

ECOLOGICAL FAUNA AND FLORA HABITAT SURVEY

**The Remaining Extent of Portion 28 of the farm Riekertsdam 109 JP,
Portion 63 of the Farm Riekertsdam 109 JP and Portion 62 of the Farm
Riekertsdam 109 JP, approximately 16 km north of Groot Marico,
Ramotshere Moiloa Local Municipality, North West Province**



The butterfly species *Leucochitonea levubu* (widespread in savanna of the northern parts of South Africa) feeding on the nectar of a flower of *Sida cordifolia* at the study area.

Photo: Reinier F. Terblanche.

MARCH 2022

Compiled by:

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

ANTHENE ECOLOGICAL CC

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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. The PhD research focuses on the landscape ecology of selected terrestrial and wetland butterflies in South Africa. 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, plant and habitat research.

Qualifications:

Qualification	Main subject matter	University
M.Sc Cum Laude, 1998: Botany: Ecology	Quantitative study of invertebrate assemblages and plant assemblages of rangelands in grasslands.	North-West University, Potchefstroom
B.Sc Honns Cum Laude, 1992 Botany: Taxonomy	Distinctions in all subjects: Plant Anatomy, Taxonomy, Modern Systematics, System Modelling, Plant Ecology, Taxonomy Project. Also completed a Statistics Attendance Course. Research project was about taxonomy of the plant genus <i>Haworthia</i> .	North-West University, Potchefstroom
B.Sc Botany, Zoology	Main subjects: Botany, Zoology.	North-West University, Potchefstroom
Higher Education Diploma, 1990	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 terrestrial and wetland 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. 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. Appointed as Research Fellow at College of Agriculture and Environmental Sciences, Department of Environmental Sciences, University of South Africa, from 1 January 2020.

EXPERIENCE

Lecturer: Zoology 1998-2008	Main subject matter and level	Organization
Lectured subjects	- <u>3rd year level</u> Ecology, Plantparasitology - <u>2nd year level</u> Ethology - <u>Master's degree</u> 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 (terrestrial and aquatic).	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*. Saffronics (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. Saffronics (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: Alooidae)? *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 *Chrysothrix 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 *Erikssonia* Trimen (Lepidoptera: Lycaenidae) *African Entomology* **18**(1): 171-191.

10. **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: 12 March 2022

1 INTRODUCTION

An ecological habitat survey is required for proposed development at the Remaining Extent of Portion 28 of the farm Riekertsdam 109 JP, Portion 63 of the farm Riekertsdam 109 JP and Portion 62 of the farm Riekertsdam 109 JP, 16 km north of Groot Marico, Ramotshere Local Municipality, North West Province, South Africa (elsewhere referred to as the site). The survey focused on the possibility that threatened fauna or flora known to occur in North West Province are likely to occur within the proposed development or not. The surveys also focused on the possibility that threatened fauna or flora known to occur in North West Province would have likely occurred or not at an area that has been cultivated (24G) at part of the site. Species of known high conservation priority that do not qualify for threatened status also received attention in the survey.

1.1 Objectives of the habitat study

- Surveys 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, should the development be approved.

2 STUDY AREA

The study area is located on the Remaining Extent of Portion 28 of the farm Riekertsdam 109 JP, Portion 63 of the farm Riekertsdam 109 JP and Portion 62 of the farm Riekertsdam 109 JP, 16 km north of Groot Marico, Ramotshere Moiloa Local Municipality, North West Province, South Africa. The site is situated at the Savanna Biome which is represented by the Zeerust Thornveld vegetation type (Mucina & Rutherford, 2006). A brief overview of the vegetation type, which serves as an outline of the ecological context of the site, follows.

SVcb 3 Zeerust Thornveld

Distribution: The Zeerust Thornveld is found in South Africa in the North West Province: Extends along the plains from the Lobatsi River in the west via Zeerust, Groot Marico and Mabaastad to the flats between the Pilanesberg and western end of the Magaliesberg in the east (including the valley of the lower Selons River). Altitude mainly 1000 – 1250 m (Mucina & Rutherford 2006).

Vegetation and landscape features: Deciduous, open to dense short thorny woodland, dominated by *Acacia* species, with herbaceous layer of mainly grasses on deep, high base- status and some clay soils on plains and lowlands. Also between rocky ridges of SVcb 4 Dwarsberg-Swartruggens Mountain Bushveld (Mucina & Rutherford 2006).

Geology and soils: Sediments of the Pretoria Group (Transvaal Supergroup) in this area, particularly the Silverton and Rayton Formations, are mostly shale with less quartzite and conglomerate. Carbonates, volcanic rocks, breccias and diamictites also occur in the Pretoria Group. Bronzite, hartzburgite, gabbro and norite of the Rustenburg Layered Suite (Bushveld Igneous Complex) are also found. Soils are mostly deep, red-yellow, apedal, freely drained with high base status also with some vertic or melanic clays. Land types mainly Ae and Ea.

Climate: Summer rainfall with very dry winters. Mean annual precipitation has a relatively narrow range of 550 - 600 mm. Frost is fairly frequent in winter (Mucina & Rutherford, 2006).

Important taxa: Tall trees: *Acacia burkei*, *Acacia erioloba*. Small trees: *Acacia mellifera* subsp. *detinens*, *Acacia nilotica*, *Acacia tortilis* subsp. *heteracantha*, *Searsia lancea*, *Acacia fleckii*, *Peltoporum africanum*, *Terminalia sericea*. Tall shrubs: *Diospyros lycioides* subsp. *lycioides*, *Grewia flava*, *Mystroxyton aethiopicum* subsp. *burkeanum*. Low Shrubs: *Agathisanthemum bojeri*, *Chaetacanthus costatus*, *Clerodendrum ternatum*, *Indigofera filipes*, *Searsia grandidens*, *Sida chrysantha*, *Stylosanthes fruticosa*. Graminoids: *Eragrostis lehmanniana*, *Panicum maximum*, *Aristida congesta*, *Cymbopogon pospischilii*. Herbs: *Blepharis integrifolia*, *Chamaecrista absus*, *Chamaecrista mimosoides*, *Cleome maculata*, *Dicoma anomala*, *Kyphocarpa angustifolia*, *Limeum viscosum*, *Lophiocarpus tenuissimus*.

Note: Not all of the above listed plant species for the vegetation types occur at the site in the study area.

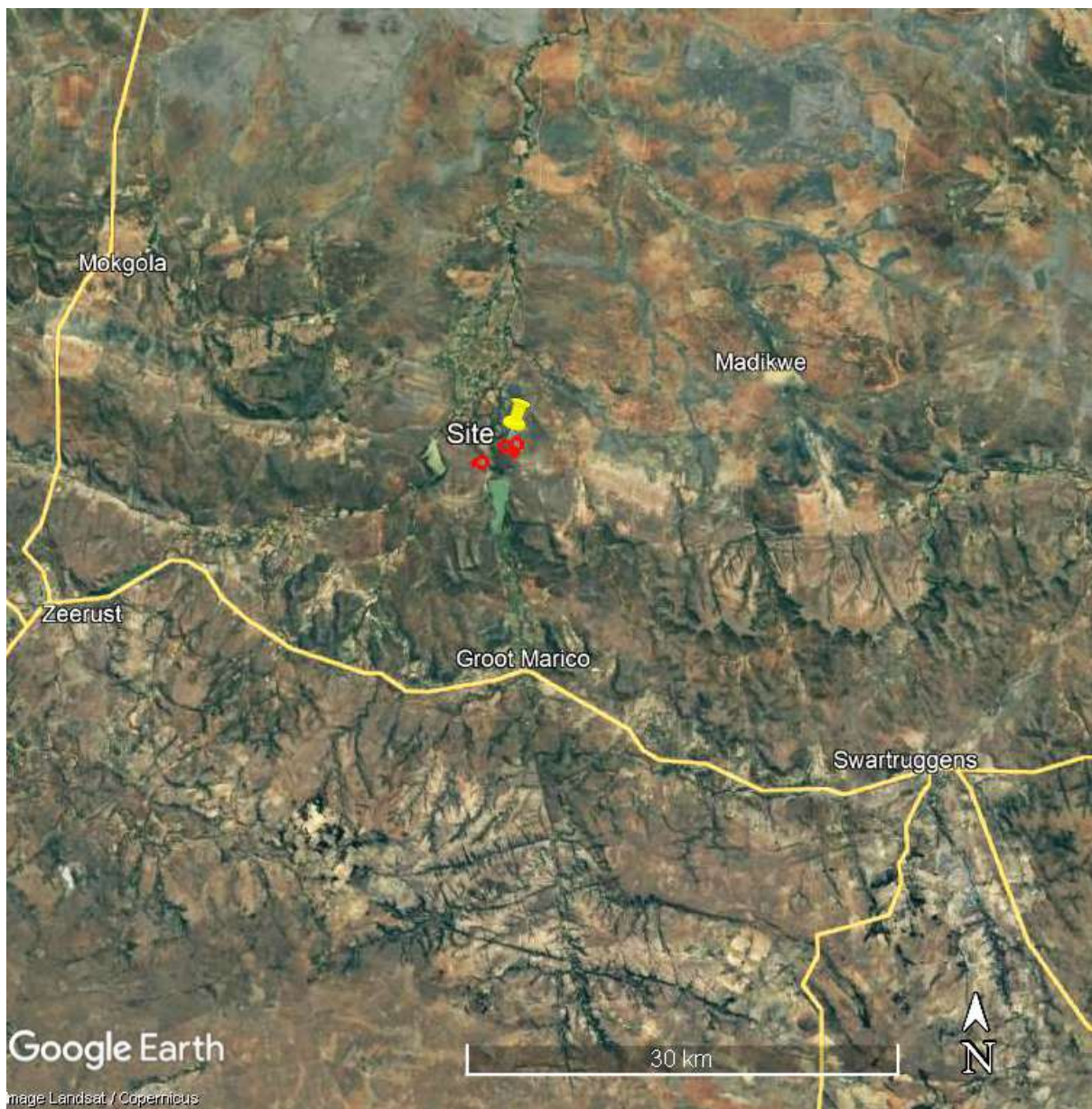


Figure 1 Map with an indication of the location of the site.

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, 2021).

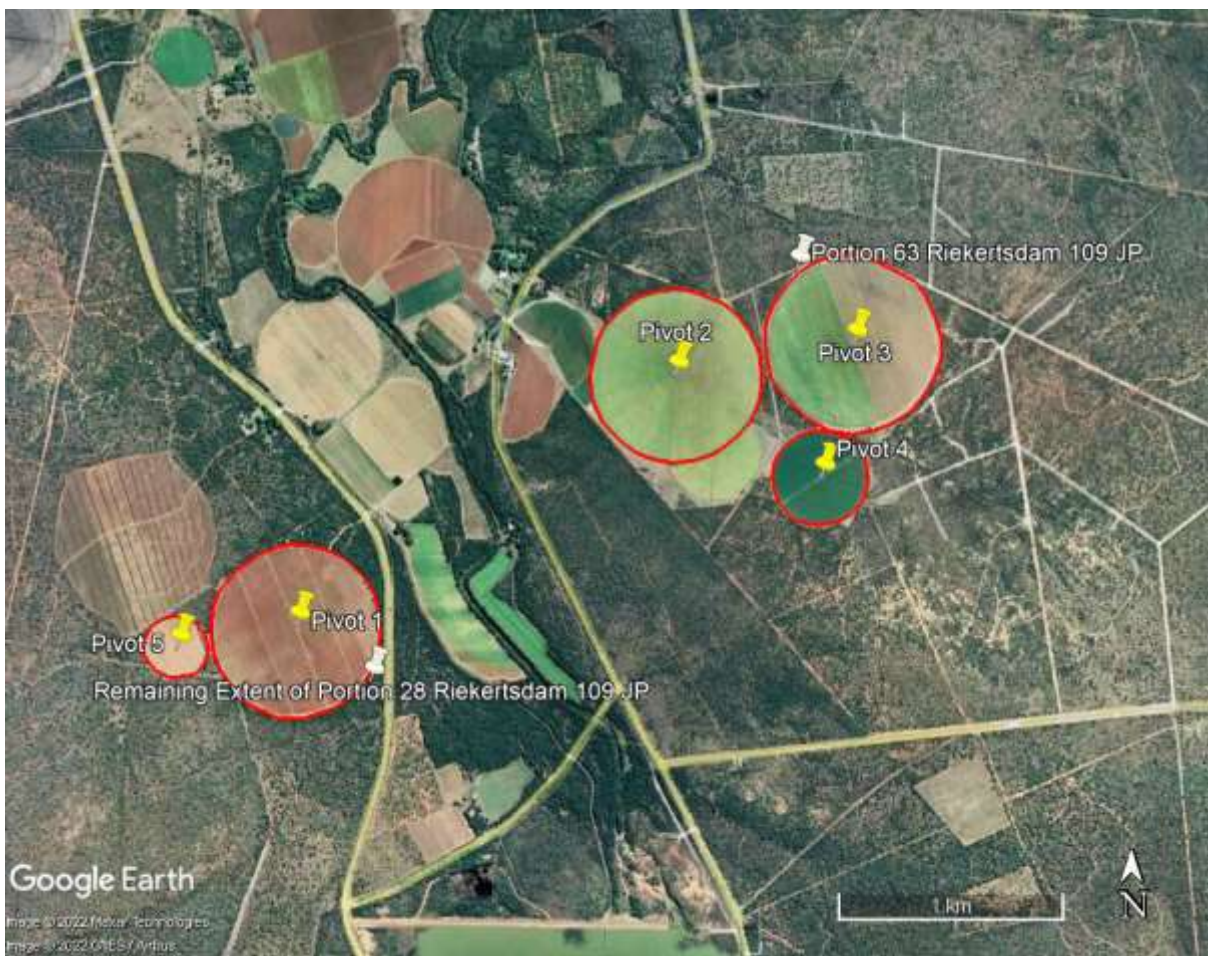


Figure 2 Map with an indication of the location of the western and eastern section at the site.

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, 2021).

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.

Survey by R.F. Terblanche during March 2022 was conducted 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 threatened species and other species of high conservation priority.

The following sections highlight the materials and methods applicable to different aspects or signs 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. In this case no plant specimens were needed to be collected as voucher specimens or to be send to a herbarium for identification. A wealth of guides and detailed works of plant identifications, ecology and conservation is fortunately available and very useful. Field guides, biogeographic works, species lists, diagnostic outlines, conservation statuses and detail on specific plant groups were sourced from Boon (2010), Court (2010), Germishuizen (2003), Germishuizen, Meyer & Steenkamp (2006), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), Manning (2003), Manning (2009), McMurtry, Grobler, Grobler & Burns (2008), Pooley (1998), Retief & Herman (1997), Smit (2008), Van Ginkel, Glen, Gordon-Gray, Cilliers, Muasya & Van Deventer (2011), Van Jaarsveld (2006), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Smith (2001), Van Wyk & Smith (2003), Van Wyk & Malan (1998) and Van Wyk & Van Wyk (2013). Lists of species, species names and the conservation status of species were mainly sourced from Raimondo, von Staden, Victor, Helme, Turner, Kamundi & Manyama (2009) and updated versions

of red lists and species from the Threatened Species Programme of SANBI and the Red List of South African Plants (sanbi.org.za).

3.2 Mammals

Mammals were noted as sight records by day. For the identification of species and observation of diagnostic characteristics Smithers (1986), Skinner & Chimimba (2005), Cillié, Oberprieler and Joubert (2004) and Apps (2000) 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, with a few exceptions, bats, rodents and shrews can only be reliably identified in the hand, and 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 and ecology Barnes (2000), Hockey, Dean & Ryan, P.G. (2005), Cillié, Oberprieler & Joubert (2004), Tarboton & Erasmus (1998) and Chittenden (2007) were consulted. Ringing of birds fell beyond the scope of this survey and was not deemed necessary. Sites have 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 are 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 Carruthers (2001), Du Preez (1996), Conradie, Du Preez, Smith & Weldon (2006) and the recent complete guide by Du Preez & Carruthers (2009) are consulted. CD's with frog calls by Carruthers (2001) 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*, *Eriksonia*, *Lepidochrysops* and *Orachrysops* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deutshländer & Bredenkamp, 1999; Terblanche, Morghental & 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 *Ichnestoma* 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 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. 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 were conducted during March 2022 which includes an optimal time of the year to find signs of animals such as invertebrates, signs of habitat sensitive plant species and vertebrate animal species high conservation priority. Weather conditions during the surveys 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 any more visits would reveal information that would change the outcome of this assessment both in terms of ecosystems of special conservation concern or suitable habitats of species of particular conservation concern. Visits that were conducted therefore appear to be sufficient to address the objectives of this study.

4 RESULTS

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

HABITAT FEATURE	DESCRIPTION
Topography	The area proposed for the development is on gentle slopes (flat plain).
Rockiness	No rocky ridges are present.
Presence of wetlands	Presence of wetlands is unlikely.
Vegetation	<p>Vegetation at the eastern section of the site (Portion 62, 63) consists of a savanna that ranges from slightly degraded to a fair condition. In some areas localised bush encroachment of the tree <i>Senegalia mellifera</i> and the shrub <i>Asparagus larycinus</i>, is present. The tree species <i>Vachellia tortilis</i> and the shrub <i>Grewia flava</i> are conspicuously abundant at the site. Other indigenous tree species include <i>Searsia lancea</i>, <i>Gymnosporia buxifolia</i>, <i>Dichrostachys cinerea</i>, <i>Peltophorum africanum</i> and <i>Senegalia burkei</i>. <i>Combretum hereroense</i> and <i>Olea europaea</i> subsp. <i>africana</i> are present in some areas. Herbaceous plant species include <i>Hibiscus trionum</i>, <i>Chamaecrista mimosoides</i> and <i>Solanum panduriforme</i>. Graminoids such as <i>Aristida congesta</i>, <i>Eragrostis lehmanniana</i>, <i>Heteropogon contortus</i>, <i>Setaria sphacelata</i>, <i>Cynodon dactylon</i> and <i>Urochloa mosambicensis</i> are visible at the site.</p> <p>A sandy area at the western part of the site (Portion 28) consists of a savanna where tree <i>Terminalia sericea</i> is visibly abundant. Other indigenous trees such as <i>Grewia monticola</i>, <i>Dombeya rotundifolia</i> and <i>Peltophorum africanum</i> are found in this area. A few individuals of the tree <i>Securidaca longepedunculata</i> are present and conserved in this area. Shrubs include <i>Lippia javanica</i>. Herbaceous plant species include <i>Cleome maculata</i>, <i>Limeum viscosum</i> and <i>Sida cordifolia</i>. Graminoids include <i>Panicum maximum</i>, <i>Eragrostis lehmanianna</i>, <i>Eragrostis rigidior</i>, <i>Setaria sphacelata</i>, <i>Eragrostis superba</i> and <i>Cenchrus ciliaris</i>.</p> <p>Alien invasive weed species are conspicuous at disturbed areas. These alien invasive weeds include <i>Alternanthera pungens</i>, <i>Datura ferox</i>, <i>Argemone ochroleuca</i>, <i>Schkuhria pinnata</i>, <i>Tagetes minuta</i>, <i>Bidens pilosa</i>, <i>Conyza bonariensis</i>, <i>Gomphrena celosiodes</i> and <i>Zinnia peruviana</i>.</p>

Signs of disturbances

Disturbances include typical infrastructure associated with farming such as buildings, fences, tracks and dirt roads. Cultivated fields are present at parts of the site.

Connectivity

There is little scope for the site to be part of a corridor of particular conservation importance.



Photo 1 View of part of the eastern section of the site.
Photo: R.F. Terblanche.



Photo 2 View of cultivated area at the study area.
Photo: R.F. Terblanche



Photo 3 View of savanna at the eastern section of the site where the tree *Vachellia tortilis* (Umbrella Thorn) is conspicuous.
Photo: R.F. Terblanche.



Photo 4 View of part of the western section of the site where *Terminalia sericea* (Silver Clusterleaf) trees are visibly abundant at a sandy area adjacent to a cultivated field.
Photo: R.F. Terblanche



Photo 5 *Vachellia tortilis* (Umbrella Thorn) which is conspicuously abundant at parts of the site.
Photo: R.F. Terblanche.



Photo 6 Foliage and fruit of *Grewia flava* (Velvet Raisin), a small indigenous tree, that is noticeable at many parts of the site.
Photo: R.F. Terblanche



Photo 7 Foliage of *Senegalia mellifera* (Black Thorn). Areas at the site where dense covers of shrub-height *Senegalia mellifera* are present, represent some localized bush encroachment.
Photo: R.F. Terblanche.



Photo 8 *Asparagus larycinus*, a widespread shrub often associated with bush encroachment, at the site.
Photo: R.F. Terblanche



Photo 9 *Combretum hereroense* (Russet Bushwillow) at the site.
Photo: R.F. Terblanche.



Photo 10 Characteristic leaves of *Grewia monticola*, at the site.
Photo: R.F. Terblanche



Photo 11 The protected tree *Securidaca longepedunculata* (Violet Tree, Krinkhout) that is conserved at a cultivated area, at the site.

Photo: R.F. Terblanche.



Photo 12 Trunk of the protected tree, *Securidaca longepedunculata*, at the site.

Photo: R.F. Terblanche



Photo 13 Foliage and fruit of the protected tree species, *Securidaca longepedunculata*, at the site.
Photo: R.F. Terblanche.



Photo 14 *Sida cordifolia*, a widespread herbaceous plant species, at the site.
Photo: R.F. Terblanche



Photo 15 *Hibiscus trionum* at the site.
Photo: R.F. Terblanche.



Photo 16 Alien invasive succulent tree, *Cereus jamacaru*, at the site.
Photo: R.F. Terblanche



Photo 17 Flower of the alien invasive herbaceous weed, *Zinnia peruviana*, at the site.
Photo: R.F. Terblanche.



Photo 18 The alien invasive herbaceous weed, *Alternanthera pungens*, at the site.
Photo: R.F. Terblanche



Photo 19 The butterfly species *Leucochitona levubu* (widespread in savanna of the northern parts of South Africa) feeding on the nectar of a flower of *Sida cordifolia* at the study area.
Photo: R.F. Terblanche.



Photo 20 The widespread butterfly species *Junonia hierta*, at the site.
Photo: R.F. Terblanche

4.2 ASSESSMENT OF PLANT SPECIES OF PARTICULAR CONSERVATION PRIORITY

4.2.1 Plant species of particular conservation concern according to the red list of plants

Table 4.2 Threatened plant species of the North West Province which 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 at the site; Yes = Plant species is a resident at the site.

Species	Status:	Resident at the site
	Global status or national status indicated	
<i>Brachystelma canum</i>	Critically Endangered	No
<i>Brachystelma gracillimum</i>	Critically Endangered	No

Table 4.3 Threatened plant species of the North West Province which 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 at the site; Yes = Plant species is a resident at the site.

Species	Status:	Resident at the site
	Global status or national status indicated	
<i>Aloe peglerae</i>	Endangered	No
<i>Brachystelma discoideum</i>	Endangered	No

Table 4.4 Threatened plant species of the North West Province which 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 a resident at the site; Yes = Plant species is a resident at the site.

Species	Status:	Resident at the site
	Global status or national status indicated	
<i>Brachycorythis conica</i> subsp. <i>transvaalensis</i>	Vulnerable	No
<i>Brachystelma incanum</i>	Vulnerable	No
<i>Ceropegia decidua</i> subsp. <i>pretoriensis</i>	Vulnerable	No
<i>Ceropegia stentiae</i>	Vulnerable	No
<i>Ledebouria atrobrunnea</i>	Vulnerable	No
<i>Marsilea farinosa</i>	Vulnerable	No
<i>Melolobium subspicatum</i>	Vulnerable	No
<i>Prunus africana</i>	Vulnerable	No
<i>Rennera stellata</i>	Vulnerable	No
<i>Searsia maricoan</i>	Vulnerable	No

Table 4.5 Near Threatened plant species of the North West 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 at the site; Yes = Plant species is a resident at the site.

Species	Status:	Resident at the site
	Global status or national status indicated	
<i>Adromischus umbraticola</i> subsp. <i>umbraticola</i>	Near Threatened	No

<i>Ceropegia turricula</i>	Near Threatened	No
<i>Cineraria austrotransvaalensis</i>	Near Threatened	No
<i>Cleome conrathii</i>	Near Threatened	No
<i>Delosperma leendertziae</i>	Near Threatened	No
<i>Drimia sanguinea</i>	Near Threatened	No
<i>Elaeodendron transvaalense</i>	Near Threatened	No
<i>Kniphofia typhoides</i>	Near Threatened	No
<i>Lithops leslei</i> subsp. <i>leslei</i>	Near Threatened	No
<i>Nerine gracilis</i>	Near Threatened	No
<i>Sporobolus oxyphyllus</i>	Near Threatened	No
<i>Stenostelma umbelluliferum</i>	Near Threatened	No

Table 4.6 Plant species of the North West Province which are not threatened and not near threatened but which are of particular conservation concern and listed in the **Critically Rare** category (Raimondo *et al.* 2009). 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 at the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
<i>Gladiolus filiformis</i>	Critically Rare	No

Table 4.7 Plant species of the North West Province which are not threatened and not near threatened but of which are of particular conservation concern and listed in the **Rare** category (Raimondo *et al.* 2009). 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 at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Brachystelma dimorphum</i> subsp. <i>gratum</i>	Rare	No
<i>Ceropegia insignis</i>	Rare	No
<i>Frithia pulchra</i>	Rare	No
<i>Gnaphalium nelsonii</i>	Rare	No
<i>Habenaria culveri</i>	Rare	No

Table 4.8 Plant species of the North West Province which are not threatened and not near threatened but which are of particular conservation concern and listed in the **Declining** category (Raimondo *et al.* 2009). 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 at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Boophone disticha</i>	Declining	No
<i>Crinum bulbispermum</i>	Declining	No
<i>Crinum macowanii</i>	Declining	No
<i>Drimia altissima</i>	Declining	No
<i>Eucomis autumnalis</i>	Declining	No
<i>Gunnera perpensa</i>	Declining	No
<i>Hypoxis hemerocallidea</i>	Declining	No
<i>Ilex mitis</i>	Declining	No
<i>Pelargonium sidoides</i>	Declining	No
<i>Vachellia erioloba</i>	Declining	No

4.2.2 Plant species of particular conservation concern: protected species

Table 4.9 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 not a resident on the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
<i>Boscia albitrunca</i> (Shepherd's tree)	Protected	No
<i>Combretum imberbe</i> (Leadwood)	Protected	Yes
<i>Sclerocarya birrea</i> (Marula)	Protected	Yes
<i>Securidaca longepedunculata</i> (Violet Tree/ Krinkhout)	Protected	Yes
<i>Vachellia erioloba</i> (Camel Thorn Tree)	Protected	Yes

4.3 ASSESSMENT OF VERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

4.3.1 Mammals of particular high conservation priority

Table 4.10 Threatened mammal species of the North West Province. Literature sources: Friedman & Daly, (2004), Skinner & Chimimba (2005), Wilson & Reeder (2005). 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	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Chrysospalax villosus</i> Rough-haired golden mole	Vulnerable	No	No
<i>Cloeotis percivali</i> Short-eared Trident Bat	Vulnerable/ Near-threatened	No	No
<i>Diceros bicornis</i> Black rhinoceros	Critically Endangered	No	No
<i>Lycaon pictus</i> African wild dog	Endangered	No	No
<i>Loxodonta africana</i> African elephant	Vulnerable	No	No
<i>Mystromys albicaudatus</i> White-tailed mouse	Endangered	No	No
<i>Neamblysomus julianae</i> Juliana's Golden Mole	Critically Endangered	No	No
<i>Panthera leo</i> Lion	Vulnerable	No	No
<i>Rhinolophus blasii</i> Blasi's Horseshoe Bat	Vulnerable	No	No
<i>Smutsia temminckii</i> Ground Pangolin	Vulnerable	No	No

Table 4.11 Near threatened mammal species known to occur in the North West Province. Literature sources: Skinner & Chimimba (2005). 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	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Ceratotherium simum</i> White Rhinoceros	Near threatened	No	No

Table 4.12 Data deficient (or uncertain) mammal species of the North West Province. Literature sources: Skinner & Chimimba (2005). 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	Recorded at site during survey	Likely be a resident at the site
<i>Myosorex varius</i> Forest shrew	Uncertain	No	No

4.3.2 Birds of particular high conservation priority

Table 4.13 Threatened bird species of the North West Province. Literature sources Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). No = Not recorded at site/ Unlikely to use site as breeding area or particular habitat on which the species depends. Yes = Recorded at site/ Likely to use site as breeding area or particular habitat on which the species depends.

Species	Common name	Threatened Status	Recorded at site during survey	Likely to use site as breeding area or habitat
<i>Aegypius tracheliotos</i>	Lappet-faced Vulture	Vulnerable	No	No
<i>Anthropoides paradiseus</i>	Blue Crane	Vulnerable	No	No
<i>Aquila rapax</i>	Tawny Eagle	Vulnerable	No	No
<i>Ardeotis kori</i>	Kori Bustard	Vulnerable	No	No
<i>Balearica regulorum</i>	Grey Crowned Crane (Mahem)	Vulnerable	No	No
<i>Botaurus stellaris</i>	Eurasian Bittern	Critically Endangered	No	No
<i>Circus ranivorus</i>	African Marsh- Harrier	Vulnerable	No	No
<i>Crex crex</i>	Corn Crane	Vulnerable	No	No
<i>Eupodotis senegalensis</i>	White-bellied Korhaan	Vulnerable	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>Gypaetus barbatus</i>	Bearded Vulture	Endangered	No	No
<i>Gyps africanus</i>	White-backed Vulture	Vulnerable	No	No
<i>Gyps coprotheres</i>	Cape Vulture	Vulnerable	No	No
<i>Pelecanus rufescens</i>	Pink-backed Pelican	Vulnerable	No	No
<i>Polemaetus bellicosus</i>	Martial Eagle	Vulnerable	No	No
<i>Rhynchops flavirostris</i>	African Skimmer	Endangered	No	No
<i>Sagittarius serpentarius</i>	Secretarybird	Vulnerable	No	No
<i>Sarothrura ayresi</i>	White-winged Flufftail	Critically Endangered	No	No
<i>Tyto capensis</i>	African Grass-Owl	Vulnerable	No	No

* Though some of the above bird species that roams over large areas may occasionally be found at the site, the site does not appear to be a habitat of particular importance to these birds, and these birds also do not use the site as breeding area.

Table 4.14 Near threatened bird species of the North West Province. Literature sources Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). No = Not recorded at site/ Unlikely to be particularly dependent on the site as breeding area or habitat. Yes = Recorded at site/ Likely to be particularly dependant on the site as breeding area or habitat.

Species	Common name	Threatened Status	Recorded at site during survey	Likely to use site breeding area or habitat
<i>Certhilauda chuana</i>	Short-clawed Lark	Near threatened	No	No
<i>Charadrius pallidus</i>	Chestnut-banded Plover	Near threatened	No	No
<i>Ciconia nigra</i>	Black Stork	Near threatened	No	No
<i>Circus macrourus</i>	Pallid Harrier	Near threatened	No	No
<i>Eupodotis caerulescens</i>	Blue Korhaan	Near threatened	No	No
<i>Falco biarmicus</i>	Lanner Falcon	Near threatened	No	No
<i>Falco peregrinus</i>	Peregrine Falcon	Near threatened	No	No
<i>Glareola nordmanni</i>	Black-winged Pratincole	Near threatened	No	No
<i>Leptoptilos crumeniferus</i>	Marabou Stork	Near threatened	No	No
<i>Mirafra cheniana</i>	Melodious lark	Near threatened	No	No
<i>Mycteria ibis</i>	Yellow-billed Stork	Near threatened	No	No
<i>Phoenicopterus minor</i>	Lesser Flamingo	Near threatened	No	No
<i>Phoenicopterus ruber</i>	Greater Flamingo	Near threatened	No	No
<i>Rostratula benghalensis</i>	Greater Painted-snipe	Near threatened	No	No
<i>Sterna caspia</i>	Caspian Tern	Near threatened	No	No

* Though some of the above bird species that roams over large areas may occasionally be found at the site, the site does not appear to be a habitat of particular importance to these birds, and these birds also do not use the site as breeding area.

4.3.3 Reptiles of particular high conservation priority

The following tables list possible presence or absence of threatened reptile or near threatened reptile species in the study area. The Atlas and Red List of Reptiles of South Africa, Lesotho and South Africa (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014) has been used as the main source to compile the list for assessment.

Table 4.15 Threatened reptile species in North West Province. Main Source: (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014). No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
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<i>Crocodylus niloticus</i> Nile Crocodile	Vulnerable	No	No	No
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Table 4.16 Near threatened reptile species in North West Province. Main Source: Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers (2014). Though *Homoroselaps dorsalis* has not yet been recorded from the North West Province, its presence in some areas of the Province is anticipated. No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Homoroselaps dorsalis</i> Striped Harlequin Snake	Near threatened	No	No	No

4.3.4 Amphibian species of particular high conservation priority

Table 4.17 Near threatened amphibian species in North West Province. No = Amphibian species is not a resident on the site; Yes = Amphibian species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Pyxicephalus adspersus</i> Giant Bullfrog	Least Concern (IUCN) Remains a species of particular conservation concern.	No	No	No

4.4 ASSESSMENT OF INVERTEBRATE SPECIES OF PARTICULAR CONSERVATION PRIORITY

4.4.1 Butterflies of particular conservation priority

Table 4.18 Threatened butterfly species in North West Province and Gauteng Province (Mecenero *et al.* 2020). Sources of information: Henning, Terblanche & Ball (2009), Mecenero *et al.* (2013), Mecenero *et al.* (2020). Invertebrates such as threatened butterfly species are often very habitat specific and residential status imply a unique ecosystem that is at stake.

Species	Threatened Status	Recorded at site during survey	Residential status at the site: Yes confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Aloeides dentatis dentatis</i> Roodepoort Toothed Russet	Endangered	No	Highly unlikely
<i>Chrysothrix aureus</i> Golden Opal/ Heidelberg Copper	Endangered	No	Highly unlikely
<i>Lepidochrysops praeterita</i> Highveld Giant Cupid/ Highveld Blue	Endangered	No	Highly unlikely
<i>Orachrysops mijburghii</i> Heilbron Cupid	Endangered	No	Highly unlikely

Table 4.19 Butterfly species of the North West Province and Gauteng Province that are Near Threatened (Mecenero *et al.*, 2020). No = Butterfly species is unlikely to be a resident at the study area; Yes = Butterfly species is a resident at the study area. Sources of information Henning, Terblanche & Ball (2009), Mecenero *et al.* (2013), Mecenero *et al.* (2020).

Species	Threatened Status	Recorded at site during survey	Residential status at the site: Yes confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Metisella meninx</i> Marsh Sylph	Near Threatened	No	Unlikely

4.4.2 Beetles of particular conservation priority

Table 4.20 Fruit chafer species (Coleoptera: Scarabaeidae: Cetoniinae) in the Gauteng Province and North-West Province which are of known high conservation priority.

Species	Threatened Status	Recorded at site during survey	Likely to be resident based on habitat assessment
<i>Ichneustoma stobbiai</i>	Uncertain	No	No
<i>Trichocephala brincki</i>	Uncertain	No	No

4.4.3 Scorpion species of particular conservation priority

Table 4.21 Rock scorpion species (Scorpiones: Ischnuridae) species that are of known high conservation priority in the Gauteng Province and North-West Province.

Species	Threatened Status	Recorded at site during survey	Likely to be resident at site based on habitat assessment
<i>Hadogenes gracilis</i>	Uncertain	No	No
<i>Hadogenes gunningi</i>	Uncertain	No	No

5.1 Habitat and vegetation characteristics

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

5.2 Plants

Extinct, threatened, near threatened and other plant species of high conservation priority in North West Province are listed in Tables 4.2 – 4.8. Protected tree species are listed in Table 4.9. The presence or not of all the species listed in the tables were investigated during the survey. None of the Threatened and Near Threatened plant species are likely to occur on the site, or to have occurred at an area at the site that has been cultivated. No other plant species of particular conservation concern is likely to occur at the site.

The Protected tree species *Combretum imberbe* (Leadwood), *Sclerocarya birrea* (Marula), *Securidaca longepedunculata* (Violet Tree) and *Vachellia erioloba* (Camel Thorn) occur at the study area. These trees occur at certain areas in the study area but could not be found in any large numbers. The Protected trees are for example conserved along the roadside of a tar road that runs through the study area. Judging from the vegetation adjacent to the cultivated area Pivot 3 and Pivot 5 that have been cleared of vegetation it is unlikely that any sensitive species, including protected tree species have occurred there. A few individuals of the Protected tree species *Securidaca longepedunculata* (Violet Tree, Krinkhout) are present at the western section of the site (Portion 28) where these individual trees are conserved, also in the cultivated area. 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.

It is recommended that the few *Securidaca longepedunculata* individuals at the western part of the site should be avoided. At present the protected tree species at the site and larger study area are conserved wherever they occur, a practice that should continue.

5.3 Vertebrates

5.3.1 Mammals

Table 4.10, Table 4.11 and Table 4.12 list the possible presence or absence of threatened mammal species, near threatened mammal species and mammal species of which the status is uncertain, respectively, at the site. Literature sources that were used are Friedman & Daly (2004), Skinner & Chimimba (2005) and Wilson & Reeder (2005). Since the site falls outside reserves, threatened species such as the black rhinoceros (*Diceros bicornis*) and the African wild dog (*Lycaon pictus*) are obviously not present. No smaller mammals of particular high conservation significance are likely to be found on the site as well.

5.3.2 Birds

Table 4.13 and Table 4.14 list the possible presence or absence of threatened bird species and near threatened bird species at the site. 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. Therefore the emphasis in the right hand columns of Table 4.12 and Table 4.13 are on the particular likely dependence or not of bird species on the site. Literature sources that were mainly consulted are Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden *et al.* (2017). No threat to any threatened bird species or any bird species of particular conservation importance are foreseen.

5.3.3 Reptiles

Table 4.15 and Table 4.16 list the possible presence or absence of threatened and near threatened reptile species on the site. The Atlas and Red List of Reptiles of South Africa, Lesotho and South Africa (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014) has been used as the main source to compile the list for assessment. There appears to be no threat to any reptile species of particular high conservation importance if the site is developed.

5.3.4 Amphibians

No frog species that occur in the North West are listed as Threatened species (Vulnerable, Endangered or Critically Endangered) or Near Threatened species according to IUCN Amphibian Specialist Group (2013). Table 4.17 lists *Pyxicephalus adspersus* (Giant Bullfrog) as Least Concern globally. According to the Biodiversity Management Directorate of GDARD (Gauteng Department of Agriculture and Rural Development) (2014) there are no amphibians in Gauteng that qualify for red listed status (red listed here indicates a category of special conservation concern such as threatened or near threatened). Suitable habitat for Giant Bullfrog at site appears to be absent.

5.4 Invertebrates

5.4.1 Butterflies

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 (Deutshländer and Bredenkamp 1999; Edge 2002, 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008). Threatened butterfly species in South Africa can then be regarded as bio-indicators of rare ecosystems.

Four species of butterfly in Gauteng Province and North West Province combined are listed as threatened in the recent butterfly conservation assessment of South Africa (Mecenero *et al.*, 2013). The expected presence or not of these threatened butterfly species as well as species of high conservation priority that are not threatened, at the site (Table 4.18 and Table 4.19) follows.

5.4.1.1 Assessment of threatened butterfly species

***Aloeides dentatis dentatis* (Roodepoort Toothed Russet)**

The proposed global red list status for *Aloeides dentatis dentatis* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2020). *Aloeides dentatis dentatis* colonies are found where one of its host plants *Hermannia depressa* or *Lotononis eriantha* is present. Larval ant association is with *Lepisiota capensis* (S.F. Henning 1983; S.F. Henning & G.A. Henning 1989). The habitat requirements of *Aloeides dentatis dentatis* are complex and not fully understood yet. See Deutschländer and Bredenkamp (1999) for the description of the vegetation and habitat characteristics of one locality of *Aloeides dentatis* subsp. *dentatis* at Ruimsig, Roodepoort, Gauteng Province. There is not an ideal habitat of *Aloeides dentatis* subsp. *dentatis* on the site and it is unlikely that the butterfly is present at the site.

***Chrysoritis aureus* (Golden Opal/ Heidelberg Copper)**

The proposed global red list status for *Chrysoritis aureus* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2020) *Chrysoritis aureus* (Golden Opal/ Heidelberg Copper) is a resident where the larval host plant, *Clusia pulchella* is present. However, the distribution of the butterfly is much more restricted than that of the larval host plant (S.F. Henning 1983; Terblanche, Morgenthal & Cilliers 2003). One of the reasons for the localised distribution of *Chrysoritis aureus* is that a specific host ant *Crematogaster liengmei* must also be present at the habitat. Fire appears to be an essential factor for the maintenance of suitable habitat (Terblanche, Morgenthal & Cilliers 2003). Research revealed that *Chrysoritis aureus* (Golden Opal/ Heidelberg Copper) has very specific habitat requirements, which include rocky ridges with a steep slope and a southern aspect (Terblanche, Morgenthal & Cilliers 2003). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon is highly unlikely.

***Lepidochrysops praeterita* (Highveld Blue)**

The proposed global red list status for *Lepidochrysops praeterita* according to the most recent IUCN criteria and categories is Endangered (G.A. Henning, Terblanche & Ball, 2009; Mecenero *et al.*, 2020). *Lepidochrysops praeterita* is a butterfly that occurs where the larval host plant *Ocimum obovatum* (= *Becium obovatum*) is present (Pringle, G.A. Henning & Ball, 1994), but the distribution of the butterfly is much more restricted than the distribution of the host plant. *Lepidochrysops praeterita* is found on selected rocky ridges and rocky hillsides in parts of Gauteng, the extreme northern Free State and the south-eastern Gauteng Province. No ideal habitat appears to be present for the butterfly on the site. It is unlikely that *Lepidochrysops praeterita* would be present on the site and at the footprint proposed for the development.

***Orachrysops mijburghi* (Mijburgh's Blue)**

The proposed global red status for *Orachrysops mijburghi* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2020). *Orachrysops mijburghi* favours grassland depressions where

specific *Indigofera* plant species occur (Terblanche & Edge 2007). The Heilbron population of *Orachrysops mijburghii* in the Free State uses *Indigofera evansiana* as a larval host plant (Edge, 2005) while the Suikerbosrand population in Gauteng uses *Indigofera dimidiata* as a larval host plant (Terblanche & Edge 2007). There is no suitable habitat for *Orachrysops mijburghii* on the site and it is unlikely that *Orachrysops mijburghii* would be present on the site.

5.4.1.2 Assessment of butterfly species that are Near Threatened

***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 20th 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.*, 2013) 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* is now regarded as Near Threatened (Mecenero *et al.*, 2020). 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). There is not an ideal habitat for the species at the site and occurrence of *Metisella meninx* at the site is unlikely.

There appears to be no threat to any threatened or near threatened butterfly species if the site is developed.

5.4.2 Fruit chafer beetles

Table 4.20 lists the fruit chafer beetle species (Coleoptera: Scarabaeidae: Cetoniinae) that are of known high conservation priority in the North West Province. No *Ichnestoma stobbiai* or *Trichocephala brincki* were found during the surveys. There appears to be no suitable habitat for *Ichnestoma stobbiai* or *Trichocephala brincki* at the site. There appears to be no threat to any of the fruit chafer beetles of particular high conservation priority if the site were developed.

5.4.3 Scorpions

Table 4.21 lists the rock scorpion species (Scorpiones: Ischnuridae) that are of known high conservation priority in the North West Province. None of these rock scorpions have been found at the site and the habitat does not appear to be optimal.

5.5 Ecological Sensitivity at the site

No rocky ridges or wetlands are present at the site. Vegetation adjacent to the cultivated areas at the western (Portion 28) and eastern section (Portion 62, 63) of the site ranges from somewhat degraded to fair condition. No threatened or near threatened plant or animal species appear to be present at the savanna adjacent to the cultivated areas. A few protected trees are present at the site and these have been conserved. Threatened ecosystems are absent at the site. The scope for the site to be part of a corridor of particular conservation importance, is small. Ecological sensitivity at the vegetation adjacent to the cultivated areas at the site, is medium. Based on the present survey of areas adjacent to the cultivated fields, the ecological sensitivity of the areas where the cultivated fields are present, have probably also been of medium sensitivity before clearance of vegetation.

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; Edg, 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). In the South Africa the pressure to develop areas are high since its infrastructure allows for improvement of human well-being. Urban nature conservation issues in South Africa are overshadowed by the goal to improve human well-being, which focuses on aspects such as poverty, equity, redistribution of wealth and wealth creation (Cilliers, Müller & Drewes 2004). Nevertheless, the conservation of habitats is the key to invertebrate 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 invertebrates. 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 eastern section of the site consists of a savanna that ranges from slightly degraded to a fair condition. In some areas localised bush encroachment of the tree *Senegalia mellifera* and the shrub *Asparagus larycinus*, is present. The tree species *Vachellia tortilis* and the shrub *Grewia flava* are conspicuously abundant at the site. Other indigenous tree species include *Searsia lancea*, *Gymnosporia buxifolia*, *Dichrostachys cinerea*, *Peltophorum africanum* and *Senegalia burkei*. *Combretum hereroense* and *Olea europaea* subsp. *africana* are present in some areas. Herbaceous plant species include *Hibiscus trionum*, *Chamaecrista mimosoides* and

Solanum panduriforme. Graminoids such as *Aristida congesta*, *Eragrostis lehmanniana*, *Heteropogon contortus*, *Setaria sphacelata*, *Cynodon dactylon* and *Urochloa mosambicensis* are visible at the site.

A sandy area at the western part of the site consists of a savanna where tree *Terminalia sericea* is visibly abundant. Other indigenous trees such as *Grewia monticola*, *Dombeya rotundifolia* and *Peltophorum africanum* are found in this area. A few individuals of the tree *Securidaca longepedunculata* are present and conserved in this area. Shrubs include *Lippia javanica*. Herbaceous plant species include *Cleome maculata*, *Limeum viscosum* and *Sida cordifolia*. Graminoids include *Panicum maximum*, *Eragrostis lehmanianna*, *Eragrostis rigidior*, *Setaria sphacelata*, *Eragrostis superba* and *Cenchrus ciliaris*.

Alien invasive weed species are conspicuous at disturbed areas. These alien invasive weeds include *Alternanthera pungens*, *Datura ferox*, *Argemone ochroleuca*, *Schkuhria pinnata*, *Tagetes minuta*, *Bidens pilosa*, *Conyza bonariensis*, *Gomphrena celosiodes* and *Zinnia peruviana*.

Disturbances include typical infrastructure associated with farming such as buildings, fences, tracks and dirt roads. Cultivated fields are present at parts of the site.

Wetlands and rocky ridges appear to be absent at the site.

Savanna at the site is represented by the Zeerust Thornveld (SVcb 3) which is not listed as a Threatened Ecosystem according to the National List of Threatened Ecosystems (2011).

No Threatened or Near Threatened plant or animal species appear to be resident at the site.

The Protected tree species *Combretum imberbe* (Leadwood), *Sclerocarya birrea* (Marula), *Securidaca longepedunculata* (Violet Tree) and *Vachellia erioloba* (Camel Thorn) occur at the study area. These trees occur at certain areas in the study area but could not be found in any large numbers. The Protected trees are for example conserved along the roadside of a tar road that runs through the study area. Judging from the vegetation adjacent to the cultivated area Pivot 3 and Pivot 5 that have been cleared of vegetation it is unlikely that any sensitive species, including protected tree species have occurred there. A few individuals of the Protected tree species *Securidaca longepedunculata* (Violet Tree, Krinkhout) are present at the western section of the site (Portion 28) where these individual trees are conserved, also in the cultivated area. 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.

It is recommended that the few *Securidaca longepedunculata* individuals at the western part of the site should be avoided. At present the protected tree species at the site and larger study area are conserved wherever they occur, a practice that should continue.

The scope for the site to be part of a corridor of particular conservation importance is small.

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 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.

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 destruction of habitat of medium ecological sensitivity.
Status	Negative
Mitigation Required	If the development is approved cultivation of indigenous vegetation at the site is imperative.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Moderate
RISK	Following the mitigation measures a moderate risk of impact is expected.

Aspect/Activity	Removal of sensitive species
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Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Sensitive species: Presence of Threatened or Near Threatened Plants, Mammals, Reptiles, Amphibians and Invertebrates at the site appear to be unlikely. One Protected tree species <i>Securidaca longepedunculata</i> , is present at the site. No other plant or animal species of particular conservation concern are anticipated to be resident at the site.
Status	Negative.
Mitigation Required	No specific mitigation measures for sensitive species apply at the site apart from avoidance of the few protected <i>Securidaca longepedunculata</i> trees at the site. These trees are already conserved wherever they occur at the site.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISK	A low risk of threat to any sensitive species at the site is anticipated.

Aspect/Activity	Fragmentation of corridors of particular conservation concern
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Savanna containing some indigenous vegetation will be cleared. The scope for the site to be a corridor of particular conservation importance is small.
Status	Negative
Mitigation Required	Where possible indigenous vegetation should be conserved/ cultivated in particular adjacent to cleared areas.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISK	Following mitigation, moderate 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
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	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.
Status	Negative
Mitigation Required	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
RISKS	A low risk is expected following mitigation.

Aspect/Activity	Possible disturbance, trapping, hunting and killing of vertebrates during construction phase
Type of Impact	Direct
Potential Impact	During the construction phase animal species could be disturbed, trapped, hunted or killed.
Status	Negative
Mitigation Required	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
RISKS	Following mitigation a low risk 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.
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Infestation by alien invasive species could replace indigenous vegetation or potential areas where indigenous vegetation could recover. It is in particular declared alien invasive species such as <i>Melia azedarach</i> (Syringa) or alien invasive <i>Prosopis glandulosa</i> (Mesquite) that should not be allowed to establish. Once established combatting these alien invasive plant species may become very expensive in the long term.
Status	Negative
Mitigation Required	Continued monitoring and eradication of alien invasive plant species are imperative. It is in particular declared alien invasive species such as <i>Melia azedarach</i> (Syringa) and alien invasive <i>Prosopis glandulos</i> (Mesquite) that should not be allowed to establish.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISKS	Following mitigation, a low risk is anticipated.

6.4 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	The removal of vegetation takes place at an area of medium ecological sensitivity. Conservation/ cultivation of indigenous plant species adjacent to cleared areas is essential.	Moderate	Moderate	High

Loss of sensitive species	Loss of sensitive species (Note no Threatened species or Near threatened species)	Neutral (Protected trees are avoided)	Site	Long-Term	Very low (No species anticipated)	Unlikely	Not applicable	Not applicable	No specific mitigation measures for threatened and near threatened species apply at the site. A few individuals of one protected tree species, <i>Securidaca longepedunculata</i> (Violet Tree, Krinkhout) are present at the western section of the site where these individual trees are conserved. 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. It is recommended that the few <i>Securidaca longepedunculata</i> individuals at the western part of the site should be avoided. At present the protected tree species at the site and larger study area are conserved wherever they occur, a practice that should continue.	Moderate	Low	High
Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	The scope for the site to be part of a corridor of particular conservation importance is small. Conservation/ cultivation of indigenous plant species adjacent to developed areas are essential and will enhance conservation corridors in the larger area.	Moderate	Low	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

6.5 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. Cultivation of indigenous plant species at the site.	Moderate	Low	High

6.6 Summary of risks and impacts

No rocky ridges or wetlands are present at the western section and eastern section of the site. Vegetation adjacent to the cultivated areas at the western and eastern section of the site ranges from somewhat degraded to fair condition. No threatened or near threatened plant or animal species appear to be present at the savanna adjacent to the cultivated areas. A few protected trees are present at the site and these have been conserved. Threatened ecosystems are absent at the site. The scope for the site to be part of a corridor of particular conservation importance, is small. Ecological sensitivity at the vegetation adjacent to the cultivated areas at the site, is medium. Based on the present survey of areas adjacent to the cultivated fields, the ecological sensitivity of the areas where the cultivated fields are present, would probably have probably also been of medium sensitivity before clearance of vegetation.

The Protected tree species *Combretum imberbe* (Leadwood), *Sclerocarya birrea* (Marula), *Securidaca longepedunculata* (Violet Tree) and *Vachellia erioloba* (Camel Thorn) occur at the study area. These trees occur at certain areas in the study area but could not be found in any large numbers. The Protected trees are for example conserved along the roadside of a tar road that runs through the study area. Judging from the vegetation adjacent to the cultivated area Pivot 3 and Pivot 5 that have been cleared of vegetation it is unlikely that any sensitive species, including protected tree species have occurred there. A few individuals of the Protected tree species *Securidaca longepedunculata* (Violet Tree, Krinkhout) are present at the western section of the site (Portion 28) where these individual trees are conserved, also in the cultivated area. 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.

It is recommended that the few *Securidaca longepedunculata* individuals at the western part of the site (Portion 28) should be avoided. At present the protected tree species at the site and larger study area are conserved wherever they occur, a practice that should continue.

Savanna at the site is represented by the Zeerust Thornveld (Gh 13) vegetation type, which is not listed as a Threatened Ecosystem according to the National List of Threatened Ecosystems (2011).

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 at the eastern section of the site consists of a savanna that ranges from slightly degraded to a fair condition. In some areas localised bush encroachment of the tree *Senegalia mellifera* and the shrub *Asparagus larycinus*, is present. The tree species *Vachellia tortilis* and the shrub *Grewia flava* are conspicuously abundant at the site. Other indigenous tree species include *Searsia lancea*, *Gymnosporia buxifolia*, *Dichrostachys cinerea*, *Peltophorum africanum* and *Senegalia burkei*. *Combretum hereroense* and *Olea europaea* subsp. *africana* are present in some areas. Herbaceous plant species include *Hibiscus trionum*, *Chamaecrista mimosoides* and *Solanum panduriforme*. Graminoids such as *Aristida congesta*, *Eragrostis lehmanniana*, *Heteropogon contortus*, *Setaria sphacelata*, *Cynodon dactylon* and *Urochloa mosambicensis* are visible at the site.
- A sandy area at the western part of the site consists of a savanna where tree *Terminalia sericea* is visibly abundant. Other indigenous trees such as *Grewia monticola*, *Dombeya rotundifolia* and *Peltophorum africanum* are found in this area. A few individuals of the tree *Securidaca longepedunculata* are present and conserved in this area. Shrubs include *Lippia javanica*. Herbaceous plant species include *Cleome maculata*, *Limeum viscosum* and *Sida cordifolia*. Graminoids include *Panicum maximum*, *Eragrostis lehmanianna*, *Eragrostis rigidior*, *Setaria sphacelata*, *Eragrostis superba*, *Melinis repens* and *Cenchrus ciliaris*.
- Alien invasive weed species are conspicuous at disturbed areas. These alien invasive weeds include *Alternanthera pungens*, *Datura ferox*, *Argemone ochroleuca*, *Schkuhria pinnata*, *Tagetes minuta*, *Bidens pilosa*, *Conyza bonariensis*, *Gomphrena celosiodes* and *Zinnia peruviana*.
- Disturbances include typical infrastructure associated with farming such as buildings, fences, tracks and dirt roads. Cultivated fields are present at parts of the site.
- Wetlands and rocky ridges appear to be absent at the site.
- Savanna at the site is represented by the Zeerust Thornveld (SVcb 3) which is not listed as a Threatened Ecosystem according to the National List of Threatened Ecosystems (2011).
- No Threatened or Near Threatened plant or animal species appear to be resident at the site.

- The Protected tree species *Combretum imberbe* (Leadwood), *Sclerocarya birrea* (Marula), *Securidaca longepedunculata* (Violet Tree) and *Vachellia erioloba* (Camel Thorn) occur at the study area. These trees occur at certain areas in the study area but could not be found in any large numbers. The Protected trees are for example conserved along the roadside of a tar road that runs through the study area. Judging from the vegetation adjacent to the cultivated area Pivot 3 and Pivot 5 that have been cleared of vegetation it is unlikely that any sensitive species, including protected tree species have occurred there. A few individuals of the Protected tree species *Securidaca longepedunculata* (Violet Tree, Krinkhout) are present at the western section of the site (Portion 28) where these individual trees are conserved, also in the cultivated area. 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.
- It is recommended that the few *Securidaca longepedunculata* individuals at the western part of the site should be avoided. At present the protected tree species at the site and larger study area are conserved wherever they occur, a practice that should continue.
- The scope for the site to be part of a corridor of particular conservation importance is small.
- Ecological sensitivity of the vegetation adjacent to the cultivated areas at the site, is medium.
- Based on the present survey of areas adjacent to the cultivated fields at the site, the ecological sensitivity of these cultivated areas would probably have been medium before the clearance of vegetation.
- Following avoidance of protected tree species, mitigations that will be upheld and the planned footprint at savanna that are not distinctly sensitive, the impact risks listed are moderate or low.
- If the development is approved a key issue would be continued monitoring and eradication of alien invasive plant species, also at and near cultivated areas. It is in particular alien invasive species such as *Melia azedarach* (Syringa) and invasive *Prosopis glandulosa* (Mesquite) which should not be allowed to establish.
- The practice of cultivating and conserving indigenous plant species in the local area should be continued.

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ANNEXURE 1

List of plant species recorded at the site.

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

Sources: Bromilow (2010); Crouch, Klopper, Court (2010); Duncan (2016); Fish, Mashau, Moeaha & Nembudani (2015); Germishuizen (2003), Goldblatt (1986); Goldblatt & Manning (1998); Johnson & Bytebier (2015); Manning (2007), Manning (2009), McMurtry, Grobler, Grobler & Burns (2008); Smith, Crouch. & Figueiredo (2017); Van Ginkel *et al.* (2011); Van Jaarsveld (2006); Van Oudtshoorn (2012); Van Wyk (2000); Van Wyk & Gericke (2000); Van Wyk & Malan (1998); Van Wyk & Van Wyk (2013); Van Wyk & Smith (2014); Van Wyk, van Oudtshoorn & Gericke (2009)

TAXON	COMMON NAMES	FAMILY
ANGIOSPERMAE: MONOCOTYLEDONS		
<i>Albuca setosa</i>		HYACINTHACEAE
<i>Aloe zebrina</i>		ASPHODELACEAE
<i>Aristida adscensionis</i>		POACEAE
<i>Aristida congesta</i>	Tassel Three-awn	POACEAE
<i>Asparagus larycinus</i>	Common Wild Asparagus	ASPARAGACEAE
<i>Chloris virgata</i>		POACEAE
<i>Cymbopogon caesius</i>	Broad-leaved Turpentine Grass	POACEAE
<i>Cymbopogon pospischilii</i>	Narrow-leaved Turpentine Grass	POACEAE
<i>Cynodon dactylon</i>	Couch Grass	POACEAE
<i>Digitaria eriantha</i>	Common Finger Grass	POACEAE
<i>Elionurus muticus</i>		POACEAE
<i>Eragrostis curvula</i>		POACEAE
<i>Eragrostis lehmanniana</i>		POACEAE
<i>Eragrostis superba</i>	Saw-toothed Love Grass	POACEAE
<i>Heteropogon contortus</i>	Spear Grass	POACEAE
<i>Melinis repens</i>	Natal Red-top	POACEAE
<i>Pogonarthria squarrosa</i>	Herringbone Grass	POACEAE
<i>Urochloa mocambicensis</i>	Bushveld Signal Grass	POACEAE
ANGIOSPERMS:		

DICOTYLEDONS		
* <i>Alternanthera pungens</i>	Dubbeltjie	AMARANTHACEAE
<i>Aptosimum decumbens</i>		SCROPHULARIACEAE
* <i>Argemone ochroleuca</i>	White-flowered Mexican poppy	PAPAVARACEAE
* <i>Bidens bipinnata</i>	Spanish Black Jack	ASTERACEAE
* <i>Bidens pilosa</i>		ASTERACEAE
<i>Chamaecrista mimosoides</i>		FABACEAE
* <i>Chenopodium album</i>	White Goosefoot	CHENOPODIACEAE
<i>Cleome maculata</i>		CAPPARACEAE
<i>Cleome monophylla</i>	Single-leaved Cleome	CAPPARACEAE
<i>Combretum hereroense</i>	Russet Bushwillow	COMBRETACEAE
<i>Commelina africana</i>		COMMELINACEAE
<i>Convolvulus sagittatus</i>	Wild Bindweed	CONVOLVULACEAE
<i>Crabbea angustifolia</i>		ACANTHACEAE
* <i>Datura ferox</i>	Thorn Apple	SOLANACEAE
* <i>Datura stramonium</i>		SOLANACEAE
<i>Dichrostachys cinerea</i>	Sicklebush	FABACEAE
<i>Diospyros lycioides</i> subsp. <i>lycioides</i>		EBENACEAE
<i>Dombeya rotundifolia</i>		MALVACEAE
<i>Felicia muricata</i>		ASTERACEAE
* <i>Flaveria bidentis</i>	Smelter's Bush	ASTERACEAE
<i>Gazania krebsiana</i> subsp. <i>krebsiana</i>		ASTERACEAE
<i>Gomphocarpus fruticosus</i>	Cotton Milkbush	APOCYNACEAE
* <i>Gomphrena celosioides</i>	Bachelor's Button	AMARANTHACEAE
<i>Grewia flava</i>	Velvet Raisin	MALVACEAE
<i>Grewia monticola</i>		MALVACEAE
* <i>Guilleminea densa</i>	Matweed	AMARANTHACEAE
<i>Gymnosporia buxifolia</i>	Spikethorn	CELASTRACEAE
<i>Helichrysum argyrosphaerum</i>	Wild Everlasting	ASTERACEAE
<i>Hibiscus pusillus</i>		MALVACEAE
<i>Hibiscus trionum</i>	Bladder Hibiscus	MALVACEAE

<i>Hilliardiella oligocephala</i>		ASTERACEAE
<i>Lepidium africanum</i>	Pepperweed	BRASSICACEAE
* <i>Lepidium bonariense</i>	Pepperweed	BRASSICACEAE
<i>Lippia javanica</i>		VERBENACEAE
<i>Nidorella microcephala</i>		ASTERACEAE
<i>Olea europaea</i> subsp. <i>africana</i>	Wild Olive	OLEACEAE
* <i>Opuntia ficus-indica</i>	Prickly Pear	CACTACEAE
<i>Osteospermum muricatum</i>		ASTERACEAE
* <i>Oxalis corniculata</i>	Creeping Sorrel	OXALIDACEAE
<i>Pavonia burchellii</i>		MALVACEAE
<i>Peltophorum africanum</i>		FABACEAE
<i>Pentarrhinum inspidum</i>		APOCYNACEAE
* <i>Portulaca oleracea</i>		PORTULACACEAE
<i>Portulaca quadrifida</i>		PORTULACACEAE
* <i>Schkuhria pinnata</i>	Dwarf Marigold	ASTERACEAE
<i>Searsia lancea</i>	Karee	ANACARDIACEAE
<i>Searsia pyroides</i>		ANACARDIACEAE
<i>Securidaca longepedunculata</i>	Violet Tree, Krinkhout	POLYGALACEAE
<i>Senegalia mellifera</i> subsp. <i>detinens</i>	Black Thorn	FABACEAE
<i>Sida cordifolia</i>		MALVACEAE
<i>Solanum panduriforme</i>	Bitter Apple	SOLANACEAE
<i>Solanum lichtensteinii</i>		SOLANACEAE
* <i>Sonchus oleraceus</i>		ASTERACEAE
* <i>Tagetes minuta</i>		ASTERACEAE
<i>Teucrium trifidum</i>		LAMIACEAE
<i>Tribulus terrestris</i>	Devil's Thorn	ZYGOPHYLLACEAE
<i>Vachellia karroo</i>	Sweet Thorn	FABACEAE
<i>Vachellia tortilis</i> subsp. <i>heteracantha</i>		FABACEAE
* <i>Verbena aristigera</i>	Fine-leaved Verbena	VERBENACEAE
* <i>Verbena bonariensis</i>	Purple Top	VERBENACEAE

* <i>Zinnia peruviana</i>		ASTERACEAE
<i>Ziziphus mucronata</i>	Buffalo-thorn	RHAMNACEAE
<i>Ziziphus zeyheriana</i>	Dwarf Buffalo-thorn	RHAMNACEAE