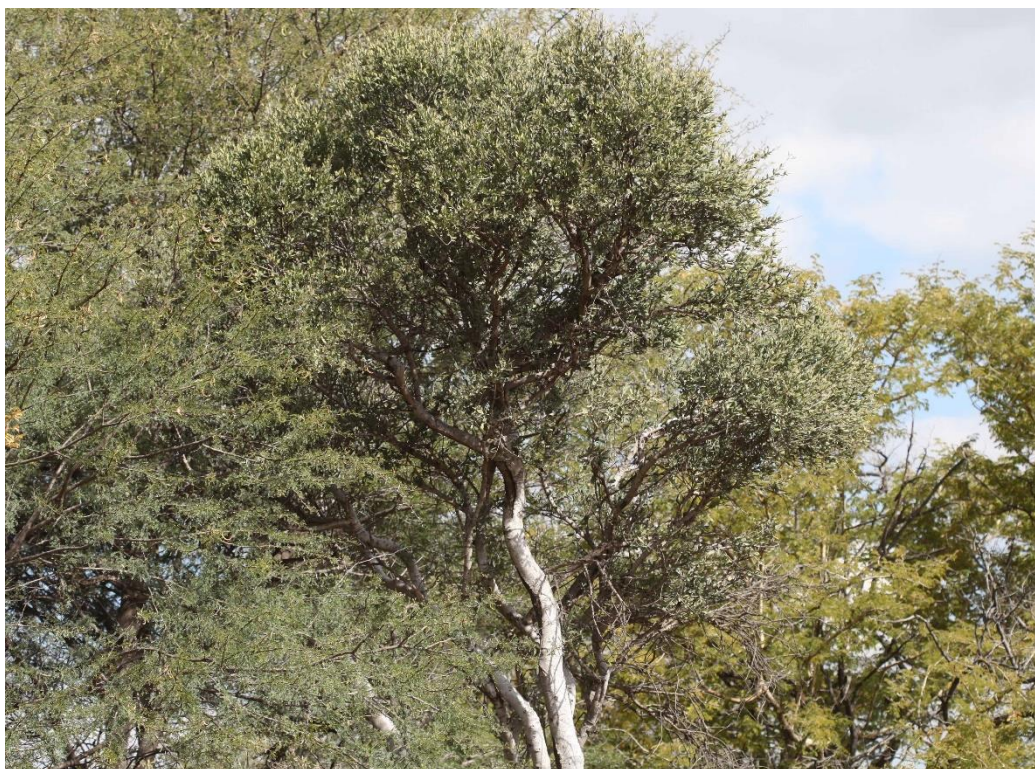


# ECOLOGICAL HABITAT SURVEY

## Proposed Lephalale Railway Yard and Borrow Areas, Lephalale, Limpopo Province, South Africa



*Boscia albitrunca* (Shepherd's Tree) at the site.  
Photo: R.F. Terblanche.

**April 2019**

**COMPILED BY:**

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(M.Sc, *Cum Laude*; Pr.Sci.Nat, Reg. No. 400244/05)

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## I) SPECIALIST EXPERTISE

### SYNOPTIC CV: REINIER. F. TERBLANCHE

Reinier is an ecologist and in particular a habitat specialist with an exceptional combination of botanical and zoological expertise which he keeps fostering, updating and improving. He is busy with a PhD for which he registered at the Department of Conservation Ecology at the University of Stellenbosch in July 2013. Reinier's experience includes being a lecturer in ecology and zoology at the North West University, Potchefstroom Campus (1998-2008). Reinier collaborates with a number of institutes, organizations and universities on animal and plant research.

#### Qualifications:

Qualification	Main subject matter	University
<b>M.Sc Cum Laude, 1998:</b> Botany: Ecology	Quantitative study of invertebrate assemblages and plant assemblages of rangelands in grasslands.	North-West University, Potchefstroom
<b>B.Sc Honns Cum Laude, 1992</b> Botany: Taxonomy	Distinctions in all subjects: Plant Anatomy 75, Taxonomy 84, Modern Systematics 82, System Modelling 75, Plant Ecology 75, Taxonomy Project 77, Statistics Attendance Course.	North-West University, Potchefstroom
<b>B.Sc</b> Botany, Zoology	Main subjects: Botany, Zoology.	North-West University, Potchefstroom
<b>Higher Education Diploma, 1990</b>	Numerous subjects aimed at holistic training of teachers.	North-West University, Potchefstroom

In research Reinier specializes in conservation biology, threatened butterfly species, vegetation dynamics and ant assemblages at butterfly habitats as well as enhancing quantitative studies on butterflies of Africa. He has published extensively in the fields of taxonomy, biogeography and ecology in popular journals, peer-reviewed scientific journals and as co-author and co-editor of books (see 10 examples beneath).

Reinier practices as an ecological consultant and has been registered as a Professional Natural Scientist by SACNASP since 2005: Reg. No. 400244/05. His experience in consultation includes: Flora and fauna habitat surveys, Threatened species assessments, Riparian vegetation index surveys, Compilation of Ecological Management Plans, Biodiversity Action Plans and Status quo of biodiversity for Environmental Management Frameworks, Wetland Assessments, Management of Rare Wetland Species.

Recent activities/ awards: Best Poster Award at Oppenheimer De Beers Group Research Conference 2015, Johannesburg. One of the co-authors of Guidelines for Standardised Global Butterfly Monitoring, 2015, Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany (UNEP-WCMC), GEO BON Technical Series 1. Most recent award: Awarded the prestigious Torben Larsen Memorial Tankard in October 2017; one is awarded annually to the person responsible for the most outstanding written account on Afrotropical Lepidoptera. Lectured as Conservationist-in-Residence in the Wildlife Conservation Programme of the African Leadership University, Kigali, Rwanda 9-23 February 2019.

## EXPERIENCE

Lecturer: Zoology 1998-2008	Main subject matter and level	Organization
Lectured subjects	- 3 <sup>rd</sup> year level Ecology, Plantparasitology - 2 <sup>nd</sup> year level Ethology - <i>Master's degree</i> Evolutionary Ethology, Systematics in Practice, Morphology and Taxonomy of Insect Pests, Wetlands.	North-West University, Potchefstroom and University of South Africa
Co-promoter	PhD: Edge, D.A. 2005. Ecological factors that influence the survival of the Brenton Blue butterfly	North-West University, Potchefstroom
Study leader/ assistant study leader	Six MSc students, One BSc Honn student: Various quantitative biodiversity studies.	North-West University, Potchefstroom
Teacher 1994-1998	Biology and Science, Secondary School	Afrikaans Hoër Seunskool, Pretoria
Owned Anthene Ecological CC 2008 – present	- Flora and Fauna habitat surveys - Highly specialized ecological surveys - Riparian vegetation index surveys - Ecological Management Plans - Biodiversity Action Plans - Biodiversity section of Environmental Management Frameworks - Wetland assessments	Private Closed Corporation that has been subcontracted by many companies
Herbarium assistant 1988-1991	- Part-time assistant at the A.P. Goossens herbarium, Botany Department, North-West University, 1988, 1989, 1990 and 1991 (as a student).	North-West University, Potchefstroom

## 10 EXAMPLES OF PUBLICATIONS OF WHICH R.F. TERBLANCHE IS AUTHOR/ CO-AUTHOR

(Three books, two chapters in books and five articles are listed here as examples)

- HENNING, G.A., **TERBLANCHE, R.F.** & BALL, J.B. (eds) **2009**. *South African Red Data Book: butterflies. SANBI Biodiversity Series 13*. South African National Biodiversity Institute, Pretoria. 158p. ISBN 978-1-919976-51-8
- MECENERO, S., BALL, J.B., EDGE, D.A., HAMER, M.L., HENNING, G.A., KRÜGER, M., PRINGLE, E.L., **TERBLANCHE, R.F.** & WILLIAMS, M.C. (eds). 2013. *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and atlas*. Safronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
- VAN SWAAY, C., REGAN, E., LING, M., BOZHINOVSKA, E., FERNANDEZ, M., MARINI-FILHO, O.J., HUERTAS, B., PHON, C.-K., KÖRÖSI, A., MEERMAN, J., PE'ER, G., UEHARA-PRADO, M., SÁFIÁN, S., SAM, L., SHUEY, J., TARON, D., **TERBLANCHE, R.F.** & UNDERHILL, L. 2015. Guidelines for Standardised Global Butterfly Monitoring. Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany. GEO BON Technical Series 1.
- TERBLANCHE, R.F.** & HENNING, G.A. **2009**. *A framework for conservation management of South African butterflies in practice*. In: Henning, G.A., Terblanche, R.F. & Ball, J.B. (eds). *South African Red Data Book: Butterflies. SANBI Biodiversity Series 13*. South African National Biodiversity Institute, Pretoria. p. 68 – 71.
- EDGE, D.A., **TERBLANCHE, R.F.**, HENNING, G.A., MECENERO, S. & NAVARRO, R.A. 2013. Butterfly conservation in southern Africa: Analysis of the Red List and threats. In: Mecenero, S., Ball, J.B., Edge, D.A., Hamer, M.L., Henning, G.A., Krüger, M., Pringle, E.L., Terblanche, R.F. & Williams, M.C. (eds). *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas*. pp. 13-33. Safronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
- TERBLANCHE, R.F.**, SMITH, G.F. & THEUNISSEN, J.D. **1993**. Did Scott typify names in *Haworthia* (Asphodelaceae: Alooideae)? *Taxon* **42**(1): 91–95. (International Journal of Plant Taxonomy).
- TERBLANCHE, R.F.**, MORGENTHAL, T.L. & CILLIERS, S.S. **2003**. The vegetation of three localities of the threatened butterfly species *Chrysoritis aureus* (Lepidoptera: Lycaenidae). *Koedoe* **46**(1): 73-90.
- EDGE, D.A., CILLIERS, S.S. & **TERBLANCHE, R.F.** **2008**. Vegetation associated with the occurrence of the Brenton blue butterfly. *South African Journal of Science* **104**: 505 - 510.
- GARDINER, A.J. & **TERBLANCHE, R.F.** **2010**. Taxonomy, biology, biogeography, evolution and conservation of the genus *Eriksonia* Trimen (Lepidoptera: Lycaenidae) *African Entomology* **18**(1): 171-191.
- TERBLANCHE, R.F.** 2016. *Acraea trimeni* Aurivillius, [1899], *Acraea stenobea* Wallengren, 1860 and *Acraea neobule* Doubleday, [1847] on host-plant *Adenia repanda* (Burch.) Engl. at Tswalu Kalahari Reserve, South Africa. *Metamorphosis* **27**: 92-102.

\* A detailed CV with more complete publication list is available.

## II) SPECIALIST DECLARATION

I, Reinier F. Terblanche, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- 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 Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Name of Specialist: Reinier F. Terblanche



Signature of the specialist

Date: 15 April 2019

# **1 INTRODUCTION**

An ecological habitat survey is required for the proposed Lephalale Railway Yard and two proposed Borrow Areas, 30 km west-southwest of Lephalale in the Limpopo Province, South Africa. Survey focused on the possibility that threatened fauna and flora known to occur in the Limpopo Province are likely to occur within the proposed development or not. Other species which are not listed as threatened or near threatened but which are of known particular conservation concern also received attention in the survey.

## **1.1 OBJECTIVES OF THE HABITAT STUDY**

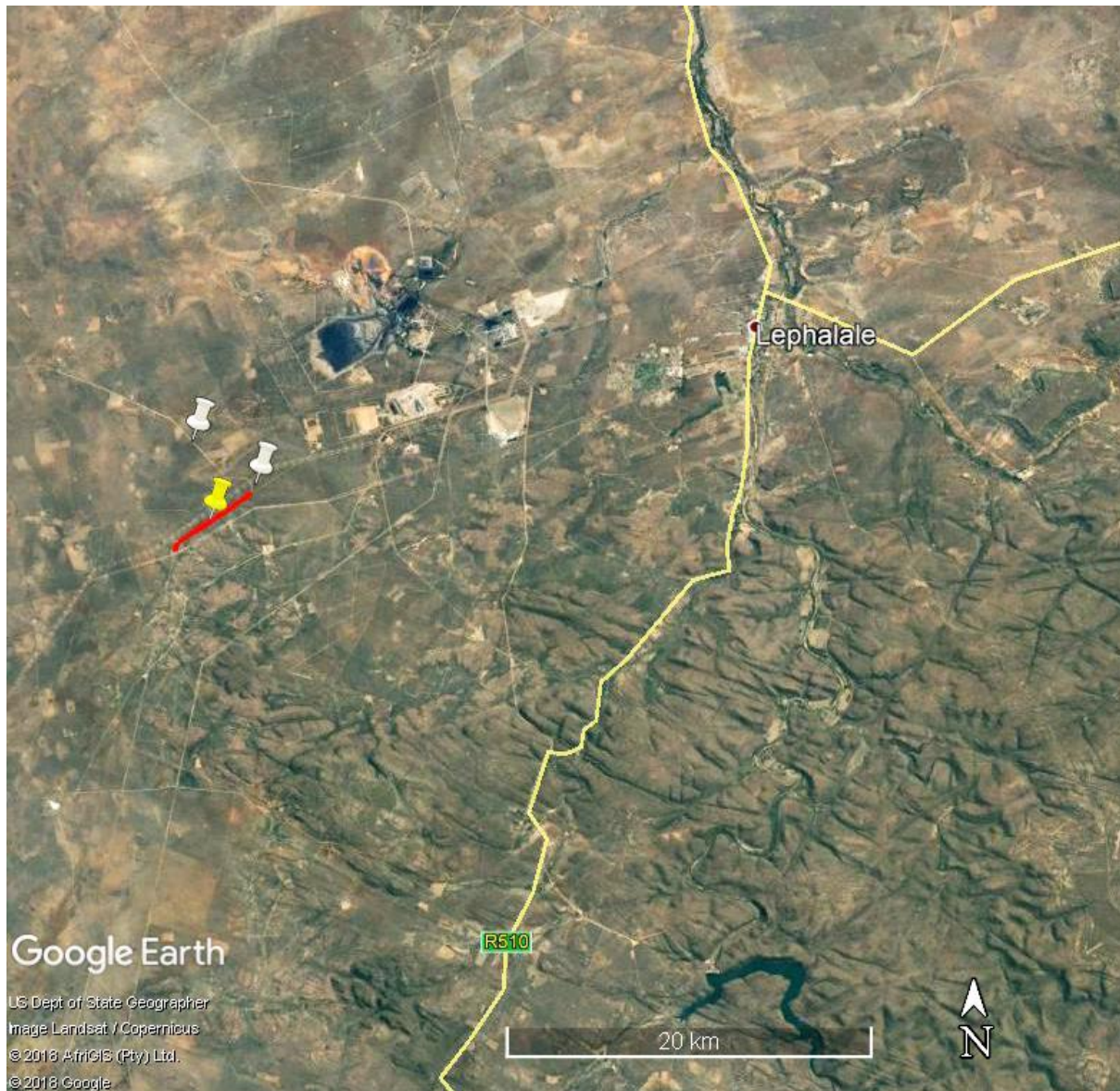
The objectives of the habitat study are to provide:

- A detailed fauna and flora habitat survey;
- A detailed habitat survey of possible threatened or localised plant species, vertebrates and invertebrates;
- Recording of possible host plants (=foodplants) of fauna such as butterflies.
- Evaluate the conservation importance and significance of the site with special emphasis on the current status of threatened species;
- Literature investigation of possible species that may occur on site;
- Make recommendations that could lead to reducing or minimising impacts, in application process for developments.

## **1.2 SCOPE OF STUDY**

- A survey consisting of visits to investigate key elements of habitats on the site, relevant to the conservation of fauna and flora.
- Recording of any sightings and/or evidence of existing fauna and flora.
- The selective and careful collecting of voucher specimens of invertebrates where deemed necessary.
- An evaluation of the conservation importance and significance of the site with special emphasis on the current status of threatened species.
- Recording of possible host plants or foodplants of fauna such as butterflies.
- Literature investigation of possible species that might occur on site.
- Integration of the literature investigation and field observations to identify potential ecological impacts that could occur as a result of the development.
- Integration of literature investigation and field observations to make recommendations to reduce or minimise impacts or enhance further surveys towards applications for developments.

## 2 STUDY AREA



**Figure 1** Map with an indication of the location of the site.

Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2019).



Site is 30 km west-southwest of Lephalale in the Limpopo Province, South Africa. The site is located in the Savanna Biome. Northern part of the study area (including the borrow areas) represents the Limpopo Sweet Bushveld (SVcb 19) vegetation type and some of the southern parts of the site represent the Western Sandy Bushveld (SVcb 16) (Mucina & Rutherford 2006). For the ecological context of the landscape, climate and vegetation in which the site is located, a description of the vegetation types from Mucina & Rutherford (2006) follows.

### **SVcb 19 Limpopo Sweet Bushveld**

**Distribution:** In South Africa the Limpopo Sweet Bushveld extends from the lower reaches of the Crocodile and Marico Rivers around Makoppa and Derdepoort, respectively, down the Limpopo River Valley including Lephalale and into the tropics past Tom Burke to the Usutu border post and Taaiboschgroet area in the north. Altitude about 700 – 1000 m. The unit also occurs on the Botswana side of the border (Mucina & Rutherford, 2006).

**Vegetation and landscape features:** Plains, sometimes undulating or irregular, traversed by several tributaries of the Limpopo River. Short open woodland, in disturbed areas thickets of *Senegalia erubescens*, *Senegalia mellifera* and *Dichrostachys cinerea* are almost impenetrable (Mucina & Rutherford, 2006).

**Geology & Soils:** The northern half of the area is dominated by gneisses, metasediments and metavolcanics of the Malala Drift Group, Beit Bridge Complex (Swazian Erathem), basalts of the Letaba Formation (Lebombo Group of the Karoo Supergroup) are also found in the northeast. Sandstone, siltstone and mudstone of the Clarens Formation (Karoo Supergroup), as well as the Matlabas Subgroup (Mokolian Waterberg Group) are found to the south and west. Soils with calcrete and surface limestone layers, brownish sandy (Clovelly soil form) clayey-loamy soils (Hutton soil form) on the plains and low-lying areas, with shallow, gravelly, sandy soils on the slightly undulating areas, localised areas of black clayey soils (Valsrivier or Arcadia soil forms) and Kalahari sand. Land types mainly Ae, Ah and Fc (Mucina & Rutherford, 2006).

Climate: Summer rainfall with very dry winters including the shoulder months of May and September. Mean Annual Precipitation about 350 mm in the northeast to about 500 mm in the southwest. Frost fairly frequent (Mucina & Rutherford, 2006).

Important Taxa: Tall trees: *Vachellia robusta*, *Senegalia burkei*. Small Trees: *Senegalia erubescens*, *Vachellia fleckii*, *Vachellia nilotica*, *Senegalia senegal* var. *rostrata*, *Albizia anthelmintica*, *Boscia albitrunca*, *Combretum apiculatum*, *Terminalia sericea*. Tall Shrubs: *Catophractes alexandri*, *Dichrostachys cinerea*, *Phaeoptilum spinosum*, *Rhigozum obovatum*, *Cadaba aphylla*, *Combretum hereroense*, *Commiphora pyracanthoides*, *Ehretia rigida* subsp. *rigida*, *Euclea undulata*, *Grewia flava*, *Gymnosporia senegalensis*. Low Shrubs: *Vachellia tenuispina*, *Commiphora africana*, *Felicia muricata*, *Gossypium herbaceum* subsp. *africanum*, *Leucosphaera bainesii*. Graminoids: *Digitaria eriantha* subsp. *eriantha*, *Enneapogon cenchroides*, *Eragrostis lehmanniana*, *Panicum coloratum*, *Schmidtia pappophoroides*, *Aristida congesta*, *Cymbopogon nardus*, *Eragrostis pallens*, *Eragrostis rigidior*, *Eragrostis trichopora*, *Ischaemum afrum*, *Panicum maximum*, *Setaria verticillata*, *Stipagrostis uniplumis*, *Urochloa mosambicensis*. Herbs: *Acanthosicyos naudinianus*, *Commelina benghalensis*, *Harpagophytum procumbens* subsp. *transvaalense*, *Hemizygia elliotii*, *Hermbsaedia odorata*, *Indigofera daleoides*. Succulent Herbs: *Kleinia fulgens*, *Plectranthus neochilus* (Mucina & Rutherford, 2006).

### **SVcb 16 Western Sandy Bushveld**

Distribution: In South Africa the Western Sandy Bushveld is present in the Limpopo and North West Provinces. Western Sandy Bushveld occurs on flats and undulating plains from Assen northwards past Thabazimbi and remaining west of the Waterberg Mountains towards Steenbokpan in the north. Some patches occur between the Crocodile and Marico Rivers to the west. Mostly at altitudes of 900 – 1200 m (Mucina & Rutherford, 2006).

Vegetation and landscape features: Western Sandy Bushveld varies from tall open woodland to low woodland. Broad-leaved as well as microphyllous tree species are prominent. Dominant species include *Acacia erubescens* on flat areas, *Combretum apiculatum* on shallow soils of gravelly upland sites and *Terminalia sericea* on deep sand. Vegetation type occurs on slightly undulating plains (Mucina & Rutherford, 2006).

Geology and soils: Sandstone and mudstone of the Matlabas Subgroup and sandstone, subordinate conglomerate, siltstone and shale of the Kransberg Subgroup (both Mokolian

Waterberg Group) are found in the north. Archaean granite and gneiss of the Swazian Erathem and granite of the Lebowa Granite Suite (Bushveld Igneous Complex) are found in the west and southeast of the area, respectively. Soils are plinthic catena, eutrophic, red-yellow apedal, free drained, high base status, Hutton and Clovely with some Glenrosa and Mispah soil forms. Several areas have less sandy soil than that of SVcb 12 Central Sandy Bushveld. Land types mainly Bd, Ah, Ae and Fa (Mucina & Rutherford, 2006).

Climate: Summer rainfall with very dry winters. Mean annual precipitation from about 450 mm in the north to about 650 mm in the south. Fairly frequent light frost in the winter (Mucina & Rutherford, 2006).

Important taxa: *Vachellia erioloba*, *Senegalia nigrescens*, *Sclerocarya birrea* subsp. *caffra*. Small trees: *Senegalia erubescens*, *Senegalia mellifera* subsp. *detinens*, *Vachellia nilotica*, *Vachellia tortilis* subsp. *heteracantha*, *Combretum apiculatum*, *Combretum imberbe*, *Terminalia sericea*, *Combretum zeyheri*, *Lannea discolor*, *Ochna pulchra* and *Peltophorum africanum*. Tall shrubs: *Combretum hereroense*, *Euclea undulata*, *Coptosperma supra-axillare*, *Dichrostachys cinerea*, *Grewia bicolor*, *Grewia flava* and *Grewia monticola*. Low shrubs: *Clerodendrum ternatum*, *Indigofera filipes*, *Justicia flava*. Graminoids: *Antheophora pubescens*, *Digitaria eriantha* subsp. *eriantha*, *Eragrostis pallens*, *Eragrostis rigidior*, *Schmidtia pappophoroides*, *Aristida congesta*, *Aristida diffusa*, *Aristida stipitata* subsp. *graciliflora*, *Eragrostis superba*, *Panicum maximum* and *Perotis patens*. Herbs: *Blepharis integrifolia*, *Chamaecrista absus*, *Evolvulus alsinoides*, *Geigeria burkei*, *Kyphocarpa angustifolia*, *Limeum fenestratum*, *Limeum viscosum*, *Lophiocarpus tenuissimus*, *Monsonia angustifolia* (Mucina & Rutherford, 2006).

Note: Not all of the above plant species listed for the vegetation types are present at the site.

### **3 METHODS**

A desktop study comprised not only an initial phase, but also it was used throughout the study to accommodate and integrate all the data that become available during the field observations.

Surveys by R.F. Terblanche took place during June 2018, February 2019 and April 2019 at the site and also surrounding areas to note key elements of habitats on the site, relevant to the conservation of fauna and flora. The main purpose of the site visits was ultimately to serve as a habitat survey that concentrated on the possible presence or not of species of particular conservation concern as well as ecosystems of particular conservation concern.

The following sections highlight the materials and methods applicable to different aspects that were observed.

#### **3.1 HABITAT CHARACTERISTICS AND VEGETATION**

The habitat was investigated by noting habitat structure (rockiness, slope, plant structure/physiognomy) as well as floristic composition. Voucher specimens of plant species were only taken where the taxonomy was in doubt and where the plant specimens were of significant relevance for invertebrate conservation. Literature sources which were consulted to confirm identifications of find more information included Bromilow (2010); Crouch *et al.* (2011); Court (2010); Duncan (2016); Fish *et al.* (2015); Germishuizen (2003); Gill & Engelbrecht (2012); Glen & Van Wyk (2016); Goldblatt (1986); Goldblatt & Manning (1998); Johnson & Bytebier (2015); Kirby (2013), Manning (2007); Manning (2009); McMurtry *et al.* (2008); Moriarty (1997); Raimondo *et al.* (2009); Smith *et al.* (2017); Van der Walt (2009); Van Ginkel *et al.* (2011); Van Jaarsveld (2006); Van Oudtshoorn (2012); Van Oudtshoorn (2015); Van Wyk & Gericke (2000); Van Wyk & Smith (2014); Van Wyk *et al.* (2009); Van Wyk & Van Wyk (2013).

#### **3.2 MAMMALS**

Mammals were noted as sight records by day. For the identification of species and observation of diagnostic characteristics as well as conervation status Smithers (1986), Skinner & Chimimba (2005), Cillié, Oberprieler and Joubert (2004), Apps (2000) and Child *et*

*al.* (2017) are consulted. Sites have been walked, covering as many habitats as possible. Signs of the presence of mammal species, such as calls of animals, animal tracks (spoor), burrows, runways, nests and faeces were recorded. Walker (1996), Stuart & Stuart (2000) and Liebenberg (1990) were consulted for additional information and for the identification of spoor and signs. Trapping was not done since it proved not necessary in the case of this study. Habitat characteristics were also surveyed to note potential occurrences of mammals. Many mammals can be identified from field sightings but a number of bats, rodents and shrews can only be reliably identified in the hand, and even then, some species need examination of skulls, or even chromosomes (Apps, 2000).

### **3.3 BIRDS**

Birds were noted as sight records, mainly with the aid of binoculars (10x30). Nearby bird calls of which the observer was sure of the identity were also recorded. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Ryan (2001) is followed. For information on identification, biogeography, ecology and conservation Hockey *et al.* (2005), Taylor *et al.* (2015) and Chittenden *et al.* (2016) were consulted. Ringing of birds fell beyond the scope of this survey and was not deemed necessary. The site has been walked, covering as many habitats as possible. Signs of the presence of bird species such as spoor and nests have additionally been recorded. Habitat characteristics were surveyed to note potential occurrences of birds.

### **3.4 REPTILES**

Reptiles were noted as sight records in the field. Binoculars (10x30) can also be used for identifying reptiles of which some are wary. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques, Branch (1998), Marais (2004), Alexander & Marais (2007) and Cillié, Oberprieler and Joubert (2004) were followed. Sites were walked, covering as many habitats as possible. Smaller reptiles are sometimes collected for identification, but this practice was not necessary in the case of this study. Habitat characteristics were surveyed to note potential occurrences of reptiles.

### **3.5 AMPHIBIANS**

Frogs and toads are noted as sight records in the field or by their calls. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques the complete guide by Du Preez & Carruthers (2009) are consulted as well as Carruthers & Du

Preez (2011). CD's with frog calls by Carruthers & Du Preez (2011) and Du Preez & Carruthers (2009) are used to identify species by their calls when applicable. Sites are walked, covering as many habitats as possible. Smaller frogs are often collected by pitfall traps put out for epigeal invertebrates (on the soil), but this practice falls beyond the scope of this survey. Habitat characteristics are also surveyed to note potential occurrences of amphibians.

### **3.6 BUTTERFLIES**

Butterflies were noted as sight records or voucher specimens. Voucher specimens are mostly taken of those species of which the taxa warrant collecting due to taxonomic difficulties or in the cases where species can look similar in the veldt. Many butterflies use only one species or a limited number of plant species as host plants for their larvae. Myrmecophilous (ant-loving) butterflies such as the *Aloeides*, *Chrysoritis*, *Erikssonia*, *Lepidochrysops* and *Orachrysops* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deutschländer & Breckenkamp, 1999; Terblanche, Morgenthal & Cilliers, 2003; Edge, Cilliers & Terblanche, 2008; Gardiner & Terblanche, 2010). Known food plants of butterflies were therefore also recorded. After the visits to the site and the identification of the butterflies found there, a list was also compiled of butterflies that will most probably be found in the area in all the other seasons because of suitable habitat. The emphasis is on a habitat survey.

### **3.7 FRUIT CHAFER BEETLES**

Different habitat types in the areas were explored for any sensitive or special fruit chafer species. Selection of methods to find fruit chafers depends on the different types of habitat present and the species that may be present. Fruit bait traps would probably not be successful for capturing *Ichneustoma* species in a grassland patch (Holm & Marais 1992). Possible chafer beetles of high conservation priority were noted as sight records accompanied by the collecting of voucher specimens with grass nets or containers where deemed necessary.

### **3.8 MYGALOMORPH SPIDERS AND ROCK SCORPIONS**

Relatively homogenous habitat / vegetation areas were identified and explored to identify any sensitive or special species. Selected stones that were lifted to search for Arachnids

were put back very carefully resulting in the least disturbance possible. The area was searched for possible signs of trap door spiders or other mygalomorph spiders (for example traces of wafer-lids, cork-lids or silk-lined burrows). Investigations by brushing the soil surface with a small broom/paint brush, scraping or digging into the soil with a spade, were made. All the above actions were accompanied by the least disturbance possible.

### **3.9 LIMITATIONS**

For each site visited, it should be emphasized that surveys can by no means result in an exhaustive list of the plants and animals present on the site, because of the time constraint. Surveys on site and surrounding study area were conducted during June 2018, February 2019 and April 2019 which include an optimal time of the year to find many of the habitat sensitive plant and animal species of high conservation priority, especially following late but substantial rains. Note, though that rainfall has been low for a number of years. Weather conditions during the survey were favourable for recording fauna and flora. The focus of the survey remains a habitat survey that concentrates on the possibility that species of particular conservation priority occur on the site or not. It is unlikely that more surveys would alter the outcome of this study.

## 4 RESULTS

### 4.1 HABITAT AND VEGETATION CHARACTERISTICS

**Table 4.1** Outline of main landscape and habitat characteristics of the site.

HABITAT FEATURE	DESCRIPTION
Topography	The site is on gentle slopes (flat terrain).
Rockiness	Rocky ridges at the site are absent.
Presence of wetlands	Two small wetland depressions (pans) are present at the proposed footprint. Four other small wetland depressions (small pans) are present within 500 m of the proposed footprint. Three narrow seasonal streambeds cross the proposed footprint and which are noted as Streamcrossing No 1, Streamcrossing No 2 and Streamcrossing No 3.
Broad overview of vegetation	<p>Vegetation at and around the present railway reserve is a woodland with a diversity of indigenous tree species. Tree species such as <i>Dichrostachys cinerea</i>, <i>Senegalia erubescens</i> and <i>Vachellia karroo</i> are conspicuous at the railway reserve. Indigenous tree species north and south of the present railway reserve include <i>Senegalia nigrescens</i> (Knob Thorn), <i>Senegalia erubescens</i> (Blue Thorn), <i>Combretum apiculatum</i> (Red Bushwillow), <i>Grewia bicolor</i> (White Raisin), <i>Grewia flavescens</i> (Sandpaper Raisin), <i>Grewia monticola</i> (Grey Raisin), <i>Vachellia karroo</i> (Sweet Thorn), <i>Terminalia sericea</i> (Silver Clusterleaf), <i>Sclerocarya birrea</i> subsp. <i>caffra</i> (Marula), <i>Commiphora mollis</i> (Velvet-leaved Corkwood), <i>Albizia anthelmintica</i> (Worm-bark False-thorn) <i>Ziziphus mucronata</i> (Buffalo Thorn), <i>Boscia foetida</i> subsp. <i>rehmanniana</i> (Smelly Shepherd's Tree) and <i>Boscia albitrunca</i> (Shepherd's Tree).</p> <p>Indigenous herbaceous species include <i>Seddera capensis</i>, <i>Limeum sulcatum</i>, <i>Solanum</i> species, <i>Geigeria burkei</i>, <i>Heliotropium giessii</i>, <i>Heliotropium nelsonii</i>, <i>Hermannia boraginiflora</i>, <i>Indigastrium costatum</i> subsp. <i>macrum</i>, <i>Indigofera daleoides</i>, <i>Commelina benghalensis</i>, <i>Sida cordifolia</i>, <i>Tephrosia purpurea</i>, <i>Tribulus terrestris</i>, <i>Syncolostemon elliottii</i>, <i>Pollichia campestris</i>, <i>Waltheria indica</i> and <i>Pavonia burchellii</i>. Indigenous grass species include <i>Eragrostis pallens</i>, <i>Aristida stipitata</i> subsp. <i>graciliflora</i>, <i>Eragrostis rigidior</i>, <i>Heteropogon contortus</i>, <i>Melinis repens</i>, <i>Panicum maximum</i> and <i>Tragus racemosus</i>. Conspicuous exotic weeds at the site, notably impacted areas at present railway reserve, are <i>Gomphrena celosioides</i> (Bachelor's Button), <i>Hibiscus trionum</i> (Bladder Hibiscus),</p>



*Tagetes minuta* (Khaki Weed), *Bidens bipinnata* (Black Jack), *Argemone ochroleuca* (White-flowered Mexican Poppy), *Solanum elaeagnifolium* (Silver-leaf Bitter Apple) and *Schkhuria pinnata* (Dwarf Marigold).

#### Borrow Area No1

Woodland with a number of indigenous tree species such as *Combretum apiculatum* (Red Bushwillow), *Grewia bicolor* (White Raisin), *Grewia flavescens* (Sandpaper Raisin), *Grewia monticola* (Grey Raisin), *Sclerocarya birrea* subsp. *caffra* (Marula) and *Bridelia mollis* (Velvet Sweetberry). Indigenous herbaceous species include *Heliotropium giessii*, *Heliotropium nelsonii*, *Hermannia boraginiflora*, *Indigastrum costatum* subsp. *macrum*, *Indigofera daleoides*, *Commelina benghalensis*, *Waltheria indica* and *Melhania acuminata* var. *acuminata*. Conspicuous grass species of open areas is *Eragrostis pallens*.

#### Borrow Area No2

Woodland with a number of indigenous tree species such as *Combretum apiculatum* (Red Bushwillow), *Commiphora africana*, *Commiphora mollis*, *Grewia bicolor* (White Raisin), *Grewia flavescens* (Sandpaper Raisin), *Grewia monticola* (Grey Raisin), *Sclerocarya birrea* subsp. *caffra* (Marula) and *Albizia harveyi* (Bushveld False-thorn). Indigenous herbaceous species include *Sida cordifolia*, *Heliotropium giessii*, *Heliotropium nelsonii*, *Indigastrum costatum* subsp. *macrum*, *Indigofera daleoides*, *Waltheria indica* and *Indigofera holubii*. Conspicuous grass species of open areas is *Eragrostis pallens* and *Stipagrostis uniplumis*.

Signs of disturbances

Part of the site, an existing railway reserve, has been developed in the past. Tracks, fences and roads are present. Large areas have been excavated west of Borrow Area No 1 and at Borrow Area No 2 in the past.

Connectivity of natural vegetation in the site and between the site and surrounding areas

There is little scope for the site to be part of a corridor of particular conservation importance. Two very small seasonal pans are present at the site which are part of a stepping stone corridor system of conservation importance. Seasonal streambeds that cross the site are conservation corridors of importance in the larger area.



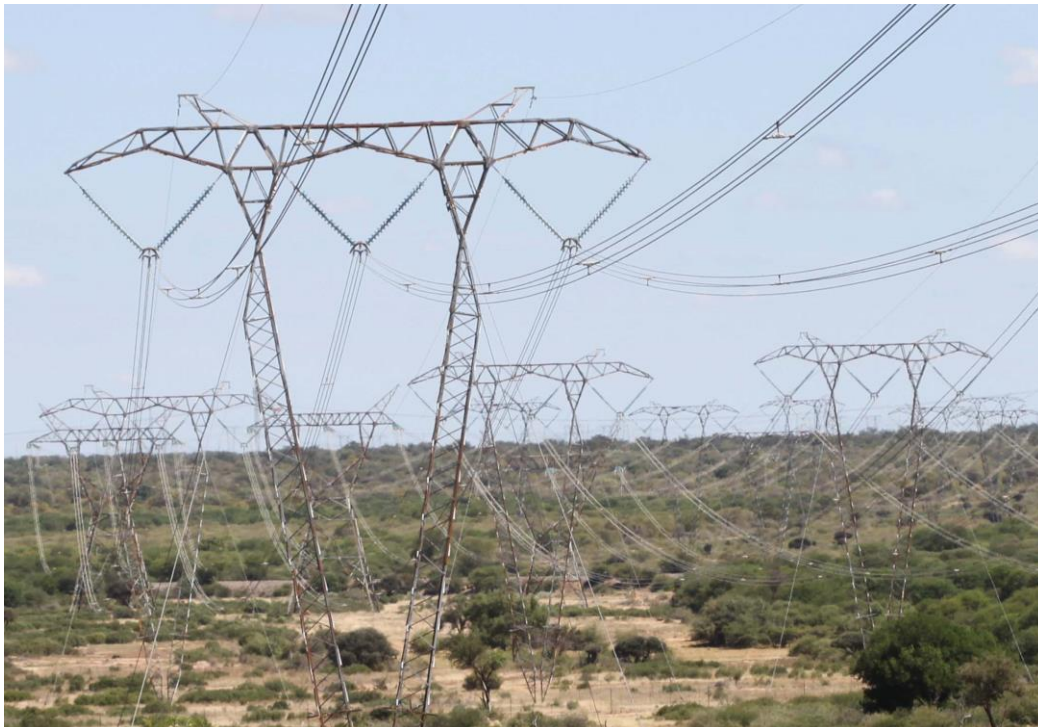
**Photo 1** View existing railway and railway reserve at part of the site.  
Photo: R.F. Terblanche



**Photo 2** Railway and railway reserve. Small trees as well as shrubs are present at the railway reserve. Taller savanna is visible north of the railway reserve.  
Photo: R.F. Terblanche



**Photo 3** Vegetation south of the current railway reserve. Pool of water visible formed after substantial rains.  
Photo: R.F. Terblanche



**Photo 4** Strip of pylons which cross south of the western end of the site (grey horizontal strip in the picture is the current railway line).  
Photo: R.F. Terblanche



**Photo 5** Characteristic trunk of *Senegalia nigrescens*, Knob Thorn, at the site.  
Photo: R.F. Terblanche



**Photo 6** Foliage and branches of *Boscia foetida* subsp. *rehmanniana* (Smelly Shepherd's Tree) at the site.  
Photo: R.F. Terblanche



**Photo 7** *Boscia foetida* subsp. *rehmanniana* (Smelly Shephersd's tree) at the site.



**Photo 8** *Boscia albitrunca* (Shepherd's Tree) at the site.  
Photo: R.F. Terblanche



**Photo 9** Trunk of *Sclerocarya birrea* (Marula Tree) at the site. Light green leaves visible in the picture are those of *Grewia flavescens* (Sandpaper Raisin). Photo R.F Terblanche



**Photo 10** *Sclerocarya birrea* (Marula tree) at the southern fence which borders the existing railway reserve at the site.  
Photo: R.F. Terblanche





**Photo 11** Two small Marula trees (*Sclerocarya birrea*) at the railway reserve at the site.  
Photo: R.F. Terblanche



**Photo 12** Thorn Trees (*Senegalia*, *Vachellia*) and Sicklebush (*Dichrostachys cinerea*) are conspicuous at the existing railway reserve.  
Photo: R.F. Terblanche



**Photo 13** Culvert of Streamcrossing No3 at the site. Water visible in picture gathered after substantial rains.  
Photo: R.F. Terblanche



**Photo 14** Erosion in the road and seasonal streambed crossing the road at Streamcrossing No3 at the site.  
Photo: R.F. Terblanche



**Photo 15** Riparian zone towards the south at Streamcrossing No3 at the site.  
Photo: R.F. Terblanche



**Photo 16** Water that gathered, following substantial rains, at small wetland depression (Pan 1) south of the railway reserve at the site.  
Photo: R.F. Terblanche



**Photo 17** Small depression (Pan 1) south of the existing railway reserve at the site.  
Photo: R.F. Terblanche



**Photo 18** Soil at small wetland depression (pan) south of the existing railway reserve at the site.  
Photo: R.F. Terblanche



**Photo 19** *Sclerocarya birrea* (Marula tree) and *Grewia* species at the proposed Borrow Area No 1 site.  
Photo: R.F. Terblanche



**Photo 20** Excavated area west of the proposed Borrow Area No 1 site.  
Photo: R.F. Terblanche



**Photo 21** Inflorescence of *Eragrostis pallens* which occurs at open areas at the proposed Borrow Area No 1 site. *Eragrostis pallens* is also often found at open vegetation across the study area.  
Photo: R.F. Terblanche



**Photo 22** Foliage and branches of *Bridelia mollis* (Velvet Sweetberry) at the proposed Borrow Area No 1 site.  
Photo: R.F. Terblanche



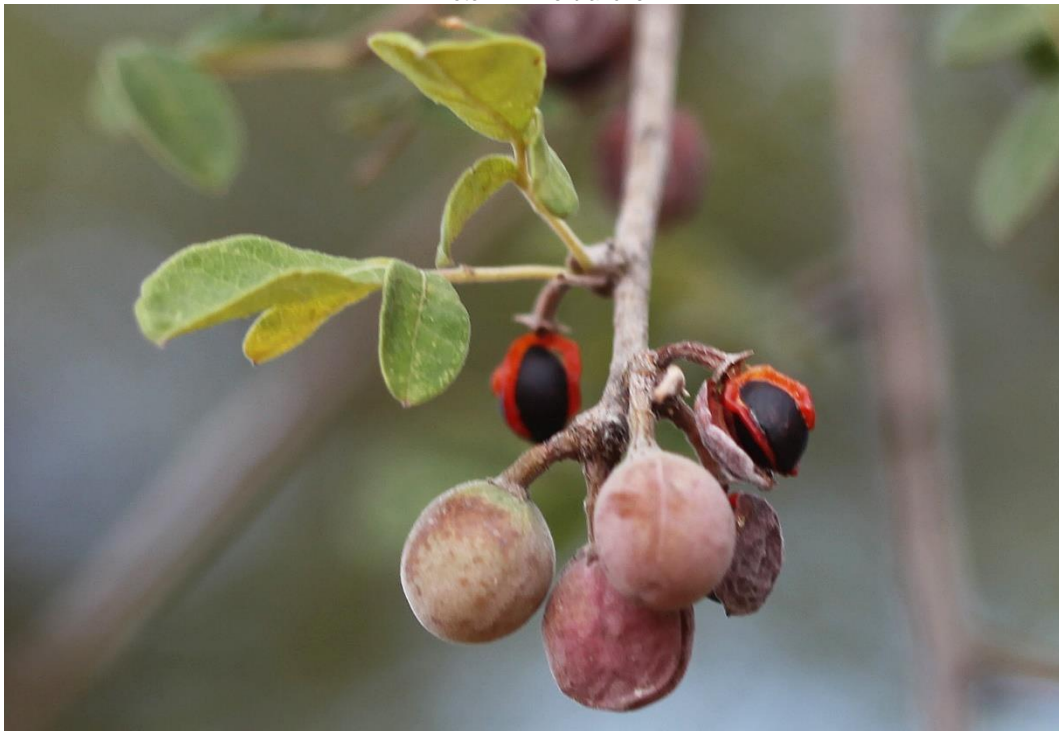
**Photo 23** View towards the south at the Borrow Area No 2 site. Whitish wall in the background (right-hand side) is a bridge that crosses an excavated area.  
Photo: R.F. Terblanche



**Photo 24** Woodland at Borrow Area No 2 site.  
Photo: R.F. Terblanche



**Photo 25** Typical “square” branches of *Grewia flavescens* photographed at the proposed Borrow Area No 2 site.  
Photo: R.F. Terblanche



**Photo 26** Fruit and leaves of *Commiphora mollis* (Velvet Corkwood) at the proposed Borrow Area No 2 site.  
Photo: R.F. Terblanche



## 4.2 ASSESSMENT OF PLANT SPECIES OF PARTICULAR CONSERVATION PRIORITY

Plant species of the Limpopo Province of high conservation priority which were extracted from Raimondo *et al.* (2009) or updates of the Threatened Species Programme (SANBI) are listed in the tables beneath. Many of these plant species could be easily eliminated from occurring in the study area based on habitat type and distributional range by a relatively quick scan to make sure these are not present on the site. For others, a habitat survey during the site visits confirm likely presence or absence.

**Table 4.2** Threatened (= red listed) plant species of the Limpopo Province that are listed in the **Critically Endangered** category. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident on the site; Yes = Plant species is a resident on the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Brackenridgea zanguebarica</i>	Critically Endangered	No
<i>Chlorophytum radula</i>	Critically Endangered	No
<i>Encephalartos cupidus</i>	Critically Endangered	No
<i>Encephalartos dolomiticus</i>	Critically Endangered	No
<i>Encephalartos dyerianus</i>	Critically Endangered	No
<i>Encephalartos eugene-maraisii</i>	Critically Endangered	No
<i>Encephalartos hirsutus</i>	Critically Endangered	No
<i>Encephalartos inopinus</i>	Critically Endangered	No
<i>Encephalartos laevifolius</i>	Critically Endangered	No
<i>Euphorbia clivicola</i>	Critically Endangered	No
<i>Euphorbia groenewaldii</i>	Critically Endangered	No
<i>Gladiolus macneilii</i>	Critically Endangered	No
<i>Gladiolus pavonia</i>	Critically Endangered	No
<i>Kniphofia crassifolia</i>	Critically Endangered	No
<i>Oberonia disticha</i>	Critically Endangered	No
<i>Orbea elegans</i>	Critically Endangered	No
<i>Raphionacme villicorona</i>	Critically Endangered	No
<i>Siphonochilus aethiopicus</i>	Critically Endangered	No
<i>Vachellia sekhukhuniensis</i>	Critically Endangered	No

**Table 4.3** Threatened plant species of the Limpopo Province that are listed in the **Endangered** category. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident on the site; Yes = Plant species is a resident on the site.

Species	Status:	Resident at the site
	Global status or national status indicated	
<i>Argyrolobium muddii</i>	Endangered	No
<i>Asparagus sekukuniensis</i>	Endangered	No
<i>Aster nubimontis</i>	Endangered	No
<i>Brachystelma gerrardii</i>	Endangered	No
<i>Cineraria cyanomontana</i>	Endangered	No
<i>Euphorbia barnardii</i>	Endangered	No
<i>Inezia speciosa</i>	Endangered	No
<i>Ledebouria crispa</i>	Endangered	No
<i>Leucospermum saxosum</i>	Endangered	No
<i>Mondia whitei</i>	Endangered	No
<i>Nemesia zimbabwensis</i>	Endangered	No
<i>Ocotea bullata</i>	Endangered	No
<i>Ophioglossum gracillimum</i>	Endangered	No
<i>Pearsonia callistoma</i>	Endangered	No
<i>Plinthus rehmannii</i>	Endangered	No
<i>Warburgia salutaris</i>	Endangered	No

**Table 4.4** Threatened plant species of the Limpopo Province that are listed in the **Vulnerable** category. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be resident on the site; Yes = Plant species is a resident on the site.

Species	Status:	Resident at the site
	Global status or national status indicated	
<i>Alepidea amatymbica</i>	Vulnerable	No
<i>Aloe chortolirioides</i> var. <i>chortolirioides</i>	Vulnerable	No
<i>Aloe monotropa</i>	Vulnerable	No
<i>Asparagus fouriei</i>	Vulnerable	No
<i>Asparagus hirsutus</i>	Vulnerable	No
<i>Barleria dolomiticola</i>	Vulnerable	No
<i>Bowiea volubilis</i> subsp. <i>volubilis</i>	Vulnerable	No
<i>Brachycorythis conica</i> subsp. <i>transvaalensis</i>	Vulnerable	No
<i>Ceropegia cimiciodora</i>	Vulnerable	No
<i>Ceropegia stentiae</i>	Vulnerable	No
<i>Cheilanthes deltoidea</i> subsp. nov.	Vulnerable	No
<i>Crassula setulosa</i> var. <i>deminuta</i>	Vulnerable	No
<i>Cucumis humifructus</i>	Vulnerable	No
<i>Cullen holubii</i>	Vulnerable	No

<i>Cyphostemma hardyi</i>	Vulnerable	No
<i>Cyrtanthus junodii</i>	Vulnerable	No
<i>Diplolophium buchananii</i> subsp <i>swynnertonii</i>	Vulnerable	No
<i>Dioscorea sylvatica</i>	Vulnerable	No
<i>Disa aristata</i>	Vulnerable	No
<i>Disa cernua</i>	Vulnerable	No
<i>Elytrophorus globularis</i>	Vulnerable	No
<i>Eulophia coddii</i>	Vulnerable	No
<i>Festuca dracomontana</i>	Vulnerable	No
<i>Gladiolus sekukuniensis</i>	Vulnerable	No
<i>Huernia nouhuysii</i>	Vulnerable	No
<i>Jamesbrittenia bergae</i>	Vulnerable	No
<i>Ledebouria dolomiticola</i>	Vulnerable	No
<i>Lithops coleorum</i>	Vulnerable	No
<i>Marsilea farinosa</i>	Vulnerable	No
<i>Plectranthus porcatus</i>	Vulnerable	No
<i>Prunus africana</i>	Vulnerable	No
<i>Rhynchosia vendae</i>	Vulnerable	No
<i>Sartidia jucunda</i>	Vulnerable	No
<i>Searsia batophylla</i>	Vulnerable	No
<i>Streptocarpus longiflorus</i>	Vulnerable	No
<i>Streptocarpus makabengensis</i>	Vulnerable	No
<i>Thesium davidsonae</i>	Vulnerable	No
<i>Thesium gracilentum</i>	Vulnerable	No
<i>Zantedeschia jucunda</i>	Vulnerable	No

**Table 4.5 Near Threatened** plant species of the Limpopo Province. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident on the site; Yes = Plant species is a resident on the site.

Species	Status:	Resident at the site
	Global status or national status indicated	
<i>Adenia fruticosa</i> subsp. <i>fruticosa</i>	Near Threatened	No
<i>Alepidea attenuata</i>	Near Threatened	No
<i>Brachystelma hirtellum</i>	Near Threatened	No
<i>Ceropegia turricula</i>	Near Threatened	No
<i>Clivia caulescens</i>	Near Threatened	No
<i>Curtisia dentata</i>	Near Threatened	No
<i>Disa extinctoria</i>	Near Threatened	No
<i>Drimia sanguinea</i>	Near Threatened	No
<i>Elaeodendron transvaalense</i>	Near Threatened	No
<i>Eulalia aurea</i>	Near Threatened	No
<i>Euphorbia rowlandii</i>	Near Threatened	No
<i>Gasteria batesiana</i> var. <i>batesiana</i>	Near Threatened	No

<i>Habenaria kraenzliniana</i>	Near Threatened	No
<i>Holothrix randii</i>	Near Threatened	No
<i>Isoetes transvaalensis</i>	Near Threatened	No
<i>Jamesbrittenia macrantha</i>	Near Threatened	No
<i>Kniphofia typhoides</i>	Near Threatened	No
<i>Lithops leslei</i> subsp. <i>leslei</i>	Near Threatened	No
<i>Lydenburgia cassinoides</i>	Near threatened	No
<i>Mystacidium brayboniae</i>	Near Threatened	No
<i>Panicum dewinteri</i>	Near Threatened	No
<i>Vachellia ormocarpoides</i>	Near Threatened	No

**Table 4.6** Plant species of the Limpopo Province which are not threatened but of particular conservation concern and listed in the **Critically Rare** category. The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident on the site; Yes = Plant species is a resident on the site.

Species	Conservation status	Resident at the site
<i>Cineraria erodioides</i> var. <i>tomentosa</i>	Critically Rare	No
<i>Crassula cymbiformis</i>	Critically Rare	No
<i>Dicliptera fionae</i>	Critically Rare	No
<i>Drimiopsis burkei</i> subsp. <i>stolonissima</i>	Critically Rare	No
<i>Gasteria batesiana</i> var. <i>dolomitica</i>	Critically Rare	No
<i>Lotononis pariflora</i>	Critically Rare	No
<i>Plectranthus dolomiticus</i>	Critically Rare	No
<i>Thorncroftia media</i>	Critically Rare	No

**Table 4.7** Plant species of the Limpopo Province which are however of particular conservation concern and listed in the **Rare** category. The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is not a resident on the site; Yes = Plant species is a resident on the site.

Species	Conservation status	Resident at the site
<i>Angraecum stella-africae</i>	Rare	No
<i>Agapanthus coddii</i>	Rare	No
<i>Aloe hardyi</i>	Rare	No
<i>Aloe soutpansbergensis</i>	Rare	No
<i>Aloe thompsoniae</i>	Rare	No
<i>Asparagus elephantinus</i>	Rare	No
<i>Berkheya radyeri</i>	Rare	No
<i>Blepharis uniflora</i>	Rare	No
<i>Brachystelma inconspicuum</i>	Rare	No
<i>Brachystelma minor</i>	Rare	No
<i>Brachystelma villosum</i>	Rare	No
<i>Ceratotheca saxicola</i>	Rare	No

<i>Combretum petrophilum</i>	Rare	No
<i>Dicoma montana</i>	Rare	No
<i>Dracaena transvaalensis</i>	Rare	No
<i>Euphorbia louwii</i>	Rare	No
<i>Euphorbia grandialata</i>	Rare	No
<i>Euphorbia restricta</i>	Rare	No
<i>Euphorbia sekukuniensis</i>	Rare	No
<i>Euphorbia waterbergensis</i>	Rare	No
<i>Euphorbia grandialata</i>	Rare	No
<i>Freylinia tropica</i>	Rare	No
<i>Gladiolus dolomiticus</i>	Rare	No
<i>Gladiolus pardalinus</i>	Rare	No
<i>Gymnosporia oxycarpa</i>	Rare	No
<i>Helichrysum junodii</i>	Rare	No
<i>Hesperantha brevicaulis</i>	Rare	No
<i>Ipomoea bisavium</i>	Rare	No
<i>Isoetes schweinfurthii</i>	Rare	No
<i>Justicia minima</i>	Rare	No
<i>Justicia montis-salinarum</i>	Rare	No
<i>Kalanchoe crundallii</i>	Rare	No
<i>Khadia borealis</i>	Rare	No
<i>Ledebouria lepida</i>	Rare	No
<i>Monsonia lanuginosa</i>	Rare	No
<i>Nesaea alata</i>	Rare	No
<i>Orbea gerstneri elongata</i>	Rare	No
<i>Orbea hardyi</i>	Rare	No
<i>Pavetta tshikondeni</i>	Rare	No
<i>Peristrophe cliffordii</i>	Rare	No
<i>Peristrophe gillilandiorum</i>	Rare	No
<i>Plectranthus venterii</i>	Rare	No
<i>Rhoicissus laetans</i>	Rare	No
<i>Searsia sekhukhuniensis</i>	Rare	No
<i>Senecio hederiformis</i>	Rare	No
<i>Syncolostemon rugosifolius</i>	Rare	No
<i>Tylophora coddii</i>	Rare	No
<i>Vangueria soutpansbergensis</i>	Rare	No
<i>Woodia singularis</i>	Rare	No

**Table 4.8** Plant species of the Limpopo Province which are not threatened but of particular conservation concern and listed in the **Declining** category. The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident on the site; Yes = Plant species is a resident on the site.

<b>Species</b>	<b>Conservation status</b>	<b>Resident at the site</b>
<i>Acridocarpus natalitius</i>	Declining	No
<i>Adenia gummifera</i> subsp. <i>gummifera</i>	Declining	No
<i>Aloe cooperi</i> subsp. <i>cooperi</i>	Declining	No
<i>Ansellia africana</i>	Declining	No
<i>Balanites maughanii</i>	Declining	No
<i>Boophone disticha</i>	Declining	No
<i>Callilepis leptophylla</i>	Declining	No
<i>Cassipourea malosana</i>	Declining	No
<i>Crinum macowanii</i>	Declining	No
<i>Crinum stuhlmanii</i>	Declining	No
<i>Cryptocarya transvaalensis</i>	Declining	No
<i>Cyathea capensis</i> var. <i>capensis</i>	Declining	No
<i>Drimia altissima</i>	Declining	No
<i>Elaeodendron croceum</i>	Declining	No
<i>Eucomis autumnalis</i>	Declining	No
<i>Eulophia speciosa</i>	Declining	No
<i>Gunnera perpensa</i>	Declining	No
<i>Hypoxis hemerocallidea</i>	Declining	No
<i>Ilex mitis</i>	Declining	No
<i>Pterocelastrus rostratus</i>	Declining	No
<i>Rapanea melanophloeos</i>	Declining	No
<i>Vachellia erioloba</i>	Declining	No

**Table 4.9** Plant species of the Limpopo Province of which the conservation status is uncertain owing to a lack of information and which are listed in the **Data Deficient** category. The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident on the site; Yes = Plant species is a resident on the site.

Species	Conservation status	Resident at the site
<i>Adenia fruticosa</i> subsp. <i>simplicifolia</i>	Data Deficient	No
<i>Asclepias nana</i>	Data Deficient	No
<i>Blepharis spinipes</i>	Data Deficient	No
<i>Buchnera remotiflora</i>	Data Deficient	No
<i>Cephalaria armerioides</i>	Data Deficient	No
<i>Christella altissima</i>	Data Deficient	No
<i>Cephalaria amerioides</i>	Data Deficient	No
<i>Cyphia corylifolia</i>	Data Deficient	No
<i>Delosperma rileyi</i>	Data Deficient	No
<i>Dicoma prostrata</i>	Data Deficient	No
<i>Eriosema fasciculatum</i>	Data Deficient	No
<i>Pentatrichia alata</i>	Data Deficient	No
<i>Plectranthus esculentus</i>	Data Deficient	No
<i>Schistostephium scandens</i>	Data Deficient	No

**Table 4.10** Tree species of the North West Province which are listed as **Protected Species** under the National Forests Act No. 84 of 1998, Section 15(1). No = Plant species is unlikely to be a resident on the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
<i>Adansonia digitata</i> (Baobab)	Protected	No
<b><i>Boscia albitrunca</i> (Shepherd's tree)</b>	<b>Protected</b>	<b>Yes</b>
<i>Combretum imberbe</i> (Leadwood)	Protected	No
<i>Philenoptera violacea</i> (Apple-leaf)	Protected	No
<b><i>Sclerocarya birrea</i> (Marula)</b>	<b>Protected</b>	<b>Yes</b>
<i>Vachellia erioloba</i> (Camel Thorn)	Protected	No

**Note:** Some plant species which are not listed in the National List of Protected trees are listed as protected by the Limpopo Province according to LEMA (Limpopo Environmental Act No. 7 of 2003; Commencing date 1 May 2004). One such species, *Spirostachys africa* (Tamboti), which is listed as a protected tree species under LEMA, is present at the site.

## 4.3 VERTEBRATE SPECIES OF PARTICULAR CONSERVATION PRIORITY

### 4.3.1 Mammals of particular high conservation priority

**Table 4.11 Threatened, Endangered** mammal species of the Limpopo Province. Main source: Child *et al.* (2017) with updates by several authors per species. With mammal species which normally needs a large range their residential status does not implicate that they are exclusively dependent on the site or use the site as important shelter or for reproduction. No = Not recorded at site/ Unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status (Regional)	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Cloeotis percivali</i> Short-eared Trident Bat	Endangered	No	No
<i>Diceros bicornis</i> Black Rhinocerus	Endangered	No	No
<i>Lycaon pictus</i> African Wild Dog	Endangered	No	No
<i>Redunca fulvorufula fulvorufula</i> Southern Mountain Reedbuck	Endangered	No	No

**Table 4.12 Threatened, Vulnerable** mammal species of the Limpopo Province. Main source: Child *et al.* (2017) with updates by several authors per species. With mammal species which normally needs a large range their residential status does not implicate that they are exclusively dependent on the site or use the site as important shelter or for reproduction. No = Not recorded at site/ Unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status (Regional)	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Acinonyx jubatus</i> Cheetah	Vulnerable	No	No
<i>Felis nigripes</i> Black-footed Cat	Vulnerable	No	No
<i>Hydrictis maculicollis</i> Spotted-necked Otter	Vulnerable	No	No
<i>Mystromys albicaudatus</i> White-tailed Rat	Vulnerable	No	No
<i>Panthera pardus</i> Leopard	Vulnerable	No	Yes
<i>Smutsia temminckii</i> Temminck's Ground Pangolin	Vulnerable	No	No

**Table 4.13 Near Threatened** mammal species of the Limpopo Province. Main source: Child *et al.* (2017) with updates by several authors per species. With mammal species which normally needs a



large range their residential status does not implicate that they are exclusively dependent on the site or use the site as important shelter or for reproduction. No = Not recorded at site/ Unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

<b>Species</b>	<b>Threatened Status (Regional)</b>	<b>Recorded at site during survey</b>	<b>Likely to be found based on habitat assessment</b>
<b><i>Aonyx capensis</i></b> Cape Clawless Otter	Near Threatened	No	No
<b><i>Atelerix frontalis</i></b> Southern African Hedgehog	Near Threatened	No	No
<b><i>Ceratotherium simum simum</i></b> Southern White Rhinoceros	Near Threatened	No	No
<b><i>Crocuta crocuta</i></b> Spotted Hyaena	Near Threatened	No	No
<b><i>Leptailurus serval</i></b> Serval	Near Threatened	No	No
<b><i>Parahyaena brunnea</i></b> Brown Hyaena	<b>Near Threatened</b>	<b>Yes</b>	<b>Yes</b>
<b><i>Pelea capreolus</i></b> Grey Rhebok	Near Threatened	No	No
<b><i>Poecilogale albinucha</i></b> African Striped Weasel	Near Threatened	No	No

### 4.3.2 Birds of particular high conservation priority

**Table 4.14** Threatened bird species of the Limpopo Province. Literature sources: Taylor *et al.* (2015), Chittenden *et al.* (2016).

Species	Common name	Conservation Status	Recorded on site	Resident at the site
<i>Aquila nipalensis</i>	Steppe Eagle	Endangered	No	No
<i>Aquila rapax</i>	Tawny Eagle	Endangered	No	No
<i>Aquila verreauxii</i>	Verreaux's Eagle	Vulnerable	No	No
<i>Botaurus stellaris</i>	Eurasian Bittern	Critically Endangered	No	No
<i>Bucorvus leadbeateri</i>	Southern Ground Hornbill	Endangered	No	No
<i>Buphagus africanus</i>	Yellow-billed Oxpecker	Vulnerable	No	No
<i>Ciconia nigra</i>	Black Stork	Vulnerable	No	No
<i>Circus ranivorus</i>	African Marsh- Harrier	Endangered	No	No
<i>Ephippiorhynchus senegalensis</i>	Saddle-billed Stork	Endangered	No	No
<i>Egretta vinaceigula</i>	Slaty Egret	Vulnerable	No	No
<i>Eupodotis senegalensis</i>	White-bellied Bustard	Vulnerable	No	No
<i>Falco biarmicus</i>	Lanner Falcon	Vulnerable	No	No
<i>Falco fasciinucha</i>	Taita Falcon	Critically Endangered	No	No
<i>Falco naumanni</i>	Lesser Kestrel	Vulnerable	No	No
<i>Geronticus calvus</i>	Southern Bald Ibis	Vulnerable	No	No
<i>Gorsachius leuconotus</i>	White-backed Night-heron	Vulnerable	No	No
<i>Gyps africanus</i>	White-backed Vulture	Critically Endangered	No	No
<i>Gyps coprotheres</i>	Cape Vulture	Vulnerable	No	No
<i>Macheiramphus alcinus</i>	Bat Hawk	Endangered	No	No
<i>Microparra capensis</i>	Lesser Jacana	Vulnerable	No	No
<i>Mycteria ibis</i>	Yellow-billed Stork	Endangered	No	No
<i>Necrosyrtes monachus</i>	Hooded Vulture	Critically Endangered	No	No
<i>Neophron percnopterus</i>	Egyptian Vulture	Regionally Extinct	No	No
<i>Neotis denhami</i>	Denham's Bustard	Vulnerable	No	No
<i>Pelecanus onocrotalus</i>	Great White Pelican	Vulnerable	No	No
<i>Pelecanus rufescens</i>	Pink-backed Pelican	Vulnerable	No	No
<i>Podica senegalensis</i>	African Finfoot	Vulnerable	No	No
<i>Polemaetus bellicosus</i>	Martial Eagle	Endangered	No	No

<b><i>Sagittarius serpentarius</i></b>	Secretarybird	Vulnerable	No	No
<b><i>Sarothrura affinis</i></b>	Striped Flufftail	Vulnerable	No	No
<b><i>Scotopelia peli</i></b>	Pel's Fishing Owl	Endangered	No	No
<b><i>Stephanoaetus coronatus</i></b>	Crowned Eagle	Vulnerable	No	No
<b><i>Streptopelia turtur</i></b>	European Turtle Dove	Endangered (Global)	No	No
<b><i>Terathopius ecaudatus</i></b>	Bateleur	Endangered	No	No
<b><i>Torgos tracheliotos</i></b>	Lappet-faced Vulture	Endangered	No	No
<b><i>Trigonoceps occipitalis</i></b>	White-headed Vulture	Critically Endangered	No	No
<b><i>Tyto capensis</i></b>	African Grass Owl	Vulnerable	No	No

**Table 4.15** Near threatened bird species of the Limpopo Province. Literature source: Taylor *et al.* (2015), Chittenden *et al.* (2016).

<b>Species</b>	<b>Common name</b>	<b>Conservation Status</b>	<b>Recorded on site</b>	<b>Likely to be resident</b>
<b><i>Alcedo semitorquata</i></b>	Half-collared Kingfisher	Near Threatened	No	No
<b><i>Ardeotis kori</i></b>	Kori Bustard	Near Threatened	No	No
<b><i>Calidris ferruginea</i></b>	Curlew Sandpiper	Near Threatened	No	No
<b><i>Certhilauda chuana</i></b>	Short-clawed Lark	Near Threatened	No	No
<b><i>Circus macrourus</i></b>	Pallid Harrier	Near Threatened	No	No
<b><i>Crithagra citrinipectus</i></b>	Lemon-breasted Canary	Near Threatened	No	No
<b><i>Falco peregrinus</i></b>	Peregrine Falcon	Near Threatened	No	No
<b><i>Falco vespertinus</i></b>	Red-footed Falcon	Near Threatened	No	No
<b><i>Geokichla gurneyi</i></b>	Orange Ground Thrush	Near Threatened	No	No
<b><i>Glareola nordmanni</i></b>	Black-winged Pratincole	Near Threatened	No	No
<b><i>Grus paradisea</i></b>	Blue Crane	Near Threatened	No	No
<b><i>Hieraaetus ayresii</i></b>	Ayres's Hawk Eagle	Near Threatened	No	No
<b><i>Leptoptilos crumenifer</i></b>	Marabou Stork	Near Threatened	No	No
<b><i>Lonchura fringilloides</i></b>	Magpie Mannikin	Near Threatened	No	No
<b><i>Oxyura maccoa</i></b>	Maccoa Duck	Near Threatened	No	No
<b><i>Pterocles gutturalis</i></b>	Yellow-throated Sandgrouse	Near Threatened	No	No
<b><i>Phoeniconaias minor</i></b>	Lesser Flamingo	Near Threatened	No	No
<b><i>Phoenicopterus roseus</i></b>	Greater Flamingo	Near Threatened	No	No
<b><i>Pterocles gutturalis</i></b>	Yellow-throated Sandgrouse	Near Threatened	No	No

<i>Rostratula benghalensis</i>	Greater Painted-snipe	Near Threatened	No	No
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### 4.3.3 Reptiles of particular high conservation priority

**Table 4.16** Reptile species of particular high conservation priority in the Limpopo Province. Main source: Bates, Branch, Bauer, Burger, Marais, Alexander & De Villiers (2014).

Species	Red Listed Status	Recorded at site during survey	Residential status at the site: Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Afroedura multiporis multiporis</i> Woodbush Flat Gecko	Vulnerable	No	Highly unlikely
<i>Acontias richardi</i> Richard's Legless Skink	Near Threatened	No	Highly unlikely
<i>Acontias rieppeli</i> Woodbush Legless Skink	Endangered	No	Highly unlikely
<i>Chamaesaura aenea</i> Coppery Grass Lizard	Near Threatened	No	Highly unlikely
<i>Chamaesaura macrolepis</i> Large Scaled Grass Lizard	Near Threatened	No	Highly unlikely
<i>Chirindia langi occidentalis</i> Western Round-headed Worm Lizzard	Vulnerable	No	Highly unlikely
<i>Homopholis mulleri</i> Muller's Velvet Gecko	Vulnerable	No	Highly unlikely
<i>Homoroselaps dorsalis</i> Striped Harlequin Snake	Near Threatened	No	Highly unlikely
<i>Lygodactylus graniticolus</i> Granite Dwarf Gecko	Near Threatened	No	Highly unlikely
<i>Lygodactylus methueni</i> Methuen's Dwarf Gecko	Vulnerable	No	Highly unlikely
<i>Lygodactylus ocellatus</i> <i>soutpansbergensis</i> Soutpansberg Dwarf Gecko	Near Threatened	No	Highly unlikely
<i>Lygodactylus waterbergensis</i> Waterberg Dwarf Gecko	Near Threatened	No	Highly unlikely
<i>Vhembelacerta rupicola</i> Soutpansberg Rock Lizard	Near Threatened	No	Highly Unlikely
<i>Pseudocordylus transvaalensis</i> Northern Crag Lizard	Near Threatened	No	Highly Unlikely
<i>Platysaurus intermedius inopinus</i> Unexpected Flat Lizard	Endangered	No	Highly unlikely
<i>Platysaurus monotropis</i> Orange- throated Flat Lizard	Endangered	No	Highly unlikely
<i>Platysaurus orientalis fitzsimonsi</i> Fitzsimon's Flat Lizard	Near Threatened	No	Highly unlikely

<b><i>Scelotes limpopoensis albiventris</i></b> White-bellied Dwarf Burrowing Skink	Near Threatened	No	Highly unlikely
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#### 4.3.4 Amphibian species of particular high conservation priority

**Table 4.17** Threatened or Near-threatened amphibian species in Limpopo Province. Literature sources (Minter, Burger, Harrison, Braack, Bishop. & Kloepfer 2004; Du Preez & Carruthers 2009). No = Amphibian species is not a resident on the site; Yes = Amphibian species is found to be resident on the site.

<b>Species</b>	<b>Conservation status</b>	<b>Recorded at site during survey</b>	<b>Residential status at the site:</b> Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<b><i>Breviceps sylvestris</i></b> Northern Forest Rain Frog	Vulnerable	No	Highly unlikely

#### 4.4 INVERTEBRATE SPECIES OF PARTICULAR CONSERVATION PRIORITY

##### 4.4.1 Butterflies of particular conservation priority

**Table 4.18 Threatened: Globally Critically Endangered** butterfly species of the Limpopo and Mpumalanga Provinces combined. Sources: Mecenero *et al.* (2013), Henning, Terblanche & Ball (2009). Invertebrates such as threatened butterfly species are often very habitat specific and residential status implies a unique ecosystem that is at stake.

<b>Species</b>	<b>Red List Status</b>	<b>Recorded at site during survey</b>	<b>Residential status at the site:</b> Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<b><i>Alaena margaritacea</i></b> Wolkberg Zulu	Critically Endangered	No	Highly unlikely
<b><i>Anthene crawshayi juanita</i></b> Juanita's Hairtail	Critically Endangered	No	Highly unlikely
<b><i>Erikssonina edgei</i>*</b> Waterberg Copper	Critically Endangered	No	Highly unlikely

\* Note South Africa populations of *Erikssonina acraeina* (also listed by LEMA 2003) belong to the Critically Endangered *Erikssonina edgei* (Gardiner & Terblanche, 2010).

**Table 4.19 Threatened: Regionally Critically Endangered** butterfly species of the Limpopo and Mpumalanga Provinces combined. Sources: Mecenero *et al.* (2013).

Species	Red List Status (Global unless stated otherwise)	Recorded at site during survey	Residential status at the site: Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Acada biseriata</i> Axehead Orange	Regionally Critically Endangered	No	Highly unlikely
<i>Charaxes guderiana guderiana</i> Blue-spangled Charaxes	Regionally Critically Endangered	No	Highly unlikely

**Table 4.20 Threatened: Endangered** butterfly species of the Limpopo and Mpumalanga Provinces combined. Sources: Mecenero *et al.* (2013), Henning, Terblanche & Ball (2009).

Species	Red List Status (Global status)	Recorded at site during survey	Residential status at the site: Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Aloeides stevensoni</i> Stevenson's Copper	Endangered	No	Highly unlikely
<i>Dingana clara</i> Wolkberg Widow	Endangered	No	Highly unlikely
<i>Lepidochrysops lotana</i> Lotana Blue	Endangered	No	Highly unlikely
<i>Telchinia induna salmontana</i> Soutpansberg Acraea	Endangered	No	Highly unlikely

**Table 4.21 Extremely Rare or Rare** butterfly species of the Limpopo and Mpumalanga Provinces combined. Source: Mecenero *et al.* (2013).

Species	Red List Status (Global unless stated otherwise)	Recorded at site during survey	Residential status at the site: Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Anthene minima minima</i> Little Hairtail	Rare (Low density)	No	Unlikely
<i>Charaxes druceanus solitarius</i> Blouberg Silver-barred Charaxes	Rare (Restricted range)	No	Highly unlikely
<i>Charaxes xiphares staudel</i> Blouberg Forest-king Charaxes	Rare (Restricted range)	No	Highly unlikely
<i>Colotis celimene amina</i> Lilac Tip	Rare (Low density)	No	Medium possibility
<i>Dingana jerinae</i> (Kransberg Widow)	Rare (Restricted range)	No	Highly unlikely
<i>Dira swanepoeli isolata</i> * Blouberg Widow	Rare (Restricted range)	No	Highly unlikely
<i>Metisella meninx</i> Marsh Sylph	Rare (Habitat specialist)	No	Highly unlikely

<b><i>Orachrysops regalis</i></b> Royal Blue	Rare (Habitat specialist)	No	Highly unlikely
<b><i>Papilio ophidicephalus entabeni</i></b> Entabeni Emperor Swallowtail	Rare (Habitat specialist)	No	Highly unlikely
<b><i>Papilio ophidicephalus transvaalensis</i></b> Woodbush Emperor Swallowtail	Rare (Habitat specialist)	No	Highly unlikely

**Table 4.22 Data deficient** butterfly species of the Limpopo and Mpumalanga Provinces combined. Source: Mecenero *et al.* (In press.).

<b>Species</b>	<b>Red Listed Status</b>	<b>Recorded at site during survey</b>	<b>Residential status at the site:</b> Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<b><i>Coenyroopsis natalii poetulodes</i></b>	Data Deficient	No	Highly unlikely
<b><i>Pseudonympha swanepoeli</i> *</b>	Data Deficient	No	Highly unlikely

#### 4.4.3 Cicadas of particular conservation priority

**Table 4.23 Data deficient** but possibly highly localised cicada species of the Limpopo Province which is of conservation priority.

<b>Species</b>	<b>Red Listed Status</b>	<b>Recorded at site during survey</b>	<b>Residential status at the site:</b> Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<b><i>Pycna sylvia</i></b> Giant Cicada	Data Deficient but possibly has restricted distribution in Sekhukhuneland.	No	Unlikely

#### 4.4.4 Beetles of particular conservation priority

**Table 4.24** Fruit chafer species (Coleoptera: Scarabaeidae: Cetoninae) of the Limpopo Province which are of known high conservation priority.

<b>Species</b>	<b>Red Listed Status</b>	<b>Recorded at site during survey</b>	<b>Residential status at the site:</b> Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<b><i>Ichnestoma stobbiai</i></b>	Taxonomic status of some populations uncertain	No	Highly unlikely
<b><i>Tmesorhina viridicyanea</i></b>	Uncertain/ rare	No	Unlikely
<b><i>Trichocephala brincki</i></b>	Uncertain	No	Highly unlikely

#### 4.4.5 Scorpions of particular conservation importance

**Table 4.25** Highly endemic and/ or habitat specific rock scorpion species of Limpopo and Mpumalanga Provinces combined. Main source: Prendini (2001)

Species	Distribution	Conservation Status	Residential status at the site: Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Hadogenes bicolor</i>	Endemic to South Africa (Mpumalanga and Limpopo)	Uncertain: Habitat specialist	Unlikely
<i>Hadogenes longimanus</i> "Steelpoort specimens"	Specimens from Steelpoort have some different characteristics and may be a different taxon pending further investigations (See Prendini, 2001).	Data deficient. Habitat specialist	Unlikely
<i>Hadogenes newlandsi</i>	Endemic to South Africa (Limpopo Province).	Uncertain: Habitat specialist	Unlikely
<i>Hadogenes troglodytes</i>	Not threatened but regarded as sensitive species with high habitat specificity.	Not threatened (pers. obs.) but clearly lithophilous (rocky habitat specialist)	Unlikely

#### 4.4.7 Baboon spiders of particular conservation importance

**Table 4.26** Baboon spiders (Arachnida: Theraphosidae) species that are of known high conservation priority in the Limpopo Province. See De Wet & Schoeman (1991), Dippenaar-Schoeman (2002) and Foord, Dippenaar-Schoeman & van der Merwe (2002) for more information on the present known distributions of species.

Species	Red List Status	Recorded at site during survey	Residential status at the site: Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Ceratogyrus bechuanicus</i>	Not threatened: All <i>Ceratogyrus</i> species are on TOPS list.	No	Unlikely
<i>Ceratogyrus brachycephalus</i>	Not threatened/ Uncertain: All <i>Ceratogyrus</i> species are on TOPS list.	No	Unlikely
<i>Pterinochilus</i> species ( <i>Pterinochilus junodi</i> , <i>P. pluridentatis</i> )	Not threatened: All <i>Pterinochilus</i> species are on TOPS list.	No	Unlikely



## 5 DISCUSSION

### 5.1 HABITAT AND VEGETATION CHARACTERISTICS

An outline of the overall habitat and vegetation characteristics is given in Table 4.1.

### 5.2 PLANT SPECIES

#### ***Assessment of threatened or other high conservation priority plant species***

Threatened (critically endangered, endangered and vulnerable), near threatened, critically rare, rare and data deficient plant species in the Limpopo Province are listed in Tables 4.2 to 4.9 (extracted from Raimondo *et al.* 2009 and updates by Threatened Species Programme, SANBI). Occurrence of Threatened and Near Threatened plant species at the site is unlikely.

#### ***Protected tree species (National)***

Indigenous tree species which are not threatened but which are protected, *Boscia albitrunca* (Shepherd's Tree) and *Sclerocarya birrea* (Marula Tree), have been found at the site (Table 4.10). These protected tree species are listed under the National Forests Act No. 84 of 1998. In terms of a part of section 15(1) of Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

#### ***Protected plant species according to LEMA (2003)***

Some plant species which are not listed in the National List of Protected trees are listed as protected according to LEMA (Limpopo Environmental Act No. 7 of 2003; Commencing date 1 May 2004). *Spirostachys africa* (Tamboti) which is listed as a protected tree species under LEMA (Schedule 12) is present at the site.

Presence of plant species which are not Threatened but listed as protected according to LEMA (Limpopo Environmental Act No. 7 of 2003; Commencing date 1 May 2004) such as the succulent stapeliad *Piранthus atrosanguineus* (not endemic, found in North West and Limpopo Province in South Africa; Least Concern) at the site, if the development is approved, appears to be unlikely.

## 5.3 VERTEBRATES

### 5.3.1 Mammals

#### *Assessment of threatened or other high conservation priority mammal species*

Tables 4.11, 4.12 and 4.13 list the possible presence or absence of mammals of particular conservation concern. Main literature source used is Child *et al.* (2017) with updates by several authors per species. Other important literature sources include Skinner & Chimimba (2005). With mammal species which normally needs a large range their residential status does not always imply that they are exclusively dependent on the site or use the site as important shelter or for reproduction.

Carnivores such as the Near Threatened *Parahyaena brunnea* (Brown Hyaena) travel through the proposed footprint and use the larger study area as its territory. Leopard (*Panthera pardus*) which is listed as Vulnerable (IUCN) could also travel through the site occasionally. Owing to the size of the proposed footprint, large areas for these animals would remain in the local study area if the development is approved. There is no distinct threat to any mammal species of particular conservation concern if the development is approved.

### 5.3.2 Birds

#### *Assessment of threatened or other high conservation priority bird species*

Table 4.14 lists the possible presence or absence of Threatened bird species at the site and Table 4.15 lists the possible occurrence or not of Near Threatened birds. With bird species which often have a large distributional range, their presence does not imply that they are particularly dependent on a site as breeding location. Literature sources used include Hockey *et al.* (2005), Taylor *et al.* (2015) and Chittenden *et al.* (2016). For the Threatened (Vulnerable, Endangered, Critically Endangered) bird species or any other bird species of particular conservation priority (Near Threatened, Data Deficient) the site does not appear to form part of any habitat of particular importance.

The study area is located in northern parts of South Africa where a number of formally protected areas are present. Threatened vulture species such as *Gyps africanus* (White-

backed Vulture) listed Nationally as Critically Endangered could cross the site from time to time. There are no signs (such as nests) or observations that indicate a specific importance of the site for threatened or near threatened bird species.

### **5.3.3 Reptiles**

#### *Assessment of threatened or other high conservation priority reptile species*

Table 4.16 lists the possible presence or absence of threatened reptile species and near threatened reptile species at the site. Main source of compiling the list in Table 4.17 is Bates, Branch, Bauer, Burger, Marais, Alexander & De Villiers (2014), that is the Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland (South African National Biodiversity Institute, Pretoria). Presence of threatened reptile species at the site is unlikely.

### **5.3.4 Amphibians**

#### *Assessment of threatened or other high conservation priority reptile species*

The only frog species from the Limpopo Province which is listed as a threatened species, in this case vulnerable, according to Minter, Burger, Harrison, Braack, Bishop and Kloepfer (2004) as well as Du Preez and Carruthers (2009) is *Breviceps sylvestris*, the northern forest rain frog. Two subspecies of *Breviceps sylvestris* are recognised and both occur in afro-montane forest or northeastern mountain grassland (Du Preez & Carruthers, 2009). No threatened frog species or any other frog species of particular conservation priority appear to be present at the site.

## 5.4 INVERTEBRATES

### 5.4.1 Butterflies

#### *Assessment of threatened butterfly species*

In terms of conservation status of invertebrates in South Africa butterflies represents the most well studied group and many of the present extinction risk assessments are relatively well refined. Three “red data assessments” have already been conducted on South African butterflies notably that of Henning & Henning (1989), Henning, Terblanche & Ball (2009) and the most recent assessment Mecenero *et al.* (2013), the latter also comprising a butterfly atlas. Studies about the vegetation and habitat of threatened butterfly species in South Africa showed that ecosystems with a unique combination of features are selected by these often localised threatened butterfly species (Deutschländer and Bredenkamp 1999; Edge 2002, 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003). Threatened butterfly species in South Africa can then be regarded as bio-indicators of rare ecosystems.

Because the habitat specificities of invertebrates are often less well known and because of recent updates of information, the expected presence or absence of butterfly species of high conservation priority that are listed in Tables 4.18 – 4.22 is outlined beneath.

#### *Threatened: Critically Endangered (global)*

##### ***Alaena margaritacea*** (Wolkberg Zulu)

The proposed global red list status for *Alaena margaritacea* according to the most recent IUCN criteria and categories is Critically Endangered (Mecenero *et al.* 2013). *Alaena margaritacea* is only known from one restricted area in the vicinity of Haenertsburg in the Wolkberg. The secluded colony is found on steep grassy slopes in the Wolkberg with where lichen covered rocks are a crucial part of the habitat (Henning, Terblanche & Ball 2009). Recently a second locality of this butterfly species has been found, also at high altitude at the Wolkberg mountains (A. Coetzer pers. comm.). Presence of this species at site is highly unlikely owing to lack of habitat requirements.

##### ***Anthene crawshayi juanitae*** (Juanita’s Ciliated Blue)

The proposed global red list status for *Anthene crawshayi juanitae* according to the most recent IUCN criteria and categories is Critically Endangered (Mecenero *et al.*, 2013).

*Anthene juanita* has only recently been rediscovered after for two decades being known from only six specimens from riverine vegetation on the banks of the Olifants River at Manoutsa Park where the butterfly was discovered in 1990 (Henning, Terblanche & Ball 2009). Recently in 2011 and 2012 the butterfly was rediscovered at Manoutsa Park and also at a new locality at the Lekgalameetse Nature Reserve. Presence of this species at site is highly unlikely owing to lack of habitat requirements.

***Erikssonia edgei*** (Waterberg Copper)

*Erikssonia edgei* was previously referred to as the Waterberg population of *Erikssonia acraeina* before it was described as a new species from South Africa by Gardiner & Terblanche (2010). The proposed global red list status for *Erikssonia edgei* (hitherto known as the South African population of *Erikssonia acraeina*) according to the most recent IUCN criteria and categories is Critically Endangered (Possibly extinct) (Mecenero *et al.*, 2013). *Erikssonia edgei* is only known from one restricted area in the vicinity of Rankin's Pass on deep sands of the Waterberg (Gardiner & Terblanche, 2010). Presence of this species at site is highly unlikely owing to lack of habitat requirements.

*Threatened: Critically Endangered (regionally: South Africa)*

***Acada biseriata*** (Axehead Orange)

*Acada biseriata* is listed as regionally Critically Endangered in South Africa (Mecenero *et al.*, 2013). In South Africa *Acada biseriata* is only recorded from Gundani northeast of Thohoyandou in the Limpopo Province (Mecenero *et al.*, 2013). *Acada biseriata* only occurs at the VhaVenda Miombo vegetation type (Mucina & Rutherford 2006) in South Africa. Presence of this species at site is unlikely.

***Charaxes guderiana guderiana*** (Blue-spangled Charaxes)

*Charaxes guderiana guderiana* is listed as regionally Critically Endangered in South Africa (Mecenero *et al.*, 2013). Only one population of this butterfly is known in South Africa in the Soutpansberg near Thohoyandou which is removed from the nearest main population in Zimbabwe by more than 500 km (Mecenero *et al.*, 2013). *Charaxes guderiana guderiana* only occurs at the VhaVenda Miombo vegetation type (Mucina & Rutherford 2006) in South Africa. Presence of this species at site is unlikely.

*Threatened: Endangered (global)*

***Aloeides stevensoni*** (Stevenson's Copper)

The proposed global red list status for *Aloeides stevensoni* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013). *Aloeides stevensoni* colonies are found on south facing, high-altitude grassy slopes of the Wolkberg (Henning, Terblanche & Ball 2009). *Aloeides stevensoni* is endemic to the Limpopo Province near Serala and Haenertsburg and up to date only found in the Woodbush Granite Grassland vegetation type (Mecenero *et al.*, 2013, Mucina & Rutherford 2006). Presence of this species at site is highly unlikely owing to lack of habitat requirements.

***Dingana clara*** (Wolkberg Widow)

The proposed global red list status for *Dingana clara* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013). Historically *Dingana clara* has been listed as Vulnerable by Henning, Terblanche & Ball (2009) so that the most recent assessment reflects an increase in the extinction risk. *Dingana clara* is endemic to South Africa and confined to the Wolkberg at Lekgalameetse Nature Reserve near Tzaneen in the south to just south of Haenertsburg in the north (Mecenero *et al.*, 2013). Adults are found on steep, rock-strewn, grassy slopes at high elevations among proteas (Henning, Ball & Terblanche, 2009). Presence of this species at site is highly unlikely owing to lack of habitat requirements.

***Lepidochrysops lotana*** (Lotana Blue)

The proposed global red list status for *Lepidochrysops lotana* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013). The type locality where the butterfly was first discovered is on the farm Rietvlei 30km south of Polokwane. Another locality is known on the Wolkberg east of Polokwane and very recently the butterfly was found in the Legalemeetse Nature Reserve (Mecenero *et al.*, 2013). The butterfly is present where the larval host plant *Ocimum obovatum* occurs on grassy slopes (Henning, Terblanche & Ball, 2009). Note that the distribution of the butterfly is much more restricted than the distribution of the host plant. Presence of this species at site is highly unlikely owing to lack of habitat requirements.

***Telchinia induna salmontana*** (Soutpansberg Acraea)

The proposed global red list status for *Telchinia induna salmontana* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013). Historically *Telchinia induna salmontana* has been listed as Vulnerable by Henning, Terblanche & Ball (2009) so that the most recent assessment reflects an increase in the extinction risk. *Telchinia induna salmontana* is found in Soutpansberg Summit Sourveld (Mucina &

Rutherford 2006) on the higher peaks in the Soutpansberg Mountains. Adults fly along exposed high rocky ridges where the food plant of the larva, *Aeschynomene nodulosa*, grows (Henning, Ball & Terblanche 2009). Presence of this species at site is highly unlikely owing to lack of habitat requirements.

Extremely Rare or Rare species (National categories)

***Anthene minima minima*** (Little Cilated Blue/ Little Hairtail)

*Anthene minima minima* is listed as Rare (Low density) by Mecenero *et al.* (2013). *Anthene minima minima* is found in a few selected spots in South Africa in KwaZulu-Natal, Limpopo, and Mpumalanga and also Botswana and Swaziland. *Anthene minima minima* has been recorded from relatively dry savanna but its habitat requirements are still poorly understood. Presence of this species at the site is unlikely.

***Charaxes druceanus solitarius*** (Blouberg Silver-barred Charaxes)

*Charaxes druceanus solitarius* is listed as Rare (Restricted Range) by Mecenero *et al.* (2013). *Charaxes druceanus solitarius* is endemic to South Africa and limited to the Blouberg inselberg near Poleni in the Limpopo Province (Mecenero *et al.* In press.). *Charaxes druceanus solitarius* has only been found at the Northern Mistbelt Forest vegetation type (Mucina & Rutherford 2006). Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements.

***Charaxes xiphares staudei*** (Blouberg Forest-king Charaxes)

*Charaxes xiphares staudei* is listed as Rare (Restricted Range) by Mecenero *et al.* (2013). *Charaxes xiphares staudei* is endemic to South Africa and limited to the Blouberg inselberg near Poleni in the Limpopo Province (Mecenero *et al.*, 2013). *Charaxes xiphares staudei* has only been found at the Northern Mistbelt Forest vegetation type (Mucina & Rutherford 2006). Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements.

***Colotis celimene amina*** (Lilac tip)

*Colotis celimene amina* is listed as Rare (Low density) by Mecenero *et al.* (2013). In South Africa *Colotis celimene amina* is present from Pietermaritzburg in the south and northwards into parts of Kwa-Zulu Natal, Gauteng, Limpopo, Mpumalanga and the North West Provinces (Mecenero *et al.* In press.). Reasons for its rarity are poorly understood apart from that the butterfly species occurs at some places where *Boscia albitrunca* is present (but clearly not at all places where *Boscia albitrunca* is present) (Terblanche, In prep.). *Colotis celimene amina*

could occur at the site but up to date the larger area has not been identified as particular suitable habitat for this rare but widespread species.

***Dingana jerinae*** (Kransberg Widow)

*Dingana jerinae* is listed as Rare (Range Restricted) by Mecenero *et al.* (2013). Historically the conservation status of *Dingana jerinae* was proposed to be Vulnerable (Henning, Terblanche & Ball 2009), however during the most recent assessment it was concluded that the habitat is currently under no immediate threat. *Dingana jerinae* is only known from the Kransberg part of the Waterberg where one of its localities extends into the Marekele National Park. Adults fly on steep slopes, below high cliffs, among fallen rocks as well as in rocky terrain on the summits (Henning, Terblanche & Ball 2009). *Dingana jerinae* is endemic to South Africa and limited to the Waterberg near Thabazimbi in the Limpopo Province (Mecenero *et al.*, 2013). Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements.

***Dira swanepoeli isolata*** (Blouberg Widow)

*Dira swanepoeli isolata* is listed as Rare (Restricted Range) by Mecenero *et al.* (2013). *Dira swanepoeli isolata* is endemic to South Africa and is only found at the southern slopes of the Blouberg in the Limpopo Province (Mecenero *et al.*, 2013). *Dira swanepoeli isolata* has only been found at montane grassy slopes of its single known locality (Mecenero *et al.*, 2013). Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements.

***Metisella meninx*** (Marsh Sylph)

Henning and Henning (1989) in the first South African Red Data Book of butterflies listed *Metisella meninx* as threatened under the former IUCN category Indeterminate. Even earlier in the 20<sup>th</sup> century Swanepoel (1953) raised concern about vanishing wetlands leading to habitat loss and loss of populations of *Metisella meninx*. According to the second South African Red Data Book of butterflies (Henning, Terblanche & Ball, 2009) the proposed global red list status of *Metisella meninx* has been Vulnerable. During a recent large scale atlassing project the *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas* (Mecenero *et al.*, In press.) it was found that more *Metisella meninx* populations are present than thought before. Based on this valid new information, the conservation status of *Metisella meninx* has been changed to least concern Rare (Habitat specialist) (Mecenero *et al.*, 2103). Though *Metisella meninx* is more widespread and less threatened than perceived before, it should be regarded as a localised rare habitat specialist of conservation priority, which is dependent on wetlands with suitable patches of grass at



wetlands (Terblanche *In prep.*). Another important factor to keep in mind for the conservation of *Metisella meninx* is that based on very recent discoveries of new taxa in the group the present *Metisella meninx* is species complex consisting of at least three taxa (Terblanche *In prep.*, Terblanche & Henning *In prep.*). The ideal habitat of *Metisella meninx* is treeless marshy areas where *Leersia hexandra* (rice grass) is abundant (Terblanche *In prep.*). The larval host plant of *Metisella meninx* is wild rice grass, *Leersia hexandra* (G.A. Henning & Roos, 2001). Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements.

***Orachrysops regalis* (Royal Blue)**

*Orachrysops regalis* is listed as Rare (Habitat specialist) (Mecenero *et al.*, 2013). *Orachrysops regalis* is endemic to the Limpopo Province and found from the Strydpoortberg mountain range near Haenertsburg in the south to Soutpansberg in the north (Mecenero *et al.*, 2013). Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements.

***Papilio ophidicephalus entabeni* (Entabeni Emperor Swallowtail)**

*Papilio ophidicephalus entabeni* is listed as Rare (Habitat specialist) by Mecenero *et al.* (2013). *Papilio ophidicephalus entabeni* is endemic to the Limpopo Province and limited to the forests of the Blouberg and Soutpansberg. *Papilio ophidicephalus entabeni* has only been found at the Northern Mistbelt Forest vegetation type (Mucina & Rutherford 2006). Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements.

***Papilio ophidicephalus transvaalensis* (Woodbush Emperor Swallowtail)**

*Papilio ophidicephalus transvaalensis* is listed as Rare (Habitat specialist) by Mecenero *et al.* (*In press.*). *Papilio ophidicephalus transvaalensis* is endemic to the Limpopo Province and limited to the forests from near Polokwane in the west to Ofcolaco in the east (Mecenero *et al.*, 2013). *Papilio ophidicephalus transvaalensis* has only been found at the Northern Mistbelt Forest vegetation type (Mucina & Rutherford 2006). Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements and distributional barriers.

*Data deficient*

***Coenyropsis natalii poetulodes***

*Coenyropsis natalii poetulodes* is listed as Data Deficient by Mecenero *et al.* (2013). *Coenyropsis natalii poetulodes* is endemic to South Africa and limited to the western

Wolkberg near Chuniespoort (Mecenero *et al.*, 2013). *Coenyropsis natalii poetulodes* has only been found at rank grassy slopes at an altitude of 1000 m to 1500 m in mixed savanna/grassland of the western parts of the Wolkberg (Mecenero *et al.*, 2013). Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements.

### ***Pseudonympha swanepoeli***

*Pseudonympha swanepoeli* is listed as Data Deficient by Mecenero *et al.* (2013). The population at the type locality near Houtbosdorp (“Woodbush Village”) where the butterfly was originally found may be extinct. If this population at high elevation in the Wolkberg is unique then the red list status would be Critically Endangered (Henning, Terblanche & Ball 2009). *Pseudonympha swanepoeli* is only known from one restricted marshy area near Houtbosdorp in the Wolkberg mountains. Previously known localities of the butterfly in the vicinity of Houtbosdorp have been destroyed (Henning, Terblanche & Ball 2009). Taxonomic uncertainty is a real problem for conservation in this case because all the *Pseudonympha swanepoeli* populations known today are clearly part of more than one taxon. Some of these taxa which are obscured by the present taxonomic predicament may be under a very high extinction risk. All *Pseudonympha swanepoeli* populations should be regarded as sensitive as a pre-cautionary principle. Presence of this species as resident at site is highly unlikely owing to lack of habitat requirements.

## **5.4.2 Cicadas**

### *Assessment of high conservation priority cicada species*

In general much progress has been made recently in South Africa to improve the taxonomy and ecological knowledge of cicadas in South Africa. However, in terms of conservation status many species and subspecies are still poorly known and extinction risk assessments are limited. Here only one species which are better known to the extent that some indication of their conservation priority could be listed (Table 4.23).

### ***Pycna (Platyleura) sylvia*** (Giant cicada)

*Pycna sylvia*, the largest endemic cicada species in South Africa, was recorded from the Mpumalanga Province in South Africa at Sekhukhuneland. *Pycna sylvia*, hitherto thought to be extinct, was rediscovered in 2001 after 95 years in the Groot Dwars River Valley, Mpumalanga during a faunal survey for Anglo Platinum (Malherbe, Burger & Stephen, 2004). The only known host plant of *Pycna sylvia* is the tree *Vitex obovata* subsp. *wilmsii*. Apparently *Pycna sylvia* is mostly found at or in the vicinity of dense stands of the host plant

(Malherbe, Burger & Stephen, 2004). Based on present information it is unlikely that *Pycna sylvia* (confined to Sekhukhuneland) is to be found at the site.

### 5.4.3 Fruit chafer beetles

#### *Assessment of threatened or other high conservation priority fruit chafer beetle species*

Table 4.24 lists the fruit chafer beetle species (Coleoptera: Scarabaeidae: Cetoninae) that are of known high conservation priority in the Limpopo Province. Some of the rare Cetoniinae is rather data deficient and more information is necessary for the extinction risk assessments. No fruit chafer beetles of particular conservation priority are expected to be resident at the site.

### 5.4.4 Scorpions

Table 4.25 lists rock scorpion species (Scorpiones: Ischnuridae) that are of known high conservation priority in the Limpopo and Mpumalanga Provinces combined. Presence of Rock Scorpions at the site proposed for development is unlikely.

### 5.4.5 Baboon spiders

In the South African context baboon spider species (Table 4.26) belonging to the genus *Ceratogyrus* has a particular presence in the Limpopo Province. *Ceratogyrus* (“horned baboon spiders”) is also of importance to the pet trade and appears on the TOPS list with other baboon spider genera *Harpactira* and *Pterinochilus*.

*Ceratogyrus bechuanicus* and *Ceratogyrus brachycephalus* appear to be only found to occur in small colonies of a few burrows scattered over wide area at each locality (De Wet & Dippenaar-Schoeman 1991). This is in contrast to other baboon spider species such as *Pterinochilus* which is found in much larger colonies. Distribution of *Ceratogyrus bechuanicus* ranges from Botswana, Central Namibia, Zimbabwe (widespread), Mozambique to the northern parts of South Africa (Limpopo Province) (Dippenaar-Schoeman 2002). *Ceratogyrus bechuanicus* has also been recorded from the western Soutpansberg (Foord, Dippenaar-Schoeman & Van der Merwe 2002). In contrast to the more widespread species mentioned above, *Ceratogyrus brachycephalus* has a much more restricted distribution, being confined to localities in central Botswana, southern Zimbabwe

and the extreme northern Limpopo (De Wet & Dippenaar-Schoeman 1991; Dippenaar-Schoeman 2002).

Burrows of *Ceratogyrus* can be found in different types of soils, ranging from sandy to very hard, compacted soils in areas sparsely covered with grass (De Wet & Dippenaar-Schoeman 1991). Most burrows are J-shaped (De Wet & Dippenaar-Schoeman 1991). In arid regions the burrow of baboon spiders (Theraphosidae) are usually deep to provide protection from high temperatures (Smith 1990). Adult males are usually not found in burrows and actively seeking females, freely wandering at night, and may also be shorter-lived than the females (De Wet & Dippenaar-Schoeman 1991; De Wet & Schoonbee 1991). Pitfall traps are found to be unsuccessful, as the males of *Ceratogyrus* are not easily captured in this manner (De Wet & Schoonbee 1991).

*Ceratogyrus bechuanicus* is well-represented in the Kruger National Park, Musina, D'nyala and Atherstone Nature Reserves as well as in the Klaserie and Sabi Sand private nature reserves (De Wet & Schoonbee 1991). *Ceratogyrus brachycephala* has only been found in the Messina Provincial Nature Reserve whilst its historic distribution includes the Langjan Nature Reserve (De Wet & Schoonbee 1991). *Ceratogyrus brachycephala* with its much smaller distribution has a higher conservation priority than *Ceratogyrus bechuanicus*. Since *Ceratogyrus* species are found in areas sparsely covered with grass, a balanced utilisation of habitat must be prescribed, and for management purposes the complete ecosystem must thus be taken into account (De Wet & Schoonbee 1991). Though De Wet & Schoonbee (1991) recommended determination of veld condition boundaries of habitats where colonies of *Ceratogyrus* occur, no detailed habitat study could be tracked in an extensive literature survey for this study. *Ceratogyrus bechuanicus* could be present at the study area but not distinct signs of the species at the site and no distinct indications of suitable habitat have been found at the site.

Though the presence of some baboon spider species of particular conservation concern are possible at the proposed footprint the site does not appear to be a habitat of particular importance for any baboon spiders of particular conservation concern.

## 5.5 Representation of Biodiversity Priority Areas at site

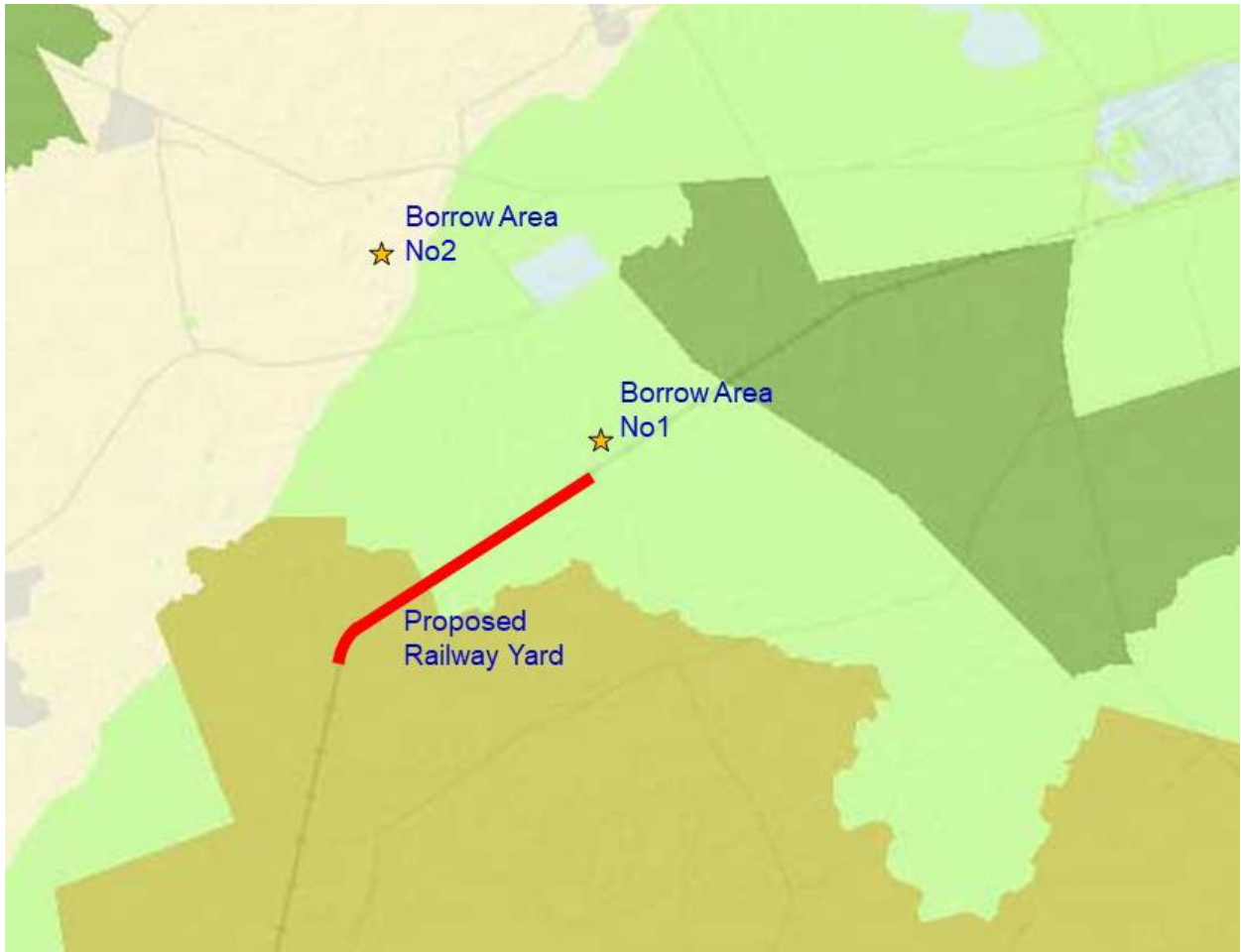
Representation of Biodiversity Priority Areas at the site is indicated in Figure 2. A CBA Map is a spatial plan for ecological sustainability. It identifies a set of biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as long term ecological functioning of the landscape as a whole (SANBI, 2017). Provided that protected areas and CBAs remain largely natural, and ecological processes are maintained in ESAs, intensive land uses can be expanded into Other Natural Areas without undue impacts on biodiversity conservation or the ecological sustainability of the landscape as a whole (SANBI, 2017).

### *At the site:*



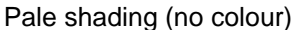


Biodiversity priority areas at the western parts of the proposed Railway Yard site are represented by a Critical Biodiversity Area 2 (CBA 2) (Figure 2). Critical Biodiversity Areas, together with protected areas, ensures that a viable representative sample of all ecosystem types and species can persist. From an environmental management perspective these Critical Biodiversity Areas must stay in largely natural condition (SANBI, 2017).

Biodiversity priority areas at the central and eastern parts of the proposed Railway Yard site as well as proposed Borrow Area No1 are represented by an Ecological Support Area 1. Ecological Support Areas ensure the long-term ecological functioning of the landscape as a whole. From an environmental management perspective these Ecological Support Areas must retain ecological processes, which often requires at least semi-natural ecological conditions (SANBI, 2017). These ESAs that are currently in severely modified ecological condition (e.g. cultivated areas in riparian zones) but which nevertheless retain sufficient ecological functioning to fulfil the purpose for which the ESA was selected. The objective is to prevent further deterioration in ecological condition (SANBI, 2017).

Biodiversity priority areas at the proposed Borrow Area No2 is represented by Other Natural Areas (ONAs). Other Natural Areas consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs (SANBI, 2017). A biodiversity sector plan or bioregional plan must not specify the desired state/ management objectives for ONAs or provide land-use guidelines for ONAs (SANBI, 2017).

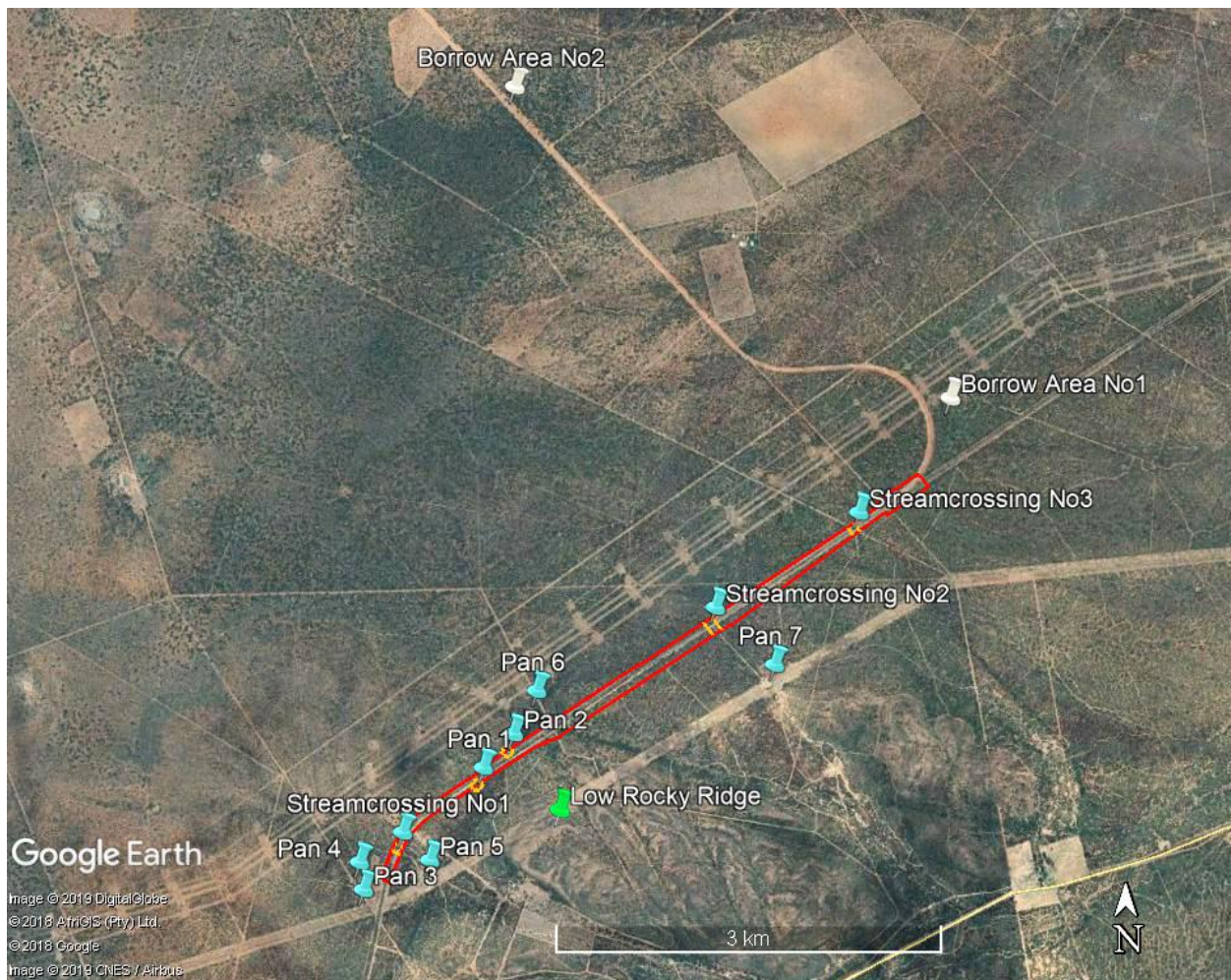


**Figure 2** Map with indications of Biodiversity Areas according to Limpopo Conservation Plan v.2. which is accompanied by its Technical Report (Desmet *et al.*, 2013). Sources: SANBI BGIS & Desmet, P.G., Holness, S., Skowno, A.L. & Egan, V.T. 2013. Limpopo Conservation Plan v.2: Technical Report for the Limpopo Department of Economic Development, Environment & Tourism (LEDET).

	Red outline	Indication of location of proposed Railway Yard site
	Stars	Indication of location of proposed Borrow Areas
	Pale shading (no colour)	Other Natural Areas
	Orange-green shading	Critical Biodiversity Area 2 (CBA 2)
	Light green shading	Ecological Support Area 1 (ESA 1)

## 5.6 Ecological Sensitivity at the site





Ecological sensitivity at the hitherto cleared areas and the existing railway reserve is low. Ecological sensitivity at the remaining savanna north and south of the railway reserve is medium. Ecological sensitivity is medium-high at the two very small wetland depressions (pan) and their buffer zones (32 m) at the site as well as the three non-perennial drainage lines with their buffer zones (32 m) (Figures 4-11). Kindly also see Wetland Assessment report which accompanies this Ecological Habitat Survey Report.



**Figure 3** Indications of site (railway yard area and borrow areas) and patches that are likely to be ecologically sensitive in the study area.







**Figure 4** Indications of ecological sensitivity at the site. Ecological sensitivity is shown closer up at parts of the site in the Figures that follow.

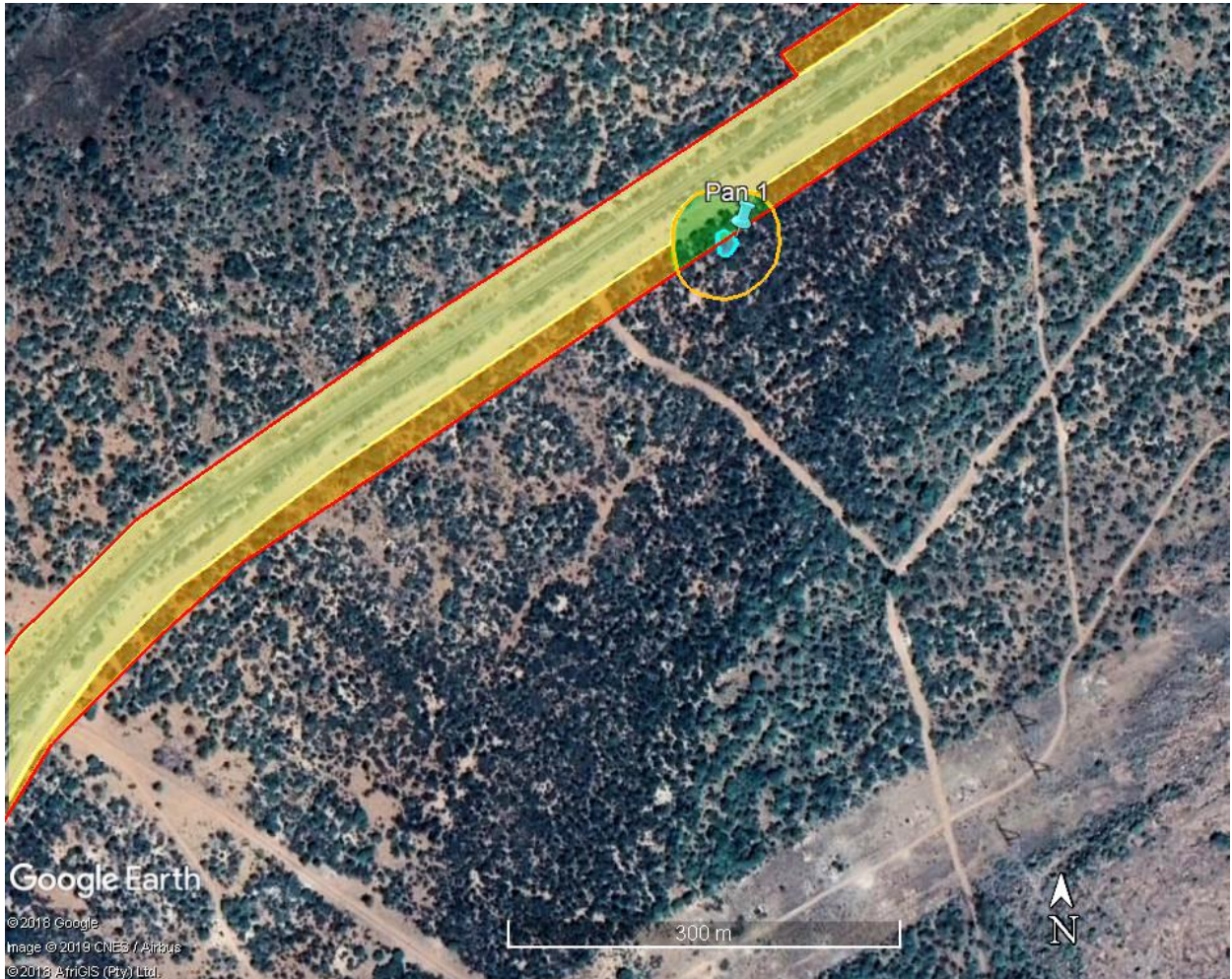
- |   |                                  |  |
|---|----------------------------------|--|
|  | Red outline                      | Boundaries at the proposed Railway Yard site |
|  | Light yellow outline and shading | Low Sensitivity                              |
|  | Orange outline and shading       | Medium Sensitivity                           |
|  | Green outline and shading        | Medium-high Sensitivity                      |









**Figure 5** Indications of ecological sensitivity at western end of the proposed railway yard site.

	Red outline	Boundaries at the proposed Railway Yard
	Light yellow outline and shading	Low Sensitivity
	Orange outline and shading	Medium Sensitivity
	Green outline and shading	Medium-high Sensitivity







**Figure 6** Indications of ecological sensitivity at the western parts of the proposed railway yard site at Pan 1.

- |   |                                  |   |
|---|----------------------------------|---|
|  | Red outline                      | Boundaries at the proposed Railway Yard |
|  | Light yellow outline and shading | Low Sensitivity                         |
|  | Orange outline and shading       | Medium Sensitivity                      |
|  | Green outline and shading        | Medium-high Sensitivity                 |



**Figure 7** Indications of ecological sensitivity at the western parts of the proposed railway yard site at Pan 2.

- |   |                                  |   |
|---|----------------------------------|---|
|  | Red outline                      | Boundaries at the proposed Railway Yard |
|  | Light yellow outline and shading | Low Sensitivity                         |
|  | Orange outline and shading       | Medium Sensitivity                      |
|  | Green outline and shading        | Medium-high Sensitivity                 |







**Figure 8** Indications of ecological sensitivity at the central parts of the proposed railway yard site.

- |   |  |
|---|--|
| <p>— Red outline</p> <p>— Light yellow outline and shading</p> <p>— Orange outline and shading</p> <p>— Green outline and shading</p> | <p>Boundaries at the proposed Railway Yard</p> <p>Low Sensitivity</p> <p>Medium Sensitivity</p> <p>Medium-high Sensitivity</p> |
|---|--|







**Figure 9** Indications of ecological sensitivity at the eastern parts of the proposed railway yard site at Streamcrossing No2.

	Red outline	Boundaries at the proposed Railway Yard
	Light yellow outline and shading	Low Sensitivity
	Orange outline and shading	Medium Sensitivity
	Green outline and shading	Medium-high Sensitivity







**Figure 10** Indications of ecological sensitivity at the eastern end of the proposed railway yard site at Streamcrossing No3.

- |   |                                  |   |
|---|----------------------------------|---|
|  | Red outline                      | Boundaries at the proposed Railway Yard |
|  | Light yellow outline and shading | Low Sensitivity                         |
|  | Orange outline and shading       | Medium Sensitivity                      |
|  | Green outline and shading        | Medium-high Sensitivity                 |



**Figure 11** Indications of ecological sensitivity at proposed Borrow Area No1 and Borrow Area No2 at the site.

- |   |                                  |   |
|---|----------------------------------|---|
|  | Red outline                      | Boundaries at the proposed Railway Yard |
|  | Light yellow outline and shading | Low Sensitivity                         |
|  | Orange outline and shading       | Medium Sensitivity                      |
|  | Green outline and shading        | Medium-high Sensitivity                 |

## 6 RISKS, IMPACTS AND MITIGATION

### Background:

Habitats of threatened plants are in danger most often due to urban developments such as is the case for the Gauteng Province (Pfab & Victor, 2002). Habitat conservation is the key to the conservation of invertebrates such as threatened butterflies (Deutschländer and Bredenkamp 1999; Edge 2002, 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008). Furthermore, corridors and linkages may play a significant role in insect conservation (Pryke & Samways, 2003, Samways, 2005).

Urbanisation is a major additional influence on the loss of natural areas (Rutherford & Westfall 1994). Nevertheless, the conservation of habitats is the key to conservation, especially for those threatened species that are very habitat specific. This is also true for any detailed planning of corridors and buffer zones for species and ecosystems of particular conservation concern. Though proper management plans for habitats are not in place, setting aside special ecosystems is in line with the recent Biodiversity Act (2004) of the Republic of South Africa.

Corridors are important to link ecosystems of high conservation priority. Such corridors or linkages are there to improve the chances of survival of otherwise isolated populations (Samways, 2005). How wide should corridors be? The answer to this question depends on the conservation goal and the focal species (Samways, 2005). For an African butterfly assemblage this is about 250m when the corridor is for movement as well as being a habitat source (Pryke and Samways 2003). Hill (1995) found a figure of 200m for dung beetles in tropical Australian forest. In the agricultural context, and at least for some common insects, even small corridors can play a valuable role (Samways, 2005). Much more research remains to be done to find refined answers to the width of grassland corridors in South Africa. The width of corridors will also depend on the type of development, for instance the effects of the shade of multiple story buildings will be quite different from that of small houses.

To summarise: In practice, as far as developments are concerned, the key would be to prioritise and plan according to sensitive species and special ecosystems.



In the case of this study:

Vegetation at the present railway line has been transformed in the past or remain as vegetation where secondary succession took place after impacts associated with the railway line construction in the past. Vegetation south and north of the present railway reserve is a woodland with a diversity of indigenous tree species. Savanna at proposed Borrow Area No1 and proposed Borrow Area No2 are fairly similar to the vegetation south and north of the railway reserve.

Threatened Ecosystems are not represented by the proposed Railway Yard site and are not represented by proposed Borrow Area No1 and proposed Borrow Area No 2. Sweet Bushveld and Western Sandy Bushveld are not listed as a threatened ecosystem according to the National List of Threatened Ecosystems (2011).

The Koedoe Nature Reserve crosses the central-eastern part of the site. Koedoe Nature Reserve is listed in the National Register of Protected areas. This nature reserve at present crosses the existing railway line which means that northern section of the Koedoe Nature Reserve was “cut-off” before. The extension of the Railway reserve for the development of the Railway Yard, if approved can further isolate the different parts of the Nature Reserve. During the construction and operation of the proposed Railway Yard the development and activities associated with construction should be restricted to the footprint so that the different sections of the Koedoe Nature Reserve could continue to fulfill its role in biodiversity conservation in particular for animals such as birds which can fly across from the one section of the reserve to the other. It is recommended that the boundaries of the Koedoe Nature Reserve should be amended to an extent which is practical for the foreseeable future in terms of most likely developments.

Biodiversity priority areas at the western parts of the proposed Railway Yard site are represented by a Critical Biodiversity Area 2 (CBA 2), at the central and eastern parts of the proposed Railway Yard site and proposed Borrow Area No1 by an Ecological Support Area 1 whereas proposed Borrow Area No2 is represented by Other Natural Areas (ONAs).

Proposed Railway Yard site and also the proposed Borrow Areas are adjacent to areas which have been developed or have been significantly disturbed in the past. Certain portions of the site being part of a Critical Biodiversity Area 2 and also an Ecological Support Area 2 implicate that the developments at the site, if approved should be restricted to the proposed

footprint. Any impacts outside these proposed footprints should be kept to an absolute minimum.

Loss of Threatened, Near Threatened and Declining plant or animal species owing to the development at the proposed footprints is unlikely. Threatened or Near Threatened mammal and bird species may cross the site for example carnivores such as *Panthera pardus* (Leopard), *Parahyaena brunnea* (Brown Hyaena) and larger birds such as *Gyps africanus* (White-backed Vulture). The site does not appear to be specific breeding habitat for any such large carnivore and bird species which roams large areas of which the site is part. Two widespread tree species which are not Threatened but which is listed as Protected tree species are present at the site. These Protected tree species are *Boscia albitrunca* (Shepherd's Tree) and *Sclerocarya birrea* (Marula). In terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

Scope for the site to be part of a corridor of particular conservation importance is small. The small wetland depressions (pan) with their buffer zones as well as the drainage lines and buffers zone at the site are part of corridors of particular conservation importance. In the case of the small seasonal pans, a stepping stone corridor apply.

The following potential risks, impacts and mitigation measures apply to the proposed development:

## **6.1 Identification of potential impacts and risks**

The potential impacts identified are:

### **Construction Phase**

- Potential impact 1: Loss of habitat owing to the removal of vegetation at the proposed footprint for development.
- Potential impact 2: Loss of sensitive species (Threatened, Near-Threatened, Rare, Declining or Protected species) during the construction phase.
- Potential impact 3: Loss of connectivity and conservation corridor networks in the landscape.
- Potential impact 4: Contamination of soil during construction in particular by hydrocarbon spills.
- Potential impact 5: Killing of vertebrate fauna during the construction phase.

### Operational Phase

- Potential impact 6: An increased infestation of exotic or alien invasive plant species owing to disturbance.

### Decommissioning Phase

- Potential impact 7 Poor recovery of habitat owing to clearance of site.
- Potential impact 8 An increased infestation of exotic or alien invasive plant species owing to clearance or disturbance at the footprint allocated for development.
- Potential impact 9 Contamination of soil during decommissioning of proposed Borrow Areas.

### Cumulative Impacts

- Cumulative impact 1 Cumulative impacts to unique and sensitive habitats.
- Cumulative impact 2 Cumulative impacts to habitat fragmentation.
- Cumulative impact 3 Cumulative impacts of emissions and pollutants into air, water and soil.

## 6.2 Potential impacts and risks during the construction phase

Classes of impacts for this study: Very High, High, Moderate, Low, Very Low

Aspect/Activity	Clearance of vegetation at part of the site for the development
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Clearing of vegetation at the proposed development. This will entail the partial destruction of habitat of medium and low ecological sensitivity.
Status	Negative
Mitigation Required	Small wetland depressions (Pan 1 and Pan 2) as well as narrow drainage lines with 32 m bufferzones are excluded from the development as far as practical (some parts of the buffer zones have already been impacted in the past). If developments are approved which involve the moving of Pan 1 and Pan 2, placement with an appropriate buffer zone should be found.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Moderate
RISK	Following the mitigation measures a moderate risk of impact is expected.

Aspect/Activity	Removal of sensitive species
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Sensitive species: Loss of Threatened or Near-Threatened Plants, Mammals, Reptiles, Amphibians and Invertebrates at the proposed footprint appears to be unlikely. Nationally Protected (but not threatened) tree species <i>Boscia albitrunca</i> (Shepherd's Tree) and <i>Sclerocarya birrea</i> (Marula) are present at the site. Provincially Protected, but not threatened tree species <i>Spirostachys africana</i> (Tamboti) is found at the site.
Status	Negative.
Mitigation Required	Mitigation measures for protected tree species if development is approved: <ul style="list-style-type: none"> <li>• Marking of <i>Boscia albitrunca</i> (Shepherd's Tree) and <i>Sclerocarya birrea</i> (Marula Tree) should take place at the site with an application of permits for the removal of these trees.</li> <li>• Marking of <i>Spirostachys africana</i> (Tamboti) should take place</li> </ul>

	<p>at the site with an application of permits for the removal of these trees.</p> <ul style="list-style-type: none"> <li>Where practical, such as is the case for <i>Sclerocarya birrea</i> (Marula tree) trees should be planted at appropriate sites at the study area. For <i>Boscia albitrunca</i> cultivation success is too low at present to be practical in which case other indigenous trees should be cultivated at appropriate sites at the study area.</li> </ul>
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Moderate
<b>RISK</b>	Marking of <i>Boscia albitrunca</i> (Shepherd's Tree) and <i>Sclerocarya birrea</i> (Marula Tree) at should take place at the site.

Aspect/Activity	Fragmentation of corridors of particular conservation concern
<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	While there is little scope for most of the site to be part of a corridor of particular conservation importance the small pans (Pan 1 and Pan 2) are part of a stepping stone corridor system of conservation importance in the larger area. Drainage lines and their buffer zones that cross the site are corridors of conservation importance.
<b>Status</b>	Negative
<b>Mitigation Required</b>	Small wetland depressions (Pan 1 and Pan 2) as well as narrow drainage lines with 32 m bufferzones are excluded from the development as far as practical (some parts of the buffer zones have already been impacted in the past). If developments are approved which involve the moving of Pan 1 and Pan 2, placement with an appropriate buffer zone should be found.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Low
<b>RISK</b>	Following mitigation, a low impact risk is expected.

Aspect/Activity	Contamination of soil by leaving rubble/ waste or spilling petroleum fuels or any pollutants on soil which could infiltrate the soil
<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	Rubble or waste could lead to infiltration of unwanted pollutants into the soil. Spilling of petroleum fuels and unwanted chemicals onto the soils that infiltrate these soils could lead to pollution of soils.
<b>Status</b>	Negative
<b>Mitigation Required</b>	Rubble or waste that could accompany the construction effort, if the development is approved, should be removed during and after construction. Measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
<b>RISKS</b>	A low risk is expected following mitigation.

Aspect/Activity	Possible disturbance, trapping, hunting and killing of vertebrates during construction phase
<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	During the construction phase animal species could be disturbed, trapped, hunted or killed.
<b>Status</b>	Negative
<b>Mitigation Required</b>	If the development is approved, contractors must ensure that no

	animal species are disturbed, trapped, hunted or killed during the construction phase.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
<b>RISKS</b>	Following mitigation, a low risk of impact is anticipated.

### 6.3 Potential impacts during the operational phase

Aspect/Activity	An increased infestation of exotic or alien invasive plant species owing to clearance or disturbance where the footprint took place.
<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	Infestation by alien invasive species could replace indigenous vegetation or potential areas where indigenous vegetation could recover. Once established combatting these alien invasive plant species may become very expensive in the long term.
<b>Status</b>	Negative
<b>Mitigation Required</b>	Continued monitoring and eradication of alien invasive plant species are imperative.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
<b>RISKS</b>	Following mitigation, a low risk is anticipated.

### 6.4 Potential impacts during the Decommissioning Phase (Borrow Areas)

Aspect/Activity	An increased infestation of exotic or alien invasive plant species owing to clearance or disturbance at the proposed footprint.
<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	Infestation by alien invasive species could replace indigenous vegetation or potential areas where indigenous vegetation could recover. Once established combatting these alien invasive plant species may become very expensive in the long term.
<b>Status</b>	Negative
<b>Mitigation Required</b>	Continued monitoring and eradication of alien invasive plant species are imperative.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
<b>RISKS</b>	Following mitigation, a low risk is anticipated.

Aspect/Activity	Continued loss of indigenous vegetation owing to poor recovery of vegetation.
<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	Poor recovery of indigenous vegetation could lead to further loss of indigenous vegetation at the site.
<b>Status</b>	Negative
<b>Mitigation Required</b>	A monitoring and rehabilitation plan for vegetation at the site are to be implemented to make sure that indigenous vegetation recover at hitherto cleared areas where possible.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)

<b>RISKS</b>	Following mitigation, a low risk is anticipated.
Aspect/Activity	Contamination of soil by leaving rubble/ waste or spilling petroleum fuels or any pollutants on soil which could infiltrate the soil during rehabilitation
<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	Rubble or waste could lead to infiltration of unwanted pollutants into the soil. Spilling of petroleum fuels and unwanted chemicals onto the soils that infiltrate these soils could lead to pollution of soils.
<b>Status</b>	Negative
<b>Mitigation Required</b>	Rubble or waste that could accompany the development if approved, should be removed throughout during the construction. Measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
<b>RISKS</b>	Following mitigation, a low risk is anticipated.

## 6.5 Cumulative impacts

Aspect/Activity	Habitat loss owing to clearing of vegetation (cumulative effects)
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Clearing of vegetation at the proposed railway yard and borrow area footprints will entail the partial destruction of medium and low sensitive habitat.
Status	Negative
Mitigation Required	Rehabilitation and monitoring of vegetation following clearing of vegetation are imperative.
Impact Significance (Pre-Mitigation)	High (Level 2)
Impact Significance (Post-Mitigation)	Moderate (Level 3)
<b>RISKS</b>	Risks are moderate as long as efficient rehabilitation takes place.

Aspect/Activity	Removal of sensitive species (cumulative effects)
<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	Cumulative impacts could have an amplified effect on the loss of sensitive species. Sensitive species: Loss of Threatened or Near Threatened species owing to the present restricted footprints are unlikely. Carnivores and large birds which are Threatened or Near Threatened still have large areas to roam and do not use the site as distinct breeding area or special part of their habitat. Sensitive tree species which are protected that occur at the site ( <i>Boscia albitrunca</i> , <i>Sclerocarya birrea</i> ) are not threatened and are still widespread in the local study area and large areas across South Africa. Loss of sensitive species are then confined to Protected tree species which are still widespread and not threatened. Cultivation of indigenous trees at suitable areas at the site is imperative.
<b>Status</b>	Negative
<b>Mitigation Required</b>	Marking of <i>Boscia albitrunca</i> (Shepherd's Tree) and <i>Sclerocarya birrea</i> (Marula Tree) at should take place at the site. Cultivation of indigenous trees at suitable areas at the site is imperative.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
<b>RISKS</b>	Following mitigation anticipated risk is low.

Aspect/Activity	Fragmentation of corridors of particular conservation concern (cumulative effects)
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<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	A number of industrial areas are present near the site which pose an increasing threat to ecosystems with indigenous biodiversity in the larger area. In the larger area there remains large savanna areas with indigenous biodiversity also for large carnivores and large bird species that are of particular conservation concern and which roam large areas.
<b>Status</b>	Negative
<b>Mitigation Required</b>	Restrict impacts to proposed footprints and leave corridors with indigenous vegetation adjacent to the proposed footprints.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
<b>RISKS</b>	Following mitigation anticipated risk is low.

<b>Aspect/Activity</b>	Emissions and pollutants into air, water and soil (cumulative impacts)
<b>Type of Impact (i.e. Impact Status)</b>	Direct
<b>Potential Impact</b>	Emissions and pollutants from this type of development will be limited when operational. During the operational phase cumulative impacts to the pollution of soils could happen. Rubble or waste could lead to infiltration of unwanted pollutants into the soil. Spilling of petroleum fuels and unwanted chemicals onto the soils that infiltrate these soils could lead to pollution of soils and if this happens at a number of construction activities in an area the cumulative effect could be detrimental to the local environment.
<b>Status</b>	Negative
<b>Mitigation Required</b>	Rubble or waste that could accompany the construction effort, if the development is approved, should be removed during and after construction. Measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
<b>RISKS</b>	Following mitigation the anticipated risk is low.

## 6.6 Risk and impact assessment summary for the Construction Phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	
Clearing of vegetation	Habitat loss, loss of indigenous species	Negative	Part of site	Long-Term	Substantial	Very likely	Low	Low	Avoid small wetland depressions (pans) as well as drainage lines with 32 m bufferzones. If developments are approved which involve the moving of Pan 1 and Pan 2 (non-avoidance), placement of new pans which allow for an appropriate buffer zone should be found.	High	Moderate	High
Loss of sensitive species	Loss of sensitive species	Negative	Site	Long-Term	Low (No Threatened species anticipated)	Unlikely	Not applicable	Not applicable	Loss limited to Protected Tree species which are not Threatened or Near Threatened.	Moderate	Moderate	High
Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	If developments are approved which involve the moving of Pan 1 and Pan 2 (non-avoidance), placement of new pans which allow for an appropriate buffer zone should be found.	High	Moderate	High



Contamination of soil by spilling pollutants on soil which could infiltrate the soil	Soil contamination	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	Rubble and waste removal. Measures that avoid hydrocarbon (petroleum) spills to get into contact with the soil.	Moderate	Low	High
Disturbance or killing of vertebrates	Disturbance or killing of species	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	If the development is approved, contractors must ensure that no animal species are disturbed, trapped, hunted or killed during the construction phase.	Moderate	Low	High

### 6.7 Risk/ Impact assessment summary for the Operational Phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	
Increased infestation of exotic or alien invasive plant species	Loss of habitat quality	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Monitoring and eradication of alien invasive plant species. Implementation of rehabilitation plan which include the establishment of indigenous plant species.	Moderate	Low	High

### 6.8 Risk/ Impact assessment summary for the Decommissioning Phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	
Increased infestation of exotic or alien invasive plant species	Loss of habitat quality	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Rehabilitation with monitoring and eradication of alien invasive plant species	Moderate	Low	High
Continued loss of indigenous vegetation	Loss of habitat integrity	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Rehabilitation and monitoring of indigenous vegetation following clearance.	High	Moderate	High
Rubble. Waste and spills of petroleum oils or other unwanted chemicals	Contamination of soil	Negative	Site	Medium-Term	Moderate	Likely	Moderate	Moderate	During rehabilitation measures should be taken to avoid spilling of any petroleum fuels or unwanted chemicals.	Moderate	Low	High

### 6.9 Cumulative impact assessment summary table

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	
Clearing of vegetation	Habitat loss, loss of indigenous species	Negative	Site	Long-Term	Substantial	Very likely	Moderate	Moderate	Rehabilitation and monitoring of indigenous vegetation following clearance.	High	Moderate	High
Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Very unlikely	Moderate	Moderate	Leave areas with indigenous vegetation adjacent to proposed footprints.	Low	Very low	High

## 6.10 Summary of risks and impacts

Vegetation is an open savanna which has been impacted by development in the past at the present railway line, railway reserve and hitherto excavated areas. A diversity of indigenous trees, shrubs, climbers, forbs and graminoids are present at parts of the site next to the railway yard reserve and also at much of the proposed borrow areas. Alien invasive weeds and indigenous pioneer plant species are conspicuous where clearings or other disturbances have taken place in the past. Dirt roads cross the site.

Two widespread tree species which are not Threatened but which is listed as Protected tree species are present at the site. These Protected tree species are *Boscia albitrunca* (Shepherd's Tree) and *Sclerocarya birrea* (Marula). In terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

Scope for most of the site to be part of a corridor of particular conservation importance is small. The small wetland depressions (pans) with their buffer zones (32 m) are part of a stepping stone corridor of conservation importance in the larger area. Note though that the Ecological Importance and Sensitivity of these small wetlands are low they remain sensitive and important in terms of biodiversity conservation corridors (including stepping stone corridors). Small pans and drainage lines are not perennial. Risks and possible impacts to the small pans exist.

Small pans and drainage lines at the site are likely to be impacted by the proposed developments. If the development is approved with limited modifications of these small pans or movement of these small pans and extension of culverts for drainage lines, the construction should be planned in such a manner that surface flow and erosion are limited. There is no distinct indication that interflow plays an important role in the maintenance of the wetlands and drainage lines. The geomorphological setting and flow regime should be as similar as possible post development, if the development is approved. Loss of any wetland animal or plant species of particular conservation importance are not expected.

Small pans outside the boundaries of the site but within 500 m from the the site are unlikely to be impacted significantly by the proposed developments. If the development is approved these small

pans are unlikely to experience significant increase in surface flow and erosion owing to the development. There is no distinct indication that interflow plays an important role in the maintenance of these wetlands outside the site. The geomorphological setting and flow regime are likely to be similar post development, if the development is approved. Loss of any wetland animal or plant species of particular conservation importance are not expected owing to this proposed development in particular at these wetlands outside the site, but within 500 m from the boundaries of the site.

Risk of cumulative impacts: A number of industrial areas are present near the site. In the larger area there remains large savanna areas with indigenous biodiversity also for large carnivores and large bird species that are of particular conservation concern and which roam large areas. This means at this stage, owing to the absence of Threatened species and Near Threatened species using the proposed footprint as habitat in particular the cumulative impact on sensitive species and connectivity of ecosystems are still limited.

A key issue at the site that emerged from the risk and impact assessment is the implementation of efficient rehabilitation. Following the mitigations which will be upheld and planned footprint for development all the impact risks listed above are moderate or low.

## 7 CONCLUSION

- Vegetation is an open savanna which has been impacted by development in the past at the present railway line, railway reserve and hitherto excavated areas. A diversity of indigenous trees, shrubs, climbers, forbs and graminoids are present at parts of the site next to the railway yard reserve and also at much of the proposed borrow areas. Alien invasive weeds and indigenous pioneer plant species are conspicuous where clearings or other disturbances have taken place in the past. Dirt roads cross the site. In the larger area extensive pylon strips run north and south, within 1 km and less, of the proposed Railway Yard site.
- The Koedoe Nature Reserve crosses the central-eastern part of the site. Koedoe Nature Reserve is listed in the National Register of Protected areas. This nature reserve at present crosses the existing railway line which means that northern section of the Koedoe Nature Reserve was “cut-off” before. The extension of the Railway reserve for the development of the Railway Yard, if approved can further isolate the different parts of the Nature Reserve. During the construction and operation of the proposed Railway Yard the development and activities associated with construction should be restricted to the footprint so that the different sections of the Koedoe Nature Reserve could continue to fulfill its role in biodiversity conservation in particular for animals such as birds which can fly across from the one section of the reserve to the other. It is recommended that the boundaries of the Koedoe Nature Reserve should be amended to an extent which is practical for the foreseeable future in terms of most likely developments.
- The study area is located in the Savanna Biome which is represented by the Limpopo Sweet Bushveld vegetation type (SVcb 19) and Western Sandy Bushveld (Mucina & Rutherford, 2006). Limpopo Sweet Bushveld and Western Sandy Bushveld are not listed as a threatened ecosystem according to the National List of Threatened Ecosystems (2011).
- Biodiversity priority areas at the western parts of the proposed Railway Yard site are represented by a Critical Biodiversity Area 2 (CBA 2), at the central and eastern parts of the proposed Railway Yard site and proposed Borrow Area No1 by an Ecological Support Area 1 whereas proposed Borrow Area No2 is represented by Other Natural Areas (ONAs).
- Proposed Railway Yard site and also the proposed Borrow Areas are adjacent to areas which have been developed or have been significantly disturbed in the past. Certain portions of the site being part of a Critical Biodiversity Area 2 and also an Ecological Support Area 2 implicate

that the developments at the site, if approved should be restricted to the proposed footprint. Any impacts outside these proposed footprints should be kept to an absolute minimum.

- Two small restricted wetland depressions, Pan 1 and Pan 2 (each less than 1 ha), are present at the proposed footprint.
- Three non-perennial rivers, with their active channels and riparian zones, cross the proposed extension of the Railway Yard. Altogether these three non-perennial rivers are in essence small seasonal drainage lines which feed into tributaries of rivers downstream.
- Riparian zones of these streamcrossings largely consist of more or less distinct concentrations of trees such as *Dichrostachys cinerea*, *Senegalia erubescens* and *Vachellia karroo*. Grass species such as *Panicum maximum* appear to be frequent at these riparian zones. Megagraminoids such as reeds and sedges appear to be absent at these small pans.
- Site is part of the Limpopo Water Management Area (WMA 1). Western part of the site falls outside any FEPA (Freshwater Ecosystem Priority Area). Eastern part of the site is included in a River FEPA and associated sub-quaternary catchment (Nel *et al.*, 2011a, 2011b).
- River FEPAs achieve biodiversity targets for river ecosystems and threatened/ near threatened fish species, and were identified in rivers that are currently in good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources. Surrounding land and smaller stream network in a River FEPA need to be managed in such a way that maintains the good condition (A or B ecological category) of the river reach (Nel *et al.*, 2011a, 2011b). A key issue is therefore avoidance and limitation of pollutants into the soil and water at the proposed footprints.
- The non-perennial rivers or drainage lines with their active channels and riparian zones at the site are biodiversity corridors of significant conservation importance in the larger area.
- The small restricted wetland depressions at and near the proposed footprints remain important as part of stepping stone corridors in the larger area (even though the Ecological Importance and Sensitivity of these wetlands emerged to be low these wetlands remain importance in terms of stepping stone corridors for biodiversity conservation; kindly see wetland assessment report which accompanies this report).
- Small pans and drainage lines at the site are likely to be impacted by the proposed developments. If the development is approved with modifications or moving of these small pans and conservation of drainage lines with extended culverts, the construction should be planned in such a manner that surface flow and erosion are limited. There is no distinct

indication that interflow plays an important role in the maintenance of the wetlands and drainage lines. The geomorphological setting and flow regime should be as similar as possible post development, if the development is approved. Loss of any wetland animal or plant species of particular conservation importance are not expected.

- Small pans outside the boundaries of the site but within 500 m from the the site are unlikely to be impacted significantly by the proposed developments. If the development is approved these small pans are unlikely to experience significant increase in surface flow and erosion owing to the development. There is no distinct indication that interflow plays an important role in the maintenance of these wetlands outside the site. The geomorphological setting and flow regime are likely to be similar post development, if the development is approved. Loss of any wetland animal or plant species of particular conservation importance are not expected owing to this proposed development in particular at these wetlands outside the site, but within 500 m from the boundaries of the site.
- Recommendations, if the development is approved, for the three Streamcrossings include the i) restriction of developments to the extension of the culverts, ii) bridge structures at roads right next to the railway reserve so that could take place at dirt roads are limited and iii) the conservation of the remainder of the drainage line and riparian zone downstream.
- The buffer zones of Pan 1 and Pan 2 are already compromised by past development. It should be noted that waterflow to these small pans are probably enhanced by the present railwayline structures (elevated) and water runoff from the roads next to the railway line where some erosion is visible. These pans are very small, not marshlands or any wetlands with distinct ecological importance and sensitivity and probably partially maintained by the present railway line structures. These pans are also encroached by terrestrial vegetation. In the case of Pan 1 and Pan 2 there is scope to move each of Pan 1 and Pan 2 fourty metres from the edge of the road next to the proposed Railway Line site during construction. Wetland characteristics of these pans may even slightly improve in such a case. It should be noted that these pans are not comparable to larger marshlands or saltpans in the region in which case a no-go zone would have applied. If the development is approved and these recommendations, which lead to two rehabilitated small pans and buffer zones, could be successfully implemented the risk of loss of biodiversity corridors and stepping stone small wetlands in the larger area shifts from high to moderate/low.
- Loss of Threatened, Near Threatened and Declining plant or animal species owing to the development at the proposed footprint is unlikely. Threatened or Near Threatened mammal



and bird species may cross the site for example carnivores such as *Panthera pardus* (Leopard), *Parahyaena brunnea* (Brown Hyaena) and larger birds such as *Gyps africanus* (White-backed Vulture). The site does not appear to be specific breeding habitat for any such large carnivore and bird species which roams large areas of which the site is part.

- Loss of plant species which are not Threatened but listed as protected according to LEMA (Limpopo Environmental Act No. 7 of 2003; Commencing date 1 May 2004) such as the succulent stapeliad *Piранthus atosanguineus* at the site, if the development is approved, is unlikely.
- Two widespread terrestrial tree species which are not Threatened but which are listed as Protected (National) tree species are present at the site. These Protected tree species are *Boscia albitrunca* (Shepherd's Tree) and *Sclerocarya birrea* (Marula). In terms of a part of section 15(1) of the National Forests Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.
- Some tree species which are not listed in the National List of Protected trees are listed as protected according to LEMA (Limpopo Environmental Act No. 7 of 2003; Commencing date 1 May 2004). *Spirostachys africana* (Tamboti) which is listed as a protected tree species under LEMA (Schedule 12) is present at the site. A permit must be acquired from LEDET if the development is approved and removal of individuals of this tree species has to take place.
- Marking of *Boscia albitrunca* (Shepherd's Tree) and *Sclerocarya birrea* (Marula Tree) should take place at the site with an application of permits for the removal of these trees.
- Marking of *Spirostachys africana* (Tamboti) should take place at the site with an application of permits for the removal of these trees.
- Where practical, such as is the case for *Sclerocarya birrea* (Marula tree) trees should be planted at appropriate sites at the study area. For *Boscia albitrunca* cultivation success is too low at present to be practical in which case other indigenous trees should be cultivated at appropriate sites at the study area.
- A key issue at the site that emerged from the risk and impact assessment is the implementation of efficient rehabilitation also along the watercourses if these are impacted.
- If the development is approved, a rehabilitation plan which includes the re-establishment of indigenous vegetation at the site should be implemented.

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## ANNEXURE 1

### List of plant species recorded at the site.

Compiled by R.F. Terblanche

Main sources used for names, identification, distribution and biology of species:

Sources include: Bromilow (2010); Crouch *et al.* (2011); Court (2010); Duncan (2016); Fish *et al.* (2015); Germishuizen (2003); Gill & Engelbrecht (2012); Glen & Van Wyk (2016); Goldblatt (1986); Goldblatt & Manning (1998); Johnson & Bytebier (2015); Kirby (2013), Manning (2007); Manning (2009); McMurtry *et al.* (2008); Moriarty (1997); Pooley (1998); Raimondo *et al.* (2009); Smith *et al.* (2017); Van der Walt (2009); Van Ginkel *et al.* (2011); Van Jaarsveld (2006); Van Oudtshoorn (2012); Van Oudtshoorn (2015); Van Wyk & Gericke (2000); Van Wyk & Smith (2014); Van Wyk *et al.* (2009); Van Wyk & Van Wyk (2013).

Plant species are listed alphabetically.

Plant species marked with an asterisk (\*) are exotic.

PLANT SPECIES	COMMON NAME	GROWTH FORM	STATUS	PLANT FAMILY
<b>GRASSES/ GRAMINOIDS</b>				
<i>Acrotome inflata</i>	Tumbleweed	Forb		LAMIACEAE
<i>Albizia amthelmintica</i>	Worm-bark False-thorn	Tree		FABACEAE
<i>Alternanthera pungens</i> *	Paper Duwweltjie	Forb	Exotic: Alien invasive weed	AMARANTHACEAE
<i>Aristida bipartita</i>		Graminoid		POACEAE
<i>Aristida canescens</i>		Graminoid		POACEAE
<i>Aristida congesta</i> subsp. <i>congesta</i>	Tassel Three-awn	Graminoid		POACEAE
<i>Aristida stipitata</i>	Long-awned Aristida	Graminoid		POACEAE
<i>Argemone ochroleuca</i> *	White-flowered Mexican poppy	Forb	Exotic: Alien invasive weed	PAPAVERACEAE
<i>Asparagus suaveolens</i>	Bushveld Asparagus	Shrub		ASPARAGACEAE
<i>Bidens bipinnata</i> *	Spanish Blackjack	Forb	Exotic: Alien invasive weed	ASTERACEAE
<i>Bidens pilosa</i> *	Common Blackjack	Forb	Exotic: Alien invasive weed	ASTERACEAE
<i>Blepharis subvolubilis</i>	Eyelash Flower	Forb		ACANTHACEAE
<i>Boscia albitrunca</i>	Shepherd's Tree	Tree	Protected Tree	CAPPARACEAE

<b><i>Bosica foetida</i></b> subsp. <b><i>rehmanniana</i></b>	Smelly Shepherd's Tree	Tree		CAPPARACEAE
<b><i>Brachiaria deflexa</i></b>		Graminoid		POACEAE
<b><i>Ceratotheca triloba</i></b>	Wild Foxglove	Forb		PEDALIACEAE
<b><i>Chenopodium album</i></b> *	Goosefoot	Forb	Exotic: Alien invasive weed	CHENOPODIACEAE
<b><i>Chloris virgata</i></b>	Feather-top Chloris	Graminoid		POACEAE
<b><i>Cleome monophylla</i></b>	Single-leaved Cleome	Forb		CAPPARACEAE
<b><i>Coccinia rehmannii</i></b>	Wild Cucumber	Climber		CUCURBITACEAE
<b><i>Combretum apiculatum</i></b>	Red Bushwillow	Tree		COMBRETACEAE
<b><i>Commelina africana</i></b>	Yellow Commelina	Forb		COMMELINACEAE
<b><i>Commelina benghalensis</i></b>		Forb		COMMELINACEAE
<b><i>Commiphora glandulosa</i></b>	Tall Common Corkwood	Tree		BURSERACEAE
<b><i>Commiphora africana</i></b>	Poison-grub Corkwood	Tree		BURSERACEAE
<b><i>Commiphora mollis</i></b>	Velvet-leaved Corkwood	Tree		BURSERACEAE
<b><i>Convolvulus sagittatus</i></b> subsp. <b><i>sagittatus</i></b>		Forb		CONVOLVULACEAE
<b><i>Conyza bonariensis</i></b> *	Flax-leaf Fleabane	Forb	Exotic: Alien invasive weed	ASTERACEAE
<b><i>Corchorus asplenifolius</i></b>		Forb		MALVACEAE
<b><i>Cymbopogon pospischilii</i></b>		Graminoid		POACEAE
<b><i>Cynodon dactylon</i></b>	Couch Grass	Graminoid		POACEAE
<b><i>Dichrostachys cinerea</i></b>	Sicklebush	Tree		FABACEAE
<b><i>Dicoma tomentosa</i></b>	Hairy Dicoma	Forb		ASTERACEAE
<b><i>Enneapogon cenchroides</i></b>		Graminoid		POACEAE
<b><i>Eragrostis lehmanniana</i></b>	Lehmann's Love Grass	Graminoid		POACEAE
<b><i>Eragrostis pallens</i></b>	Broom Love Grass	Graminoid		POACEAE
<b><i>Eragrostis rigidior</i></b>	Curly Leaf	Graminoid		POACEAE
<b><i>Eragrostis superba</i></b>	Saw-tooth Love Grass	Graminoid		POACEAE
<b><i>Evolvulus alsinoides</i></b>		Forb		CONVOLVULACEAE
<b><i>Euclea undulata</i></b>		Tree		EBENACEAE
<b><i>Flaveria bidentis</i></b> *	Smelter's Bush	Forb	Exotic: Alien invasive weed	ASTERACEAE
<b><i>Felicia muricata</i></b>		Forb		ASTERACEAE
<b><i>Geigeria burkei</i></b> subsp. <b><i>burkei</i></b>		Forb		ASTERACEAE

<i>Gisekia africana</i>		Forb		GISEKIACEAE
<i>Gomphocarpus fruticosus</i>	Cotton Milkweed	Shrub		APOCYNACEAE
<i>Gomphrena celosioides</i> *	Bachelor's Button	Forb	Exotic: Alien invasive weed	AMARANTHACEAE
<i>Grewia flava</i>	Velvet Raisin	Tree		MALVACEAE
<i>Grewia flavescens</i>	Sandpaper Raisin	Tree		MALVACEAE
<i>Grewia monticola</i>	Grey Raisin	Tree		MALVACEAE
<i>Heliotropium ciliatum</i>	Kalahari String of Stars	Forb		BORAGINACEAE
<i>Heliotropium giessii</i>	Large String of Stars	Forb		BORAGINACEAE
<i>Heliotropium nelsonii</i>	Common String of Stars	Forb		BORAGINACEAE
<i>Heteropogon contortus</i>	Spear Grass	Graminoid		POACEAE
<i>Hibiscus trionum</i> *	Bladder hibiscus	Forb	Exotic: Alien invasive weed	MALVACEAE
<i>Hirpicium bechuanense</i>		Forb		ASTERACEAE
<i>Indigastrum costatum</i>		Forb		FABACEAE
<i>Indigofera daleoides</i>		Forb		
<i>Indigofera holubii</i>		Forb		FABACEAE
<i>Kyphocarpa angustifolia</i>	Silky Burweed	Forb		AMARANTHACEAE
<i>Limeum fenestratum</i>	Lintblommetjie	Forb		LIMEACEAE
<i>Limeum sulcatum</i> var. <i>sulcatum</i>		Forb		LIMEACEAE
<i>Lycium schizocalyx</i>		Shrub		SOLANACEAE
<i>Melhania acuminata</i>		Forb	Bush Honeycup	MALVACEAE
<i>Melinis repens</i>	Natal Red Top	Graminoid		POACEAE
<i>Mollugo cerviana</i> *	Thread-stem Carpetweed	Forb	Exotic: Weed	MOLLUGINACEAE
<i>Ocimum americanum</i>	Wild Basil	Forb		LAMIACEAE
<i>Oxygonum sinuatum</i>		Forb		POLYGONACEAE
<i>Panicum maximum</i>	Guinea Grass	Graminoid		POACEAE
<i>Pavonia buchellii</i>		Forb		MALVACEAE
<i>Pentarrhinum insipidum</i>	African Heartvine	Climber		ASCLEPIADACEAE
<i>Pergularia daemia</i> subsp. <i>daemia</i>	Trellis Vine	Climber		APOCYNACEAE
<i>Pollichia campestris</i>	Waxberry	Forb		ILLECEBRACEAE
<i>Pogonarthria squarrosa</i>	Herringbone Grass	Graminoid		POACEAE

<i>Portulaca kermesina</i>		Forb		PORTULACACEAE
<i>Pupalia lappacea</i>		Forb		AMARANTHACEAE
<i>Schkuhria pinnata</i> *	Dwarf Marigold	Forb	Exotic: Alien invasive weed	ASTERACEAE
<i>Schmidtia pappophoroides</i>		Graminoid		POACEAE
<i>Sclerocarya birrea</i> subsp. <i>caffra</i>	Marula	Tree	Protected Tree	ANACARDIACEAE
<i>Seddera capensis</i>	Small White Seddera	Forb		CONVOLVULACEAE
<i>Senegalia erubescens</i>	Blue Thorn	Tree		FABACEAE
<i>Senegalia mellifera</i> subsp. <i>detinens</i>	Black Thorn	Tree		FABACEAE
<i>Senegalia nigrescens</i>	Knob Thorn	Tree		FABACEAE
<i>Setaria verticillata</i>	Bur Bristle Grass	Graminoid		POACEAE
<i>Sida cordifolia</i>	Heartleaf Sida	Forb		MALVACEAE
<i>Solanum catombetense</i>	Bitter Apple	Forb		SOLANACEAE
<i>Solanum elaeagnifolium</i> *	Silverleaf Bitter Apple	Forb	Exotic: Alien invasive weed	SOLANACEAE
<i>Solanum lichtensteinii</i>	Large Yellow Bitter Apple	Forb		SOLANACEAE
<i>Solanum panduriforme</i>	Poison Apple	Forb		SOLANACEAE
<i>Spirostachys africana</i>	Tamboti			EUPHORBIACEAE
<i>Syncolostemon elliottii</i>		Forb		LAMIACEAE
<i>Tagetes minuta</i> *	Khakiweed	Forb	Exotic: Alien invasive weed	ASTERACEAE
<i>Tephrosia purpurea</i>		Forb		FABACEAE
<i>Teucrium trifidum</i>		Forb		LAMIACEAE
<i>Tragus racemosus</i>	Carrot-seed Grass	Graminoid		POACEAE
<i>Tribulus terrestris</i>	Devil's Thorn	Forb		ZYGOPHYLLACEAE
<i>Urochloa mosambicensis</i>	Bushveld Signal Grass	Graminoid		POACEAE
<i>Urochloa trichopus</i>	Annual Signal Grass	Graminoid		POACEAE
<i>Vachellia karroo</i>	Sweet Thorn	Tree		FABACEAE
<i>Vachellia tortilis</i> subsp. <i>heteracantha</i>	Umbrella Thorn	Tree		FABACEAE
<i>Waltheria indica</i>		Forb		MALVACEAE
<i>Xenostegia tridentata</i> var. <i>angustifolia</i>		Forb		CONVOLVULACEAE
<i>Ximenia americana</i>	Blue Sourplum	Tree		OLACACEAE
<i>Ziziphus mucronata</i>	Buffalo-thorn	Tree		RHAMNACEAE

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Growth forms:

Climbers: Plants of which the stems grow upon and are supported by branches of trees, shrubs or other tall objects.

Forbs: Plants which are not woody and also not graminoid. For the purposes of the list above herbs as well as most ferns and geophytes are regarded as forbs.

Graminoids: Grasses, reeds, sedges and rushes.

Shrubs: Woody plants (often multi-stemmed) which across their distribution range seldom reach heights of 2 m. Most mistletoes are in this study also regarded as shrubs.

Trees: Perennial woody plants which across their range have enough individuals over 2 m (often with single main stem from the ground) to be regarded as trees. Sometimes trees are shrub-height at a site but still noted as trees such as generally accepted to be in main botanical texts.