

ECOLOGICAL FAUNA AND FLORA HABITAT SURVEY

**Proposed Pipeline and Pump Station, Obed Nkosi,  
Heidelberg, Gauteng, South Africa**



Widespread butterfly species, *Junonia orithya*, at the site.  
Photo: Reinier F. Terblanche.

**MAY 2021**

**COMPILED BY:**

**Reinier F Terblanche**

(M.Sc Ecology, *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. 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
<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, Taxonomy, Modern Systematics, System Modelling, Plant Ecology, Taxonomy Project, 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 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. Reinier won a photographic competition which resulted his photograph of the Critically Endangered *Erikssonia edgei* (Waterberg Copper) being on the front cover of the Synthesis Report of the National Biodiversity Assessment (2018) prepared by SANBI.

## 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 (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., KÓRÓSI, 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: 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 *Chrysonotis 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 stenobeia* 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: 5 May 2021

## **1 INTRODUCTION**

An ecological habitat survey was required for a proposed pipeline and pumpstation development at Obed Nkosi, southwest of Heidelberg, Gauteng Province, South Africa (elsewhere referred to as the site). The survey focused on the possibility that threatened fauna or flora known to occur in Gauteng Province are likely to occur within the proposed development or not. 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**

The objectives of the habitat study are to provide:

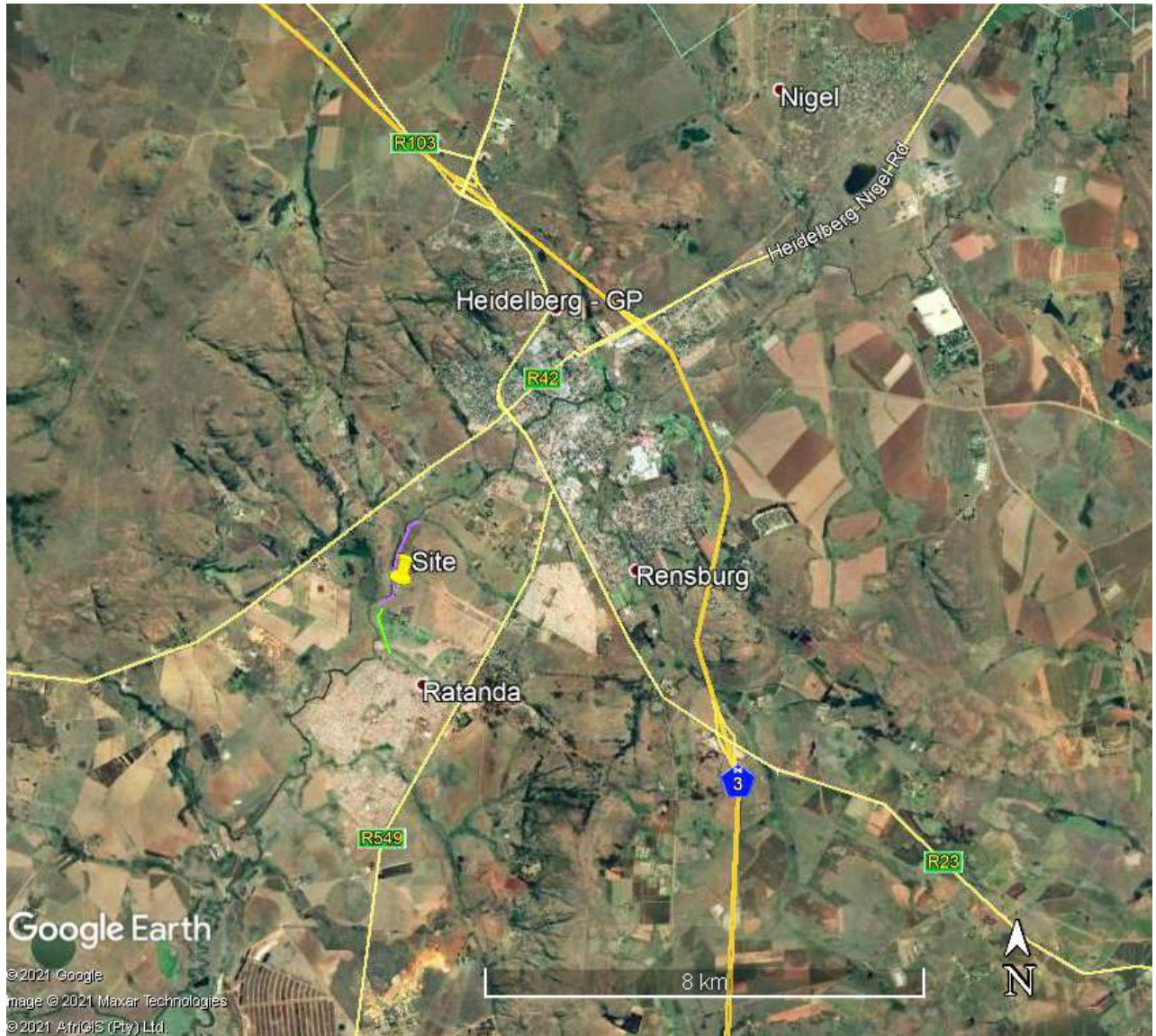
- A detailed fauna and flora habitat survey;
- A detailed habitat survey of possible threatened or localised plant species, vertebrates and invertebrates;
- Recording of possible host plants or foodplants of fauna such as butterflies.
- Evaluate the conservation importance and significance of the site with special emphasis on the current status of threatened species;
- Literature investigation of possible species that may occur on site;
- Identification of potential ecological impacts on fauna and flora that could occur as a result of the development; and
- Make recommendations to reduce or minimise impacts, should the development be approved.

### **1.2 SCOPE OF 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



**Figure 1** Map of larger area with indication of the location of the site.

*Red outline*                      Boundaries 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).

The study area is southwest of Heidelberg in the Gauteng Province, South Africa. Study area is situated at the Grassland Biome (Mucina & Rutherford 2006). Grassland Biome at the site is represented by Soweto Highveld Grassland (Gm 8) (Mucina & Rutherford 2006).

## Gm 8 Soweto Highveld Grassland

Distribution: In South Africa the Soweto Highveld Grassland is found in Mpumalanga, Gauteng (and to a very small extent also in neighbouring Free State and North West) Provinces; In a broad band roughly delimited by the N17 road between Ermelo and Johannesburg in the north, Perdekop in the southeast and the Vaal River (border with the Free State) in the south. It extends further westwards along the southern edge of the Johannesburg Dome (including part of Soweto) as far as the vicinity of Randfontein. In southern Gauteng it includes the surrounds of Vanderbijlpark and Vereeniging as well as Sasolburg in the northern Free State. Altitude 1420 – 1760 m (Mucina & Rutherford 2006).

Vegetation and landscape features: Gently to moderately undulating landscape on the Highveld plateau supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus*, *Eragrostis racemosa*, *Heteropogon contortus* and *Tristachya leucothrix*. In places not disturbed, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover (Mucina & Rutherford 2006).

Geology and soils: Shale, sandstone or mudstone of the Madzaringwe Formation (Karoo Supergroup) or the intrusive Karoo Suite dolerites which feature prominently in the area. In the south, the Volksrust Formation (Karoo Supergroup) is found and in the west, the rocks of the older Transvaal, Ventersdorp and Witwatersrand Supergroups are most significant. Soils are deep, reddish on flat plains and are typically Ea, Ba and Bb land types (Mucina & Rutherford 2006).

Climate: Climate is characterized by summer-rainfall with mean annual precipitation of 662 mm. Frequent occurrence of frost and large thermic diurnal differences are recorded (Mucina & Rutherford 2006).

Important taxa of the Soweto Highveld Grassland listed by Mucina & Rutherford (2006): Graminoids: *Andropogon appendiculatus*, *Brachiaria serrata*, *Cymbopogon pospischilii*, *Cynodon dactylon*, *Elionurus muticus*, *Eragrostis capensis*, *Eragrostis chloromelas*, *Eragrostis curvula*, *Eragrostis plana*, *Eragrostis planiculmis*, *Eragrostis racemosa*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Setaria nigrirostris*, *Setaria sphacelata*, *Themeda triandra*, *Tristachya leucothrix*, *Andropogon shirensis*, *Aristida adscensionis*, *Aristida bipartita*, *Aristida congesta*, *Aristida junciformis* subsp. *galpinii*, *Cymbopogon caesius*, *Digitaria diagonalis*, *Diheteropogon amplexans*, *Eragrostis micrantha*, *Eragrostis superba*, *Harporchloa falx*, *Microchloa caffra*, *Paspalum dilatatum*. Herbs: *Hermannia depressa*, *Acalypha angustata*, *Berkheya setifera*, *Dicoma anomala*, *Euryops gilfillanii*, *Geigeria aspera* var. *aspera*, *Graderia subintegra*,



*Haplocarpha scaposa*, *Helichrysum miconiifolium*, *Helichrysum nudifolium* var. *nudifolium*, *Helichrysum rugulosum*, *Hibiscus pusillus*, *Justicia anagalloides*, *Lippia scaberrima*, *Rhyncosia effusa*, *Schistostephium crataegifolium*, *Selago densiflora*, *Senecio coronatus*, *Vernonia oligocephala*, *Wahlenbergia undulata*. Geophytic Herbs: *Haemanthus humilus* subsp. *hirsutus*, *Haemanthus montanus*. Herbaceous Climber: *Rhyncosia totta*. Low Shrubs: *Anthospermum hispidulum*, *Anthospermum rigidum* subsp. *pumilum*, *Berkheya annectans*, *Felicia muricata*, *Ziziphus zeyheriana*.

Note: The above is an outline of the vegetation type that serves as a larger ecological context within which the site occurs. Not all the plant species listed above for the vegetation type necessarily occur 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.

A survey consisted of visits by R.F. Terblanche during April 2021 to note key elements of habitats on the site, relevant to the conservation of fauna and flora. The main purpose of the site visit 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 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), Fish, Mashau, Moeaha & Nembudani (2015), 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 (1997). 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](http://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 needs 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 (Deutschländer & Bredenkamp, 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 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. Site surveys were conducted during April 2021 which includes an optimal time of the year to find animals such as invertebrates as well as habitat sensitive plant and vertebrate animal species high conservation priority. 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 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

### 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 proposed for the developments is on gentle to moderate slopes in a slightly undulating area.
Rockiness	Rocky outcrops at the site appear to be absent.
Presence of wetlands	The narrow, proposed footprint crosses four watercourses: 1) an artificial waterbody, 2) a wetland (a seep) and 3,4) two small tributaries of the Blesbokspruit at the southern part of the site. These water courses appear to be modified by excavations, cultivated fields, planting of alien invasive <i>Eucalyptus</i> tree species, possible overgrazing by cattle as well as impacts from the residential areas upstream. A perennial river, the Blesbokspruit, is present west of the site and is excluded from the proposed footprint.
Vegetation	<p>Terrestrial vegetation: Conspicuously disturbed grassland with few trees characterizes the terrestrial vegetation at the site. Pioneer grass species as well as <i>Seriphium plumosum</i> (Bankrupt Bush) are noticeable. Indigenous grass species such as <i>Aristida canescens</i>, <i>Eragrostis curvula</i>, <i>Eragrostis chloromelas</i>, <i>Aristida congesta</i>, <i>Cynodon dactylon</i>, <i>Eragrostis curvula</i>, <i>Sporobolus africanus</i>, <i>Elionurus muticus</i> and <i>Sporobolus africanus</i> are found at the site. Examples of indigenous shrublets and forbs at the site are <i>Conyza podocephala</i>, <i>Hilliardiella oligocephala</i>, <i>Helichrysum nudifolium</i>, <i>Helichrysum rugulosum</i>, <i>Gazania krebsiana</i> and <i>Felicia muricata</i>. The herbaceous shrub <i>Gomphocarpus fruticosus</i> is present at many parts of the site. Conspicuous exotic weeds at the site are <i>Flaveria bidentis</i>, <i>Gomphrena celosioides</i>, <i>Guilleminea densa</i>, <i>Galinsoga parviflora</i>, <i>Schkuhria pinnata</i>, <i>Sonchus oleraceus</i>, <i>Chenopodium album</i>, <i>Tagetes minuta</i>, <i>Conyza bonariensis</i>, <i>Datura ferox</i>, <i>Datura stramonium</i>, <i>Xanthium spinosum</i>, <i>Malva parviflora</i>, <i>Plantago lanceolata</i>, <i>Verbena aristigera</i>, <i>Verbena bonariensis</i> and <i>Argemone ochroleuca</i>.</p> <p>Vegetation at the artificial waterbody and its inlet contains wetland plant species such as the sedge <i>Cyperus fastigiatus</i>, herbaceous <i>Persicaria</i> species and the grass species <i>Paspalum distichum</i>.</p> <p>The wetland seep vegetation is visibly dominated by graminoids such as the sedges <i>Pycnus macranthus</i> and <i>Pycnus mundtii</i> and the grass species <i>Paspalum distichum</i>, whereas trees are absent. Some diversity of indigenous wetland graminoids is found at the wetland seep.</p> <p>The two small tributaries at the southern parts of the site have narrow poorly defined riparian zones with a noticeable high cover of exotic weeds. Exotic plant species at the streambank include the herbs <i>Rumex crispus</i> and <i>Trifolium repens</i> as well as the grass <i>Pennisetum clandestinum</i>. The indigenous herb <i>Berkheya radula</i> as well as the alien invasive herb <i>Cirsium vulgare</i> are found at the riparian zone and adjacent terrestrial zone.</p> <p>Vegetation at riparian zone of perennial river, Blesbokspruit (which is near the proposed footprint but excluded from it): Exotic tree species are visible at the riparian zone of the Blesbokspruit and include <i>Eucalyptus camaldulensis</i>, <i>Acacia decurrens</i>, <i>Acacia mearsii</i>, <i>Morus alba</i>, <i>Sesbania punicea</i> and <i>Salix babylonica</i>. Exotic forbs such as <i>Nasturtium officinale</i> and <i>Iris pseudacorus</i> occur at the riparian zone. Indigenous plant species at the riparian zone include <i>Cyperus sexangularis</i>, <i>Phragmites australis</i> and <i>Persicaria</i> species. The alien invasive climber <i>Ipomoea purpurea</i> is also visible at the riparian zone of the Blesbokspruit river.</p>
Signs of disturbances	Ecological disturbances include various excavations in the past, areas with conspicuous cover of alien invasive plant species, possible overgrazing by cattle, man-made ditches, impacts on the water regime from the residential areas upstream and sewage leaks. An old pipeline exists closer to the perennial stream west of the proposed footprint, the latter which is then further away from the perennial stream (Blesbokspruit).
Ecological connectivity at site and surrounding areas.	There is little scope for the terrestrial modified grassland at the site to be a conservation corridor of particular importance. The perennial river (Blesbokspruit; outside the site), the artificial waterbody, the Wetland Seep and the small non-perennial tributaries at the southern parts of the study area, are part of a corridor of particular conservation importance. The narrow strip proposed for the development does not cross the active channel and riparian zone of the Blesbokspruit.



**Photo 1** View of part of the site. The perennial river, the Blesbokspruit and its riparian zone (where the alien invasive *Eucalyptus* trees are in the picture) are excluded from the proposed development.  
Photo: R.F. Terblanche.



**Photo 2** View of disturbed area at the site.  
Photo: R.F. Terblanche





**Photo 3** View of part of the site south of the proposed pumpstations. The riparian zone and beyond in the background fall outside the boundaries of the site.  
Photo: R.F. Terblanche.



**Photo 4** View of the southern part of the site. Greyish-green shrubs in the middle of the picture are *Seriphium plumosum* (Bankrupt Bush).  
Photo: R.F. Terblanche.



**Photo 5** Artificial waterbody at the site.  
Photo: R.F. Terblanche.



**Photo 6** The sedge *Cyperus fastigiatus* is conspicuous at the artificial waterbody at the site.  
Photo: R.F. Terblanche





**Photo 7** Wetland seep at the site.  
Photo: R.F. Terblanche.



**Photo 8** View towards the outlet of the Wetland seep at the site.  
Photo: R.F. Terblanche.



**Photo 9** View of tributary that runs from the waterworks.  
Photo: R.F. Terblanche.



**Photo 10** Tributary that runs from the waterworks. Riparian zone appears to be narrow and poorly defined.  
Photo: R.F. Terblanche





**Photo 11** Sewage leak at the tributary at the southern part of the site.  
Photo: R.F. Terblanche.



**Photo 12** Tributary at the southern part of the site.  
Photo: R.F. Terblanche.



**Photo 13** Flowers of the widespread indigenous shrublet *Felicia muricata* at the site.  
Photo: R.F. Terblanche.



**Photo 14** Alien invasive weed *Flaveria bidentis* at the site.  
Photo: R.F. Terblanche





**Photo 15** Alien invasive weed *Solanum sisymbriifolium* at the site.  
Photo: R.F. Terblanche.



**Photo 16** Flowers of the alien invasive weed *Trifolium repens* at the site.  
Photo: R.F. Terblanche.





**Photo 17** Alien invasive weed *Plantago major* growing among grass at the site.  
Photo: R.F. Terblanche.



**Photo 18** Flowers of the alien invasive weed *Cirsium vulgare* at the site.  
Photo: R.F. Terblanche



**Photo 19** A *Persicaria* species at the artificial waterbody at the site.  
Photo: R.F. Terblanche.



**Photo 20** *Paspalum disticha* at the artificial waterbody at the site.  
Photo: R.F. Terblanche.





**Photo 21** Birds, notably Hadada Ibis (*Bostrychia hagedash*), Blacksmith Plover (*Vanellus armatus*) and African Sacred Ibis (*Threskiornis aethiopicus*) at the tributary at the southern part of the study area.  
Photo: R.F. Terblanche.



**Photo 22** The widespread butterfly species *Junonia orithya* at the site.  
Photo: R.F. Terblanche

## 4.2 ASSESSMENT OF PLANT SPECIES OF CONSERVATION CONCERN

**Table 4.2** Threatened plant species of the Gauteng 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 not a resident on the site; Yes = Plant species is a resident at a site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Encephalartos middelburgensis</i>	Critically Endangered	No

**Table 4.3** Threatened plant species of the Gauteng 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 not a resident on the site; Yes = Plant species is a resident at a site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Aloe peglerae</i>	Endangered	No
<i>Brachystelma discoideum</i>	Endangered	No
<i>Delosperma purpureum</i>	Endangered	No
<i>Frithia humilis</i>	Endangered	No
<i>Habenaria mossii</i>	Endangered	No
<i>Holothrix micrantha</i>	Endangered	No

**Table 4.4** Threatened plant species of the Gauteng 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 not a resident on the site; Yes = Plant species is a resident at a site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Bowiea volubilis</i> subsp. <i>volubilis</i>	Vulnerable	No
<i>Brachycorythis conica</i> subsp. <i>transvaalensis</i>	Vulnerable	No
<i>Ceropegia decidua</i> subsp. <i>pretoriensis</i>	Vulnerable	No
<i>Cheilanthes deltoidea</i> subsp. <i>silicicola</i>	Vulnerable	No
<i>Cineraria longipes</i>	Vulnerable	No
<i>Cucumis humifructus</i>	Vulnerable	No
<i>Delosperma gautengense</i>	Vulnerable	No
<i>Dioscorea sylvatica</i>	Vulnerable	No
<i>Encephalartos lanatus</i>	Vulnerable	No
<i>Eulophia coddii</i>	Vulnerable	No
<i>Khadia beswickii</i>	Vulnerable	No
<i>Melolobium subspicatum</i>	Vulnerable	No
<i>Prunus africana</i>	Vulnerable	No

**Table 4.5 Near Threatened** plant species of the Gauteng Province. The list here follows the most recent updated 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 at the site.

<b>Species</b>	<b>Status:</b> Global status or national status indicated	<b>Resident at the site</b>
<i>Alepidea attenuata</i>	Near Threatened	No
<i>Adromischus umbraticola</i> subsp. <i>umbraticola</i>	Near Threatened	No
<i>Argyrobium campicola</i>	Near Threatened	No
<i>Argyrobium megarrhizum</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>Gladiolus robertsoniae</i>	Near Threatened	No
<i>Habenaria barbertoni</i>	Near Threatened	No
<i>Habenaria bicolor</i>	Near Threatened	No
<i>Habenaria kraenzliniana</i>	Near Threatened	No
<i>Holothrix randii</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>Searsia gracillima</i> var. <i>gracillima</i>	Near Threatened	No
<i>Stenostelma umbelluliferum</i>	Near Threatened	No

**Table 4.6 Least Concern** (= not threatened) plant species of the Gauteng Province that 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 at the site.

<b>Species</b>	<b>Status:</b> Global status or national status indicated	<b>Resident at the site</b>
<i>Blepharis uniflora</i>	Rare	No
<i>Frithia pulchra</i>	Rare	No
<i>Gladiolus pole-evansii</i>	Rare	No
<i>Gnaphalium nelsonii</i>	Rare	No

**Table 4.7** Not threatened plant species of the Gauteng Province which are however 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 not a resident on the site; Yes = Plant species is a resident at the site.

<b>Species</b>	<b>Status:</b> Global status or national status indicated	<b>Resident at the site</b>
<i>Boophone disticha</i>	Declining	No
<i>Callilepis leptophylla</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

**Table 4.8** Plant species of the Gauteng 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 not a resident on the site; Yes = Plant species is a resident at the site.

<b>Species</b>	<b>Status:</b> Global status or national status indicated	<b>Resident at the site</b>
<i>Lepidium mossii</i>	Data Deficient	No

**Table 4.9** Some of the tree species of the Gauteng Province which are not threatened but listed as **Protected Species** under the National Forests Act No. 84 of 1998, Section 51(1). No = Plant species is not a resident on the site; Yes = Plant species is a resident at the site.

<b>Species</b>	<b>Conservation status</b>	<b>Resident at the site</b>
<i>Boscia albitrunca</i>	Protected	No
<i>Combretum imberbe</i>	Protected	No
<i>Sclerocarya birrea</i>	Protected	No
<i>Vachellia erioloba</i>	Protected	No

### 4.3 ASSESSMENT OF VERTEBRATE SPECIES OF CONSERVATION CONCERN

#### 4.3.1 Mammals of particular high conservation priority

**Table 4.10 Threatened** mammal species of the Gauteng Province. Literature sources: Friedman & Daly, (2004), Skinner & Chimimba (2005), Wilson & Reeder (2005). Furthermore golden mole species that are rare and being reported from the adjacent Free State and Limpopo Provinces have also been included.

Species	Red Listed Status	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Chrysoxalax 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 Gauteng Province, Free State Province and North-West Province. Literature sources: Skinner & Chimimba (2005).

Species	Red Listed Status	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Ceratotherium simum</i> White Rhinoceros	Near-threatened	No	No

#### 4.3.2 Birds of particular high conservation priority

**Table 4.12** Threatened bird species of the Gauteng Province. Literature sources Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007).

Species	Common name	Red Listed Status	Recorded at site during survey	Likely to be found breeding on site based on being dependant on site
<i>Aegypius tracheliotos</i>	<b>Lappet-faced Vulture</b>	Vulnerable	No	No
<i>Anthropoides paradiseus</i>	<b>Blue Crane</b>	Vulnerable	No	No
<i>Aquila rapax</i>	<b>Tawny Eagle</b>	Vulnerable	No	No
<i>Ardeotis kori</i>	<b>Kori Bustard</b>	Vulnerable	No	No
<i>Botaurus stellaris</i>	<b>Eurasian Bittern</b>	Critically Endangered	No	No
<i>Buphagus africanus</i>	<b>Yellow-billed Oxpecker</b>	Vulnerable	No	No
<i>Circus ranivorus</i>	<b>African Marsh- Harrier</b>	Vulnerable	No	No
<i>Crex crex</i>	<b>Corn Crake</b>	Vulnerable	No	No
<i>Eupodotis senegalensis</i>	<b>White-bellied Korhaan</b>	Vulnerable	No	No
<i>Gorsachius leuconotus</i>	<b>White-backed Night-heron</b>	Vulnerable	No	No
<i>Gyps africanus</i>	<b>White-backed Vulture</b>	Vulnerable	No	No
<i>Gyps coprotheres</i>	<b>Cape Vulture</b>	Vulnerable	No	No
<i>Neophron percnopterus</i>	<b>Egyptian Vulture</b>	Regionally almost extinct	No	No
<i>Neotis denhami</i>	<b>Denham's Bustard</b>	Vulnerable	No	No
<i>Pelecanus rufescens</i>	<b>Pink-backed Pelican</b>	Vulnerable	No	No
<i>Polemaetus bellicosus</i>	<b>Martial Eagle</b>	Vulnerable	No	No
<i>Rhynchops flavirostris</i>	<b>African Skimmer</b>	Endangered	No	No
<i>Sarothrura ayresi</i>	<b>White-winged Flufftail</b>	Critically Endangered	No	No
<i>Therathopius ecaudatus</i>	<b>Bateleur</b>	Vulnerable (in South Africa)	No	No
<i>Tyto capensis</i>	<b>African Grass-Owl</b>	Vulnerable	No	No

**Table 4.13 Near threatened** bird species of the Gauteng Province. Literature sources Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007).

Species	Common name	Red Listed Status	Recorded at site during survey	Likely to be found breeding on site based or being dependant on site
<i>Alcedo semitorquata</i>	<b>Half-collared Kingfisher</b>	Near threatened	No	No
<i>Anastomus lamelligerus</i>	<b>African Openbill</b>	Near threatened	No	No
<i>Aquila ayresii</i>	<b>Ayres's Hawk-Eagle</b>	Near threatened	No	No
<i>Buphagus erythrorhynchus</i>	<b>Red-Billed Oxpecker</b>	Near threatened	No	No
<i>Charadrius pallidus</i>	<b>Chestnut-banded Plover</b>	Near threatened	No	No
<i>Ciconia nigra</i>	<b>Black Stork</b>	Near threatened	No	No
<i>Circus macrourus</i>	<b>Pallid Harrier</b>	Near threatened	No	No
<i>Falco biarmicus</i>	<b>Lanner Falcon</b>	Near threatened	No	No
<i>Falco peregrinus</i>	<b>Peregrine Falcon</b>	Near threatened	No	No
<i>Glareola nordmanni</i>	<b>Black-winged Pratincole</b>	Near threatened	No	No
<i>Leptoptilos crumeniferus</i>	<b>Marabou Stork</b>	Near threatened	No	No
<i>Mirafra cheniana</i>	<b>Melodious lark</b>	Near threatened	No	No
<i>Mycteria ibis</i>	<b>Yellow-billed Stork</b>	Near threatened	No	No
<i>Pelecanus onocrotalus</i>	<b>Great White Pelican</b>	Near threatened	No	No
<i>Phoenicopterus minor</i>	<b>Lesser Flamingo</b>	Near threatened	No	No
<i>Phoenicopterus ruber</i>	<b>Greater Flamingo</b>	Near threatened	No	No
<i>Pterocles gutturalis</i>	<b>Yellow-throated Sandgrouse</b>	Near threatened	No	No
<i>Rostratula benghalensis</i>	<b>Greater Painted-snipe</b>	Near threatened	No	No
<i>Sagittarius serpentarius</i>	<b>Secretarybird</b>	Near threatened	No	No
<i>Sterna caspia</i>	<b>Caspian Tern</b>	Near threatened	No	No

### 4.3.3 Reptiles of particular high conservation priority

The following table lists possible presence or absence of reptile species of particular conservation concern at the site. This list to assess the possible presence or not of reptile species of conservation concern was compiled by using mainly the source Bates, Branch, Bauer, Burger, Marais, Alexander & De Villiers (2014), that is the Atlas and Red List of South Africa, Lesotho and Swaziland.

**Table 4.1 Near Threatened** reptile species in Gauteng 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	Red Listed Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Chamaesaura aenea</i>	Near	No	No	No
<b>Coppery Grass Lizard</b>	Threatened			
<i>Homoroselaps dorsalis</i>	Near	No	No	No
<b>Striped Harlequin Snake</b>	threatened			

## 4.4 ASSESSMENT OF INVERTEBRATE SPECIES OF CONSERVATION CONCERN

### 4.4.1 Butterflies of particular conservation priority

**Table 4.15 Threatened (Endangered) butterfly** species of the Gauteng Province. 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 dentatis dentatis</i> Roodepoort Copper	Endangered	No	Highly unlikely
<i>Chrysoritis aureus</i> Golden Opal/ Heidelberg Opal	Endangered	No	Highly unlikely
<i>Lepidochrysops praeterita</i> Highveld Blue	Endangered	No	Highly unlikely
<i>Orachrysops mijburghi</i> Mijburgh's Blue	Endangered	No	Highly unlikely

**Table 4.16** Rare butterfly species of the Gauteng Province. Source: Mecenero *et al.* (2013).

Species	Red List Status	Recorded at site during survey	Residential status at the site: Confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Colotis celimene amina</i> Lilac Tip	Rare (Low density)	No	Highly unlikely
<i>Lepidochrysops procera</i> Grassland Blue	Rare (Habitat specialist)	No	Highly unlikely
<i>Metisella meninx</i> Marsh Sylph	Rare (Habitat specialist)	No	<b>Possibly, but no ideal habitat observed at the site</b>
<i>Platylesches dolomitica</i> (Hopper)	Rare (Low density)	No	Highly unlikely

#### 4.4.2 Beetles of particular conservation priority

**Table 4.17** Fruit chafer species (Coleoptera: Scarabaeidae: Cetoninae) in the Gauteng Province and Gauteng Province which are of known high conservation priority.

Species	Red Listed Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Ichneustoma stobbiai</i>	Uncertain (Probably endangered)	No	No	No
<i>Trichocephala brincki</i>	Uncertain	No	No	No

#### 4.4.3 Mygalomorph spiders of particular conservation priority

**Table 4.18** Baboon spiders species (Araneae: Teraphosidae) species that are of known high conservation priority in the Gauteng Province and Gauteng Province.

Species	Red Listed Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Brachionopus pretoriae</i>	Uncertain	No	No	No

#### 4.4.4 Scorpions of particular conservation priority

**Table 4.19** Rock scorpion species (Scorpiones: Ischnuridae) species that are of known high conservation priority in the Gauteng Province and Gauteng Province.

<b>Species</b>	<b>Red Listed Status</b>	<b>Resident at site</b>	<b>Recorded at site during survey</b>	<b>Likely to be found based on habitat assessment</b>
<i>Hadogenes gracilis</i>	Uncertain	No	No	No
<i>Hadogenes gunningi</i>	Uncertain	No	No	No

## **5 DISCUSSION**

### **5.1 HABITAT AND VEGETATION CHARACTERISTICS**

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

### **5.2 PLANT SPECIES**

Extinct, threatened, near threatened and other plant species of high conservation priority in Gauteng Province are listed in Tables 4.2 – 4.9. The presence or not of all the species listed in the tables were investigated during the survey. Presence of Threatened and Near Threatened species of plants at the site is unlikely.

### **5.3 VERTEBRATES**

#### **5.3.1 Mammals**

Table 4.10 and Table 4.11 list the possible presence or absence of threatened mammal species and near threatened mammal species at the site. Literature sources that were used are Friedman & Daly (2004), Skinner & Chimimba (2005) and Wilson & Reeder (2005). Because 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 4.12 and Table 4.13 list the possible presence or absence of threatened bird species and near threatened bird species at the site. Literature sources that were mainly consulted are Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). The site does not appear to form part of any habitat of particular importance for any threatened bird species or any bird species of particular conservation importance.

### **5.3.3 Reptiles**

Table 14 lists the possible presence or absence of near threatened reptile species on the site. The Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland were used to compile the list for the assessment (Bates, Branch, Bauer, Burger, Marais, Alexander & De Villiers, 2014). 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 Gauteng are red listed as threatened species or near threatened species at present. There appears to be no threat to any amphibian species of particular high conservation importance if the site is developed. Presence of *Pyxicephalus adspersus* (Giant Bullfrog), a species hitherto listed as near threatened is unlikely.

## **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 (Deutschländer and Bredenkamp 1999; 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.

Because invertebrates are often less well known the expected presence or not of threatened butterfly species in the Endangered category (Table 4.15) and other high conservation priority species such as Rare butterfly species (Table 4.16) follows.

#### 5.4.1.1 Assessment of threatened butterfly species (Endangered) in the Gauteng Province

##### *Aloeides dentatis dentatis* (Roodepoort Copper)

The proposed global red list status for *Aloeides dentatis dentatis* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.* 2013). *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.

##### *Chrysothrix aureus* (Highveld Golden Opal/ Heidelberg Copper)

The proposed global red list status for *Chrysothrix aureus* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.* 2013) *Chrysothrix 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 *Chrysothrix 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 *Chrysothrix 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.* 2013). *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.* 2013). *Orachrysops mijburghi* favours grassland depressions where specific *Indigofera* plant species occur (Terblanche & Edge 2007). The Heilbron population of *Orachrysops mijburghi* 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). No *Orachrysops mijburghi* has been observed at the site and it is unlikely that *Orachrysops mijburghi* would be present at the site.

#### *Conclusion on threatened butterfly species*

There appears to be no threat to any red listed butterfly species if the site is developed.

#### *5.4.1.2 Butterfly species that are not threatened but also of high conservation priority*

##### *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.* 2013). Reasons for its rarity are poorly understood. It is highly unlikely that *Colotis celimene amina* would be present at the site.

##### *Lepidochrysops procera* (Savanna Blue)

*Lepidochrysops procera* is listed as Rare (Habitat specialist) by Mecenero *et al.* (2013). *Lepidochrysops procera* is endemic to South Africa and found in Gauteng, KwaZulu-Natal, Mpumalanga and North West (Mecenero *et al.* 2013). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

*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 Rare (Habitat specialist) (Mecenero *et al.* 2013). 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 a 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 remains a possibility that *Metisella meninx* may be present at the site though ideal habitat has not been noticed.

*Platylesches dolomitica* (Hilltop Hopper)

*Platylesches dolomitica* is listed as Rare (Low density) by Mecenero *et al.* (2013). Historically the conservation status of *Platylesches dolomitica* was proposed to be Vulnerable (Henning, Terblanche & Ball 2009). However, this butterfly which is easily overlooked has a wider distribution than perceived before. *Platylesches dolomitica* has a patchy distribution and is found on rocky ledges where *Parinari capensis* occurs, between 1300 m and 1800m (Mecenero *et al.* 2013, Dobson Pers comm.). At the study area, it is highly unlikely that *Platylesches dolomitica* would be present.

#### 5.4.2 FRUIT CHAFER BEETLES

Table 4.17 lists the fruit chafer beetle species (Coleoptera: Scarabaeidae: Cetoninae) that are of known high conservation priority in the Gauteng Province.

*Ichnestoma stobbiai* is an endangered fruit chafer (Scarabaeidae: Cetoniinae) that occurs in small habitat fragments of South Africa (Kryger & Scholtz, 2008). The adults of this species are short-lived and the females are flightless. Thus, the vagility of these beetles is extremely low (Kryger & Scholtz, 2008). The Cetoniinae (Coleoptera: Scarabaeidae) genus *Ichnestoma* Gory & Percheron, 1833 currently comprises 13 described species and is endemic to South Africa. The species *I. stobbiai* Holm, 1992 is thought to occur in a very restricted area in and around Gauteng Province and all habitat patches should be protected (Kryger & Scholtz, 2008; Deschodt, Scholtz & Kryger, 2009). Unlike most cetoniine larvae, the larvae of this species usually occur in dolomitic to cherty, well-drained soils (Deschodt, Scholtz & Kryger, 2009). *Ichnestoma* larvae feed under the soil surface and also pupate under the soil surface in specific grassland areas (Perissinotto, Smith & Stobbiai, 1999). All the habitat requirements of *Ichnestoma stobbiai* in these grassland patches are not fully understood yet, but it is normally a rocky area (dolomite to chert: see Deschodt, Scholtz & Kryger, 2009), consisting of grassland with a variety of indigenous grass species. From personal experience few trees occur in such patches, with species diverse grassland that are well developed in terms of succession. Rocks, often well-embedded in the soil, are scattered throughout such areas. Occurrence of *Ichnestoma stobbiai* at the site is highly unlikely. There appears to be no threat listed rare and localized fruit-chafer beetles if the site is developed.

#### 5.4.3 MYGALOMOPH SPIDERS






Table 4.18 lists the baboon spider species (Araneae: Teraphosidae) that are of known high conservation priority in the Gauteng Province. The assessment of the conservation status of baboon spiders in South Africa is in process but as a pre-caution the species listed in Table 4.18 has been included. None of the above baboon spider species were found on the site, or are likely to be resident at the site. There appears to be no threat to the baboon spider species of high conservation significance if the study site is developed.

#### **5.4.4 SCORPIONS**

Table 4.19 lists the rock scorpion species (Scorpiones: Ischnuridae) that are of known high conservation priority in the Gauteng Province. There appears to be no threat to the rock scorpion species of high conservation priority if the study site is developed.



**Figure 2** Indication of perennial river (Blesbokspruit outside the proposed footprint), an artificial waterbody, a wetland seep and two small tributaries at the site.

- |   |                                 |  |
|---|---------------------------------|--|
|  | Purple outline                  | Part of the site (proposed pipeline)     |
|  | Green outline                   | Part of the site (proposed pipeline)     |
|  | Orange outline                  | Outer edge of riparian zone              |
|  | Darker blue outline and shading | Active channels and artificial waterbody |
|  | Light blue outline and shading  | Wetland at the site                      |





**Figure 3** Indication of perennial river (Blesbokspruit outside the site) at the northern part of the study area.

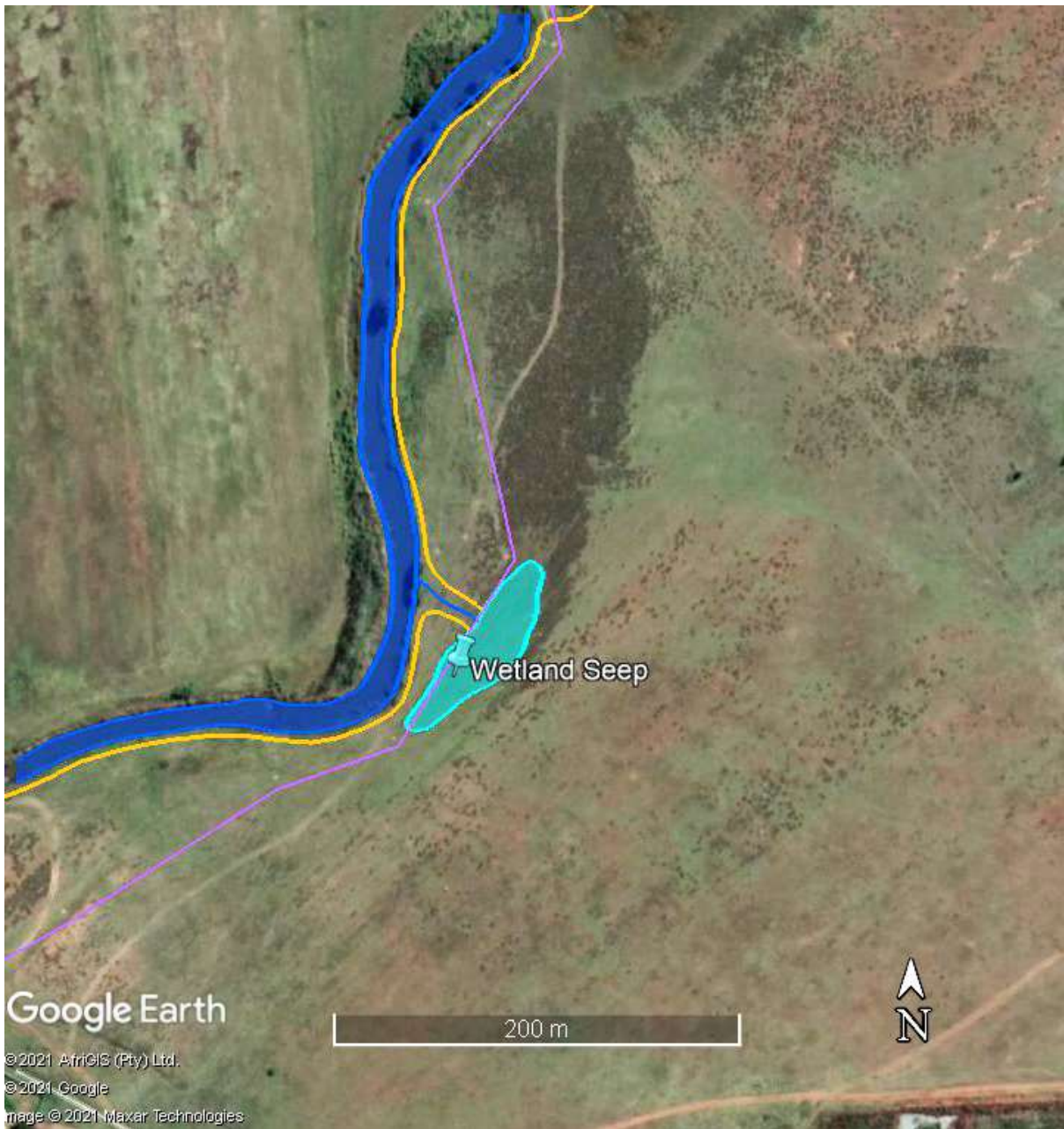
- |                                   |  |
|-----------------------------------|--|
| — Purple outline                  | Part of the site (proposed pipeline)     |
| — Orange outline                  | Outer edge of riparian zone              |
| — Darker blue outline and shading | Active channels and artificial waterbody |









**Figure 4** Indication of perennial river (Blesbokspruit outside the site) and an artificial waterbody at the study area.

- |                                   |  |
|-----------------------------------|--|
| — Purple outline                  | Part of the site (proposed pipeline)     |
| — Orange outline                  | Outer edge of riparian zone              |
| — Darker blue outline and shading | Active channels and artificial waterbody |






**Figure 5** Indication of perennial river (Blesbokspruit outside the site) and a wetland seep at the study area.

- |   |                                 |                                      |
|---|---------------------------------|--------------------------------------|
|  | Purple outline                  | Part of the site (proposed pipeline) |
|  | Orange outline                  | Outer edge of riparian zone          |
|  | Darker blue outline and shading | Active channel                       |
|  | Light blue outline and shading  | Wetland at the site                  |





**Figure 6** Indication of perennial river (Blesbokspruit outside the site) and two small non-perennial tributaries at the southern parts of the site. The small tributaries were fed by outflow from a water treatment plant or sewage leakages at the time of the site visits.

- |   |                                 |                                      |
|---|---------------------------------|--------------------------------------|
|  | Green outline                   | Part of the site (proposed pipeline) |
|  | Orange outline                  | Outer edge of riparian zone          |
|  | Darker blue outline and shading | Active channels                      |

## 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). 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:

The site proposed for the developments is on gentle to moderate slopes in a slightly undulating area. Rocky outcrops at the site appear to be absent.

The narrow, proposed footprint crosses four watercourses: 1) an artificial waterbody, 2) a wetland (a seep) and 3,4) two small tributaries of the Blesbokspruit at the southern part of the site. These water courses appear to be modified by excavations, cultivated fields, planting of alien invasive *Eucalyptus* tree species, possible overgrazing by cattle as well as impacts from the residential areas upstream. A perennial river, the Blesbokspruit, is present west of the site and is excluded from the proposed footprint.

Terrestrial vegetation consists of conspicuously disturbed grassland with few trees. Pioneer grass species as well as *Seriphium plumosum* (Bankrupt Bush) are noticeable. Conspicuous exotic weeds are present at disturbed or hitherto cleared areas.

Vegetation at the artificial waterbody and its inlet contains wetland plant species such as the sedge *Cyperus fastigiatus*, herbaceous *Persicaria* species and the grass species *Paspalum distichum*. The wetland seep vegetation is visibly dominated by graminoids such as the sedges *Pycnus macranthus* and *Pycnus mundtii* and the grass species *Paspalum distichum*, whereas trees are absent. Some diversity of indigenous wetland graminoids is found at the wetland seep. The two small tributaries at the southern parts of the site have narrow poorly defined riparian zones with a noticeable high cover of exotic weeds. Exotic plant species at the streambank include the herbs *Rumex crispus* and *Trifolium repens* as well as the grass *Pennisetum clandestinum*. The indigenous herb *Berkheya radula* as well as the alien invasive herb *Cirsium vulgare* are found at the riparian zone and adjacent terrestrial zone.

Ecological disturbances include various excavations in the past, areas with conspicuous cover of alien invasive plant species, possible overgrazing by cattle, man-made ditches, impacts on the water regime from the residential areas upstream and sewage leaks. An old pipeline exists closer to the perennial stream west of the proposed footprint, the latter which is then further away from the perennial stream (Blesbokspruit).

Grassland at the site is represented by the Soweto Highveld Grassland (Gm 8) which is listed as a Threatened Ecosystem, Vulnerable, according to the National List of Threatened Ecosystems (2011). Terrestrial vegetation at the site has been modified in the past and is currently considerably degraded. The scope for the restoration and conservation of natural grassland at the site is small.

No Threatened or Near Threatened plant or animal species appear to be resident at the site. No other plant or animal species of particular conservation concern are likely to be found at the strip allocated for the development.



There is little scope for the terrestrial modified grassland at the site to be a conservation corridor of particular importance. The perennial river (Blesbokspruit; outside the site), the artificial waterbody, the Wetland Seep and the small non-perennial tributaries at the southern parts of the study area, are part of a corridor of particular conservation importance. The narrow strip proposed for the development does not cross the active channel and riparian zone of the Blesbokspruit.

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 partial destruction of habitat of medium-high and medium-low ecological sensitivity.
Status	Negative
Mitigation Required	Artificial waterbody, wetland seep and small non-perennial active channels are excluded from the development as far as practical, with limited invasion at an area with an existing footprint. The perennial river, the Blesbokspruit, is excluded from the development
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: Presence of Threatened or Near Threatened Plants, Mammals, Reptiles, Amphibians and Invertebrates, or any other plant or animal species of particular conservation concern at the site appear to be unlikely.
Status	Neutral.
Mitigation Required	No specific mitigation measures for Threatened or Near Threatened or any other sensitive species apply at the site.
Impact Significance (Pre-Mitigation)	Low
Impact Significance (Post-Mitigation)	Low
RISK	It is unlikely that there would be a threat to any sensitive species at the site.

Aspect/Activity	Fragmentation of corridors of particular conservation concern
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-high and medium-low ecological sensitivity.
Status	Negative
Mitigation Required	Artificial waterbody, wetland seep and small non-perennial active channels are excluded from the development as far as practical, with limited invasion at an area with an existing footprint. The perennial river, the Blesbokspruit, is excluded from the development.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISK	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
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 (i.e. Impact Status)	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 Australian <i>Acacia</i> species (Australian Wattles) that should not be allowed to establish. Once established these 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 Australian <i>Acacia</i> species (Australian wattles) 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	Keep disturbance to less sensitive area. Clearing of vegetation at the proposed development. This will entail the partial destruction of habitat of medium-high and medium-low ecological sensitivity.	High	Moderate	High
Loss of sensitive species	Loss of sensitive species (Note no Threatened species or Near-threatened species, or any other species of particular conservation concern)	Neutral	Site	Long-Term	Very low (No species anticipated)	Unlikely	Not applicable	Not applicable	No specific mitigation measures for Threatened or Near Threatened or any other sensitive species apply at the site.	Low	Low	High
Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	Artificial waterbody, wetland seep and small non-perennial active channels are excluded from the development as far as practical, with limited invasion at an area with an existing footprint. The perennial river, the Blesbokspruit, is excluded from the development.	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	Moderate	Low	High

## 6.5 Summary of risks and impacts

Vegetation at the terrestrial zone and watercourses at the site is disturbed owing to the route of a previous pipeline development closer to the main perennial river at the study area. The narrow, proposed footprint crosses four watercourses: 1) an artificial waterbody, 2) a wetland (a seep) and 3,4) two small tributaries of the Blesbokspruit at the southern part of the site. These water courses appear to be modified by excavations, cultivated fields, planting of alien invasive *Eucalyptus* tree species, possible overgrazing by cattle as well as impacts from the residential areas upstream. A perennial river, the Blesbokspruit, is present west of the site and is excluded from the proposed footprint.

Terrestrial vegetation consists of conspicuously disturbed grassland with few trees. Pioneer grass species as well as *Seriphium plumosum* (Bankrupt Bush) are noticeable. Conspicuous exotic weeds are present at disturbed or hitherto cleared areas.

Vegetation at the artificial waterbody and its inlet contains wetland plant species such as the sedge *Cyperus fastigiatus*, herbaceous *Persicaria* species and the grass species *Paspalum distichum*. The wetland seep vegetation is visibly dominated by graminoids such as the sedges *Pycnus macranthus* and *Pycnus mundtii* and the grass species *Paspalum distichum*, whereas trees are absent. Some diversity of indigenous wetland graminoids is found at the wetland seep. The two small tributaries at the southern parts of the site have narrow poorly defined riparian zones with a noticeable high cover of exotic weeds. Exotic plant species at the streambank include the herbs *Rumex crispus* and *Trifolium repens* as well as the grass *Pennisetum clandestinum*. The indigenous herb *Berkheya radula* as well as the alien invasive herb *Cirsium vulgare* are found at the riparian zone and adjacent terrestrial zone.

Ecological disturbances include various excavations in the past, areas with conspicuous cover of alien invasive plant species, possible overgrazing by cattle, man-made ditches, impacts on the water regime from the residential areas upstream and sewage leaks. An old pipeline exists closer to the perennial stream west of the proposed footprint, the latter which is then further away from the perennial stream (Blesbokspruit).

Grassland at the site is represented by the Soweto Highveld Grassland (Gm 8) which is listed as a Threatened Ecosystem, Vulnerable, according to the National List of Threatened Ecosystems (2011). Terrestrial vegetation at the site has been modified in the past and is currently considerably degraded. The scope for the restoration and conservation of natural grassland at the site is small.

No Threatened or Near Threatened plant or animal species appear to be resident at the site. No other plant or animal species of particular conservation concern are likely to be found at the strip allocated for the development.

There is little scope for the terrestrial modified grassland at the site to be a conservation corridor of particular importance. The perennial river (Blesbokspruit; outside the site), the artificial waterbody, the Wetland Seep and the small non-perennial tributaries at the southern parts of the study area, are part of a corridor of particular conservation importance. The narrow strip proposed for the development does not cross the active channel and riparian zone of the Blesbokspruit.

Ecological sensitivity at most of the site is medium-low. Ecological sensitivity at the watercourses is medium-high owing to the importance of this watercourse as a conservation corridor in the larger area.

The watercourses at the site are excluded from the development as far as practical, with invasion limited to a largely existing footprint. Because the soil at the narrow strip allocated for the development will be closed again after inserting the pipeline, the risks for high impact is furthermore limited. Risks and possible impacts to the watercourses are not expected to be significant because excessive surface flow and erosion are not anticipated. There is no distinct indication that interflow plays an important role in the maintenance of the watercourses. The geomorphological setting and flow regime will not be impacted. Loss of any wetland animal or plant species are not expected.

Following the mitigations which will be upheld and planned footprint for development all the impact risks listed above are moderate or low.

## 7 CONCLUSION

- The site proposed for the developments is on gentle to moderate slopes in a slightly undulating area. Rocky outcrops at the site appear to be absent.
- Terrestrial vegetation: Conspicuously disturbed grassland with few trees characterizes the terrestrial vegetation at the site. Pioneer grass species as well as *Seriphium plumosum* (Bankrupt Bush) are noticeable. Indigenous grass species such as *Aristida canescens*, *Eragrostis curvula*, *Eragrostis chloromelas*, *Aristida congesta*, *Cynodon dactylon*, *Eragrostis curvula*, *Sporobolus africanus*, *Elionurus muticus* and *Sporobolus africanus* are found at the site. Examples of indigenous shrublets and forbs at the site are *Conyza podocephala*, *Hilliardiella oligocephala*, *Helichrysum nudifolium*, *Helichrysum rugulosum*, *Gazania krebsiana* and *Felicia muricata*. The herbaceous shrub *Gomphocarpus fruticosus* is present at many parts of the site. Conspicuous exotic weeds at the site are *Flaveria bidentis*, *Gomphrena celosioides*, *Guilleminea densa*, *Galinsoga parviflora*, *Schkuhria pinnata*, *Sonchus oleraceus*, *Chenopodium album*, *Tagetes minuta*, *Conyza bonariensis*, *Datura ferox*, *Datura stramonium*, *Xanthium spinosum*, *Malva parviflora*, *Plantago lanceolata*, *Verbena aristigera*, *Verbena bonariensis* and *Argemone ochroleuca*.
- The narrow, proposed footprint crosses four watercourses: 1) an artificial waterbody, 2) a wetland (a seep) and 3,4) two small tributaries of the Blesbokspruit at the southern part of the site. These water courses appear to be modified by excavations, cultivated fields, planting of alien invasive *Eucalyptus* tree species, possible overgrazing by cattle as well as impacts from the residential areas upstream. A perennial river, the Blesbokspruit, is present west of the site and is excluded from the proposed footprint.
- Vegetation at the artificial waterbody and its inlet contains wetland plant species such as the sedge *Cyperus fastigiatus*, herbaceous *Persicaria* species and the grass species *Paspalum distichum*.
- The wetland seep vegetation is visibly dominated by graminoids such as the sedges *Pycnus macranthus* and *Pycnus mundtii* and the grass species *Paspalum distichum*, whereas trees are absent. Some diversity of indigenous wetland graminoids is found at the wetland seep.
- The two small tributaries at the southern parts of the site have narrow poorly defined riparian zones with a noticeable high cover of exotic weeds. Exotic plant species at the streambank include the herbs *Rumex crispus* and *Trifolium repens* as well as the grass *Pennisetum clandestinum*. The indigenous herb *Berkheya radula* as well as the alien invasive herb *Cirsium vulgare* are found at the riparian zone and adjacent terrestrial zone.
- Vegetation at riparian zone of perennial river, Blesbokspruit (which is near the proposed footprint but excluded from it): Exotic tree species are visible at the riparian zone of the Blesbokspruit and include *Eucalyptus camaldulensis*, *Acacia decurrens*, *Acacia mearnsii*, *Morus alba*, *Sesbania punicea* and *Salix babylonica*. Exotic

forbs such as *Nasturtium officinale* and *Iris pseudacorus* occur at the riparian zone. Indigenous plant species at the riparian zone include *Cyperus sexangularis*, *Phragmites australis* and *Persicaria* species. The alien invasive climber *Ipomoea purpurea* is also visible at the riparian zone of the Blesbokspruit river.

- Ecological disturbances include various excavations in the past, areas with conspicuous cover of alien invasive plant species, possible overgrazing by cattle, man-made ditches, impacts on the water regime from the residential areas upstream and sewage leaks. An old pipeline exists closer to the perennial stream west of the proposed footprint, the latter which is then further away from the perennial stream (Blesbokspruit).
- Grassland at the site is represented by the Soweto Highveld Grassland (Gm 8) which is listed as a Threatened Ecosystem, Vulnerable, according to the National List of Threatened Ecosystems (2011). Terrestrial vegetation at the site has been modified in the past and is currently considerably degraded. The scope for the restoration and conservation of natural grassland at the site is small.
- No Threatened or Near Threatened plant or animal species appear to be resident at the site. No other plant or animal species of particular conservation concern are likely to be found at the strip allocated for the development.
- There is little scope for the terrestrial modified grassland at the site to be a conservation corridor of particular importance. The perennial river (Blesbokspruit; outside the site), the artificial waterbody, the Wetland Seep and the small non-perennial tributaries at the southern parts of the study area, are part of a corridor of particular conservation importance. The narrow strip proposed for the development does not cross the active channel and riparian zone of the Blesbokspruit.
- Ecological sensitivity at most of the site is medium-low. Ecological sensitivity at the watercourses is medium-high owing to the importance of this watercourse as a conservation corridor in the larger area.
- The watercourses at the site are excluded from the development as far as practical, with invasion limited to a largely existing footprint. Because the soil at the narrow strip allocated for the development will be closed again after inserting the pipeline, the risks for high impact is furthermore limited. Risks and possible impacts to the watercourses are not expected to be significant because excessive surface flow and erosion are not anticipated. There is no distinct indication that interflow plays an important role in the maintenance of the watercourses. The geomorphological setting and flow regime will not be impacted. Loss of any wetland animal or plant species are not expected.
- Following the mitigations which will be upheld and planned footprint for development all the impact risks listed above are moderate or low.

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## ANNEXURE 1

### List of plant species recorded at the site and also adjacent to the narrow strip proposed for the development

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);

**Plant species are listed alphabetically under main taxonomic groups.  
Species marked with an asterisk \* are exotic.**

TAXON	COMMON NAMES	FAMILY
<b>ANGIOSPERMAE: MONOCOTYLEDONS</b>		
<i>Aristida canescens</i>		POACEAE
<i>Aristida congesta</i> subsp. <i>congesta</i>	Tassel Three-awn	POACEAE
<i>Asparagus larycinus</i>	Common Wild Asparagus	ASPARAGACEAE
<i>Bulbine narcissifolia</i>		ASPHODELACEAE
<i>Chloris virgata</i>	Feather-top Chloris	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>Cyperus fastigiatus</i>	Sedge	CYPERACEAE
<i>Cyperus sexangularis</i>	Sedge	CYPERACEAE
<i>Digitaria eriantha</i>	Common Finger Grass	POACEAE
<i>Eleusine coracana</i>	Goose Grass	POACEAE
<i>Eragrostis chloromelas</i>	Curly Leaf	POACEAE
<i>Eragrostis curvula</i>	Weeping Love Grass	POACEAE
<i>Eragrostis superba</i>	Saw-toothed Love Grass	POACEAE

<i>Heteropogon contortus</i>	Spear Grass	POACEAE
<i>Hyparrhenia hirta</i>	Common Thatching Grass	POACEAE
* <i>Iris pseudacorus</i>	Yellow Flag	IRIDACEAE
<i>Juncus effusus</i>		JUNCACEAE
<i>Melinis repens</i>	Natal Red-top	POACEAE
<i>Paspalum dilatatum</i>		POACEAE
<i>Paspalum distichum</i>		POACEAE
* <i>Pennisetum clandestinum</i>	Kikuyu Grass	POACEAE
<i>Phragmites australis</i>	Common Reed	POACEAE
<i>Pogonarthria squarrosa</i>	Herringbone Grass	POACEAE
<i>Pycreus macranthus</i>		CYPERACEAE
<i>Pycreus mundtii</i>		CYPERACEAE
<i>Setaria sphacelata</i> var. <i>torta</i>	Creeping Bristle Grass	POACEAE
<i>Sporobolus africanus</i>	Rat's-tail Dropseed	POACEAE
<i>Sporobolus fimbriatus</i>	Dropseed Grass	POACEAE
<i>Themeda triandra</i>	Red Grass	POACEAE
<i>Typha capensis</i>	Bulrush	TYPHACEAE
<i>Urochloa mocambicensis</i>	Bushveld Signal Grass	POACEAE
<b>ANGIOSPERMS: DICOTYLEDONS</b>		
* <i>Acacia decurrens</i>	Green Wattle	FABACEAE
* <i>Acacia mearnsii</i>	Black Wattle	FABACEAE
* <i>Argemone ochroleuca</i>	White-flowered Mexican poppy	PAPAVARACEAE
<i>Arctotis arctotooides</i>		ASTERACEAE
<i>Berkheya radula</i>		ASTERACEAE
* <i>Chenopodium album</i>	White Goosefoot	CHENOPODIACEAE
* <i>Cirsium vulgare</i>	Spear Thistle	ASTERACEAE
<i>Convolvulus sagittatus</i>	Wild Bindweed	CONVOLVULACEAE
<i>Conyza podocephala</i>		ASTERACEAE
* <i>Datura stramonium</i>	Thorn Apple	SOLANACEAE



* <i>Eucalyptus camaldulensis</i>	Red Gum	MYRTACEAE
<i>Falckia oblonga</i>		CONVOLVULACEAE
<i>Felicia muricata</i>		ASTERACEAE
* <i>Flaveria bidentis</i>	Smelter's Bush	ASTERACEAE
* <i>Galinsoga parviflora</i>	Small-flowered Quickweed	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>Haplocarpha lyrata</i>		ASTERACEAE
<i>Helichrysum argyrosphaerum</i>	Wild Everlasting	ASTERACEAE
<i>Helichrysum nudifolium</i>	Hottentot's tea	ASTERACEAE
<i>Helichrysum rugulosum</i>		ASTERACEAE
<i>Hibiscus trionum</i>	Bladder Hibiscus	MALVACEAE
<i>Hilliardiella oligocephala</i>		VERBENACEAE
<i>Jamesbrittenia aurantiaca</i>	Cape Saffron	SCROPHULARIACEAE
<i>Lepidium africanum</i>	Pepperweed	BRASSICACEAE
* <i>Lepidium bonariense</i>	Pepperweed	BRASSICACEAE
* <i>Malva parviflora</i>	Small Mallow	MALVACEAE
* <i>Melia azedarach</i>	Seringa	MELIACEAE
* <i>Melilotus alba</i>	Sweet Clover	FABACEAE
<i>Monsonia angustifolia</i>	Crane's Bill	GERANIACEAE
* <i>Morus alba</i>	Mulberry	MORACEAE
* <i>Nasturtium officinale</i>		BRASSICACEAE
<i>Oenothera indecora</i>	Evening Primrose	ONAGRACEAE
* <i>Oenothera rosea</i>	Rose Evening Primrose	ONAGRACEAE
* <i>Oenothera tetraptera</i>	White Evening Primrose	ONAGRACEAE
* <i>Oxalis corniculata</i>	Creeping Sorrel	OXALIDACEAE
<i>Persicaria species</i>	Knotweeds	POLYGONACEAE
* <i>Plantago lanceolata</i>	Buckhorn Plantain	PLANTAGINACEAE
* <i>Plantago major</i>	Broadleaf Ribwort	PLANTAGINACEAE
<i>Ranunculus multifidus</i>		RANUNCULACEAE
* <i>Rumex crispus</i>	Curly Dock	POLYGONACEAE
* <i>Salix babylonica</i>	Weeping Willow	SALICACEAE
* <i>Sesbania punicea</i>	Red Sesbania	FABACEAE

<b><i>Seriphium plumosum</i></b>	Bankrupt Bush	ASTERACEAE
* <b><i>Schkuhria pinnata</i></b>	Dwarf Marigold	ASTERACEAE
* <b><i>Solanum elaeagnifolium</i></b>	Silverleaf Bitter Apple	SOLANACEAE
* <b><i>Solanum sisymbriifolium</i></b>		SOLANACEAE
* <b><i>Sonchus oleraceus</i></b>	Sowthistle	ASTERACEAE
* <b><i>Tagetes minuta</i></b>	Khaki Weed	ASTERACEAE
<b><i>Thesium</i> sp.</b>		SANTALACEAE
* <b><i>Trifolium repens</i></b>	White Clover	FABACEAE
<b><i>Vachellia karroo</i></b>	Sweet Thorn	FABACEAE
* <b><i>Verbena aristigera</i></b>	Fine-leaved Verbena	VERBENACEAE
* <b><i>Verbena bonariensis</i></b>	Purple Top	VERBENACEAE