

# AN ECOLOGICAL EVALUATION FOR THE PROPOSED TUNA PARK OPEN SPACE PROJECT, CITY OF EKURHULENI MUNICIPALITY, NIGEL, GAUTENG

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## EXECUTIVE SUMMARY

Pachnoda Consulting CC was requested by NuLeaf Planning and Environmental (Pty) Ltd to provide an ecological evaluation report for the proposed Tuna Park open space project (herewith referred to as the "study site") situated in Nigel, Gauteng.

The floristic and faunal attributes of the study site were investigated during 06 August 2019 with the objective to evaluate the structure, composition and conservation value of the prevalent broad-scale habitat units.

More than 50 % (c. 56.4 %) of the study site consisted of degraded and/ or transformed habitat units, which surrounded depression wetland. Of the transformed and degraded habitat units, approximately 11.08 ha (c. 34.18 %) consisted of infrastructure and recreational facilities such as sport fields, a school and community centres. The remaining transformed terrestrial habitat consisted of 7.2 ha (22.22 %) of degraded Soweto Highveld Grassland which provided habitat for widespread generalists and eurytopic species. The degraded Soweto Highveld Grassland unit was also subjected to poor grassland management regimes such as intense grazing by livestock, while some areas showed signs of soil disturbances and the disposal of rubble. These areas (degraded grasslands and infrastructure) supported low levels of biodiversity. The central section of the study site consisted of a large depression wetland (c. 13.1 ha), and although already impacted by domestic waste and litter, it also received effluent of poor water quality from nearby stormwater and faulty sewer reticulation systems. However, the depression wetland system was utilised by a number of waterbird species and provided potential habitat for three bird species of conservation concern and two near threatened small mammal species.

It is of the opinion that the rehabilitation initiative could enhance the local biodiversity of the study site, especially the terrestrial and degraded grassland units bordering the central depression wetland.

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## DECLARATION OF INDEPENDENCE

I, Lukas Niemand (Pachnoda Consulting CC) declare that:

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



Lukas Niemand (Pr.Sci.Nat)  
07 September 2019

Lukas Niemand is registered with The South African Council for Natural Scientific Professionals (400095/06) with more than 14 years of experience in ecological-related assessments. He has conducted numerous ecological, botanical and avifaunal impact assessments including Eskom Transmission projects, hydro-electric schemes, mining related projects in South Africa and other African countries.

# 1. INTRODUCTION

## 1.1 Background

Pachnoda Consulting CC was requested by NuLeaf Planning and Environmental (Pty) Ltd to provide an ecological evaluation report for the proposed Tuna Park open space project (herewith referred to as the "study site") situated in Nigel, Gauteng.

The open space project will include the development and open space rehabilitation of Tuna Park. This will include the clean-up and rehabilitation of a wetland feature and its surroundings, as well as improving the recreational quality of the park through the development of a community park that will incorporate pedestrian pathways, sports fields and bridges – this will guide the rehabilitation, landscape design and open space optimisation of the existing Tuna Park. Figure 1 and Figure 2 provides a draft master plan of the proposed open space and a concept plan regarding the proposed recreational activities.

The objective behind the proposed Tuna Park Open Space Project is for the development of an open space that integrates ecological and social factors, thereby providing a safe, accessible and well-managed area for the community to utilize in their daily lives. This project will serve to:

- Develop much needed formalized public open space adjacent watercourse for local community enjoyment.
- Ensure public safety through the formalizing of movement routes, access points and crossings along the watercourse.
- Support and formalize appropriate and compatible existing activities within the open space, including sport and recreation.
- Foster community buy-in and civic pride.

## 1.2 Terms of Reference

The terms of reference are to:

- provide a description of *broad-scale habitat units* (based on floristic composition and structure) and *dominant* faunal communities on the proposed study site, including the compilation of a preliminary species list of *observed* indigenous and naturalised plant species (to provide an indication of the floristic diversity) according to the latest taxonomic treatments;
- mapping of remaining areas of *untransformed* vegetation and *transformed* habitat units (c. land-cover types) and providing brief descriptions of the dominant and typical plant species identified within broad-scale habitat types;

- conduct a survey of *observed* and *expected* threatened, near threatened plant species, including plant species of conservation concern (e.g. protected species) on the study site;
- provide a habitat description of the study site and an indication of the occurrence of suitable habitat (e.g. foraging, breeding or roosting habitat) for threatened or near threatened animal taxa;
- provide an indication on the relative ecological importance and function of the habitat types and structures on the study site (to be incorporated into a sensitivity map); and
- provide recommendations regarding the proposed project, where ecologically viable.

## **2. BACKGROUND INFORMATION**

### **2.1 Location**

The study site is located in Cerutiville and is adjacent to Mackenzieville and Alra Park, situated in Nigel, within the city Ekurhuleni Municipality, Gauteng. The approximate centre position of the study site is S26° 26.582' E28° 30.773' while also corresponding to the quarter-degree grid (QDS) 2628BC (Figure 3). The surface extent of the study site is approximately 32.5 ha in extent.

### **2.2 Land use, existing infrastructure and important landscape features**

The study site consists of a natural wetland, public open space, sport fields and sport facilities. Most of the terrestrial natural vegetation on the study site shows signs of anthropogenic disturbances and grazing by livestock, with dumping of waste was present on most parts of the study site. The surrounding area corresponds to residential and build-up land (Figure 4). According to the 2013-2014 land cover dataset (Geoterraimage, 2015), the study site consists primarily of build-up land and thicket vegetation (Figure 5).

### **2.3 Biophysical Description**

#### *2.3.1 Climate*

The area has a typical Highveld climate characterised by warm, wet summers and cool dry winters. The summer rainfall averages between 650 – 750 mm/yr and temperatures range from -12°C to 39°C with an average of 16°C (Mucina & Rutherford, 2006).

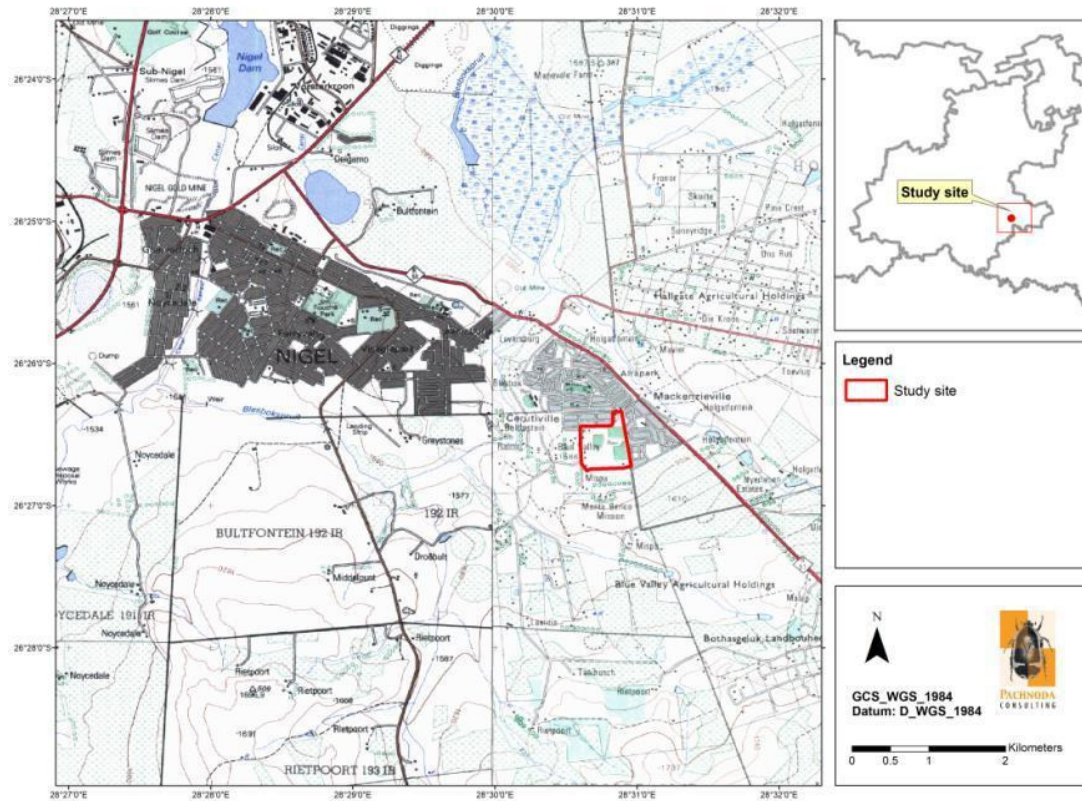


**Figure 1:** The proposed Tuna Park Open Space Project master plan

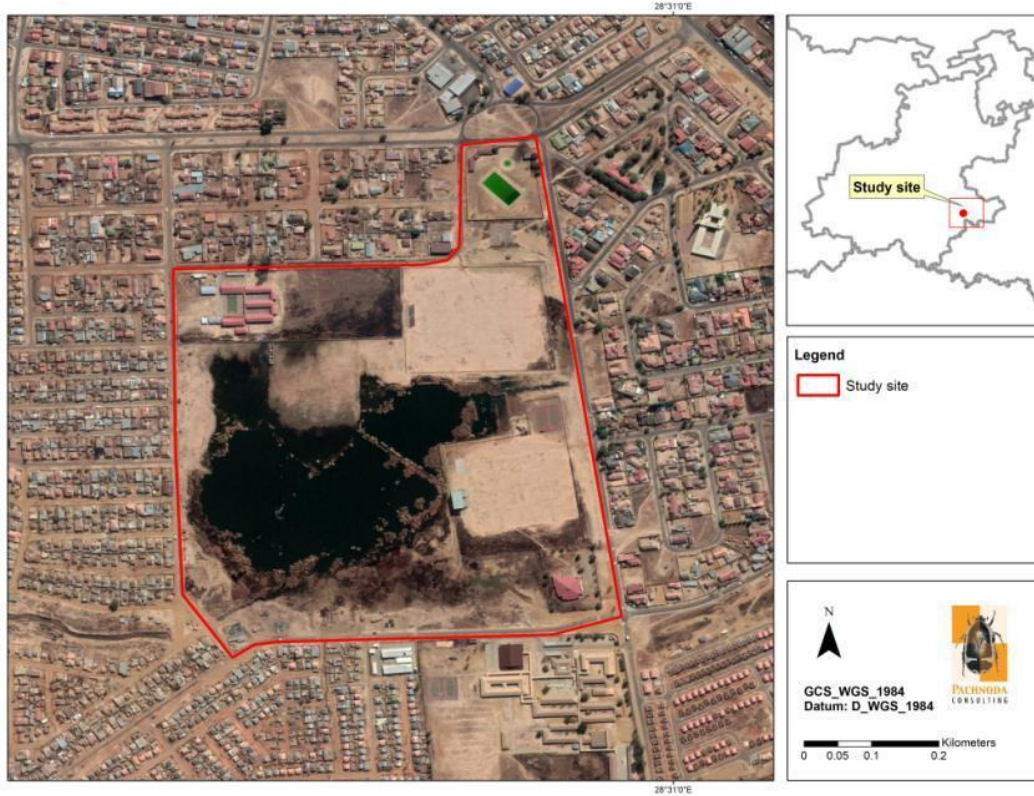




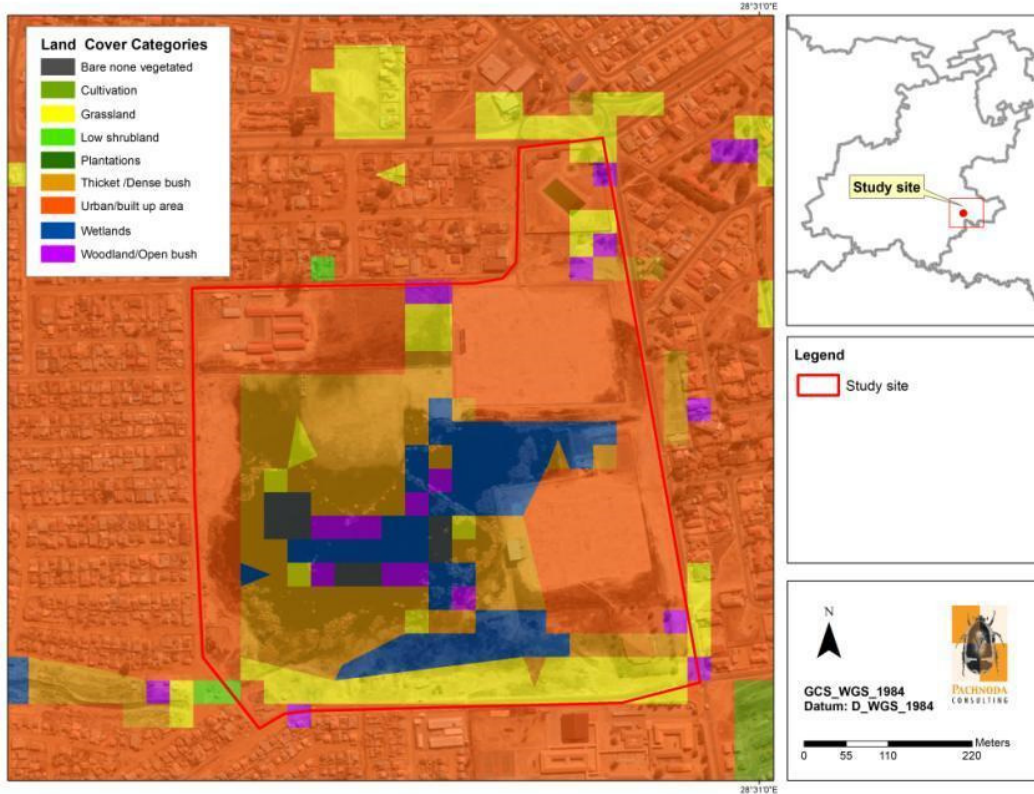
Figure 2: The proposed Tuna Park Open Space Project concept plan.



**Figure 3:** A topocadastral map illustrating the spatial locality of the study site.



**Figure 4:** A satellite image illustrating the current land use and existing infrastructure on the study site.



**Figure 5:** A map illustrating the national land cover classes (Geoterraimage, 2015) corresponding to the study site.

### 2.3.2 Geology

The study site is underlain by shale and quartzite of the West Rand Group (Randian Erathem).

### 2.3.3 Regional Vegetation Description & Threatened Ecosystems

The study area corresponds to the Grassland Biome and more particularly to the Mesic Highveld Grassland Bioregion as defined by Mucina & Rutherford (2006). The proposed development represents an ecological type known as Soweto Highveld Grassland (Figure 6).

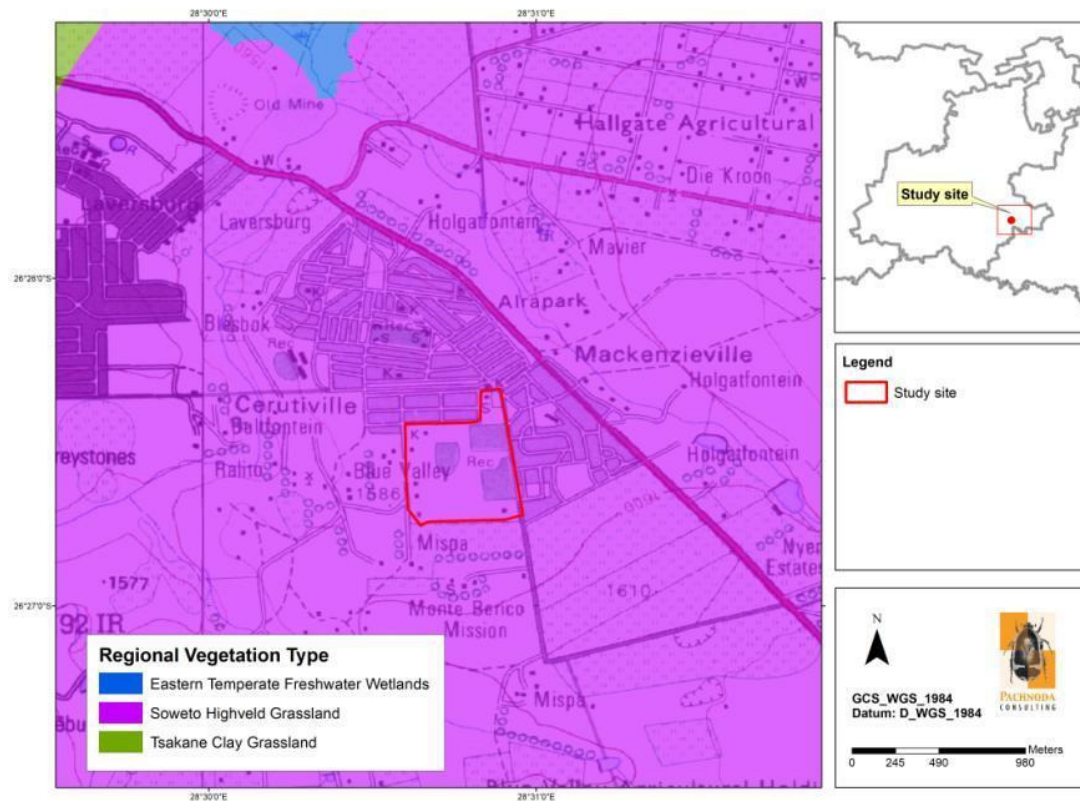
This grassland type occurs on gently to moderately undulating landscapes supporting a medium-high, dense, and tufted grassland dominated almost entirely by *Themeda triandra* when in untransformed condition (Mucina & Rutherford, 2006), while also accompanied by a variety of other grasses such as *Elionurus muticus*, *Eragrostis racemosa*, *Heteropogon contortus* and *Tristachya leucothrix*. Untransformed Soweto

Highveld Grassland is a threatened ecosystem that is locally known as Blesbokspruit Highveld Grassland, which is a critically endangered ecosystem as per Section 52 of the National Environmental Management Biodiversity Act, (Act No. 10 of 2004). Figure 7 shows the remaining extent of Blesbokspruit Highveld Grassland on the study site. However, Blesbokspruit Highveld Grassland patches on the study site are severely transformed by anthropogenic activities and no longer represent an untransformed (primary) grassland composition.

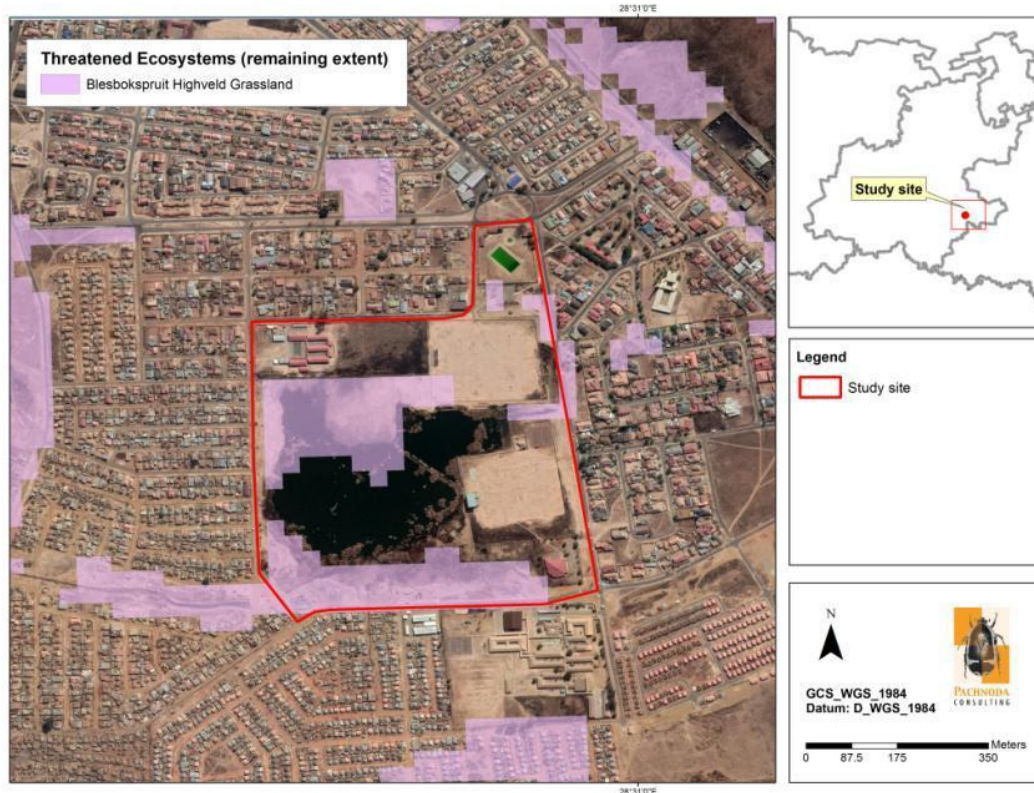
Table 1 summarises a list of plant species characteristic of the Soweto Highveld Grassland.

**Table 1:** A list of the characteristic plant species for each stratum (e.g. grass, forb & woody layer) representing Soweto Highveld Grassland (Mucina & Rutherford, 2006).

Soweto Highveld Grassland		
Grassy Layer	Forb Layer	Woody Layer
<i>Andropogon appendiculatus</i> , <i>Themeda triandra</i> , <i>Brachiaria serrata</i> , <i>Cymbopogon pospischilii</i> , <i>Elionurus muticus</i> , <i>Eragrostis capensis</i> , <i>E. chloromelas</i> , <i>E. curvula</i> , <i>E. plana</i> , <i>Heteropogon contortus</i> , <i>Hyparrhenia hirta</i> , <i>Microchloa caffra</i> , <i>Paspalum dilatatum</i>	<b>Herbs:</b> <i>Hermannia depressa</i> , <i>Acalypha angustata</i> , <i>Berkheya setifera</i> , <i>Geigeria aspera</i> , <i>Graderia subintegra</i> , <i>Haplocarpha scaposa</i> , <i>Helichrysum rugulosum</i> , <i>H. nudifolium</i> , <i>Justicia anagalloides</i> , <i>Selago densiflora</i> , <i>Hilliardiella oligocephala</i> <b>Geophytic herb:</b> <i>Haemanthus humilis</i> , <i>H. montanus</i>	<b>Low shrubs:</b> <i>Anthospermum hispidulum</i> , <i>A. rigidum</i> , <i>Felicia muricata</i> , <i>Ziziphus zeyheriana</i>



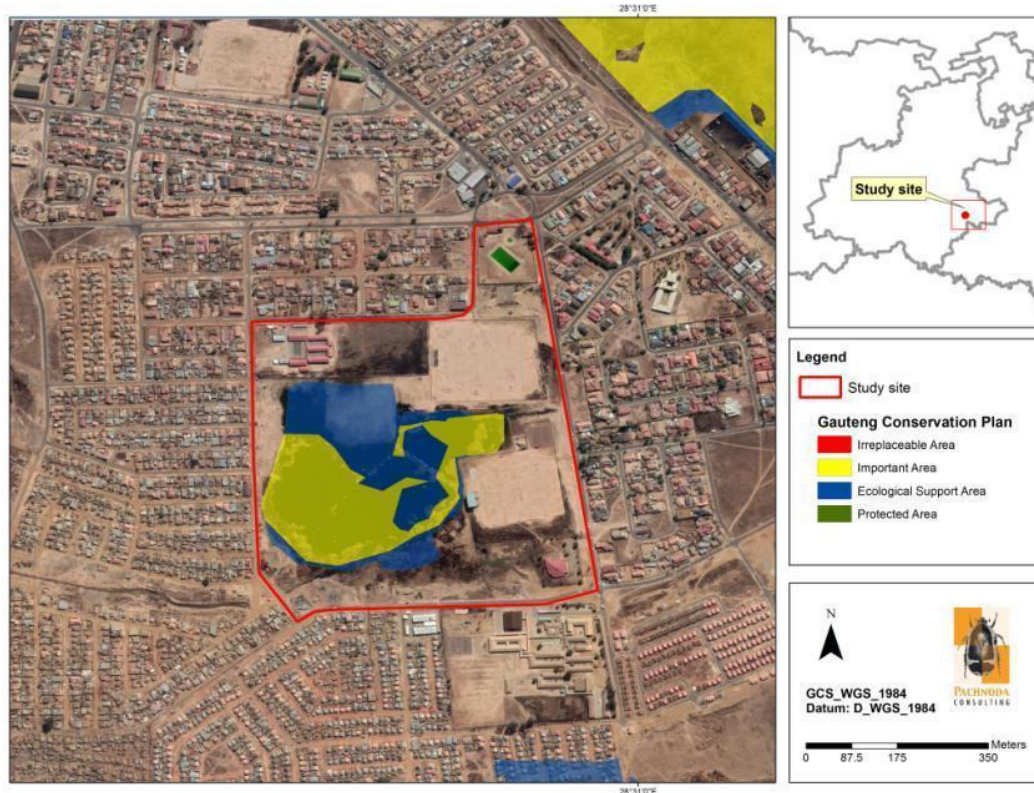
**Figure 6:** The spatial position of the proposed study site and the regional vegetation types as defined by Mucina & Rutherford (2006).



**Figure 7:** The spatial position of the study site in relation to the remaining extent of a threatened ecosystem represented by a vegetation type locally known as the Blesbokspuit Highveld Grassland (part of the Soweto Highveld Grassland regional vegetation type).

#### 2.3.4 Gauteng Conservation Plan and Ridges

A map illustrating the conservation priorities of the study site, using C-Plan version 3 (GDARD, 2017), showed that the wetland system on the central part of study site represents an "important area" (Figure 8) and an "ecological support area". It provides potential habitat for untransformed ("primary") vegetation.



**Figure 8:** A map illustrating the conservation categories based on the Gauteng Conservation Plan, V.3 (GDARD, 2017).

### 3. METHODS AND APPROACH

The floristic and prominent faunal attributes of the study site were investigated on 06 August 2019 with the objective to evaluate the structure, composition and conservation value of the prevalent broad-scale habitat units on the study site. A total of 6 hours was spent on site during the ecological evaluation.

#### 3.1 Vegetation & Flora of conservation concern

##### 3.1.1 Description and dominance estimation

- 1: 50 000 topographical maps and Google Earth and BirdsEye satellite imagery were used to subjectively stratify specific areas of uniform vegetation, structure and land cover (including highly localised and spatially restricted habitats). By using a stratified sampling approach, it is possible to obtain a more accurate species inventory and description of the vegetation, rather than using other site selection methods (e.g. random sampling).



- The dominant and typical floristic species was based on visual estimates while performing a "timed random meander" transects.
- In order to facilitate the search for plant taxa of conservation concern, a 'timed random search' method was used. The 'timed random search' method is a semi-quantitative survey procedure that focuses on the detection of rare vascular plant species or taxa occurring naturally at low densities (Goff *et al.*, 1982; Huebner, 2007). This method is highly effective and time efficient when describing the  $\alpha$ -diversity of a particular area (Huebner, 2007).
- Where possible, all plant taxa were positively identified in the field. Plant names used in Appendix 1 follow Germishuizen *et al.* (2006) with the relevant updates included in the Plants of South Africa web-based database (<http://newposa.sanbi.org/>) and the Online SANBI Red list of South African Plants ([redlist.sanbi.org](http://redlist.sanbi.org/)).

### 3.1.2 Literature review and database acquisition

In addition, the following parameters were also documented to aid the vegetation survey:

- The occurrence of threatened taxa, including near threatened, declining and rare taxa was provided by Raimondo *et al.* (2009). Prior to the conduction of the field survey, historical records of plant 'species of conservation concern' within the quarter degree grid corresponding to the study site (2628BC) were obtained from the National Herbarium's PRECIS database, utilising the new BRAHMS Online Botanical Research and Herbarium Management Software to access the botanical database of southern Africa ([newposa.sanbi.org/](http://newposa.sanbi.org/)).
- The prominence of declared weeds and invader species (as amended under Notice 3 during 29 July 2016 in the Government Gazette, No. 40166) as promulgated under the Alien and Invasive species regulations of the National Environmental Management: Biodiversity (NEMBA) Act 10 of 2004 was included.
- An indication of the provincial and national protected plant species was also provided (*sensu* Notice 389 of 2013 of the Biodiversity Act of 2004 and Schedule 11 of the Transvaal Nature Conservation Ordinance (No.12 of 1983).

## 3.2 Faunal Taxa of conservation concern

### 3.2.1 Literature review and database requisition

#### Mammals

- The potential occurrence and conservation status of mammal taxa were based on the IUCN Red List (2019) and the recently revised national Red Data Book by Child *et al.* (2016), while mammalian nomenclature was based MammalMap.
- The historical and extant (recent) distribution ranges of mammal taxa sympatric to the study site (2628BC) was sourced from MammalMap and various applicable field guides.

#### Birds

- Hockey *et al.* (2005) and Harrison *et al.* (1997) were consulted for general information on the life history attributes of the relevant bird species. These datasets also provide small scale distributional information.
- The conservation status of bird species was categorised according to the global IUCN Red List of threatened species (IUCN, 2019) and a recent regional conservation assessment by Taylor *et al.* (2015).
- Distributional data pertaining to species of conservation concern was sourced from the first South African Bird Atlas Project (SABAP1) and verified against Harrison *et al.* (1997) for species corresponding to the quarter-degree grid cell 2628BC (Endicott) and adjacent grid 2628AD (Springs). The SABAP1 data provides a “snapshot” of the abundance and composition of species recorded within a quarter degree grid square (QDS) which was the sampling unit chosen (corresponding to an area of approximately 15 min x 15 min). It should be noted that the atlas data makes use of reporting rates that were calculated from observer cards submitted by the public as well as citizen scientists. It provides an indication of the thoroughness of which the QDS were surveyed between 1987 and 1991.
- Additional distributional data was sourced from the second South African Bird Atlas Project (SABAP2; [www.sabap2.adu.org.za](http://www.sabap2.adu.org.za)). Since bird distributions are dynamic (based on landscape changes such as fragmentation and climate change), SABAP2 was born (and launched on 1 July 2007) from SABAP1 with the main difference being that all sampling is done at a finer scale known as pentad grids (5 min lat x 5 min long, equating to 9 pentads within a QDS). Therefore, the data is more site-specific, recent and more comparable with observations made during the site visit (due to increased standardisation of data

- collection). The pentad grid relevant to the current project includes 2625\_2830, although the surrounding eight pentads were also investigated.
- The status of 'birds of conservation concern' was also verified during the site visit by means of random transect walks while covering as much of the habitat types as possible. Birds were also identified by means of their calls and other signs such as nests, discarded egg shells (Tarboton, 2001) and feathers. Particular attention was paid to suitable roosting, foraging and nesting habitat for species of conservation concern.

#### *Herpetofauna*

- Red List categories for potential occurring reptile species were chosen according to the conservation assessment conducted by Bates *et al.* (2014).
- Red List categories and listings of potential occurring amphibian taxa follow Measey (2010).
- The distribution of reptile and amphibian species was verified against the Animal Demography's (ADU) database consisting of ReptileMap and FrogMap.

#### *3.2.2 Field Surveys*

##### *Mammals*

- Mammals were identified by means of visual sightings during *ad hoc* transect walks. In addition, mammals were also identified by means of spoor, droppings, roosting sites or likely habitat types.

##### *Avifauna*

- The status of 'birds of conservation concern' was verified during the site visit by means of random transect walks while covering as much of the habitat types as possible. Birds were also identified by means of their calls and other signs such as nests, discarded egg shells (Tarboton, 2001) and feathers. Particular attention was paid to suitable roosting, foraging and nesting habitat for species of conservation concern.

##### *Herpetofauna*

- Possible burrows, or likely reptile habitat (termitaria, stumps or rocks) were inspected for any inhabitants. Amphibians were identified by their vocalisations (if any) and through likely habitat types (e.g. water features, drainage lines, etc.).

### 3.3 Ecological Sensitivity

The ecological sensitivity of any piece of land is based on its inherent ecosystem service (e.g. wetlands) and overall preservation of biodiversity. In addition, the sensitivity of any piece of land is a key consideration when identifying impacts.

#### 3.3.1 Ecological function & connectivity

The extent to which a site is ecologically connected to surrounding areas is an important determinant of its sensitivity. Systems with a high degree of landscape connectivity amongst one another were perceived to be more sensitive and will be those contributing to better ecosystem service (e.g. wetlands) or overall preservation of biodiversity.

#### 3.3.2 Biodiversity Importance

Biodiversity importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

#### 3.3.3 Sensitivity Scale

- *High* – Sensitive and untransformed ecosystems with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems OR with high species diversity and usually provide suitable habitat for a number of threatened, near threatened or rare species.
- *Medium* – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems OR ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species.
- *Low* – Degraded and highly transformed systems with little ecological function and are generally very poor in species diversity (many species are exotic or weeds).
- *Negligible* – Permanently transformed systems with no natural habitat remaining (mainly infrastructure, mining activities or build-up areas).

### **3.4 Limitations**

The results of the ecological assessment were based on a dry season (austral winter) study, undertaken on 06 August 2019. Although a summer study is recommended, it was not possible, presumably since a detailed ecological study was not required according to the Gauteng Conservation Plan. Summer surveys are in general required by the "GDARD minimum requirements for biodiversity studies" policy for ecological assessments, specifically since plant species are often dormant during the dry winter season. However, a follow-up survey during the summer will be recommended if deemed necessary based on the outcome of the 06 August 2019 site visit. According to the experience of the author, the current survey was considered to be sufficient since it describes approximately 70-75 % of the plant richness that is expected to be present.

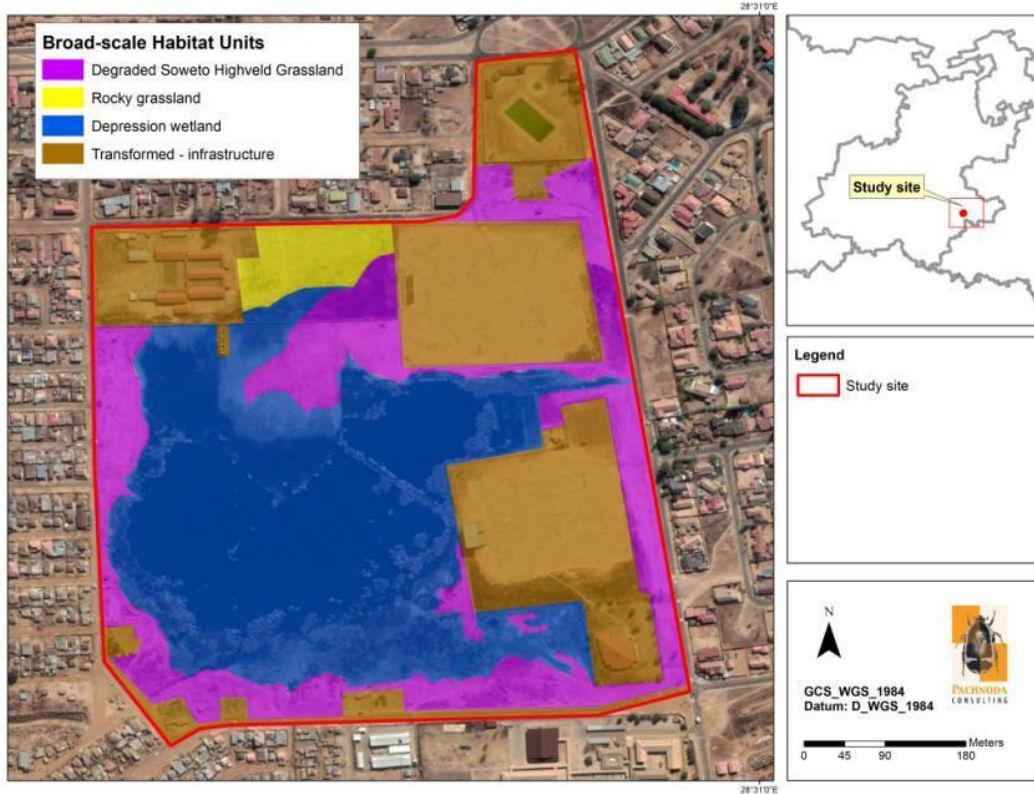
The information as presented in this document only has reference to the *investigated study site boundaries* and cannot be applied to any other area without prior investigation. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.

## **4. RESULTS AND DISCUSSION**

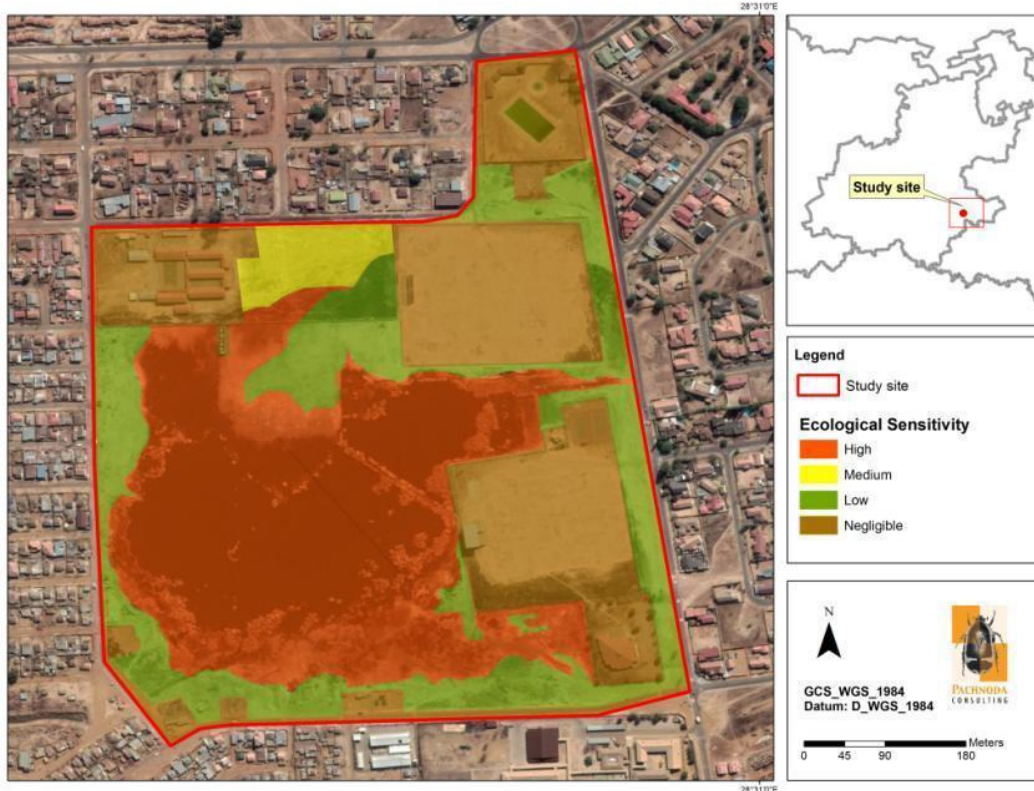
### **4.1 Broad-scale habitat units (vegetation associations)**

Three broad-scale habitat types representing natural degraded grassland, rocky grassland and a depression wetland are present on the study site (Figure 9 and Figure 10). The spatial extent of each habitat type is given in Table 2. A shortlist of the plant composition representing each habitat type (or vegetation association) is provided in Appendix 1.

A total of 67 plant species (37 dicotyledons and 30 monocotyledons) represented by 20 families were recorded during the survey.



**Figure 9:** A map illustrating the broad-scale habitat units (vegetation associations) on the study site.



**Figure 10:** A sensitivity map of the habitat units on the study site.

**Table 2:** Nature, transformation status and size of the vegetation associations on the study site.

Vegetation association	Transformation Status	Area (ha)	% of total
Degraded Soweto Highveld Grassland	Transformed	7.20	22.22
Rocky grassland	Semi-transformed & fragmented	1.02	3.15
Depression Wetland	Semi-transformed	13.11	40.44
Infrastructure	Transformed	11.08	34.18
<b>Total</b>		<b>32.41</b>	<b>100.00</b>

#### 4.1.1 Degraded Soweto Highveld Grassland

This vegetation association is located along the study site perimeter, and represents a degraded terrestrial grassland confined to an area of approximately 7.2 ha in total (22.22 %) (Figure 9 and Figure 11). The floristic structure can be described as being short and human-modified as evidenced by the persistent grazing by livestock (goats, cattle and horses) and widespread soil disturbances (e.g. dumping and diggings), thereby altering the grassland structure to form distinctive "lawns". The floristic composition is dominated by secondary graminoids and forbs species, with a high proportion of ruderal and annual alien weed species.

Dominant grass species include *Cynodon dactylon* and the alien species *Pennisetum clandestinum*, although other noteworthy grass species include *Eragrostis curvula*, *E. chloromelas*, *Hyparrhenia hirta*, *Aristida congesta* and *Pogonarthria squarrosa*. Noteworthy forb species include primarily alien and declared invader species such as *Xanthium strumarium*, *Solanum sisymbriifolium*, *Zinnia peruviana*, *Gomphrena celosioides*, *Tagetes minuta*, *Verbena bonariensis*, *Plantago lanceolata*, *Guilleminea densa*, *Alternanthera pungens*, *Cirsium vulgare*, *Conyza albida*, *Hypochoeris radicata* and *Verbena aristigera*. Typical secondary indigenous forb species include *Seriphium plumosum*, *Pseudognaphalium luteo-album*, *Felicia muricata* and *Gomphocarpus fruticosus*,

This species composition is representative of transformed Soweto Highveld Grassland (Mucina & Rutherford, 2006). Species richness was low with a total of 32 species recorded (47 % of the total richness on the study site; Appendix 1).

This grassland unit is considered to be of **low ecological sensitivity** (Figure 10) for the following reasons:

- It is representative of transformed and degraded Soweto Highveld Grassland.
- Floristic richness is low and a high proportion of the species composition consists of alien and ruderal weed species.
- The probability for plant species of conservation concern to occur is low.





**Figure 11:** An example of degraded Soweto Highveld Grassland.

#### 4.1.2 Rocky Grassland

This vegetation association is located within the Happiness Primary School yard, of which the floristic composition could not be assessed due to restricted access (Figure 9). It represents a floristic composition and structure confined to surface outcrops with similarities to semi-transformed grassland. However, due to the small surface area of the unit along with edge effects caused by anthropogenic activities (e.g. veld fires), it appears that a higher proportion of secondary species is expected, thereby classifying the successional composition as semi-transformed rather than being untransformed. It covers only 1.02 ha of the study site, which equates to 3.15 % of the entire study site.

Since the area was not accessible, it was not possible to compile a floristic species list for this unit.

The grassland unit is tentatively considered to be of **medium ecological sensitivity** (Figure 10) for the following reasons:

- It appears to be representative of semi-transformed grassland confined to a threatened ecosystem.
- The unit is fragmented and of small surface area.

- A second follow-up site visit in summer is recommended to confirm the ecological status and the presence of species of concern should any planned development coincide with this unit.

#### 4.1.3 Depression Wetland

This vegetation association is confined to a large depression wetland on the central part of the study site (Figure 9 & Figure 12). It represents two discrete vegetation sub-units confined to a marginal zone and an inundation zone. The former is seasonally inundated during the austral wet season, while the latter is confined to an area of perennial inundation. The association covers a large section of 13.11 ha, which equates to 40.44 % of the entire study site.

The marginal zone consists of a small floristic area along the outer edge of the wetland system, which is dominated by *Pennisetum clandestinum* and *Trifolium repens*. Other noteworthy grass species include *Themeda triandra*, *Sporobolus africanus*, *Andropogon eucomus*, *Imperata cylindrica* and *Eragrostis micrantha*. Noteworthy forb species include *Helichrysum aeronitens*, *Seriphium plumosum*, *Hypochoeris radicata* and *Juncus oxycarpus*.

The permanent inundation zone is dominated by *Leersia hexandra*, *Juncus effuses* and *Typha capensis*. Other noteworthy graminoid species include *Phragmites australis*, *Hemarthria altissima*, *Paspalum dilatatum* and *P. urvillei*. Other noteworthy plant species include many members of the Juncaceae and Cyperaceae, including *Juncus oxycarpus*, *J. exsertus*, *J. dregeanus*, *Cyperus denudatus*, *C. fastigiatus*, *C. laevigatus*, *Schoenoplectus corymbosus*, *Nasturtium officinale*, *Ludwigia adscendens*, *Centella asiatica*, *Plantago major* and *Rumex crispus*.

Species richness was high with a total of 51 species recorded in the depression wetland (76 % of the total richness on the study site; Appendix 1).

This unit is considered to be of **high ecological sensitivity** (Figure 10) for the following reasons:

- It represents a wetland system with a high proportion of obligate and facultative wetland plant species.
- The floristic structure, flooded grassland and open water provide habitat for a high richness of waterbird and wading bird species, with the potential for two near threatened and one vulnerable bird species to occur.



**Figure 12:** An example of the depression wetland.

## 4.2 Occurrence of plant 'species of conservation concern'

### 4.2.1 *Threatened and near threatened plant species*

South Africa has been recognised globally as having a remarkable plant diversity with high levels of endemism. Almost ten percent of the earth's plants are found within South Africa approximating 23 420 species (Golding, 2002). Of the 948 taxa assessed, 414 species are threatened with extinction, while 270 of these have populations with extremely localised geographic distributions (Golding, 2002).

In terms of conserving biodiversity, there has been a shift towards focussing on ecosystems and landscapes (habitats) rather than efforts in conserving specific species. This is the case due to the variety of living organisms, which make up ecosystems relying on suitable habitats to which they have become adapted over an extended temporal scale. Habitat degradation is one of the main reasons for species becoming extinct in a particular area. However, it can be viewed that threatened species are seen as indicators of the overall health of an ecosystem and serve, with varying degrees of success, as 'umbrellas' for the protection of other organisms as well as ecosystems (Hilton-Taylor, 1996; 2000). According to Hilton-Taylor (1996), threatened species can be seen as "biodiversity attention grabbers". In addition, Victor & Keith (2004) introduced

the concept of an Orange List for plant taxa that warrant conservation measures but do not meet the IUCN criteria. These taxa include those species at risk of becoming threatened (all taxa currently considered “Near threatened” or “Data Deficient”) or represent rare or declining populations. These categories were developed to highlight species that are not threatened with extinction, but require some conservation effort and monitoring.

Table 3 provides a list of four threatened and near threatened species with known distribution patterns sympatric (QDS: 2628BC) to the study area, and an indication of their probability of occurrence. However, all of these species have a low probability of occurrence on the study site (see Table 3).

#### 4.2.2 Protected plant species

The following legislation provides protected status to selected indigenous plant species and is of relevance to the study area:

- National Forests Act (Act 84 of 1998),
- NEMA Biodiversity Act (Act 10 of 2004, as amended in 2015 by Notice 255 of the Government Gazette, 31 March 2015, No. 38600), and
- Transvaal Nature Conservation Ordinance (to be replaced by the Gauteng Nature Conservation Ordinance) (No.12 of 1983).

Schedule A of the National Forests Act (Act 84 of 1998) lists 47 tree species that are protected in South Africa. In terms of the National Forests Act, a licence should be granted by the Department of Forestry (or a delegated authority) prior to the removal, damage or destruction of any individual tree. Therefore, such activities (as mentioned above) should be directed to the responsible Forestry official in each province or area. However, it was evident from the site visit that *none* of the 47 tree species listed in Schedule A of the National Forests Act occurs on the proposed study site.

The Biodiversity Act (Act 10 of 2004, as amended in 2013) is intended to protect plant and animal species that are directly threatened by utilisation or illegal trade. The Act assigns four categories (namely Critically Endangered, Endangered, Vulnerable and Protected) to species threatened by utilisation which appears to be similar to those used by the IUCN, although it should be emphasised that these categories are not as rigorously defined as per the IUCN Ver. 3.1 categories (IUCN, 2015). The destruction, collection or trading of any species listed in the Act requires a permit which must be obtained from the relevant authority. However, it was evident from the site visit that *none* of these taxa occurs on the proposed study site.

A number of plant species occurring in Gauteng are not considered to be threatened or near-threatened (*sensu* Raimondo *et al.*, 2009), but are protected under Schedule 11 of

the Transvaal Nature Conservation Ordinance (No.12 of 1983). Although old, the Act is still applicable to the province. A permit is required to remove or disturb a protected plant. However, no protected plant species as listed in Schedule 11 was observed during the site visit.

**Table 3:** List of all plant 'species of conservation concern' (*sensu* Raimondo *et al.*, 2009) historically recorded from the quarter degree grid square within which the vast majority of the study area is situated (2628BC) and the SANBI PRECIS database (<http://newposa.sanbi.org>, accessed during August 2019).

Taxon	Latest (IUCN version 3.1) Conservation Status Category*	Habitat	Flowering Time	Probability of occurrence within the study area
ASPHODELACEAE				
<i>Kniphofia typhoides</i> Codd.	Near Threatened A2ac	Low-lying wetlands and seasonally wet areas in climax <i>Themeda triandra</i> grasslands on heavy black clay soils, tends to disappear from degraded grasslands.	February-March	Low
APOCYNACEAE				
<i>Pachycarpus suaveolens</i> (Schltr.) Nicholas & Goyder	Vulnerable B1ab(iii)	Grassland.  A showy plant known from eight historical locations and probably extremely rare. One location, last collected in Gauteng in 1929 has subsequently been lost to urban expansion and this species is likely to be locally extinct in Gauteng. The grasslands habitat across its range (EOO 19 900 km <sup>2</sup> ) is extensively transformed by urban development, crop cultivation, mining and invasive alien plants. Mining is causing a continuing decline in habitat between Witbank and Carolina.	September-February	Low
IRIDACEAE				
<i>Gladiolus robertsoniae</i> F.Bolus	Near Threatened B1ab(iii)	Moist highveld grasslands, found in rocky sites, mostly dolerite outcrops. Corms are wedged in rock crevices. Restricted to seeps and streambanks where moisture is available at the end of the dry season.	October-December	Low
ORCHIDACEAE				
<i>Habenaria bicolor</i> Conrath & Kraenzl.	Near Threatened B1ab(iii)+2ab(iii)	Well-drained grasslands at around 1600m.  There are 10-20 locations with a continuing decline in habitat due to urban expansion in Gauteng.	January-April	Low

\* Status follows the latest Red Data Plant Book of South African Plants (Raimondo *et al.*, 2009), and the continuously updated online Red List of SANBI (<http://redlist.sanbi.org>, accessed in November 2017). Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001).

#Probability of occurrence, as follows: LOW – no suitable habitats occur within the study site based on available habitat descriptions for the species and authors personal observations; MODERATE – habitats on site match available general habitat description for the species, but based on authors experience available microhabitat does not meet the requirements for the species (e.g. rocky grassland on shallow, moist soils overlying dolomite) OR, seemingly suitable microhabitat present but species is conspicuous and most available microhabitats searched and species not found and therefore probability of occurrence not considered high, HIGH – habitats on site strongly match the general and microhabitat description for the species, RECORDED – species found within study area.

### 4.3 Declared invader plant species (study site only)

Seven (7) Declared Weeds and Invader species (Table 4) were observed on the study site.

Invaders and weed species are plants that invade natural or semi-natural habitats, especially areas disturbed by humans, and are commonly known as environmental weeds. Weeds that invade severely disturbed areas are known as ruderal and agrestal weeds. Most of these weeds are annuals colonising waste sites and cultivated fields. These weeds only persist on recently disturbed areas and seldom invade established areas (Henderson, 2001).

Declared weeds and invaders have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems.

The Alien and Invasive species regulations were published on 1 August 2014 in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental Management: Biodiversity (NEMBA) Act 10 of 2004. The Act provides a list of prohibited invasive plant species under section 71(A) (as amended during 29 July 2016) and identifies four categories:

- Category 1a listed invasive species: Species which must be combatted or eradicated. It basically instructs a person to comply with section 73(2) of the Act. In addition, an authorised official from the Department must be allowed to assist with the eradication of these species.
- Category 1b invasive species: Species that should be controlled as listed by the notice in terms of section 70(1)(a). Any person in control of these species must control these species, and must allow an authorised official from the Department to assist with the control of these species.
- Category 2 invasive species: Species that requires a permit to carry out a restricted activity (e.g. afforestation) on a specified area. A person in possession of a permit or who owns land with Category 2 species must also ensure that these species will not spread outside the land. Unless otherwise specified, if any Category 2 species occurs outside any specified area, it should be treated as a Category 1b species and must be managed accordingly.
- Category 3 invasive species: A species that is subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of the Act. If any of these species occur in a riparian area it should be treated as a Category 1b species, and must be managed accordingly.



**Table 4:** A list of weeds and invader plant species identified on the study site.

Species	Vernacular Name	Type	Control Measure	NEMBA Category	Locality
<i>Agave sisalana</i>	Sisal	Invader	Control	2	Localised
<i>Cirsium vulgare</i>	Scotch thistle	Weed	Control	1b	Widespread
<i>Xanthium strumarium</i>	Rough cocklebur	Weed	Monitor	1b	Degraded grassland
<i>Eucalyptus cf. camaldulensis</i>	Red River Gum	Invader	Remove when within 32 m from edge of river or stream. No removal is required if the tree trunks are >400mm in diameter (at 1000mm height) when these occur within 50m of a derelict homestead or when within urban area  <b>However, all individuals correspond to listed threatened ecosystem should be removed</b>	1b	Scattered on study site.
<i>Nasturtium officinale</i>	Watercress	Weed	Control	2	Depression wetland - permanent inundation zone
<i>Solanum sisymbriifolium</i>		Invader	Eradicate	1b	Degraded grassland
<i>Verbena bonariensis</i>	Wild verbena	Weed	Control	1b	Widespread in moist grassland

#### 4.4 Occurrence of vertebrate 'species of conservation concern'

##### 4.4.1 Regional Perspective and Richness

The study site (at a geographic scale of 1:50 000) is surrounded by residential development with limited ecological connectivity with natural systems which occur in the immediate surroundings. This limitation will affect the dispersal ability of terrestrial mobile fauna (apart from birds), thereby constraining the colonisation or emigration of fauna to and from the study site. In addition, the presence of human activities on the study site is

high, which will deter large-bodied and even medium-bodied fauna (in particular mammal species) taxa from utilising the site. Such taxa are likely to be hunted or displaced by feral and domestic dogs and cats, including grazing disturbances caused by livestock. Therefore, the fauna richness is expected to be low, and will consist mainly of very widespread taxa and generalists.

From a regional perspective, 24 mammal species (sensu MammalMap, excluding introduced game or unidentified rodent taxa), 10 frog species (sensu FrogMap), 27 reptile species (sensu ReptileMap) and 147 bird species (sensu SABAP2) were previously recorded in the region.

#### 4.4.2 Mammals

Due to the high transformation of natural habitat, the occurrence of human activities and limited ecological connectivity on the study site, the probability for any large-bodied threatened or near threatened mammal species to occur is low. Only two near threatened species could occur on the study site, namely the Swamp Mush Shrew (*Crocidura mariquensis*) and the Vlei rat (*Otomys auratus*). Both these species could associate with the seasonally flooded and moist grassland of the marginal zone (along the depression wetland). However, even the predicted occurrence of these two species are regarded to be low-medium due to disturbances and habitat modifications caused by grazing livestock.

The depression wetland also provides potential foraging habitat for the near threatened Cape Clawless Otter (*Aonyx capensis*). However, when considering the high frequency human activities and feral animals (e.g. dogs), the occurrence of *A. capensis* on the study site is regarded as irregular and occasional. In addition, signs pertaining to the presence of this species such as latrines, scats and spoor along the depression wetland was searched for during the site visit but was not encountered, thereby rendering the presence of this species on the study site as low, although it has been recorded within QDS 2628BC (c. 17 records in total, sensu MammaMap).

The only species that are abundant on the study site are widespread and generalist taxa such as the African Savanna Hare (*Lepus victoriae*), Multimammate Mouse (*Mastomys cf. coucha*), Four-striped Grass Mouse (*Rhabdomys pumilio*) and the Highveld Mole-rat (*Cryptomys pretoriae*).

#### 4.4.3 Amphibians

The only frog species of "conservation concern" that could potentially occur in the area is the near threatened Giant Bullfrog (*Pyxicephalus adspersus*) (Measey, 2010). It is unknown whether this species will utilise the depression wetland for breeding purposes,

although given the low reporting rate (only a single historical observation) for this species in the region, it is of the opinion to be rare or uncommon in the area.

Please note that *P. adspersus* is no longer considered by GDARD to be a provincial conservation entity (GDARD, 2017).

#### 4.4.4 Reptiles

There are no threatened or near threatened reptile species expected to be present on the study site.

#### 4.4.5 Birds

Of the potentially occurring bird species, one near threatened bird species was confirmed from pentad grid 2625\_2830, while another threatened and two near threatened species could occur as irregular foraging visitors to the depression wetland during optimal conditions (e.g. presence of preferred food, water levels, etc.):

- Red-footed Falcon *Falco vespertinus* (Near Threatened; IUCN, 2019) – The most recent observation of this species in the study region was during 2015. It is regarded as an uncommon foraging visitor during summer where it often co-occurs with Amur Falcons (*Falco amurensis*). This species is unlikely to be adversely affected by the proposed development.
- Greater Flamingo *Phoenicopterus roseus* (Near threatened; Taylor *et al.*, 2015) – This species is regarded as an irregular foraging visitor to the depression wetland. According to the SABAP2 database, *P. roseus* has not been recorded in the pentad grid corresponding to the study area. However, it is often highly nomadic, and individuals of this species may utilise the depression wetland during optimal conditions (e.g. presence of suitable prey). Even though it could occur, observations are regarded as erratic.
- Lesser Flamingo *Phoeniconaias minor* (Near threatened; IUCN, 2019) – This species is regarded as an irregular foraging visitor to the depression wetland. According to the SABAP2 database, *P. minor* has not been recorded in the pentad grid corresponding to the study area. However, it is often highly nomadic, and individuals of this species may utilise the depression wetland during optimal conditions (e.g. presence of suitable prey). Even though it could occur, observations are regarded as erratic.
- Maccoa Duck *Oxyura maccoa* (Vulnerable; IUCN, 2019) – This species is regarded as an irregular foraging visitor to the depression wetland. According to

the SABAP2 database, *O. maccoa* has not been recorded in the pentad grid corresponding to the study area. However, it is nomadic, and post-breeding individuals may on occasion utilise the depression wetland. Even though it could occur, observations are regarded as erratic.

#### 4.5 Conclusion & Recommendations

As per Appendix 6 of the Environmental Impact Regulations of 2014 (No. R. 982) of the National Environmental Management Act (Act No. 107 of 1998) a reasoned opinion should be provided as to whether the proposed activity or portions thereof should be authorised.

More than 50 % (c. 56.4 %) of the study site consists of degraded and/ or transformed habitat units. Of the transformed and degraded habitat units, approximately 11.08 ha (c. 34.18 %) consist of infrastructure and recreational facilities such as sport fields. The remaining habitat consists of degraded grassland of 7.2 ha (22.22 %) which provides habitat for widespread generalists and eurytopic species. The degraded grassland unit was also subjected to poor grassland management regimes and intense grazing, while some areas show signs of soil disturbances and the disposal of rubble. These areas (degraded grassland and infrastructure) support low levels of biodiversity and the proposed rehabilitation of the study site have the potential to enhance the local biodiversity and ecological function in the area. The central section of the study site consists of a large depression wetland (c. 13.1 ha), and although already impacted by domestic waste and litter, it also receives effluent of poor water quality from nearby stormwater and faulty sewer reticulation systems. However, the depression wetland system is utilised by a number of waterbird species and provide potential habitat for two near threatened small mammal species and three bird species of conservation concern.

##### 4.5.1 Recommendations

The draft master plan includes a linear wetland park along the depression wetland, a streetscape along Ahzed Avenue and a picnic and playground area. As a general rule, the following recommendations should be taken into consideration:

- All walkways/pedestrian pathways should be constructed of a material that is water permeable in order to minimise stormwater run-off or the ponding of water. In addition, appropriate stormwater features should be installed to minimise erosion.
- Walkways that are crossing the depression wetland should make use of elevated boardwalks rather than utilising bermed or infill walkways (e.g. walkways that are elevated by means of soil berms) which could facilitate surface run-off and erosion.

- All stormwater management features should be constructed in a manner that will ensure the continued functioning of the natural drainage lines and wetland features on the study site. Stormwater management should not impede or divert surface water flow, as any changes in surface water flow quality or quantity could have significant impacts on associated fauna groups.
- All landscaping should make use of indigenous plants, and should preferably make use of plant species that are native to the area (e.g. native to the regional vegetation types). The use of *Pennisetum clandestinum* (kikuyu) as a "lawn" grass or ornamental should be avoided.
- The trees to be used along the pedestrian streetscape should be indigenous and preferably hardy and draught resistant (e.g. *Searsia lancea*).
- A communal grazing plan should be formulated and implemented whereby grazing regimes are defined, and rotational grazing is allowed in order to improve the natural grassland condition and structure.
- All construction activities must be restricted to daytime (e.g. from sunrise to sunset).
- As a precautionary principle, a brief follow-up survey during summer is recommended and aimed specifically at searching for potentially occurring threatened and near threatened plant species on the rocky grassland section contained within the Happiness Primary School yard. The follow-up survey is only applicable if development or land use activities are planned to take place within the rocky grassland habitat.
- According to the Alien and Invader Species regulations, all declared alien weeds and invader plants must be effectively controlled or eradicated by means of an alien and invader control programme.
- No faunal species may unnecessarily be handled, killed, hunted or harassed.

## 5. REFERENCES

Bates, M.F, Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & De Villiers, M.S. (eds). 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. *Suricata 1*. South African National Biodiversity Institute, Pretoria.

Child, M.F., Roxburgh, L., Do Linh San, E., Raimondo, D. & Davies-Mostert, H.T. (eds) 2016. *The Red List of Mammals of South Africa, Swaziland and Lesotho*. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Gauteng Nature Conservation Ordinance (No.12 of 1983)

Geoterraimage. 2015. The South African National Land cover Dataset. Version 05.

GDARD. 2017. GDARD requirements for Biodiversity Assessments. Version 3. Directorate of Nature Conservation: Technological Services. Updated August 2017.

Germishuizen, G., Meyer, N.L., Steenkamp, Y. & Keith, M. (eds.). 2006. *A checklist of South African Plants*. Southern African Botanical Biodiversity Network Report No. 41, SABONET, Pretoria.

Goff, F.G., Dawson, G.A. & Rochow, J.J. 1982. Site examination for threatened and Endangered plant species. *Environmental Management*: 6 (4): 307-316.

Golding, J. 2002. Southern African Plant Red Data Lists. *South African Botanical Diversity Network Report no 14*. SABONET. Pretoria

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. (eds.). 1997. *The Atlas of Southern African Birds. Vol. 1 & 2*. BirdLife South Africa, Johannesburg.

Henderson, L 2001. *Alien Weeds and Invasive Plants: a complete guide to declared weeds and invaders in South Africa*. ARC Publications. Pretoria.

Hilton-Taylor, C. 1996. Red Data List of southern African plants. *Strelitzia 4*. National Botanical Institute, Pretoria.

Hilton-Taylor, C. 2000. The IUCN/SSC Red List Program: Toward the 2000 IUCN Red List of Threatened Species. *Species 33*: 21-29.

Hockey, P.A.R., Dean, W.R.J. & Ryan, P.G. (eds.) 2005. *Roberts – Birds of Southern Africa*, VII<sup>th</sup> ed. The Trustees of the John Voelker Bird Book Fund, Cape Town.

Huebner, C.D. 2007. Detection and Monitoring of Invasive Exotic Plants: a comparison of four sampling methods. *North-eastern Naturalist*: 14 (2): 183-206.

International Union for Conservation of Nature. 2019. <http://www.iucnredlist.org/>

Measey, G.L. (ed). 2010. Ensuring a future for South Africa's frogs: a strategy for conservation research on South African amphibians. *SANBI Biodiversity Series* 19, National Biodiversity Institute, Pretoria.

Mucina, L. & Rutherford, M.C. (eds). 2006. The vegetation map of South Africa, Lesotho and Swaziland. *Strelitzia* 19, South African National Biodiversity Institute.

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

National Forests Act, 1998 (Act No. 84 of 1998).

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Mayama, P.A. (eds). 2009. Red List of South African plants. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.

Tarboton, W. 2001. *A guide to the Nests & Eggs of Southern African Birds*. Struik Publishers, Cape Town.

Transvaal Nature Conservation Ordinance (No.12 of 1983)

Taylor, M.R., Peacock, F. and Wanless, R. (eds.). 2015. *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa, Johannesburg.

Victor, J.E. & Keith, M. 2004. The Orange List: a safety net for biodiversity in South Africa. *South African Journal of Science* 100: 139-141.

[www.sabap2.adu.org.za](http://www.sabap2.adu.org.za)

## 6. APPENDICES

**Appendix 1:** A shortlist of plant species recorded during the site visit. \*-denotes alien/exotic taxa.

Species	Family	Declared Invader	Broad-scale Habitat Unit (Vegetation Association)		
			Degraded Soweto Highveld Grassland	Depression wetland: Marginal zone	Depression wetland: Inundation zone
<b>Dicotyledons</b>					
<i>Alternanthera pungens</i> *	Amaranthaceae		1		
<i>Aster squamatus</i> *	Asteraceae				1
<i>Centella asiatica</i> *	Apiaceae				1
<i>Chenopodium album</i> *	Chenopodiaceae		1		
<i>Cirsium vulgare</i> *	Asteraceae	1	1	1	1
<i>Conyza albida</i> *	Asteraceae		1		
<i>Eucalyptus cf. camaldulensis</i> *	Myrtaceae	1	1		
<i>Felicia muricata</i>	Asteraceae		1		
<i>Gomphocarpus fruticosus</i>	Apocynaceae		1	1	
<i>Gomphrena celosioides</i> *	Amaranthaceae		1		
<i>Guilleminea densa</i> *	Amaranthaceae		1		
<i>Helichrysum argyrograpta</i>	Asteraceae		1		
<i>Helichrysum aureonitens</i>	Asteraceae			1	
<i>Helichrysum cerastioides</i>	Asteraceae		1		
<i>Helichrysum nudifolium</i>	Asteraceae		1		
<i>Helichrysum rugulosum</i>	Asteraceae		1		
<i>Hypochaeris radicata</i> *	Asteraceae		1	1	
<i>Ludwigia adscendens</i>	Onagraceae				1
<i>Nasturtium officinale</i> *	Brassicaceae	1			1
<i>Oleraceus roseus</i> *	Onagraceae			1	
<i>Plantago lanceolata</i> *	Plantaginaceae		1	1	
<i>Plantago major</i> *	Plantaginaceae				1
<i>Portulaca sp.</i>	Portulacaceae			1	
<i>Pseudognaphalium luteo-album</i>	Asteraceae		1	1	
<i>Rumex crispus</i>	Amaranthaceae				1
<i>Schkuhria pinnata</i> *	Asteraceae			1	
<i>Searsia lancea</i>	Anacardiaceae		1		
<i>Senecio inaequidens</i>	Asteraceae			1	
<i>Seriphium plumosum</i>	Asteraceae		1	1	
<i>Solanum sisymbriifolium</i> *	Solanaceae	1	1	1	
<i>Tagetes minuta</i> *	Asteraceae		1	1	
<i>Trifolium repens</i> *	Fabaceae			1	
<i>Ulmus parvifolia</i> *	Ulmaceae		1		
<i>Verbena aristigera</i> *	Verbenaceae		1	1	



<i>Verbena bonariensis</i> *	Verbenaceae	1	1	1	
<i>Xanthium strumarium</i> *	Solanaceae	1	1	1	
<i>Zinnia peruviana</i> *	Asteraceae		1		
<b>Subtotal</b>	<b>36</b>	<b>6</b>	<b>25</b>	<b>17</b>	<b>7</b>
<b>Monocotyledons</b>					
<i>Agave sisalana</i> *	Agavaceae	1		1	
<i>Andropogon eucomus</i>	Poaceae			1	
<i>Aristida congesta</i>	Poaceae		1		
<i>Cynodon dactylon</i>	Poaceae		1	1	
<i>Cyperus denudatus</i>	Cyperaceae				1
<i>Cyperus esculentus</i>	Cyperaceae			1	
<i>Cyperus fastigiatus</i>	Cyperaceae				1
<i>Cyperus laevigatus</i>	Cyperaceae				1
<i>Eragrostis aspera</i>	Poaceae			1	
<i>Eragrostis chloromelas</i>	Poaceae		1		
<i>Eragrostis curvula</i>	Poaceae		1	1	
<i>Eragrostis micrantha</i>	Poaceae			1	
<i>Eragrostis plana</i>	Poaceae			1	
<i>Hemarthria altissima</i>	Poaceae				1
<i>Hyparrhenia hirta</i>	Poaceae		1		
<i>Imperata cylindrica</i>	Poaceae			1	
<i>Juncus dregeanus</i>	Juncaceae				1
<i>Juncus effuses</i>	Juncaceae				1
<i>Juncus exsertus</i>	Juncaceae				1
<i>Juncus oxycarpus</i>	Juncaceae			1	1
<i>Leersia hexandra</i>	Poaceae				1
<i>Paspalum dilatatum</i> *	Poaceae				1
<i>Paspalum urvillei</i> *	Poaceae				1
<i>Pennisetum clandestinum</i> *	Poaceae		1	1	
<i>Phragmites australis</i>	Poaceae				1
<i>Pogonarthria squarrosa</i>	Poaceae		1		
<i>Schoenoplectus corymbosus</i>	Cyperaceae				1
<i>Sporobolus africanus</i>	Poaceae			1	
<i>Themeda triandra</i>	Poaceae			1	
<i>Typha capensis</i>	Typhaceae				1
<b>Subtotal</b>	<b>30</b>	<b>1</b>	<b>7</b>	<b>13</b>	<b>14</b>
<b>Total</b>	<b>66</b>	<b>7</b>	<b>32</b>	<b>30</b>	<b>21</b>