occur without obtaining a water use licence authorising the proponent to do so.	This habitat unit is of low ecological importance and sensitivity. Alternative 1 is proposed as the preferred alternative from an ecological conservation perspective. However, should the proponent choose alternative 2 that traverses the wetland feature, a water use license will be required before any construction related activities can take place.

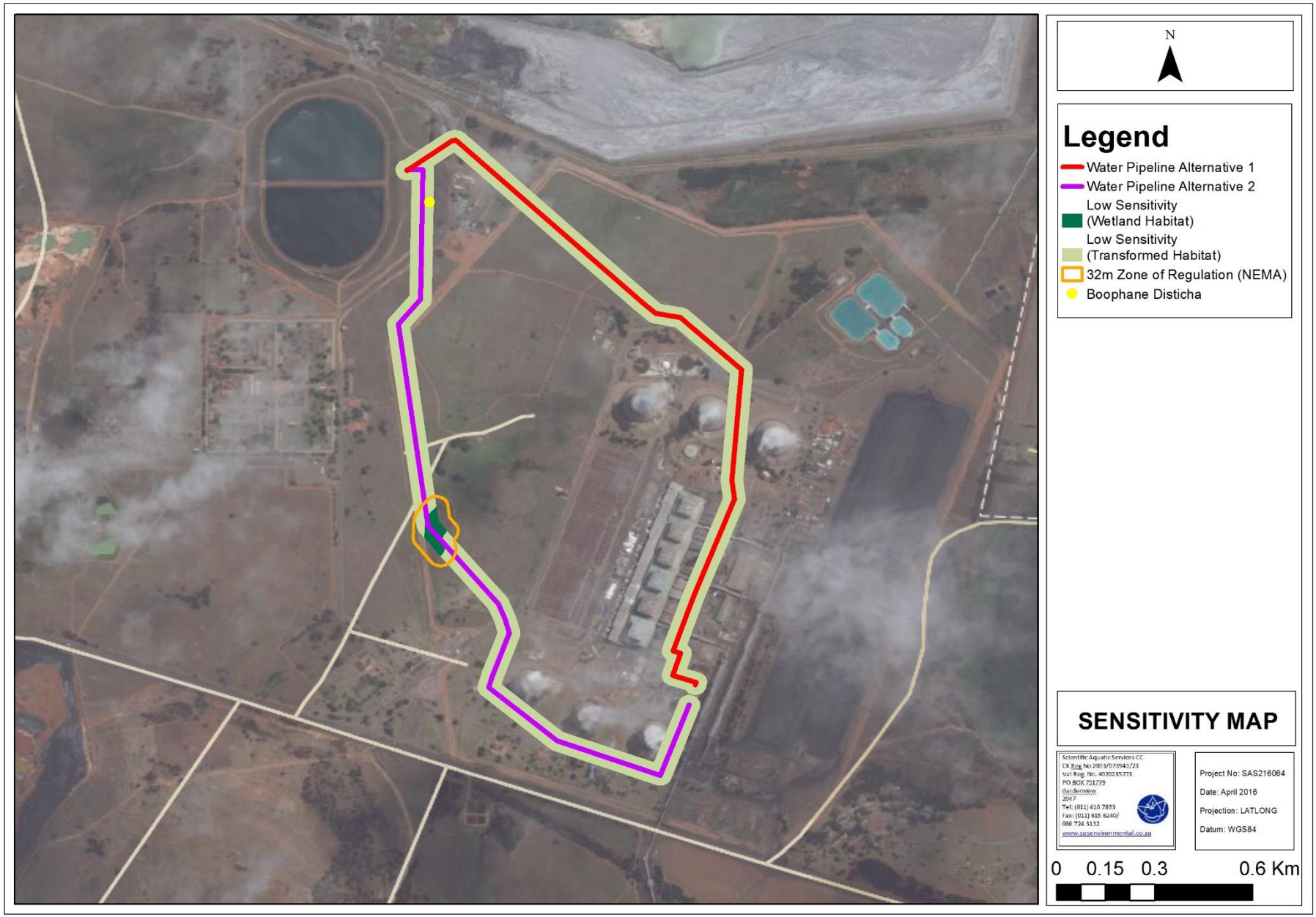


Figure 10: Sensitivity map of the study area.

8. IMPACT ASSESSMENT

The tables below serve to summarise the significance of perceived impacts on the terrestrial ecology and wetland ecology of the study area, with each individual impact identified presented in Section 8.1, 8.2 and 8.3 of this report. A summary of all potential pre-construction, construction and operational impacts is provided in Section 8.4.

The tables below present the impact assessment according to the method described in Appendix D. All impacts are considered without mitigation taking place as well as with mitigation fully implemented. All the required mitigatory measures needed to minimise the impact is presented in Section 8.5.

8.1 IMPACT 1: Impact on Floral Species of Conservation Concern

During the field assessment the floral SCC *B. disticha* was encountered within the transformed habitat unit. During construction activities, with special mention to vegetation clearing, it is proposed that individuals of this species will be removed and reolcated. Considering that the majority of the linear development footprint has been significantly transformed (transformed habitat unit) and the impact associated with the loss of habitat for this species is considered to be of low significance during the construction phase of the development, and low during the operational phase of the project prior to the implementation of mitigation measures. With the implementation of mitigation measures (notably the section of alternative 1 as the preferred alternative), the impact significance of the loss of important species may further be reduced (SAS (b), 2015).

Activities and aspects register

Pre-Construction	Construction	Operational
Planning of infrastructure placement and design within sensitive habitat	Site clearance and removal of important/ indigenous vegetation within wetland habitat	An increase in alien plant species leading to loss of medicinal plant species by outcompeting these species
	Construction of infrastructure and access roads through natural areas	Collection of medicinal floral species
	Increased anthropogenic activity and an increase in the collection of plant material for medicinal purposes	Maintenance activities such as vegetation clearing resulting in ongoing impact on floral SCC

	Increased fire frequency and intensity, as well as uncontrolled fires due to increased human activity may impact on plant communities	

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	3	3	3	4	5	10	50 (Low)
Operational phase	2	3	3	3	4	5	10	50 (Low)
Managed								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	1	3	2	2	3	4	7	28 (Low)
Operational phase	1	3	2	2	4	4	8	32 (Low)

8.2 IMPACT 2: Impact on Faunal Species of Conservation Concern

The proposed water pipeline is unlikely to have any impact on faunal SCC that occur within both within the Mpumalanga Province as well as on a national scale. This is mainly attributed to the already disturbed nature of the majority of the study area, as well as the pre-existing anthropogenic activities and infrastructure that already restrict the presence of sensitive faunal species within this area. The most suitable habitat for faunal SCC is associated with alternative 2 (artificial wetland), and as such is considered to be of increased importance in terms of faunal SCC. Should alternative 1 be considered as the preferred alternative and all related maintenance impacts be contained within the footprint area, and edge effects correctly managed, the construction of the pipeline will have a minimal impact on faunal SCC within the region.

Activities and aspects register

Pre-Construction	Construction	Operational/Maintenance
Planning of infrastructure placement and design within sensitive habitat	Increased poaching risk and fire hazards due to increased personnel on potential faunal SCC	Increased poaching and fire hazard which would lead to potential loss of SCC as well as the SCC habitat due to increased personnel
	Vehicles accessing the construction area through sensitive habitat areas	Vehicles accessing site through sensitive potential faunal SCC habitat areas

Pre-Construction	Construction	Operational/Maintenance
	Collision of vehicles with faunal species.	Collision of vehicles with faunal species.

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	2	2	2	2	4	4	7	28 (Low)
Operational phase	2	2	1	1	4	4	6	24 (Very Low)
Managed								
Managed	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	1	2	1	1	3	3	5	15 (Very Low)
Operational phase	1	2	1	1	4	3	6	18 (Very-Low)

8.3 IMPACT 3: Overall Impact on The Wetland Feature

Since the wetland traversed by alternative 2 provides potential habitat and migratory connectivity for faunal species as well as the potential to host a higher diversity of floral species, it is considered to be of importance in the maintenance of biodiversity and habitat provision. Development activities expected to most likely be the cause of loss wetland habitat and ecological structure include digging of the trench through the wetland to lay the water pipeline underground, or dumping of construction waste materials into the wetland area. Ineffective rehabilitation may lead to excessive erosion and the loss of wetland soils which in turn will lead to reduced wetland habitat availability and suitability for both faunal and floral species.

If alternative 1 is chosen as the preferred alternative, any significant impacts are unlikely, and with implementation of mitigation measures the impact significance may be reduced to low levels.

Activities and aspects register

Pre-Construction	Construction	Operational
Inconsiderate design of infrastructure leading to changes to wetland habitat	Site clearing and the removal of wetland vegetation	Insufficient aftercare and maintenance leading to ongoing erosion and increased sedimentation due to poor management

Pre-Construction	Construction	Operational
	Compaction of soils due to construction activities	Continuous introduction and proliferation of alien plant species and further transformation of natural habitat
	Site clearing and the disturbance of soils	
	Movement of construction vehicles as well as access road construction within wetland zones	
	Dumping waste and construction material within the wetland	
	Dumping of material leading to alien plant species proliferation	

Unmanaged								
	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	4	3	2	2	2	7	6	42 (Low)
Operational phase	2	3	2	2	2	5	6	30 (Low)
Managed								
Managed	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction phase	3	3	2	2	2	6	6	36 (Low)
Operational phase	1	3	1	1	1	4	3	18 (Very Low)

8.4 Impact Assessment Summary

The tables below summarises the findings indicating the significance of the impact on the receiving environment before mitigation takes place and the likely impact if management and mitigation takes place. In the consideration of mitigation, it is assumed that a high level of mitigation takes place but which does not lead to prohibitive costs. From the tables it is evident that prior to mitigation the impacts on floral and faunal SCC and wetland ecology are low significance impacts. If effective mitigation takes place, all impacts may be reduced to very-low significance impacts.

Table 10: A summary of the results obtained from the impact assessment for the construction phase.

Impact	Unmanaged	Managed
1: Impact on Floral Species of Conservation Concern	Low	Low
2: Impact on Faunal Species of Conservation Concern	Low	Very-Low

3: Overall impact on the wetland feature	Low	Low

Table 11: A summary of the results obtained from the impact assessment for the operational phase.

Impact	Unmanaged	Managed
1: Impact on Floral Species of Conservation Concern	Low	Low
2: Impact on Faunal Species of Conservation Concern	Very-Low	Very-Low
3: Overall impact on the wetland feature	Very-Low	Very-Low

8.5 Integrated Impact Mitigation

Mitigation measures

- From an ecological conservation perspective, it is recommended that alternative 1 be considered as the preferred alternative.
- Appropriate sanitary facilities must be provided for the construction phase and all waste removed to an appropriate waste facility;
- All soils compacted as a result of construction activities falling outside of the project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive vegetation control should take place throughout all phases to prevent loss of floral habitat;
- To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any drainage lines and areas susceptible to erosion. Stockpiles should be placed away from areas known to contain hazardous substances such as fuel and if any soils are contaminated, it should be stripped and disposed of at a registered hazardous waste dumping site;
- All areas of disturbed and compacted soils need to be ripped and reprofiled;
- No dumping of waste should take place. If any spills occur, they should be immediately cleaned up;
- Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil;
- The following applies to all individuals of *B disticha* encountered during the field assessment, as well as any other floral or faunal SCC encountered during the construction phase of the development within the study area;
    - Effective relocation of individuals to suitable similar habitat in the vicinity of the study area must be ensured:

- A rescue and relocation plan must be implemented, and all rescue and relocation activities should be overseen by a suitably qualified specialist;

- It is recommended that site clearing take place in a phased manner (where possible) to allow for any faunal species present to move away from the study area to the surrounding open space areas;
- No trapping or hunting of any faunal species are to take place during the construction phase within the study area or within the surrounding area;
- Upon completion of construction activities, it must be ensured that no bare areas remain and that indigenous grassland species are reintroduced (where possible);
- Informal fires by construction personnel within the study area should be prohibited; and
- It must be ensured that soil disturbance does not occur outside of the development footprint, as to ensure that further alien proliferation does not occur within the vicinity of the development footprint, which would further reduce the present ecological state of the surrounding area.

Possible latent impacts:

- Local loss of indigenous floral habitat and floral species; and
- Local loss of indigenous faunal habitat and faunal species.

9. CONCLUSION

Based on the terrestrial and wetland impact assessment of potential impacts on floral and faunal SCC as well as wetland ecology within the study area, it is evident that the impact on floral and faunal SCC are considered to be low prior to mitigation. These impacts can be lowered to low and very low levels for floral SCC and very low levels for faunal SCC should mitigation measures be put in place, and floral SCC species encountered during the field assessment and indicated in this report be rescued and relocated to suitable habitat outside the development footprint. The impacts on the wetland feature is also considered to be low prior to mitigation measure, and will be lowered to even lower levels once mitigation measures are adhered to. The impact on the wetland feature will be negligible if alternative 1 is considered the preferred alternative.

It is the opinion of the ecologists that, from a terrestrial and aquatic ecological point of view, the proposed development be considered favorably provided that the recommended mitigation measures for the identified impacts (as outlined in Section 8.1, 8.2 and 8.3) are adhered to. In addition, it is the opinion of the ecologists that alternative 1 is the preferred alternative, as it situated within the transformed habitat unit in its entirety.

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APPENDIX A – Legislative Requirements and Indemnity

Indemnity and Terms of use of this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and STS CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

National Environmental Management Act, 1998

The National Environmental Management Act (NEMA; Act 107 of 1998) and the associated Environmental Impact Assessment (EIA) Regulations (GN R982 of 2014) and well as listing notices 1, 2 and 3 (GN R983, R984 and R985 of 2014), state that prior to any development taking place which triggers any activity as listed within the abovementioned regulations, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment process or the EIA process depending on the nature of the activity and scale of the impact.

National Environmental Management Biodiversity Act (NEMBA, Act No. 10 of 2004)

The objectives of this act are (within the framework of NEMA) to provide for:

- The management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity;
- The use of indigenous biological resources in a sustainable manner;
- The fair and equitable sharing among stakeholders of the benefits arising from bio prospecting involving indigenous biological resources;
- To give effect to ratify international agreements relating to biodiversity which are binding to the Republic;
- To provide for cooperative governance in biodiversity management and conservation; and
- To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.

This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of the surrounding areas are not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of the benefits arising from indigenous biological resources.

Furthermore, a person may not carry out a restricted activity involving either:

a) A specimen of a listed threatened or protected species;
b) Specimens of an alien species; or
c) A specimen of a listed invasive species without a permit.

Conservation of Agricultural Resources Act (CARA, Act 43 of 1983)

Removal of the alien and weed species encountered in the application area must take place in order to comply with existing legislation (amendments to the regulations under the CARA, 1983 and Section 28 of the NEMA, 1998). Removal of species should take place throughout the construction and operation, phases.

National Water Act (NWA; Act 36 of 1998)

The NWA (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved;

- No activity may therefore take place within a watercourse unless it is authorised by DWS or registered;
- A watercourse is defined by the NWA as:
  - A river or spring;
  - A natural channel in which water flows regularly or intermittently;
  - A wetland, lake or dam into which, or from which, water flows; and
  - Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from DWA in terms of Section 21.

APPENDIX B – Floral Method of assessment

Floral Method of Assessment

Floral Species of Conservational Concern Assessment

Prior to the field visit, a record of floral SCC and their habitat requirements was acquired from SANBI for the Quarter Degree Square in which the study area is situated, as well as relevant regional, provincial and national lists. Throughout the floral assessment, special attention was paid to the identification of any of these SCC as well as the identification of suitable habitat that could potentially support these species.

The Probability of Occurrence (POC) for each floral SCC was determined using the following calculations wherein the distribution range for the species, specific habitat requirements and level of habitat disturbance were considered. The accuracy of the calculation is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Each factor contributes an equal value to the calculation.

Distribution						
	Outside of known distribution range					**Inside known distribution range**
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat availability						
	No habitat available					**Habitat available**
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat disturbance						
	0	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score						
EVC 1 score	5	4	3	2	1	0

[Distribution + Habitat availability + Habitat disturbance] / 15 x 100 = POC%

Floral Habitat Sensitivity

The floral habitat sensitivity of each habitat unit was determined by calculating the mean of five different parameters which influence floral communities and provide an indication of the overall floristic ecological integrity, importance and sensitivity of the habitat unit. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Floral SCC:** The confirmed presence or potential for floral SCC or any other significant species, such as endemics, to occur within the habitat unit;
- **Unique Landscapes:** The presence of unique landscapes or the presence of an ecologically intact habitat unit in a transformed region;
- **Conservation Status:** The conservation status of the ecosystem or vegetation type in which the habitat unit is situated based on local, regional and national databases;
- **Floral Diversity:** The recorded floral diversity compared to a suitable reference condition such as surrounding natural areas or available floristic databases; and
- **Habitat Integrity:** The degree to which the habitat unit is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the floral habitat sensitivity class in which each habitat unit falls. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the habitat unit in question. In order to present the results use is made of spider diagrams to depict the significance of each aspect of floral ecology for each vegetation type. The different classes and land-use objectives are presented in the table below:

Table 1: Floral habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1> and <2	Low	Optimise development potential.
2> and <3	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
3> and <4	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
4> and <5	Moderately high	Preserve and enhance the biodiversity of the habitat unit limit development and disturbance.
5	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.

APPENDIX C – Faunal Method of Assessment

Faunal Assessment Methodology

A reconnaissance 'walk through' on foot was undertaken to determine the general habitat types found throughout the study area. Special emphasis was placed on areas that may potentially support faunal SCC. Sites were investigated on foot in order to identify the occurrence of the dominant faunal communities, species and habitat diversities. The presence of any faunal inhabitants of the study area was also assessed through direct visual observation or identifying such species through calls, tracks, scats and burrows.

It is important to note that faunal species have varied life cycles, breeding patterns, and are subject to seasonal fluctuations. As such, it is unlikely that all faunal species will have been recorded during the site assessment. However, even though some faunal species may not have been identified during the sight assessment, the habitat units and degree of transformation can be used to establish an accurate understanding of faunal assemblages most likely associated with the study area.

Faunal Species of Conservational Concern Assessment

The Probability of Occurrence (POC) for each faunal SCC was determined using the following four parameters:

- Species distribution;
- Habitat availability;
- Food availability; and
- Habitat disturbance.

The accuracy of the calculation is based on the available knowledge about the species in question. Therefore, it is important that the literature available is also considered during the calculation.
Each factor contributes an equal value to the calculation.

Scoring Guideline				
Habitat availability				
No Habitat	**Very low**	**Low**	**Moderate**	**High**
1	2	3	4	5
Food availability				
No food available	**Very low**	**Low**	**Moderate**	**High**
1	2	3	4	5
Habitat disturbance				
Very High	**High**	**Moderate**	**Low**	**Very Low**
1	2	3	4	5
Distribution/Range				
Not Recorded		**Historically Recorded**		**Recently Recorded**
1		3		5

[Habitat availability + Food availability + Habitat disturbance + Distribution/Range] / 20 x 100 = POC%

Faunal Habitat Sensitivity

The sensitivity of the study area for each faunal class (i.e. mammals, birds, reptiles, amphibians and invertebrates) was determined by calculating the mean of five different parameters which influence each faunal class and provide an indication of the overall faunal ecological integrity, importance and sensitivity of the study area for each class. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Faunal SCC:** The confirmed presence or potential for faunal SCC or any other significant species, such as endemics, to occur within the habitat unit;

- **Habitat Availability:** The presence of suitable habitat for each class;
- **Food Availability:** The availability of food within the study area for each faunal class;
- **Faunal Diversity:** The recorded faunal diversity compared to a suitable reference condition such as surrounding natural areas or available faunal databases; and
- **Habitat Intactness:** The degree to which the habitat is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the suitability and sensitivity of the study area for each faunal class. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the study area in relation to each faunal class. The different classes and land-use objectives are presented in the table below:

Table 2: Faunal habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1> and <2	Low	Optimise development potential.
2> and <3	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
3> and <4	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
4> and <5	Moderately high	Preserve and enhance the biodiversity of the habitat unit limit development and disturbance.
5	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.

APPENDIX D - Impact Assessment Methodology

Ecological Impact Assessment Method

In order for the Environmental Assessment Practitioner (EAP) to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[1]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the Table 3. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance-rating matrix and are used to determine whether mitigation is necessary[2].

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National

[1] The definition has been aligned with that used in the ISO 14001 Standard.

[2] Some risks/impacts that have low significance will however still require mitigation.

Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table 3: Criteria for assessing significance of impacts

LIKELIHOOD DESCRIPTORS

Probability of impact	**RATING**
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	**RATING**
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

CONSEQUENCE DESCRIPTORS

Severity of impact	**RATING**
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**RATING**
Activity specific/ < 5 ha impacted / Linear developments affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Linear developments affected <	2
Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear developments affected <	3
Regional within 5 km of the site boundary / < 2000ha impacted / Linear developments affected < 3000m	4
Entire habitat unit / Entire system/ > 2000ha impacted / Linear developments affected > 3000m	5
Duration of impact	**RATING**
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5

Table 4: Significance Rating Matrix.

LIKELIHOOD (Frequency of activity + Frequency of impact)	CONSEQUENCE (Severity + Spatial Scope + Duration)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table 5: Positive/Negative Mitigation Ratings.

Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
Very high	126-150	Critically consider the viability of proposed projects Improve current management of existing projects significantly and immediately	Maintain current management
High	101-125	Comprehensively consider the viability of proposed projects Improve current management of existing projects significantly	Maintain current management
Medium-high	76-100	Consider the viability of proposed projects Improve current management of existing projects	Maintain current management
Medium-low	51-75	Actively seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Low	26-50	Where deemed necessary seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Very low	1-25	Maintain current management and/or proposed project criteria and strive for continuous improvement	Maintain current management and/or proposed project criteria and strive for continuous improvement

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for all stages of the project cycle including:
  - Pre-construction;
  - Construction; and
  - Operation.
- If applicable, transboundary or global effects were assessed.
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed development.

- *Mitigation* and *performance improvement measures* and actions that address the risks and impacts[3] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.
- Desired outcomes are defined, and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, with estimates of the *resources* (including human resource and training requirements) *and responsibilities for implementation.*

Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through to construction and operation.

[3] *Mitigation measures should address both positive and negative impacts*

APPENDIX E – Vegetation Types

Rand Highveld Grassland

Distribution

Rand Highveld Grassland occurs in Gauteng, North-West, Free State and Mpumalanga Provinces. In areas between rocky ridges from Pretoria to Witbank, extending onto ridges in the Stoffberg and Roossenekal regions as well as west of Krugersdorp centred in the vicinity of Derby and Potchefstroom, extending southwards and northwards from there. Altitude 1 300-1 635m, but reaches 1 760m in places.

Climate

Strongly seasonal summer-rainfall, warm-temperate region, with very dry winters. MAP is 654 mm, ranging between 570mm and 730mm, slightly lower in the western regions. The coefficient of variation of MAP is 28% in the west and 26-27% in the east and varies only slightly from 25% to 29% across the unit. The incidence of frost is higher in the west (30-40 days) than in the east (10-35 days).

Geology and Soils

Quartzite ridges of the Witwatersrand Supergroup and the Pretoria Group as well as the Selons River Formation of the Rooiberg Group (last two are of the Transvaal Supergroup), supporting soils of various quality (shallow Glenrosa and Mispah forms especially on rocky ridges), typical of Ba, Bc, Bb and Lb land types.

Conservation

The vegetation type is considered to be Endangered, with a conservation target of 24%, however it is poorly conserved (only 1%). Small patches protected in statutory reserves (Kwaggavoetpad, Van Riebeeck Park, Bronkhorstspruit, Boskop Dam Nature Reserve) and in private conservation areas (e.g. Doornkop, Zemvelo, Rhenosterpoort and Mpopomeni). Almost half has been transformed mostly by cultivation, plantations, urbanisation and dam-building. Cultivation may also have had impacts on additional portions 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. Scattered aliens (almost prominently *Acacia mearnsii)* occurs in about 7% of this unit. Only about 7% has been subjected to moderate to high erosion levels.

Dominant Floral Taxa

Highly variable landscape with extensive sloping and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrub land 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,* is also a typical feature. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra subsp. caffra, Protea welwitschii, Acacia caffra and Celtis africana,* accompanies by a rick suite of shrubs among which the genus *Sersia (S. magalismonata)* is most prominent.

Table E1: Dominant and typical floristic species of *Rand Highveld Grassland* (Mucina & Rutherford, 2006).

Grass species	Forb species	Tree/shrub species
Ctenium concinnum (d)	*Acanthospermum australe* (d)	*Anthospermum rigidum* subsp.
Cynodon dactylon (d)	*Justicia anagalloides* (d)	*pumilum*
Digitaria monodactyla (d)	*Pollichia campestris* (d)	*Indigofera comosa*
Diheteropogon amplectens (d)	*Acalypha angustata*	*Searsia magalismontana*
Eragrostis chloromelas (d)	*Chamaecrista mimosoides*	*Stoebe plumose*
Heteropogon contortus (d)	*Dicoma anomala*	*Lopholaena coriifolia* (d)
Loudetia simplex (d)	*Helichrysum caespititium*	*Elephantorrhiza elephantina*
Monocymbium ceresiiforme (d)	*Helichrysum nudifolium* var.	
Panicum natalense (d)	*nudifolium*	

Grass species	Forb species	Tree/shrub species
Schizachyrium sanguineum (d)	*Helichrysum rugulosum*	
Setaria sphacelata (d)	*Ipomoea crassipes*	
Themeda triandra (d)	*Kohautia amatymbica*	
Trachypogon spicatus (d)	*Lactuca inermis,*	
Tristachya biseriata (d)	*Macledium zeyheri sunsp.*	
Tristachya rehmannii (d)	*Argyrophylum*	
Andropogon schirensis	*Nidorella hottentotica*	
Aristida aequiglumis	*Oldenlandia herbacea*	
Aristida congesta	*Rotheca hirsuta*	
Aristida junciformis subsp. *galpinii*	*Selago densiflora*	
Bewsia biflora	*Senecio coronatus*	
Brachiaria nigropedata	*Sonchus dregeanus*	
Brachiaria serrata	*Vernonia oligocephala*	
Bulbostylis burchellii	*Xerophyta retinervis*	
Cymbopogon caesius	*Boophane disticha*	
Digitaria tricholaenoides	*Cheilanthes hirta*	
Elionurus muticus	*Haemanthus humilis* subsp. *humilis*	
Eragrostis capensis	*Hypoxis rigidula* var. *pilosissima*	
Eragrostis curvula	*Ledebouria ovatifolia*	
Eragrostis gummiflua	*Oxalis corniculata*	
Eragrostis plana	*Aloe greatheadii* var. *davyana*	
Eragrostis recemosa		
Hyparrhenia hirta		
Melinis nerviglumis		
Melinis repens subsp. repens		
Microchloa caffra		
Setaria nigrirostris		
Sporobolus pectinatus		
Trichoneura grandiglumis		
Urelytrum agropyroides		

Biographically Important Taxa

Geophytic herbs: *Agapanthus inapertus subsp. pendulus and Eucomis vandermerwei*
Succulent herb*: Huernia insigniflora*
Low shrub: *Melhanis randii*

Endemic taxa

Herbs: *Melanospermum rudolfii and Polygala spicata*
Succulent herb: *Anacampseros subnuda subsp. lubbersii and Frithia humilis*
Succulent shrubs: *Crassula arborescens subsp. undulatifolia and Delosperma purpureum*
Small trees: *Encephalartos lanatus and Encephalartos middelburgensis*

Eastern Highveld Grassland

Distribution

Eastern Highveld Grassland occurs in the Mpumalanga and Gauteng Provinces: It occurs in the plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief. Altitude ranges from 1520m to 1780m, but also declines as low as 1300m (Mucina & Rutherford, 2006).

Climate

Eastern Highveld Grassland is characterised by strongly seasonal summer rainfall, with very dry winters. The Mean Annual Precipitation (MAP) is between 650-900 mm (overall average: 726 mm),

MAP is relatively uniform across most of this unit, but increases significantly in the extreme southeast. The coefficient of variation in MAP is 25% across most of the unit, but drops to 21% in the east and southeast. Incidences of frost form (13-42 days) have been recorded, but increase at higher elevations (Mucina & Rutherford, 2006).

The Mean Annual Soil Moisture Stress (MASMS) value for the region is 73%. These values, when compared to the MAT and MAPE averages of 14.7°C and 1,926mm, respectively, show the region to be a relatively water-stressed area. Conservation of surface (and ground) water resources is therefore imperative to biodiversity conservation within the region.

Table E2: General climatic information for the *Eastern Highveld Grassland* (Mucina & Rutherford, 2006).

Bioregion	Vegetation types	Altitude (m)	MAP* (mm)	MAT* (°C)	MAPE* (mm)	MASMS* (%)
Mesic Highveld Grassland	*Eastern Highveld Grassland*	1520 - 1780	726	14.7	1926	73

**MAP – Mean annual precipitation; MAT – Mean annual temperature; MAPE – Mean annual potential evaporation; MASMS – Mean annual soil moisture stress (% of days when evaporative demand was more than double the soil moisture supply).*

Geology and soils

The area is characterised by red to yellow sandy soils of Ba and Bb land types found on shale's and sandstones of Madzaringwe formation (Karoo Super group), which are prominent throughout the *Eastern Highveld Grassland* (Mucina & Rutherford, 2006).

Conservation

Eastern Highveld Grassland is considered *Endangered.* Only a very small fraction is conserved in statutory reserves (Nooitgedacht Dam and Jericho Dam Nature Reserves) and in private reserves (Holkranse, Kransbank, Morgenstond). Some 44% is transformed primarily by cultivation, plantations, mines, and urbanisation and by building of dams. Cultivation may have had a more extensive impact, indicated by land-cover data. No serious alien invasions are reported, but *Acacia mearnsii* can become dominant in disturbed areas. Erosion is very low (Mucina & Rutherford, 2006).

Dominant Floral Taxa

In terms of recent vegetation classifications, the assessed area occurs within the *Eastern Highveld Grassland* vegetation type (Mucina & Rutherford, 2006). This vegetation occurs in slightly to moderately undulating plains including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual Highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya* etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Acacia caffra, Celtis africana, Diospyros lyciodes* subsp *lyciodes, Parinari capensis, Protea caffra, P. welwitschii and Rhus magalismontanum*).

Table E3: Dominant and typical floristic species of *Eastern Highveld Grassland* (Mucina & Rutherford, 2006).

Grass species	Forb species	Tree/Shrub species
Aristida aequiglumis *A. congesta* *A. junciformis subsp. galpinii* *Brachiaria serrata* *Cynodon dactylon* *Digitaria monodactyla* *D. tricholaenoides* *Elionurus muticus* *Eragrostis chloromelas* *E. curvula* *E. plana* *E. racemosa*	*Aloe ecklonis* *Gladiolus crassifolius* *Haemanthus humilis subsp. hirsutus* *Hypoxis rigidula var. pilosissima* *Ledebouria ovatifolia* *Berkheya setifera* *Haplocarpha scaposa* *Justicia anagalloides* *Pelargonium luridum* *Acalypha angustata* *Chamaecrista mimosoides*	*Anthospermum rigidium* subsp. *pumilum* *Stoebe plumosa*

E. sclerantha *Heteropogon contortus* *Loudetia simplex* *Microchloa caffra* *Monocymbium ceresiiforme* *Setaria sphacelata* *Sporobolus africanus* *Sporobolus pectinatus* *Themeda triandra* *Trachypogon spicatus* *Tristachya leucothrix* *T. rehmannii* *Alloteropsis semialata subsp. eckloniana* *Andropogon appendiculatus* *A. schirensis* *Bewsia biflora* *Ctenium concinnum* *Diheteropogon amplectens* *Harpochloa falx* *Panicum natalense* *Rendlia altera* *Schizachyrium sanguineum* *Setaria nigrirostris* *Urelytrum agropyroides*	*Dicoma anomala* *Euryops gilfillanii* *E. transvaalensis subsp. setilobus* *Helichrysum aureonitens* *H. caespititium* *H. callicomum* *H. oreophilum* *H. rugulosum* *Ipomoea crassipes* *Pentanisia prunelloides subsp. latifolia* *Selago densiflora* *Senecio coronatus* *Vernonia oligocephala* *Wahlenbergia undulata.*	

APPENDIX F- Species List

Table F1: Dominant floral species encountered in the linear development. Alien species are indicated with an asterisk (*). Also indicated are species falling within an alien invasive category as per the National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, 2014.

Grass/sedge/reed species	Forb & Herb Species	Tree/Shrub Species
Aristida bipartata	*Acalypha angustata*	*Seriphium plumosum*
Aristida congesta subsp. congesta	**Tagetes minuta*	**Acacia mearnsii*
Cynodon dactylon	**Bidens pilosa*	**Eucalyptus camaldulensis* **1b**
Digitaria tricholaenoides	**Bidens Formosa*	**Melia azedarach* ***3 (Urban areas)***
Digitaria eriantha	*Pelargonium luridum*	*Sida rhombifolia*
Eragrostis curvula	*Helichrysum kraussii*	
Eragrostis chloromelas	**Asclepias fruticosa*	
Hyparrhenia hirta	**Conyza albida*	
Themeda triandra	**Conyza bonariensis*	
Harpochloa falx	**Campuloclinium macrocephalum* ***1b***	
Pogonarthria squarrosa	**Verbena bonariensis*	
Cymbopogon plurinodis	*Vernonia oligocephala*	
Sporobolus africanus	*Vernonia poskeana*	
Paspalum notatum	**Alternanthera pungens*	
Perotis patens	**Richardia brasiliensis*	
Brachiaria brizantha	**Amaranthus hybridus*	
Schoenoplectus corymbosus	*Tragopogon dubius*	
Melinis repens	*Cucumus zeyheri*	
Juncus effusus	*Commelina Africana* var. *krebsiana*	
Cyperus rupestris	*Boophane disticha*	
Eragrostis plana	*Babiana hypogea*	
Hyparrhenia tamba	**Canna* sp.	
	Cyanotis speciosa	
	Helichrysum species	
	Datura stramonium* **1b	
	Datura ferox* **1b	
	**Schkuhria pinnata*	
	Solanum elaeagnifolium* **1b	
	Persicaria lapathifolia	

1a: Category 1a – Invasive species that require compulsory control.
1b: Category 1b – Invasive species that require control by means of an invasive species management programme.
2: Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.
3: Category 3 – Ornamentally used plants that may no longer be planted; existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

Table F2: Mammal species recorded during the field surveys as well as their IUCN status.

Scientific Name	Common Name	IUCN
Damaliscus pygargus phillipsi	Blesbok	LC
Equus quagga	Palins Zebra	LC

Scientific Name	Common Name	IUCN
Cynictis penicillata	Yellow mongoose	LC

Table F3: Avifaunal species recorded during the field surveys as well as their 2016 IUCN status.

Scientific Name	Common Name	IUCN
Hirundo rustica	Barn Swallow	*LC*
Vanellus armatus	Blacksmith lapwing	
Lamprotornis nitens	Cape Glossy Starling	*LC*
Passer melanurus	Cape Sparrow	*LC*
Streptopelia capicola	Cape Turtle Dove	*LC*
Bubulcus ibis	Cattle egret	
Acridotheres tristis	Common Myna	*LC*
Apus apus	Common Swift	*LC*
Vanellus coronatus	Crowned Lapwing	*LC*
Pycnonotus tricolor	Dark-capped Bulbul	*LC*
Bostrychia hagedash	Hadeda Ibis	*LC*
Numida meleagris	Helmeted Guineafowl	*LC*
Passer domesticus	House Sparrow	*LC*
Streptopelia senegalensis	Laughing Dove	*LC*
Ploceus velatus	Southern masked weaver	
Euplectes orix	Southern Red Bishop	*LC*
Ploceus cucullatus	Village Weaver	*LC*

Table F4: Invertebrate species recorded during the site survey.

Order	Family	Scientific Name	Common Name	IUCN 2016
Lepidoptera	Pieridae	*Belenois aurota*	Brown-veined White	NYBA
		Eurema hecabe	Common grass Yellow	NYBA
	Nymphalidae	*Junonia hierta*	Yellow pansy	LC
		Danaus chrysippus	African monarch	NYBA
		Junonia orithya madagascariensis	Eyed pansy	NYBA
		Vanessa cardui	Painted lady	NYBA
	Pieridae	*Pontia helice helice*	Meadow white	
		Eurema brigitta brigitta		
Diptera	Calliphoridae	*Musca domestica*	House fly	NYBA
Orthoptera	Acrididae	*Ancanthacris ruficornis*	Garden locust	NYBA
Hymenoptera	Apidae	*Apis mellifera scutellata*	African honey bee	NYBA
Odonata	Libellulidae	*Orthetrum* species	Skimmer	LC
	Acrididae	*Rhachitopis* species		

APPENDIX G – Floral SCC

Table 9: PRECIS plant list and GDARD Conservation list for the QDS 2529CD (Raimondo *et al*., 2009; SANBI, www.sanbi.org).

Species	Habitat	POC	Motivation
Crinum bulbispermum	Near rivers, streams, seasonal pans and in damp depressions.	60%	This species will most likely occur around the waterbodies encountered in the 30m corridor of Alternative 1, however it was not recorded during assessment.
Crinum macowanii	Mountain grassland and stony slopes in hard dry shale, gravely soil or sandy flats.	40%	This species will most likely occur around Alternative 1. Not recorded during assessment.
Pachycarpus suaveolens	Short or annually burnt grasslands, 1400-2000 m.	40%	Moderate habitat suitability, however habitat transformation lessens the probability of occurring. Not recorded during assessment.
Ilex mitis var. mitis	Along rivers and streams in forest and thickets, sometimes in the open. Found from sea level to inland mountain slopes.	0%	No suitable habitat present and highly unlikely to occur.
Callilepis leptophylla	Grassland or open woodland, often on rocky outcrops or rocky hill slopes.	0%	No suitable habitat in the form of rocky outcrops present. Not recorded during assessment.
Hypoxis hemerocallidea	Widespread in the eastern part of southern Africa from the Eastern Cape to Botswana and Mozambique.	60%	This species will most likely throughout the linear development. Not recorded during assessment.
Khadia carolinensis	Well-drained, sandy loam soils among rocky outcrops, or at the edges of sandstone sheets, Highveld Grassland, 1700 m.	0%	No suitable habitat in the form of rocky outcrops or sheets present. Not recorded during assessment.
Pavetta zeyheri subsp. middelburgensis	Outcrops of rocks and boulders or rocky sheets.	0%	No suitable habitat in the form of rocky outcrops or sheets present. Not recorded during assessment.
Encephalartos lanatus	Sheltered, wooded ravines in sandstone ridges, 1 200-1 500 m.	0%	No suitable habitat found within the study area to support this species.

APPENDIX H – Faunal SCC

Appendix H1: RDL Mammalian species that occur in the Mpumalanga Province (MP SoER, 2003).

English Name	Species	Status
Cape mole rat	*Georychus capensis yatesi*	**EN**
Sclater's golden mole	*Chlorotalpa sclateri montana*	**CR**
Highveld golden mole	*Amblysomus septentrionalis*	**VU**
Rough-haired golden mole	*Chrysospalax villosus rufopallidus*	**CR**
Rough-haired golden mole	*Chrysospalax villosus rufus*	**EN**
Juliana's golden mole	*Neamblysomus julianae*	**EN**
Robust golden mole	*Amblysomus robustus*	**VU**
Meester's golden mole	*Amblysomus hottentotus meesteri*	**VU**
Laminate vlei rat	*Otomys laminatus*	**VU**
Peak-saddle horseshoe bat	*Rhinolophus blasii empusa*	**EN**
Lesser long-fingered bat	*Miniopterus fraterculus*	**VU**
Welwitsch's hairy bat	*Myotis welwitschii*	**EN**
Short-eared trident bat	*Cloeotis percivali australis*	**EN**
Antbear	*Orycteropus afer*	**NE**
Oribi	*Ourebia ourebi*	**VU**
African striped weasel	*Poecilogale albinucha*	**NE**
Wild dog	*Lycaon pictus*	**EN**

Pangolin	*Manis temminckii*	**VU**
Aardwolf	*Proteles cristatus*	**NE**
African Leopard	*Panthera pardus*	**NE**
Natal red rock rabbit	***Pronolagus crassicaudatus ruddi***	**NE**

LC = Least concerned, CE = Critically Endangered, E = Endangered, VU = Vulnerable, NT = Near Threatened. NYBA = Not yet been assessed by the IUCN.

Appendix H2: List threatened bird species which occur in Mpumalanga (MP SoER, 2003).

English Name	Species	Status
Whitewinged Flufftail	*Sarothrura ayresi*	CR
Rudd's Lark	*Heteromirafra ruddi*	CR
Yellowbreasted Pipit	*Hemimacronyx chloris*	VU
Bald Ibis	*Geronticus calvus*	VU
Botha's Lark	*Spizocorys fringillaris*	EN
Wattled Crane	*Bugeranus carunculatus*	CR
Blue Crane	*Anthropoides paradiseus*	VU
Grey Crowned Crane	*Balearica reguloru,*	VU
Blue Swallow	*Hirundo atrocaerulea*	CR
Pinkthroated Twinspot	*Hypargos margaritatus*	NT
Chestnutbanded Plover	*Charadrius pallidus*	NT
Striped Flufftail	*Sarothrura affinis*	VU
Southern Ground Hornbill	*Bucorvus leadbeateri*	VU
Blackrumped Buttonquail	*Turnix hottentotta nana*	EN
Blue Korhaan	*Eupodotis caerulescens*	VU
Stanley's Bustard	*Neotis denhami*	VU
African Marsh Harrier	*Circus ranivorus*	VU
Grass Owl	*Tyto capensis*	VU
Whitebellied Korhaan	*Eupodotis cafra*	VU
Saddlebilled Stork	*Ephippiorhynchus senegalensis*	CR
Lappetfaced Vulture	*Torgos tracheliotos*	EN
Whiteheaded Vulture	*Trigonoceps occipitalis*	EN
Bateleur	*Terathopius ecaudatus*	VU
Cape Vulture	*Gyps coprotheres*	VU
Martial Eagle	*Polemaetus bellicosus*	VU
Peregrine Falcon	*Falco peregrinus minor*	VU
Taita Falcon	*Falco fasciinucha*	NT

LC = Least concerned, CE = Critically Endangered, E = Endangered, VU = Vulnerable, NT = Near Threatened. NYBA = Not yet been assessed by the IUCN. T = listed as threatened but with no specific status for the Limpopo Province.

Appendix H3: Threatened amphibian species of Mpumalanga (SoER, 2003).

English Name	Species	Status
Karoo Toad	Bufo gariepensis nubicolus	VU
Natal Ghost Frog	Heleophryne natalensis	VU
Spotted Shovel-Nosed Frog	Hemisus guttatus	VU
Yellow Striped Reed Frog	Hyperolius semidiscus	VU
Plain Stream Frog	Strongylopus wageri	VU
Giant Bullfrog	Pyxicephalus adspersus	VU
Greater Leaf-Folding Frog	Afrixalus fornasinii	VU
Whistling Rain Frog	Breviceps sp.	VU

LC = concerned, CE = Critically Endangered, E = Endangered, VU = Vulnerable, NT = Near Threatened, P = Peripheral. NYBA = Not yet been assessed by the IUCN.Least

Appendix H4: Threatened reptile species of Mpumalanga (MP SoER, 2003).

English Name	Species	Status
Haacke's flat gecko	Afroedura haackei	EN
Abel Erasmus Pass flat gecko	Afroedura sp.	EN
Mariepskop flat gecko	Afroedura sp.	EN
Rondavels flat gecko	Afroedura sp.	EN
Forest/Natal purpleglossed snake	Amblyodipsas concolor	VU

Lowveld shieldnosed snake	Aspidelaps scutatus intermedius	VU
Dwarf chameleon	Bradypodion transvaalense complex	VU
Sungazer/ Giant girdled lizard	Cordylus giganteus	VU
Barberton girdled lizard	Cordylus warreni barbertonensis	VU
Lebombo girdled lizard	Cordylus warreni warreni	VU
Swazi rock snake	Lamprophis swazicus	VU
Transvaal flat lizard	Platysaurus orientalis orientalis	NT
Wilhelm's flat lizard	Platysaurus wilhelmi	VU
Montane burrowing skink	Scelotes mirus	LC
Breyer's longtailed seps	Tetradactylus breyeri	VU

R = Rare, DD = Data Deficient, LC = Least concerned, CE = Critically Endangered, E = Endangered, VU = Vulnerable, NT = Near Threatened, P = Peripheral. NYBA = Not yet been assessed by the IUCN.

Appendix H5: Threatened invertebrate species of Mpumalanga (SoER, 2003).

English Name	Species	Status
Barbara's Copper	*Aloeides barbarae*	EN
Cloud Copper	*Aloeides nubilis*	VU
Rossouw's Copper	*Aloeides rossouwi*	EN
Stoffberg Widow	*Dingana fraterna*	EN
Irving's Blue	*Lepidochrysops irvingi*	VU
Swanepoel's Blue	*Lepidochrysops swanepoeli*	EN
Jeffery's Blue	*Lepidochrysops jefferyi*	EN
Rossouw's Blue	*Lepidochrysops rossouwi*	VU
Marsh Sylph*	*Metisella meninx*	VU

R = Rare, DD = Data Deficient, LC = Least concerned, CE = Critically Endangered, E = Endangered, VU = Vulnerable, NT = Near Threatened. NYBA = Not yet been assessed by the IUCN. T = listed as threatened but with no specific status for the Limpopo Province. * Very little detailed or general information exists on terrestrial invertebrates in the Limpopo Province, thus in general there is very little consolidated information regarding invertebrates (Limpopo DFED, 2004).

Avifaunal Species for the pentad 2600_2750 within the QDS 2529CD.

http://sabap2.adu.org.za/pentad_info.php?pentad=2600_2750&section=species

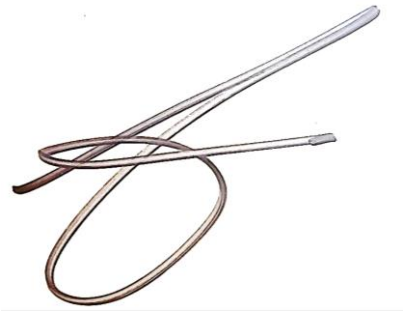
APPENDIX I – Declaration and Specialists CV's

Declaration

Declaration that the specialist is independent in a form as may be specified by the competent authority

I, Emile van der Westhuizen, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



Signature of the Specialist

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF EMILE BASSON VAN DER WESTHUIZEN

PERSONAL DETAILS

Position in Company	Ecologist, Botanist
Date of Birth	30 May 1984
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2008

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Candidate Member of the South African Council for Natural Scientific Professions (SACNASP) (Reg. Number 100008/15).

EDUCATION

Qualifications

BSc (Hons) Plant Science (University of Pretoria)	2012
B.Sc. Botany and Environmental Management (University of South Africa)	2010

Short Courses

Grass Identification – Africa Land Use Training	2009
Wild Flower Identification – Africa Land Use Training	2009

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Free State, Eastern Cape.
Mozambique (Tete, Sofala and Manica Provinces)
Democratic Republic of the Congo (Katanga and Kivu Provinces)
Ghana (Western and Greater Accra Provinces)

SELECTED PROJECT EXAMPLES

Floral Assessments

- Floral assessment for the proposed Modikwa Platinum Mine South 2 Shaft Project, Burgersfort, Limpopo Province.
- Floral assessment for the proposed New Clydesdale Colliery Stoping Project, Vandyksdrift, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Harriet's Wish PGM Project, Limpopo Province.
- Floral assessment as part of the environmental authorisation process for the proposed Shanduka Coal Argent Colliery in the vicinity of Argent, Mpumalanga.
- Floral assessment for the Auroch Resources Manica Gold Mining Project, Manica, Mozambique.
- Floral assessment for the Namoya Gold Mine project in Namoya, Democratic Republic of Congo.
- High level floral risk assessment and alternatives analysis for the proposed new Tete Airport, Tete, Mozambique.
- Floral assessment for the proposed Richardsbay Harbour Compactor Slab development, Richardsbay, Kwa-Zulu-Natal Province.
- Site walkdown and floral ecological input prior to the construction of the proposed 180km Mfolozi-Mbewu powerline, Richardsbay, Kwa-Zulu-Natal Province.
- Floral assessment as part of the EIA process for the proposed Peerboom Colliery, Lephalale, Limpopo Province.
- Floral assessment as part of the EIA process for the proposed Overvaal Underground Coal Mine Project, Ermelo, Mpumalanga Province.

- Floral assessment as part of the EIA process for the proposed King's City Takoradi 3000 hectare development, Takoradi, Ghana
- Floral assessment as part of the EIA process for the proposed Aquarius Platinum Fairway Platinum Mine, Steelpoort, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Geniland Lubumbashi City 4000 hectare development, Likasi, Katanga Province, Democratic Republic of Congo.
- Floral, faunal, aquatic and wetland assessment as part of the EIA process for the proposed Appollonia City Accra 3000 hectare development, Accra, Ghana.
- Floral assessment as part of the EIA process for the proposed Leeuw Colliery, Utrecht, Kwa-Zulu Natal Province.
- Floral assessment as part of the EIA process for the proposed Lubembe Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Kinsenda Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Lonshi Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Jozini Shopping Mall, Jozini, Kwa-Zulu Natal Province.
- Floral assessment as part of the Biodiversity Action Plan for the Assmang Chrome Dwarsrivier Mine, Steelpoort, Mpumalanga Province.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF SANJA SWANEPOEL

PERSONAL DETAILS

Position in Company	Ecologist, GIS Technician, Faunal Specialist
Date of Birth	8 April 1991
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2014

EDUCATION

Qualifications	
BSc Zoology	2013

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, KwaZulu-Natal

SELECTED PROJECT EXAMPLES

GIS Assessments

- Completed GIS mapping and GIS analysis for a significant number of ecological projects
- Desktop assessment of 45 wetland and river crossings identified along the proposed Fibreco Fibre Optic Cable Route changes between Cape Town to George, George to Port Elizabeth and from Port Elizabeth to Durban
- High level desktop ecological study and site sensitivity report as part of the site selection process for the possible Rapid Rail Extension to the Gauteng Rapid Rail Network
- Ecological scan and site sensitivity report as part of the environmental authorisation process prior to prospecting activities for two prospecting areas in Newcastle, Kwazulu-Natal

Wetland Assessments

- Illiso Consulting. Wetland and aquatic ecological assessment for the proposed N3 De Beers Pass Route.
- Wetland assessment as part of the environmental authorisation process for the proposed Sappi Enstra Mill Wastewater Pipeline in Springs
- Wetland Verification and Rehabilitation Criteria for Aspen Hills Estate
- Wetland Ecological Assessment for development in Shoshanguve, adjacent to Tshwane University of Technology
- Wetland assessment as part of the environmental authorisation process for the proposed Braakfontein Coal Mine near Newcastle, Kwazulu-Natal Province

Faunal Assessments

- Faunal assessment as part of the environmental authorisation process for the proposed New Belfast Mine Railway Siding, Mpumalanga
- Terrestrial ecological scan as part of the environmental authorisation process for the proposed construction of a sewer system in the Ekangala Township, Gauteng Province
- Faunal assessment as part of the environmental authorisation process for the Ledig Water Project near Pilanesberg National Park, North West Province
- Faunal assessment as part of the ecological assessment for the Op Goedenhoop Section 102 Coal Project, Mpumalanga Province

Rehabilitation Plan

- Wetland Rehabilitation and Management Plan for proposed mixed land use development (Kosmosdal extension 92) on the remainder of portion 2 of the farm Olievenhoutbosch 389 jr, Gauteng Province
- Wetland rehabilitation plan for Dorothy Road, Midrand, Gauteng Province

Risk Assessment

- Motivation for General Authorisation for the development of a pipeline at Sappi in Springs, Gauteng Province