April 2021

# *AN ECOLOGICAL ASSESSMENT OF THE FLORA & FAUNA AND RIVERINE AREA:*

## *Portion 8 of the Farm Rietspruit (Shapiro) 152, Gauteng*

A report commissioned by

COSMOPOLITAN PROJECTS JOHANNESBURG (PTY) LTD

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# CONTENTS

## CONDITIONS RELATING TO THIS REPORT

**Declaration of interest**

Enviroguard Ecological Services cc and its members/co-workers:

- Have no vested interest in the property studied nor is it affiliated with any other person/body involved with the property and/or proposed development.
- Is not a subsidiary, legally or financially of the proponent.
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).
- Declare that remuneration for services provided by Enviroguard Ecological Services cc and its members/co-workers is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA.
- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and/or further work in this field.
- Is committed to biodiversity conservation but concomitantly recognize the need for economic development. We reserve the right to form and hold our own opinions within the constraints of our specialities and experience, and therefore will not submit willingly to the interests of other parties or change our statements to appease them.

The study was undertaken by Prof. LR Brown (PhD UP) & Mr C Cook (MSc UP). Both are registered as a Professional Natural Scientists with the following details:

Prof LR Brown: Reg. No. 400075/98 (Botanical Science and Ecological Science).
Mr C Cook: Reg. No. 400084/08 (Zoological Science)

They have the following qualifications:

| SPECIALIST | QUALIFICATION |
|---|---|
| Prof. L.R. Brown | PhD Terrestrial plant ecology<br>MSc. Water ecology<br>BSc Hons (Botany)<br>BSc (Ed) (Botany, Zoology, Education)<br>Wetland and Riparian Delineation *(DWAF Accredited Course)*<br>Soil Classification and Wetland Delineation Short Course – TERRASOIL |

| | |
|---|---|
| | Science<br>Wetland Legislation Course - Wetrest |
| Mr C Cook | MSc Zoology (Aquatic Science)<br>BSc Hons Zoology<br>BSc Botany & Zoology<br>Wetland and Riparian Delineation *(DWAF Accredited Course)* |

**Indemnity**

Although Enviroguard Ecological Services cc exercises due care and diligence in rendering services and preparing documents, the client takes full responsibility for this report and its implementation in terms of the National Environmental Management Act of 1998, and exempt Enviroguard Ecological Services cc and its associates and their sub-contractors from any legal responsibility based on the timing of the assessment, the result and the duration thereof, which has an influence on the credibility and accuracy of this report. .Enviroguard Ecological Services cc accepts no liability, and the client, by receiving this document, indemnifies Enviroguard Ecological Services cc and its directors, managers, agents and employees against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Enviroguard Ecological Services cc and by the use of the information contained in this report.

**Factors limiting the quality of this study**

Flora: A once off survey was conducted while the study was done on 27 & 29 April and on 14 November 2021. Thus, only those flowering plants that flowered at the time of the visit could be identified with high levels of confidence. Some of the more rare and cryptic species may have been overlooked due to their inconspicuous growth forms. Many of the rare and endangered succulent species can only be distinguished (in the veld) from their very similar relatives on the basis of their reproductive parts. These plants flower during different times of the year. Multiple visits to any site during the different seasons of the year could therefore increase the chances to record a larger portion of the total species complex associated with the area. The survey of the study site is however considered as successful with a correct identification of the different vegetation units.

Fauna: It must be stressed that no actual faunal surveys of mammal, bird, reptile and amphibian species occurring on the site were conducted but merely an assessment of available and specialised habitat. By surveying the site for specialised habitats, as well as the remaining vegetation and specific habitats, one can make an assumption of the possible presence or absence of threatened faunal species. In order to ascertain actual species lists more intensive surveys are required over several seasons.

Limitation to a faunal screening exercise based on two site visitations (8 hours) conducted during the late summer/autumn, and early summer months on 27th of April, 11th May and 14 November 2021. All animals (mammals, reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as nests, feathers and animal tracks (footprints, droppings) to identify animals. The majority of threatened species are extremely secretive and difficult to observe even during intensive field surveys conducted over several years this is especially pertinent to the highly elusive and secretive South African hedgehog, Rough-haired Golden Mole, Serval, White-tailed Rat, Swamp Musk Shrew, Coppery Grass Lizard, Striped Harlequin Snake and Giant Bullfrog. There is a limitation of historic data and available databases for the majority of threatened species especially the Striped Harlequin Snake where only 80 records exist for Southern Africa, Swaziland and Lesotho and only 2 records of Coppery Grass Lizard during an intensive reptile survey of Gauteng (Whittington-Jones et al. 2008). The presence of threatened species on site is assessed mainly on habitat availability and suitability as well as desk research (literature, personal records and previous surveys conducted in the similar habitats within the Midvaal-Heidelberg areas between 2000 and 2021.

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**Approach**

Conclusions reached, and recommendations made are based not only on occurrence of individual species, but more appropriately on habitats and ecosystem processes. Planning must therefore allow for the maintenance of species, habitats and ecosystem processes, even if Red Data or endemic plant or animal species are absent.

**Prof LR Brown *Pri.SciNat*; MGSSA**
**Enviroguard Ecological Services cc**

# INTRODUCTION

The natural resources of southern Africa, with its highly complex and diversified society, are continually under threat from development especially in areas richly endowed with natural resources. Uncontrolled and ill-planned development is one of the biggest threats to the naturally evolved life forms on earth. Past development in many parts of the world has led to the destruction of various plant and animal species and their habitats. Urbanisation causes land transformation and fragmentation and resultant loss of biodiversity. The achievement of balanced development satisfying the human needs and simultaneously conserving the natural resources/habitats is one of the biggest challenges faced by decision-makers. In practice, a foundation for sustainability entails natural resources, for example to link the vegetation of a site directly or indirectly to its closest natural surroundings, to establish green corridors and to create functional landscapes that maintain biodiversity (Pickett & Cadenasso, 2008).

In order to prevent the destruction of any ecosystem, it is important that systematic planning and co-ordination of human activities and development should receive priority. This planning should include studies of the natural environment (soil, water, vegetation, animals and cultural / historical aspects). The planning and design of urban areas must therefore be done in such a way as to ensure that important ecosystem functions and services of the environment is maintained. Biodiversity must be protected to ensure the continued existence of plant and animal life in an area. It is therefore important that urban developers, landscapers and environmentalists together design development within urban areas. Before any development can take place it is important that all aspects of the environment is first assessed to identify areas of concern and inform the planning of the proposed development.

Plant communities are regarded as fundamental units of an ecosystem and therefore form the base for environmental planning and the compilation of environmental management plans. Plant species assemblages reflect habitat and ecosystem health and rarity and are therefore imperative for an Environmental Impact Assessment.

Wetlands and riparian zones are ecosystems (with specific plant and animal communities) that are associated with bodies of water or are dependent on permanent, seasonal or ephemeral surface/subsurface water. The vegetation of these areas is normally more lush than that of the surrounding terrestrial vegetation. These areas play an important role in

channelling water, retention of water and release of water to adjacent ecosystems. These areas also support a unique floral and faunal component.

## AIMS OF THE STUDY

This report aims to present ecological report on the flora and fauna as well as a watercourse assessment of Portion 8 of the Farm Rietspruit (Shapiro) 152, Gauteng (hereafter referred to as the study area).

The objectives of this study were to:

- Identify, describe and delineate the different vegetation units present on the study site.
- Provide a description of the fauna (**mammals, avifauna (birds), reptiles, amphibians**) occurring within the study area.
- Identify species of conservation importance that could possibly occur on the proposed site.
- Identify and delineate the stream present on the property.
- To provide a sensitivity map of the study area (where applicable).
- To provide management recommendations to mitigate negative and enhance positive impacts of the proposed development.

# STUDY AREA

## Location

The study site is located south of the R550 Road (Heidelberg Road) near the town of Meyerton in Gauteng. The area is a small holding surrounded by other smallholdings in the east, south and west, while the Palm Ridge suburb within the larger Vosloorus area is located towards the north opposite the R550. The area is used for cultivation purposes with the Rietspruit flowing through the southern section of the study site.

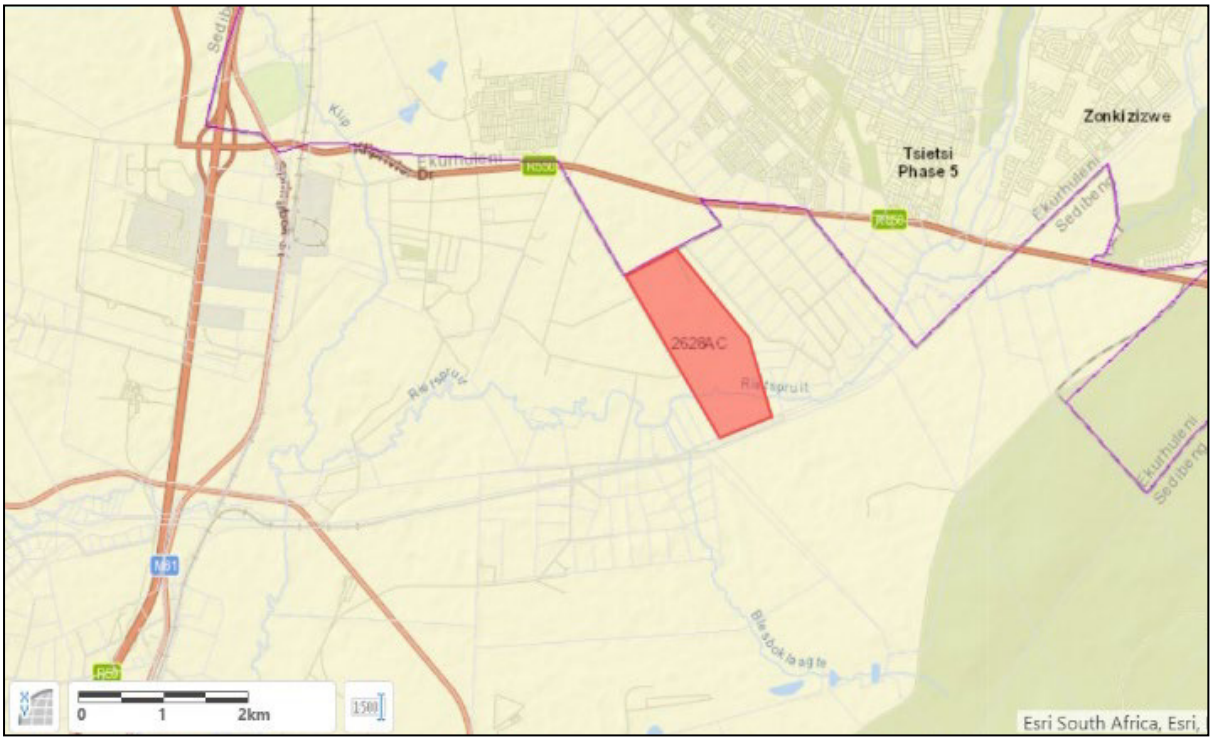



**Figure 1**. Locality the study area (Source: SANBI GIS, 2021).

### Existing impacts

- The site is partially fenced and is located between various agricultural holdings and commercial/residential developments.
- Large sections are currently cultivated or have been left fallow for the soil to recover.
- Various informal roads are present on the site.

# METHODS

## VEGETATION

The Braun-Blanquet survey principles to survey and describe plant communities as ecological units were used for this study. This vegetation survey method has been used as the basis of a national vegetation survey of South Africa (Mucina et al. 2000) and is considered to be an efficient method of classifying and describing vegetation (Brown *et al.* 2013). The study is based on the floristic composition of the different vegetation units. An overview of the vegetation was first obtained from relevant literature. The vegetation was stratified into relative homogeneous units using Google Earth images and topographic maps. All these units were verified on foot and vegetation sample plots placed in each. The different vegetation units (ecosystems) are not only described in terms of their plant species composition, but also evaluated in terms of the potential habitat for sensitive/red data plant species. Ecological sensitivity and conservation value of the plant communities were assessed and categorised according to habitat and plant species assemblages (even though red data species or suitable habitat for such species could be absent an area could still have pristine habitat comprising a high diversity of climax species giving it a high conservation value).

**Data recorded included:**

Data pertaining to the vegetation physiognomy and floristic composition (species richness and canopy cover of each species) was gathered. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence.

**Red data species**

An investigation was also carried out on rare and protected plants that might possibly occur in the region. For this investigation the National Red List of Threatened Plants of South Africa, Lesotho & Swaziland, compiled by the Threatened Species Programme, South African National Biodiversity Institute (SANBI) was used. Internet sources were also consulted on the distribution and habitat of these species in the area as well as available literature.

Other information used included:

- The IUCN conservation status categories on which the Threatened Species Programme, Red List of South African Plants (2013) is based, was also obtained.

The presence of rare and protected species or suitable habitat was recorded during the field visit.

QDG data as well as other red data lists are used as guidelines to assist when conducting the field work. Unless a specific species was recorded previously on the specific site under investigation, the QDG lists cannot be used as meaning that the species listed do occur on the site. These lists are not comprehensive and continually change as people find and record new habitats and red data species. It could therefore mean that a red data species found in an adjacent QDG or one even further away, could potentially occur in another QDG. However, since no study has been done in that grid it will result in it not being listed for that QDG. The fact that it is not listed does however, not mean that the species or suitable habitat is not present. It is therefore imperative that a **physical site visit is conducted** to determine firstly, the presence of the listed red data species OR suitable habitat on the site, and secondly, and most importantly the suitability of the site for the presence other red data species also.

**Data processing**

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the vegetation units include the tree, shrub and herbaceous layers. The conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Grassland and Savanna biomes of South Africa. The following four conservation priority categories were used for each vegetation unit:

| | |
|---|---|
| **High:** | Area with natural vegetation with a high species richness and habitat diversity; presence of viable populations of red data plant species OR suitable habitat for such species; presence of unique habitats; less than 5% pioneer/alien plant species present. These areas are ecologically valuable and important for ecosystem functioning. This land should be conserved and managed and is not suitable for development purposes. |
| **Medium-high:** | Natural area with a relatively high species richness and diversity; not a threatened or unique ecosystem; moderate habitat diversity; between 5-10% pioneer/alien plant species present; that would need low financial input and management to improve its current condition; and where low-density development could be considered with limited impact on the vegetation / ecosystem. It is recommended that larger sections of the vegetation are maintained**.** |
| **Medium:** | An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species diversity; between 11-20% pioneer/alien |

plant species present; that would need moderate to major financial input to rehabilitate to an improved condition; and where medium density development could be considered with limited impact on the vegetation / ecosystem. Where possible certain sections of the vegetation could be maintained.

**Low-medium:** Area with relatively natural vegetation, though a common vegetation type; moderate to low species and habitat diversity; previously or currently degraded or in secondary successional phase; between 20-40% pioneer and/or alien plant species; low ecosystem functioning; low rehabilitation potential.

**Low:** A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants; >40% pioneer and/or alien plant species present; very low habitat uniqueness; whose recovery potential is extremely low; and on which development could be supported with little to no impact on the natural vegetation / ecosystem.

## Impact analysis

An **impact analysis** was done for the vegetation units identified. This was achieved by evaluating the different vegetation units against a set of habitat criteria. For impact assessment the **potential impacts** on the vegetation were assessed by using the NEMA 2014 guidelines and criteria. To further quantify the severity of each impact, values were assigned to criteria ratings (Table 1).

**Table 1:** Criteria, criteria ratings and values (in brackets) used in this study to assess possible impacts on vegetation during the proposed development

| Criteria | Rating (value) |
|---|---|
| Extent of impact | Site (1), Region (2), National (3), International (4) |
| Duration of impact | Short term (1), Medium term (3), Long term (4), Permanent (5) |
| Magnitude of impact | Low (2), Moderate (6), High (8) |
| Probability of impact | Improbable (1), Probable (2), Highly probable (4), Definite (5) |

## Sensitivity analysis

A sensitivity analysis was done for the vegetation units to determine their ecological sensitivity in terms of the vegetation and its associated ecosystem. The different units were scored against set vegetation criteria. A score between 80 and 100 means the area has a high vegetation ecological sensitivity; 50-79 a medium vegetation ecological sensitivity; 30-49 a low-medium vegetation ecological sensitivity; and 0-29 a low vegetation ecological sensitivity.

## FAUNA

This faunal survey focused mainly on mammals, birds, reptiles and amphibians within the proposed Rietspruit site. The survey focused on the current status of threatened animal species occurring, or likely to occur within the study area, describing the available and sensitive habitats on the site, identifying potential impacts and providing mitigation measures for the identified impacts of the proposed project.

### Predictive methods

Satellite imagery of the area was obtained from Google Earth™ was studied in order to get a three-dimensional impression of the topography and current land use.

### Literature Survey

A detailed literature search was undertaken to assess the current status of threatened fauna that have been historically known to occur within the 2628 AC Quarter Degree Grid Cell (QDGC) in which the site is situated. The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description as well as *National Red List of Threatened Plants of South Africa* (Raimondo *et al,* 2009. *The Mammals of the Southern African Subregion* (Skinner & Chimimba 2005) and *The Red List of Mammals of South Africa, Swaziland and Lesotho* (Taylor *et al.* 2016) as well as ADU's MammalMAP (http://vmus.adu.org.za/vm_sp_list.php) for mammals. Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). 2005. *Roberts- Birds of Southern Africa VII$^{th}$ ed*. And BARNES, K.N. (ed.) (2000) *The 2014/2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland* (Taylor *et al.* 2015) for avifauna (birds) as well as the internet SABAP2 (http://sabap2.adu.org.za). *A Complete Guide to the Frogs of Southern Africa* (du Preez & Carruthers 2009) and *The Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter *et al.* 2004) and Ensuring *a future for South Africa's frogs: a strategy for conservation research*. *SANBI Biodiversity Series* 19 (Measey *et. al.* 2010) for amphibians as well as SAFAP FrogMAP (http://vmus.adu.org.za). The *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001) and Atlas *and Red List of the Reptiles of South Africa, Lesotho and Swaziland* (Bates *et. al.* 2014) as well as SARCA (http://sarca.adu.org.za) for reptiles.

**Site Investigation Methodology**

A preliminary faunal habitat assessment of the status, spatial requirements and habitat preferences of all priority faunal species (mammals, birds, reptiles and amphibians) likely to occur within or surrounding the Rietspruitsite was undertaken. For certain species, an estimate of the expected or historical distribution for the area could be extrapolated from published information and unpublished reports, while habitat and spatial requirements were generally derived from the literature. For other species such as the Striped Harlequin Snake and Coppery Grass Lizard little of this information was readily available and conservation targets remain speculative. Species assessments will be updated when additional data becomes available and where appropriate, proposed conservation targets will be revised.

A survey of the proposed Rietspruit site was carried out on foot during daylight hours on the 27th and 29th of April 2021. The temperature was mild with temperatures ranging between 18-24°C. Emphasis was placed on the Carletonville Dolomite Grasslands in various stages of transformation and degradation, the macro-channel embankments and riparian zones of the perennial Rietspruit, the artificially created irrigation dam. Due to the large size little time was spent surveying the current agricultural lands and developed and totally degraded habitats. All animals (mammals (larger), birds, reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as nests, feathers and animal tracks (footprints, droppings) to identify animals. The majority of mammals were identified by visual observations as well as droppings and various burrow types. The majority of amphibians identified on the site were calling adults as well as incidentally observed adults (under rocks, logs etc) and from dip netting for tadpoles as well as emerging juveniles. Reptiles were actively searched for under suitable refuges such as loosely embedded flat rocks, logs, stumps, dumped building rubble, tyres and carpets and identified by actual specimens observed. The survey was heavily augmented with previous faunal surveys conducted in the adjacent Nigel-Heidelberg and Midvaal areas between 2000 and 2021. The field verification for the site was restricted to two days (8 hours) during the late summer; early autumnal months. No specialist faunal survey techniques; including camera trapping, pit-fall and funnel trapping were used during the brief field verification of the mammals, reptiles and amphibians on the site. No nocturnal surveys were undertaken.

## WATERCOURSE ASSESSMENT

WETLANDS

The term “wetland” is a generic term for all the different kinds of habitats where the land is wet for some period of time each year, but not necessarily permanently wet. Wetlands are defined in the National Water Act (36 of 1998) as “land which is transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”. Wetlands are found where the landform (topography) or geology slows down or obstructs the movement of water through the catchment, or where the groundwater surfaces causing the soil layers in the area to be temporarily, seasonally or permanently wet. This provides an environment where particular plants (hydrophytes) that are adapted to wet conditions tend to grow in abundance. The plants in turn affect the soil and hydrology by further slowing down the movement of water (e.g. reed beds) or by producing organic matter that may accumulate in the soil.

Wetlands are important because of the functions and values that they provide which benefit mankind. These benefits can be either direct or indirect benefits. Until very recently the benefits of wetlands to society were often not recognized, and many wetlands have been destroyed, or poorly managed. Wetland benefits refer to: "*those functions, products, attributes and services provided by the ecosystem that have values to humans in terms of worth, merit, quality or importance. These benefits may derive from outputs that can be consumed directly; indirect uses which arise from the functions or attributes occurring within the ecosystem; or possible future direct outputs or indirect uses*" (Howe et al., 1991 in Kotze et al., 2005).

The functioning of a wetland is also affected by other factors, many of which result from the activities of people. These include "off-site" factors which take place in the surrounding catchment (e.g. a change in land cover from natural grassland to a gum tree plantation which would decrease the amount of water reaching the wetland) and "on-site" factors which take place at the wetland (e.g. fire, draining, damming, etc.).

Humans have traditionally seen wetlands as wasteland areas and many of these sensitive ecosystems have as a result been transformed and developed. Due to the sensitive nature of these systems as well as the different ecosystem functions they perform, it is important that wetlands are identified and assessed in any area where development is planned.

The classification system developed for the National Wetlands Inventory in South Africa is based on the principle of "hydro-geomorphic (HGM) units". HGM units take into consideration various factors that determine the nature and direction of water movement into, through and out of the wetland system. All together HGM units encompass three key elements (Kotze et al, 2005; USDA; 2011):

- *Landscape position*: This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment).
- *Dominant water source*: There are usually several sources such as surface water, precipitation, sub-surface water, springs, stream flow, etc.
- *Hydrodynamics:* This refers to the source and direction of water movement (this can be horizontal, vertical, unidirectional or bidirectional) (Figure 2).

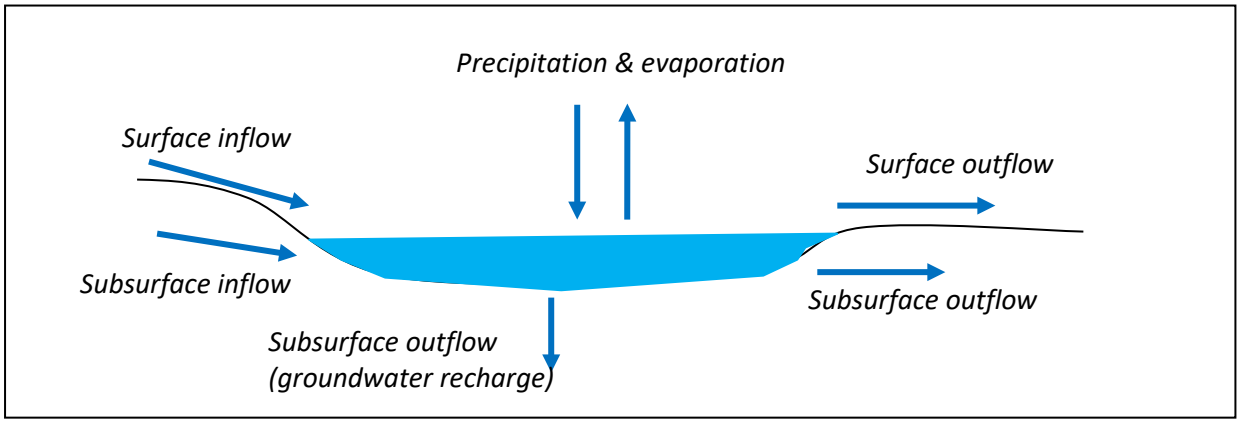



**Figure 2**. Water budget/movement in a wetland system (Adapted from USDA, 2011)

Dini, Cowan & Goodman (1998) classifies South African wetlands into the following classes:

- *Lacustrine*: Limnetic and Littoral (natural freshwater lakes).
- *Palustrine*: Flat, Slope, Valley Bottom, Floodplain (freshwater marshes, peatlands, springs, swamp forest, floodplains).
- *Endorheic* (permanent and seasonal pans).

For delineation purposes only, the wetland boundary is defined as the edge where the ***hydric indicators are encountered within the top 50cm or 500 mm of the surface***, but from a wetland management perspective consideration should extend beyond the boundaries to include the wetland catchment as a whole.

**Terrain Unit Indicator:**

Identifies those parts of the landscape where wetlands are likely to occur: Pans are usually concentrated in areas with an average slope of less than one degree and are characterised by a

lack of integrated drainage. Inundation is usually seasonal or ephemeral. This indicator cannot be used for mapping but is useful for screening purposes.

**Soil Form Indicator:**

Particular forms of soil are associated with wetlands and display hydromorphic characteristics, and their presence at a site indicates that permanent or periodic (temporary or seasonal) saturation of the soil near the surface occurs. No comprehensive soil survey has been undertaken for the site.

**Vegetation Indicator**

The presence of indicator plant species or hydrophytes can be used to denote the presence of wetlands. This indicator is very useful as verification of the boundaries in undisturbed sites.

**Soil wetness Indicator**

Wetland soils can be permanently, seasonally or temporarily saturated. This normally results in anoxic (low oxygen) conditions in the saturated zone. Soil colour is markedly influenced by the oxidation statues of manganese and iron. Yellow, red and reddish-brown soil form under well-oxidised conditions and greyish colours when aeration is poorer. Under anoxic conditions, iron becomes soluble and can be leached out of the soil. Where the soil is permanently wet; the iron can all be dissolved out of the soil; resulting in a greyish or blueish colour. This is termed gleying. Consequently, it is possible to identify wetland areas on the basis of soil colour, while mottle hue and chroma initially increase and then decrease the more saturated the soils become.

By observing the evidence of these features, in the form of indicators, wetlands can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF 2005).

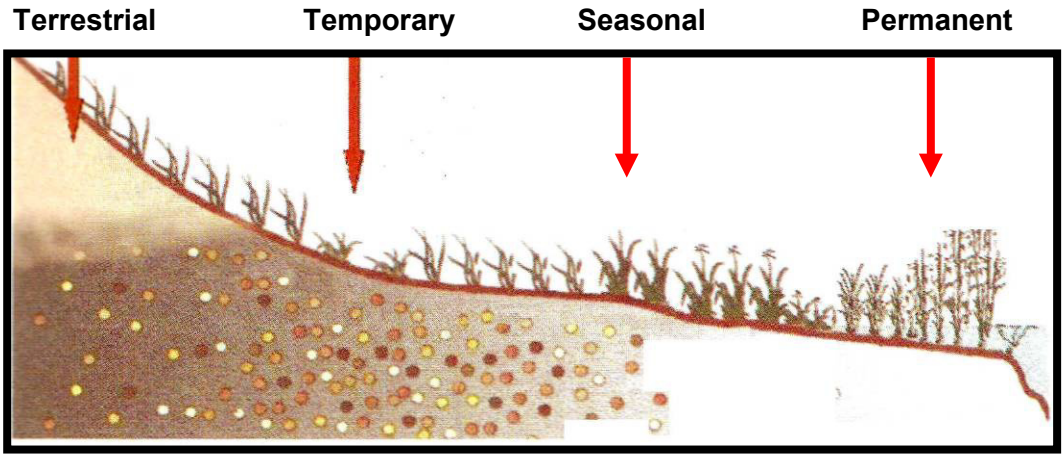



**Figure 3.** Cross section through a valley bottom wetland indicating how soil wetness and vegetation indicators change as one moves along a gradient of decreasing wetness, from the permanent wet hydrological zone to the temporarily wet hydrological zone and eventually into the non-wetland or terrestrial zone (Department of Water Affairs and Forestry, 2003 as adapted by Kotze, 1996)

The word “riparian” is drawn from the Latin word “riparious” meaning “bank” (of the stream). Thus the “a riparian area” is simply the land adjacent to a body of water that is channelled or life on the bank of this body of water (Ilhardt *et al.* 2000).

A riparian zone refers to the interface between land and a river or stream (non-perennial, seasonal, occasional). The term “Riparian” is also the term used to refer to one of the fifteen biomes of the world. Plant species composition of these areas are different from that of the adjacent terrestrial systems as as well as that of the permanently wet or seasonally inundated vegetation areas of the river. These areas are separate ecosystems and not “buffers” as many people see these areas. They support a completely different set of functional characteristics and are large enough although sometimes narrow, to function on their own independently from other systems.

The number of functions that is part of an aquatic ecosystem and contributes to its functioning would decrease the further one moves away from the water. Thus, the probability of a function being part of the riparian system will change across the riparian zone moving toward the terrestrial zone IIlhardt *et al.* (2000).

River areas and associated floodplains are important since they channel water and also supply various terrestrial areas of water and nutrients. The vegetation around river systems present unique habitats that are different from the surrounding terrestrial areas and therefore have unique plant and animal species living in and utilising these areas. Furthermore, these systems are important from a water quality and quantity perspective and any degradation of these systems will negatively influence these aspects.

Humans also use these systems for recreational and economic purposes while sediment is naturally filtered by these water systems.

It is therefore important that these systems are properly managed and protected to ensure their and all other dependant ecosystems’ existence and prevent degradation that could lead to total ecosystem collapse.

Riparian zones are delineated by examining how the ecosystem function, species composition and topography changes with distance from the water. For the purposes of riparian zone delineation using plant species, we (re)define and utilize the following terms (adapted from MacKenzie & Rountree, 2007):

> **Obligate riparian**: these are species which are found almost exclusively in the riparian zone (> 90% probability). It is highly unlikely that they would occur outside the riparian zone and are regarded as indicators of wetness. Obligate riparian species are conservative as such i.e. an obligate will remain an obligate throughout all geographic regions and their occurrence would taper off from the water edge towards the terrestrial areas.

**Preferential riparian**: these are species that are preferentially, but not necessarily always found in the riparian zone (>75% probability). They may be found in terrestrial areas where moist conditions (e.g. indentation of soil with some moisture collection in the soil) occur. They will however, be more abundant closer to riparian areas. These species always indicate sites with increased moisture availability and are therefore good indicator species especially if abundant (a plot of species occurrence from the aquatic zone will peak and taper off predominantly within the riparian zone, but may extend beyond):

**Facultative riparian**: these species may occur in either riparian zones or the upland (>25% probability of occurrence in the riparian zone). They can tolerate a variety of environmental and moisture conditions in the environment. They are therefore not good national indicators, but rather circumstantial indicators depending on the region the study is conducted e.g. a species such as *Searsia pyroides* may not be an indicator of the riparian zone in perennial rivers in one region, but often is useful as an indicator of the riparian zone of ephemeral streams in another region.

**Upland**: these species are mostly terrestrial, and rarely occur in a riparian zone (<25% probability). They therefore characterize terrestrial landscapes that border onto riparian zones. Upland species usually occur in low-abundance in the upper parts of the riparian zone. An abundance of these species in the riparian zone may indicate altered/decreased flows and a subsequent “drying” out of the riparian zone.

## FIELD SURVEYS & DATA ANALYSIS

Prior to the site visit, a desktop study was conducted of the wetland unit/s present on the site using 1:50 000 topographical maps, aerial images obtained from Google Earth and the SANBI BGIS Map Viewer (accessed April 2021).

### *Wetlands*

A Dutch soil auger was used to extract the cores to a depth of 50cm. All soil samples were evaluated in hand for soil composition, colour, number, size and chroma of mottles as well as wetness, after which they were discarded. The location of each soil core was marked using a hand-held Garmin Colorado 300 GPS. Field verification was limited to the presence of hydric soils on the site as well as presence of hygrophytic and hydrophilic vegetation.

Soil auger samples were taken in transects that were laid parallel to each other in the study area. Soil samples were taken along transects radiating away from the visibly ‘wettest’ parts of the area at regular intervals.

### *Riparian areas*

Surveys started at the edge of the water and continued in a transect outwards away from the water. All common obligates within the riparian area were identified and noted. Sample

plots of 0.5 x 0.5 m were placed along the transect and all plant species identifiable noted. The riparian zone extends to where the plant obligates did not occur anymore. The greatest width where obligates occur was then used to delineate the riparian zone.

Terrestrial species normally decline as one moves towards the riparian zone. All nickpoints, down curves and peaks (indicator points) were noted and incorporated within the riparian zone. The riparian zone plays an important ecological role in providing habitat for various plant and animal species, diffusing and assimilating pollutants from the adjacent terrestrial areas. As such the riparian habitat is regarded as part of the aquatic buffer zone (Figure 4).

The edge of the channel is used as the starting point from where the aquatic buffer zone is determined and zoned (Macfarland & Bedin, 2016.). For this study the riparian zone was determined and from there a buffer zone implemented.

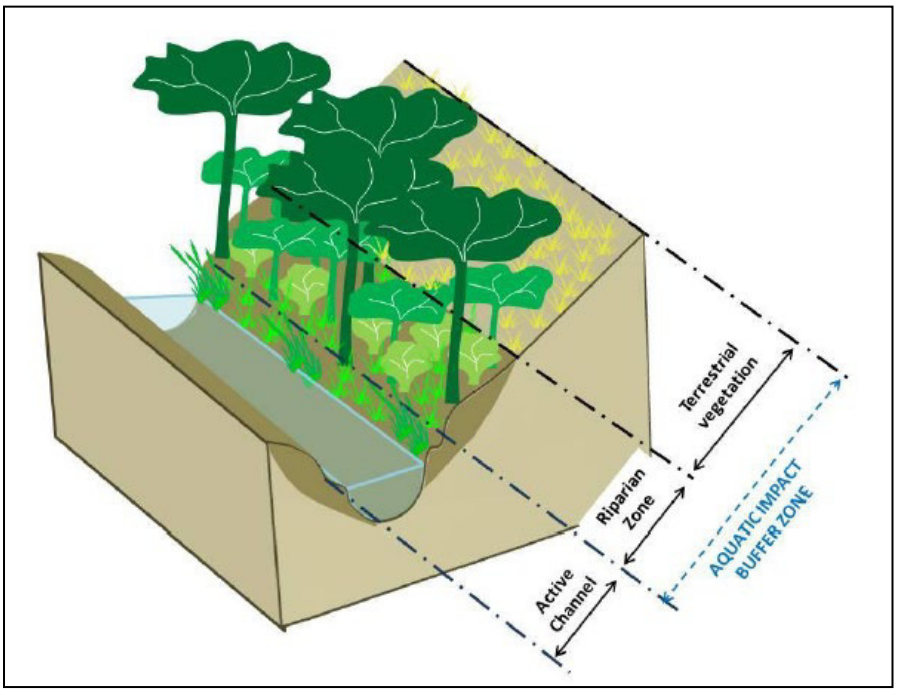



**Figure 4.** Schematic diagram of the riparian habitat (taken from Macfarland & Bredin, 2016)

Other characteristics also used in the delineation of the riparian zone included vegetation structure. There is normally a definite difference in vegetation structure between the riparian zone and the adjacent terrestrial vegetation areas. In most cases the riverine areas consist of larger woody species and a different species composition than that of the terrestrial zone.

Other aspects also measured include the channel width, river depth (estimation), retention time, and usage of the area.

***Watercourse assessment***

**Wetland health**

An adapted Wetland Health assessment was conducted for the stream due to the absence of a natural wetland. The assessment evaluates the intactness of the wetland and is determined by a score known as the Present Ecological Score (PES). The Present Ecological State (PES) refers to the current state or condition of a watercourse in terms of all its characteristics and reflects the change to the watercourse from its reference condition. The health assessments for the hydrology, geomorphology and vegetation components were then represented by the Present Ecological State (PES) categories. The PES categories are divided into six (A-F) units based on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table 2.

**Table 2.** Present Ecological State categories used to define health of water courses (adapted from Kleynhans, 1999).

| Description | PES Score (%) | PES Category |
|---|---|---|
| **Unmodified, natural.** | **90-100** | **A** |
| Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place. | **80-90** | **B** |
| Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact | **60-80** | **C** |
| Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred. | **40-60** | **D** |
| The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable. | **20-40** | **E** |
| Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota. | **0-20** | **F** |

**Ecological Importance and Sensitivity**

The **Ecological Importance and Sensitivity** (EIS) of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales, and both abiotic and biotic components of the system are taken into consideration. Sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The ecological importance and sensitivity categories are indicated in Table 3.

**Table 3.** Ecological Importance & Sensitivity Categories of Wetlands (DWAF, 1999)

| EIS CATEGORIES | DESCRIPTION | RATING |
|---|---|---|
| LOW/MARGINAL | Not ecologically important and sensitive at any scale. The biodiversity of wetland is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers | >0 and <1 |
| MODERATE | Ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers | >1 and <2 |
| HIGH | Ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers | >2 and <3 |
| VERY HIGH | Ecologically important and sensitive on a national (or even international) level. Biodiversity usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in rivers | >3 and <4 |

## Habitat integrity

The Habitat Integrity (HI) evaluation is used to provide a degree of measure to which a stream or river has been modified from its natural state. In order to determine the HI a qualitative assessment is done using various anthropogenic and other factors that could potentially affect the ecosystem. The severity of each impact is ranked using six classes: 0 (no impact); 1-5 (small impact); 6-10 (moderate impact); 11-15 (large impact); 16-20 (serious impact); 21-25 (critical impact) (DWAF 1999). The determination of the HI category is calculated as follows: Total of ratings/maximum valuesx100. The percentage obtained is deducted from 100 and the class determined from the HI category table (Table 4).

**Table 4.** Habitat Integrity for rivers & streams (DWAF, 1999)

| CATEGORY | DESCRIPTION | SCORE (%) |
|---|---|---|
| A | Unmodified, natural | 90-100 |
| B | Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged | 80-89 |
| C | Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged | 60-79 |
| D | Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred | 40-59 |
| E | The loss of natural habitat, biota and basic ecosystem functions is extensive | 20-39 |
| F | Critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat. In worst instances the basic ecosystem functions have been destroyed and changes are irreversible. | 0 |

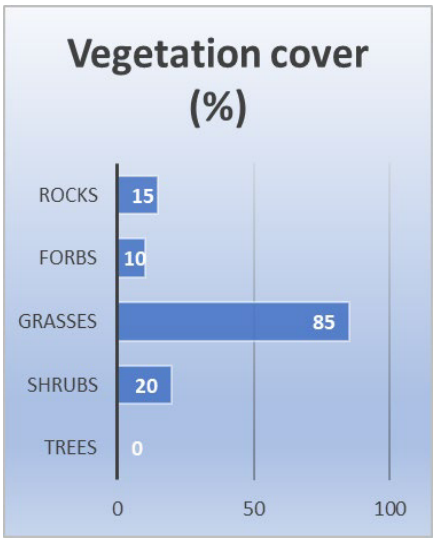
# RESULTS OF THE VEGETATION SURVEY

## Vegetation units

The study area comprises five vegetation units (Figure 5) namely:

1. Rocky grassland
2. *Hyparrhenia hirta* grassland
3. Cultivated fields
4. Stream area
5. Developed areas

## 1. Rocky grassland




| | | | |
|---|---|---|---|
| **Status:** | Semi-natural rocky grassland | | |
| **Topography:** | Southern slope slope ($3^0$) | **Soil** | Loamy gravelly |
| **Unit size** | 11.2 ha | | |
| **Need for rehabilitation** | Medium | | |
| **Conservation Priority** | **Medium** | | |

This vegetation unit is in the south-western section and the south-eastern corner of the study area. The soil is shallow gravelly with rocks covering between 30 and 50% of the area. The grasses have the highest cover followed by the forbs (see figure above). The woody vegetation is represented by the dwarf shrub *Seriphium plumosum* that covers between 15 and 20% of the area.

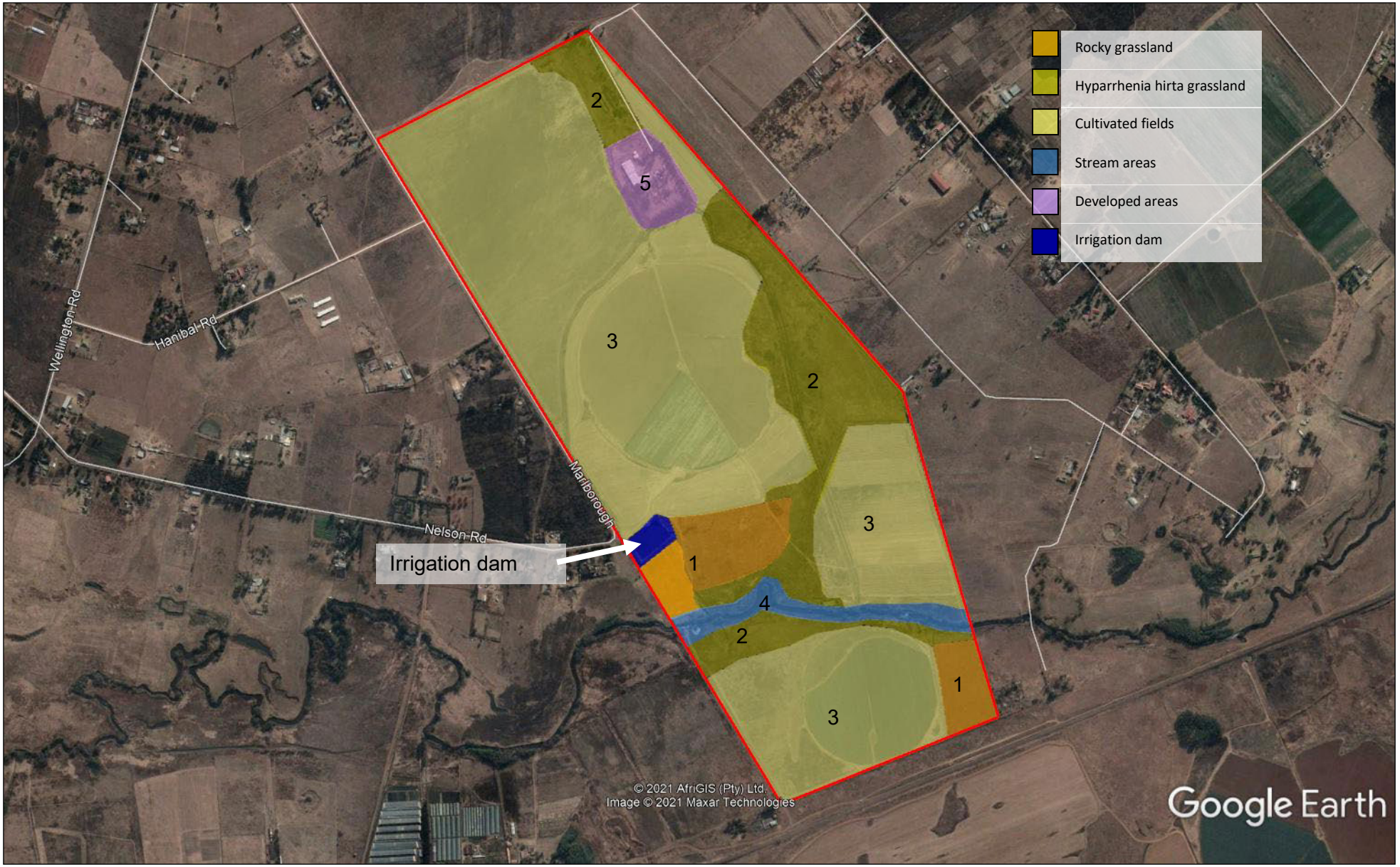



**Figure 5.** Vegetation units of the study area (Image obtained from Google Earth 2021).

The vegetation of this unit is characterised by the dominance the grasses *Themeda triandra* and *Eragrostis chloromelas* together with the dwarf shrub *Seriphium plumosum.* Other species that are prominent include the grasses *Cymbopogon caesius* and *Hyparrhenia hirta.* Other species present include the grasses *Sporobolus africanus, Pogonarthria squarrosa, Heteropogon contortus,* and the forbs *Bidens pilosa, Vernonia oligocephala, Hermannia depressa* and *Felicia muricata.*

The section of this grassland located along the north-western boundary directly below the irrigation dam is moist due to the constant leaching of water from the dam onto this area. As a result, apart from the grass *Themeda triandra,* some moist-loving species such as the grasses *Paspalum urvillei, Paspalum dilatatum, Phragmites australis* and the forbs *Typha capensis* and *Verbena bonariensis* are present in some localities of this section.

*Red data species*

No red data species were found, though marginally suitable habitat exists for two species (Annexure 1).

*Alien plant species*

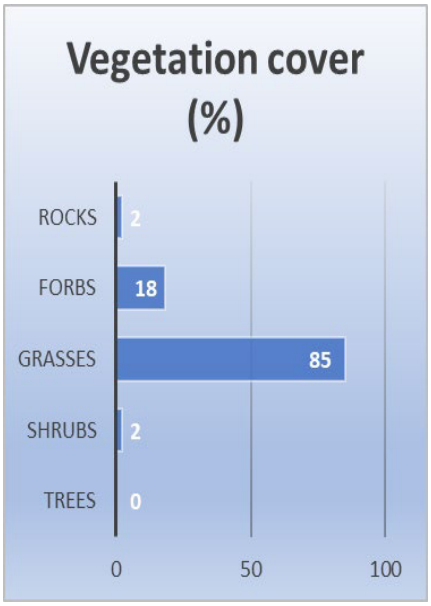
*Verbena bonariensis*

The following is a list of plant species identified in this unit during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid; =pioneer/encroacher) (W=woody; G=grass; F=forb):

| Cat | Species | Class |
|---|---|---|
| | *Acalypha angustata* | F |
| | *Asparagus laricinus* | W |
| | *Berkheya setifera* | F |

| | | |
|---|---|---|
| ◉ | *Bidens pilosa* | F |
| | *Brachiaria serrata* | G |
| | *Bulbine abyssinica* | F |
| | *Cephalaria zeyheriana* | F |
| | *Conyza podocephala* | F |
| | *Chenopodium album* | F |
| | *Cymbopogon caesius* | G |
| ◉ | *Cynodon dactylon* | G |
| | *Dicoma zeyheri* | F |
| | *Eragrostis chloromelas* | G |
| | *Eragrostis curvula* | G |
| | *Eragrostis gummiflua* | G |
| | *Eragrostis racemosa* | G |
| | *Felicia muricata* | F |
| | *Gerbera viridiflora* | F |
| | *Gnidia capitata* | F |
| | *Helichrysum kraussii* | F |
| | *Helichrysum miconiifolium* | F |
| | *Hermannia depressa* | F |
| | *Heteropogon contortus* | G |
| | *Hyparrhenia hirta* | G |
| | *Justicia anagalloides* | F |
| | *Nidorella hottentotica* | F |
| | *Peucedanum magalismontanum* | F |
| | *Pogonarthria squarrosa* | G |
| | *Polygala hottentotica* | F |
| ◉ | *Seriphium plumosum* | W |
| ✚ | *Scabiosa columbaria* | F |
| | *Sporobolus africanus* | G |
| ◉ | *Tagetes minuta* | F |
| | *Tephrosia capensis* | F |
| | *Themeda triandra* | G |
| | *Thesium utile* | F |
| | *Trachypogon spicatus* | G |
| 👹 | *Verbena bonariensis* | F |
| ✚ | *Vernonia oligocephala* | F |
| | *Vernonia poskeana* | F |
| | *Ziziphus zeyheriana* | W |
| | *Zornia milneana* | F |

## 2. *Hyparrhenia hirta* grassland




| | | | |
|---|---|---|---|
| **Status** | Degraded grassland | | |
| **Vegetation structure:** | Medium-tall grassland | | |
| **Topography:** | Southern slope (2-3°) | **Soil** | Loamy to clayey |
| **Unit size:** | 29.4 ha | | |
| **Need for rehabilitation** | High | | |
| **Conservation Priority** | **Low** | | |

This vegetation unit is found in the eastern and southern parts of the study area. The soil is dark brown loamy to clayey with rocks covering less than 3% of the area. The vegetation is dominated by the herbaceous layer with the grasses having the highest canopy cover (see figure top) followed by the forbs. The woody layer is absent.

The vegetation is dominated by the anthropogenic grass *Hyparrhenia hirta* while the grasses *Melinis repens, Eragrostis curvula, Cynodon dactylon* and the forb *Bidens pilosa* form dense patches in areas and are dominant/co-dominant. In some areas the dward encroacher shrub *Seriphium plumosum* is co-dominant with

*Hyparrhenia hirta.* Other species present include the grasses *Aristida congesta* subsp. *barbicollis, Sporobolus africana, Cymbopogon caesius* and the forbs *Conyza bonariensis, Gomphocarpus fruticosus, Pseudognaphalium luteo-album* and *Verbena bonariensis.*

*Red data species*

No red data species were found within this vegetation unit and no such habitat is present.

*Alien plant species*

*Verbena brasiliensis.*

The following is a list of plant species identified in this unit during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid; =pioneer/encroacher) (W=woody; G=grass; F=forb):

| Cat | Species | Class |
|---|---|---|
| | *Aristida congesta subsp barbicollis* | G |
| | *Asparagus laricinus* | W |
| | *Bidens bipinnata* | F |
| | *Bidens pilosa* | F |
| | *Cymbopogon caesius* | G |
| | *Cynodon dactylon* | G |
| | *Eragrostis curvula* | G |
| | *Gomphocarpus fruticosus* | F |
| | *Hyparrhenia dregeana* | G |
| | *Hyparrhenia hirta* | G |
| | *Melinis repens* | F |
| | *Pseudognaphalium luteo-album* | F |
| | *Schkuhria pinnata* | F |
| | *Seriphium plumosum* | W |
| | *Sporobolus africanus* | G |
| | *Tagetes minuta* | F |
| | *Verbena bonariensis* | F |
| | *Vernonia poskeana* | F |

## 3. Cultivated fields

| | | | |
|---|---|---|---|
| **Status:** | Transformed | | |
| **Topography:** | Southern & western slope (1-3°) | **Soil** | Loam & dark clay |
| **Unit size** | 120.3 ha | | |
| **Need for rehabilitation** | High | | |
| **Conservation Priority** | **Low** | | |

This vegetation unit comprises the largest part of the study area. The area consists of a various cultivated fields with a variety of crops planted, while some areas are left fallow for the next season's planting. The fields are actively irrigated with various large drainage channels dug around these fields to channel surface water during rainfall events towards the stream in the south to prevent erosion.

Apart from the planted crops various weedy pioneer species such as the forbs *Tagetes minuta, Bidens pilosa, Schkuhria pinnata* and *datura stramonium* are present within this unit.

*Red data species*

No red data species were found to be present within this unit and no suitable habitat exists.

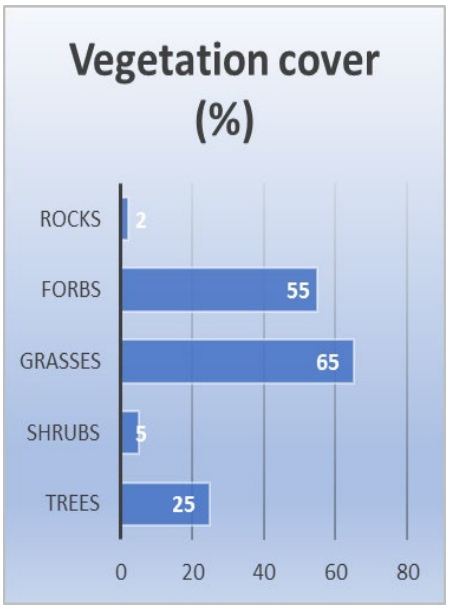
*Alien plant species*

*Datura stramonium, Ricinus communis.*

Apart from the crops the following is a list of plant species identified in this unit during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid; =pioneer/encroacher) (W=woody; G=grass; F=forb):

| Cat | Species | Class |
|---|---|---|
| | *Amaranthus hybridus* | F |
| | *Bidens pilosa* | F |
| | *Cynodon dactylon* | G |
| | *Datura stramonium* | F |
| | *Eragrostis chloromelas* | G |
| | *Eragrostis tef* | G |
| | *Hibiscus trionum* | F |
| | *Poa annua* | G |
| | *Ricinus communis* | |
| | *Schkuhria pinnata* | F |
| | *Sonchus oleraceus* | F |
| | *Tagetes minuta* | F |

## 4. Stream




| | | | |
|---|---|---|---|
| **Status:** | Degraded riverine area and embankment | | |
| **Topography:** | N/A | **Soil** | Dark clay |
| **Unit size** | 5 ha | | |
| **Need for rehabilitation** | High | | |
| **Conservation Priority** | **High** | | |

The perennial Rietspruit flows through the southern part of the study area. This area varies in vegetation composition and structure with large clumps of the declared alien invader tree *Salix babylonica* and the alien invasive grass *Pennisetum clandestinum* (kikuyu) that dominate the vegetation of the embankment and stream. Other species also present on the embankment include the grass *Imperata cylindrica* and the forbs *Bidens pilosa* and *Bidens formosa*. The soil is dark clay with few rocks present.

*Red data species*

No red data species was found within this section though marginally suitable habitat exists for three species (Annexure 1).

*Alien plant species*

*Pennisetum clandestinum; Verbena bonariensis; Xanthium strumarium*

The following is a list of plant species identified in this unit during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid; =pioneer/encroacher) (W=woody; G=grass; F=forb):

| Cat | Species | Class |
|---|---|---|
| | *Asparagus laricinus* | W |
| ◉ | *Bidens pilosa* | F |
| ◉ | *Chenopodium album* | F |
| ◉ | *Conyza podocephala* | F |
| ◉ | *Cosmos bipinnatus* | F |
| ◉ | *Cynodon dactylon* | G |
| | *Imperata cylindrica* | G |
| | *Paspalum dilatatum* | G |
| ◉ 👽 | *Pennisetum clandestinum* | G |
| 👽 | *Salix babylonica* | W |
| | *Sporobolus africanus* | G |
| 👽 | *Verbena bonariensis* | F |
| 👽 | *Xanthium strumarium* | F |

## 5. Developed area

| | | | |
|---|---|---|---|
| **Vegetation structure:** | Houses & outbuildings | | |
| **Topography:** | Mostly level | **Soil** | Red loam |
| **Unit size** | 4.6 ha | | |
| **Need for rehabilitation** | High | | |
| **Conservation Priority** | **Low** | | |

This vegetation unit occurs in the north eastern section of the study area where and consists of houses , store rooms and various outbuildings. The vegetation cover varies.

The vegetation consists of a mixture of ornamental plant species, a few indigenous species to being totally dominated by pioneer weeds such as *Bidens pilosa* and *Tagetes minuta* as well as the alien invasive grass *Pennisetum clandestinum* in areas where the activities have stopped and the structures removed. Tall *Eucalyptus camaldulensis* trees occur around the perimeter of this area.

*Red data species*

No red data species were found to be present in this unit due to the transformed condition thereof.

*Alien plant species*

*Eucalyptus camaldulensis; Ipomoea purpurea; Pinus pinaster.*

The following is a list of plant species identified in unit 1a during the survey (=alien invasive species; =medicinal value; =Protected species; =Garden hybrid; =pioneer/encroacher) (W=woody; G=grass; F=forb):

| Cat | Species | Class |
|---|---|---|
| | *Bidens pilosa* | F |
| | *Cynodon dactylon (L.) Pers.* | G |
| | *Eucalyptus camaldulensis Dehnh.* | W |
| | *Ipomoea purpurea (L.) Roth* | F |
| | *Ligustrum lucidum Thunb.* | W |
| | *Pennisetum clandestinum* | G |
| | *Searsia lancea L.f.* | W |
| | *Tagetes minuta* | F |

## RESULTS OF THE FAUNAL SURVEY

The vegetation unit on which the site is situated is **Carletonville Dolomite Grassland (Gh15)** in various stages of transformation and degradation. The majority of the site comprises of current and old agricultural lands. Large areas where under cultivation or were left fallow for a year. The eastern and southern portions of the site are homogenous *Hyparrhenia hirta* grasslands which have been previously ploughed or utilised for annual grass harvesting activities. The vegetation is dominated by the anthropogenic grass *Hyparrhenia hirta* while the grasses *Melinis repens, Eragrostis curvula, Cymbopogon caesius* are dominant/co-dominant in these areas. The south-western and south-eastern portions of the site are dominated by low-lying rocky grasslands dominated by Themeda triandra and *Eragrostis chloromelas*. Disturbed or overgrazed ares are dominated by the dwarf shrub *Seriphium plumosum.* Moist grasslands or seeps occur below the large irrigation dam on the north-eastern boundary extend towards the Rietspruit. The area is dominated by *Themeda triandra* and other hydrophilic species such as the grasses *Paspalum urvillei, Paspalum dilatatum* as well as the obligate hygrophytes *Phragmites australis* and *Typha capensis*.

The degraded perennial Rietspruit occurs on the southern portion of the site. The riparian zone of the Rietspruit has been impacted by previous agricultural activities and has been colonised by the declared alien invader Weeping Willows (*Salix babylonica*) as well as Kikuyu (*Pennisetum clandestinum*). The banks have been in-filled and deterioration in water quality within active channel. Situated on the north-eastern boundary consists of developed areas with houses, store rooms and various outbuildings. The perimeter is dominated by large alien invasive *Eucalyptus camaldulensis* and *Pinus pinaster.* No surveys were conducted in the developed areas.

**EXISTING IMPACTS ON FAUNA AND VEGETATION ON THE SITE INCLUDE:**

- Change in land use: natural grasslands containing a diversity of vertebrate and invertebrate fauna are converted into irrigated agricultural lands and increased anthropogenic disturbances; leading to considerable loss of faunal biodiversity.
- Small tracts of indigenous grassland become surrounded by extensive transformed and homogenous agricultural lands, major road networks, residential developments (Palm Ridge) causing fragmentation of previously intact natural habitats.
- The remaining remnants of natural grassland are more susceptible to exotic invasion and degradation due to increased edge effects.

- Habitat fragmentation also eliminates corridors between similar undisturbed habitats.
- The fragmentation of interconnected valley bottom wetlands, hillslope seepage wetlands and drainage lines (Rietspruit) from each other and their surrounding terrestrial environment threatens species that move between palustrine wetlands and those that require intact terrestrial habitats in close proximity to valley bottom wetlands or streams (e.g. Giant Bullfrog, Cook 2003). Major road networks (R550) to the north can be considered as migratory or dispersal barriers for numerous faunal species including Giant Bullfrogs, Hedgehogs and Owls.
- Alien vegetation invasion of the perennial Rietspruit riparian zones with Weeping Willow (*Salix* babylonica) and Kikuyu (*Pennisetum clandestinum*)

**The perennial Rietspruit has been severely impacted by surrounding agricultural activities including:**

- The artificial creation of dams and weirs upstream and downstream alters the natural hydrological flow regimes.
- Stormwater channels have disrupted the natural hydrological flow regimes within the adjacent agricultural lands. Surface runoff enters directly into the perennial Rietspruit through artificial drainage channels during heavy downpours.
- The low-lying bridges and culverts results in flow restriction due to collected wood and rubbish forming barriers or scags. This results in the flooding as well as erosion of the surrounding macro-channel banks.
- Extensive littering in the riparian zones and along the edges of the active channels of the rivers as well as washed in from the stormwater pipes.
- Foul smelling water in the perennial Rietspruit due to poor water quality and raw sewerage entering the system due to poorly maintained bulk sewer lines. Consultant has observed extensive sewerage flows in the Palm Ridge area to the north.
- Deterioration of water quality of the perennial Rietspruit from surface runoff from surrounding agricultural activities (pesticides and fertilisers), residential areas, industrial and commercial areas, roads as well as organic pollution (burst bulk sewers, bush toilets and pit latrines).
- Severe bank destabilization and erosion occur along the perennial Rietspruit due to altered flow regimes and clearance of riparian vegetation during previous and current agricultural activities.

- Alien vegetation invasion along the riparian zones of the degraded perennial Rietspruit including Weeping Willow (*Salix babylonica*) and Kikuyu (*Pennisetum clandestinum*).

***Amphibians***

Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried 1989) and are such worthy of both research and conservation effort. This is made additionally relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but as yet is poorly understood (Wyman 1990; Wake 1991). Frog populations throughout the world have crashed dramatically in the last twenty years. Deforestation, wetland draining, and pollution are immediately obvious causes. But other, more fundamental, man-made impacts are causing population declines in 'pristine' habitats such as national parks and remote rainforests. Reductions in atmospheric ozone levels are allowing increased UV-radiation, pollutants are accumulating in natural systems and bacterial and virus distribution is accelerating across the globe (Carruthers 2001). Most frogs have a biphasic life cycle, where eggs laid in water develop into tadpoles and these live in the water until they metamorphose into juvenile fogs living on the land.

This fact coupled with being covered by a semi-permeable skin makes frogs particularly vulnerable to pollutants and other environmental stresses. Consequently, frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment. The Giant Bullfrog (*Pyxicephalus adspersus*) has been chosen as a flagship species for the grassland ecoregion (Cook in le Roux 2002)

Breeding in African frogs is strongly dependent on rain, especially in the drier parts of the country where surface water only remains for a short duration. The majority of frog species in Gauteng Province can be classified as explosive breeders. Explosive breeding frogs utilise ephemeral pans or inundated grasslands for their short duration reproductive cycles.

As the survey was undertaken during daylight hours during the late summer months (April-May 2021), only a few species of frogs were recorded. Ideally, a herpetological survey should be undertaken throughout the duration of the wet season (November-March). It is only during this period accurate frog lists can be compiled. During this survey; fieldwork was augmented with species lists compiled from personal records; data from the South African Frog Atlas Project (SAFAP) and published data, and the list provided in Table below is therefore regarded as likely to be fairly comprehensive.

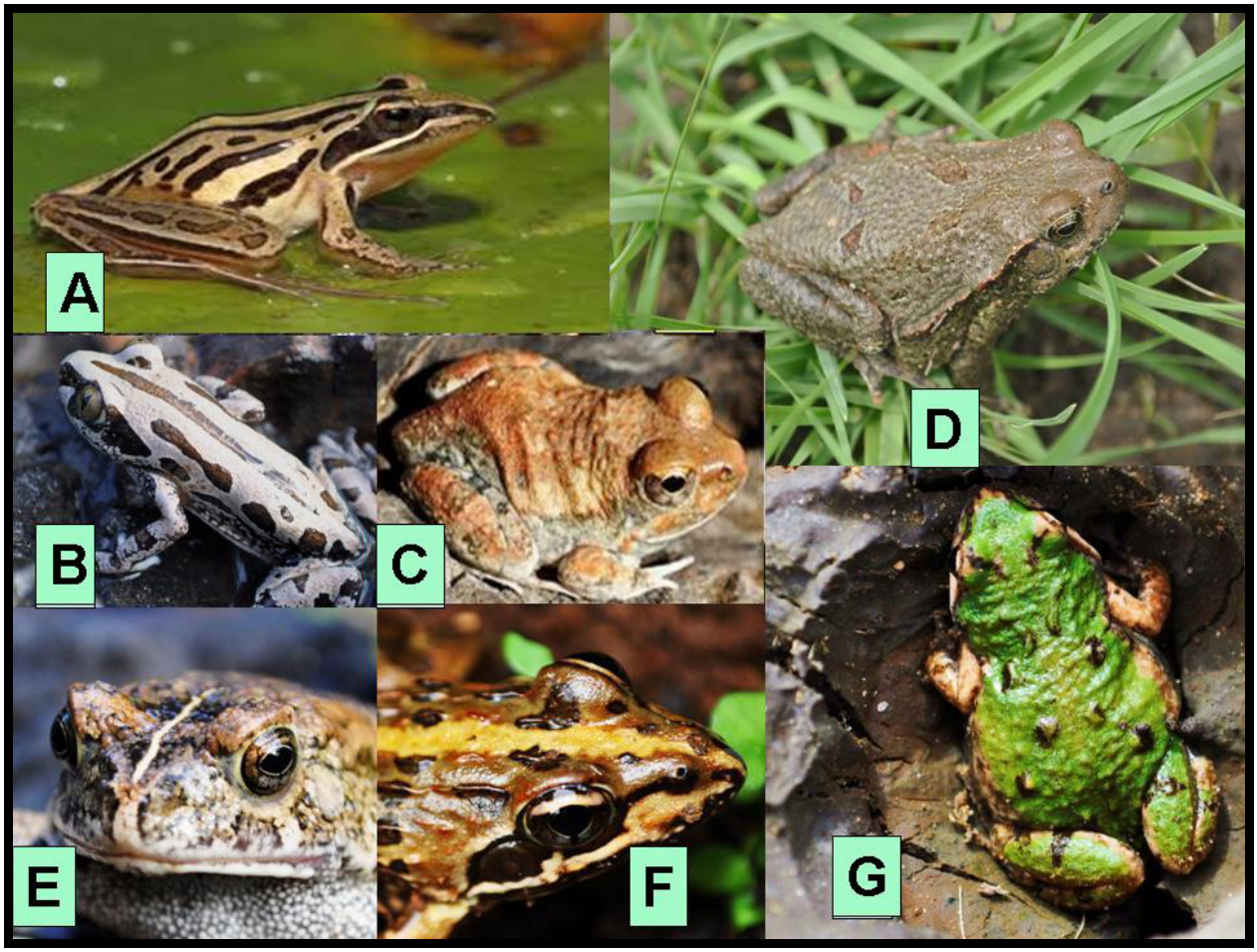



**Figure 6.** **A conglomerate of photographs displaying the frog species recorded by the consultant within the Midvaal area. A:** Striped Stream Frog (Strongylopus fasciatus) **B:** Bubbling Kassina (*Kassina senegalensis*) **C:** Natal Sand Frog (*Tomopterna cryptotis*), **D:** Red Toad (*Schismaderma carens*), **E:** Guttural Toad (*Sclerophrys gutturalis*), F: Delalande's River Frog (*Amietia delalandii*), **G:** Boettger's Caco (*Cacosternum boettgeri*).

**Table 5.** Frog species recorded by the consultant in the Midvaal area. Species highlighted in yellow were recorded during current survey.

| COMMON NAME | SCIENTIFIC NAME | BREEDING HABITAT |
|---|---|---|
| Olive Toad | *Sclerophrys garmani* | Seasonal and permanent wetlands and artificial dams |
| Guttural Toad | *Sclerophrys gutturalis* | Seasonal and permanent wetlands and artificial dams. Adult collected below dam within moist grasslands. |
| Raucous Toad | *Sclerophrys capensis* | Seasonal and permanent pans, dams |
| Red Toad | *Schismaderma carens* | Deeper (>1m) *Typha capensis-Phragmites australis* seasonal and permanent dams. |

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| Common Platanna | *Xenopus laevis* | Seasonal and permanent pans and dams. Adult observed in irrigation dam. |
| Boettger's or Common Caco | *Cacosternum boettgeri* | Seasonal pans and inundated grassland. Calling from moist grassland below dam wall |
| Bubbling Kassina | *Kassina senegalensis* | Seasonal pans and inundated grassland |
| Tremelo Sand Frog | *Tomopterna cryptotis* | Seasonal pans and inundated grassland |
| Natal Sand Frog | *Tomopterna natalensis* | Seasonal pans and inundated grassland |
| Delalande's River Frog | *Amietia delalandii* | Seasonal and permanent wetlands, Rivers and Streams. |
| Cape River Frog | *Amietia fuscigula* | Farm dams, permanent rivers and streams. |
| Poynton's River Frog | | Permanent rivers and streams, farm dams and water features. |

The site offers suitable foraging and dispersal habitat for three toad species namely Guttural Toad (*Sclerophrys gutturalis*), Olive Toad (*Sclerophrys garmani*) and Raucous Toad (*Sclerophrys capensis*) which could potentially breed in the farm dam on the western boundary as well as small dam adjacent tol Rietspruit on the southern portion of the site.
The Rietspruit potentially provides suitable habitat for three species of river frogs namely Delalande's River Frog (*Amietia delalandii*), Cape River Frog (*Amietia fuscigula*) and Poynton's River Frog (*Amietia poyntoni*). An adult river frog was flushed from the macrochannel banks of the Rietspruit; but could not be positively identified. Red Toads (*Schismaderma carens*) favour rocky grassland areas as well as *Typha capensis* dominated deeper permanent waterbodies.

The large irrigation dam with steep, poorly vegetated embankments and margins offers limited suitable breeding habitat for frog species The small artificial depressions/pools below the large irrigation dam as well as moist grasslands and reeds offers suitable breeding habitat for Tremelo Sand Frogs (*Tomopterna cryptotis*), Natal Sand Frogs (*Tomopterna natalensis*), Common Caco (*Cacosternum boettgeri*) and Bubbling Kassina (*Kassina senegalensis*). The creation of artificial drainage channels on the western boundary, central and eastern portion of the site have disrupted the natural hydrological patterns towards the Rietspruit. The artificial drainage channels could provide breeding habitat for certain frog species such as Common Caco (Cacosternum boettgeri), Bubbling Kassina (Kassina senegalensis), Natal sand Frog (Tomopterna natalensis) and Tremelo Sand Frog (*Tomopterna cryptotis*). The channels disrupt the natural dispersal movements of frogs between the grasslands and the lower-lying Rietspruit.

The majority of frog species in the area, including the threatened Giant Bullfrog breed in shallow seasonally inundated pools or depressions which are well vegetated with hygrophilous and hydrophilic grassland and sedge vegetation. The destruction and transformation of the majority of seepage wetlands in the area due to on-going agricultural activities as well as deterioration of water quality within the lower-lying Rietspruit will have had a high impact on remaining frog species.

## Reptiles

Most knowledge of the reptiles of Gauteng is based on the extensive survey done by N.H.G. Jacobsen (1989); providing a detailed account of all reptiles in the then Transvaal province. This survey resulted in descriptions of life histories, habitat requirements and conservation status and maps of the known distributions. More recent surveys have revealed that 92 reptile species (Whittington-Jones *et al.* 2008) occur in Gauteng Province and of these, 2 species are threatened mainly due to habitat destruction as well as habitat fragmentation.

Comprehensive reptile species lists are impossible to determine without extensive fieldwork over a number of months or even years. No pitfall or funnel trapping was conducted due to time constraints and the survey was based primarily on visual encounters.

This method entails active searching in suitable habitat components such as searching in the different vegetation communities, turning over objects such as logs and loosely embedded rocks, searching in crevices in rocks and bark and replacing all surface objects after examining the ground beneath. Logs, termite mounds and other substrates are not torn apart to minimize disturbance to important habitat elements in the sample unit. Observers note only presence of individuals or sign and identify the detection to the most specific taxonomic level possible. Specimens are only captured when necessary to confirm identification especially of difficult to distinguish species.

The majority reptile species are sensitive to severe habitat alteration and fragmentation. Due to current and historic agricultural activities in the area coupled with increased habitat destruction for urban expansion to the north of the site (Palm Ridge), degradation (alien plant invasion) and disturbances are all causal factors in the alteration of reptile species occurring in these areas. The indiscriminate killing of all snake species as well as the illegal collecting of certain species for private and the commercial pet industry reduces reptile

populations especially snake populations drastically. The frequent burning or harvesting of the grasslands on the site will have a high impact on remaining reptiles. Fires during the winter months will severely impact on the hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

Because of human presence in the area, coupled with habitat destruction and disturbances with current agricultural activities and more recent increased urban sprawl to the north, alterations to the original reptilian fauna are expected to have already occurred within and adjacent to the Rietspruit site. The majority reptile species are sensitive to severe habitat alteration and fragmentation of the open Highveld grasslands as well as quartzite and andesite ridges and granitic and dolomitic rocky outcrops. Due to current agricultural activities on the site and adjacent areas; coupled with increased habitat destruction and degradation (alien plant invasion) and disturbances are all causal factors in the alteration of reptile species occurring in these areas.

A few active termite mounds as well as limited old moribund mounds were observed within the non-arable rocky *Themeda triandra-Eragrostis chloromelas* grasslands on the south-western and south-eastern portions of the site above the Rietspruit. Moribund (old abandoned or dead mounds) termite mounds offer important refuges for certain frog, lizard and snake species (Striped Harlequin Snake, Aurora House Snake). Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). These mass emergences coincide with the first heavy summer rains and the emergence of the majority of herpetofauna.

Reptile species recorded within the *Themeda triandra-Eragrostis chloromelas* rocky grasslands on the south-western and south-eastern portions of the site included Distants' Ground Agama (*Agama aculeata distanti*), Yellow-Throated Plated Lizard (*Gerrhosaurus flavigularis*), Speckled Rock Skink (*Trachylepis punctatissima*), Cape Skink (*Trachylepis capensis*), Southern Rock Agama (*Agama atra*) and Transvaal Thick-toed Gecko (*Pachydactylus affinis*). Several artificial rock piles have been formed from clearing of rock material from adjacent agricultural lands.

Snake species likely to occur on and around the site include Rinkhals (Haemachatus haemachatus), Black-headed Centipede Eater (*Aparallactus capensis)*, Rhombic Egg-eater (Dasypeltis scabra), Red-lipped Snake (*Crotaphopeltis hotamboeia*), Brown House Snake

(*Boaedon capensis*), Mole Snake (*Pseudaspis cana*) Aurora House Snake (*Lamprophis aurora*), Brown Water Snake (*Lycodonomorphus rufulus*), Spotted Grass Snake (*Psammophylax rhombeatus*), Striped Grass Snake (*Psammophylax tritaeniatus*), Puff Adder (*Bitis arietans*), Rhombic Night Adder (*Causus rhombeatus*). Population sizes are expected to be low due to high levels of habitat transformation as well as high levels of anthropogenic disturbances. Illegal reptile collecting will have a high impact on the small populations of snake species. No snake species were observed during the two site visitations.

The degraded perennial Rietspruit on the southern portion as well as the irrigation dam provides suitable habitat for Nile Monitor (*Varanus niloticus*) and the South African or Marsh Terrapin (*Pelomedusa galeata*). The artificially excavated drainage channels are dispersal barriers for certain smaller reptile species


**Figure 7.** **A collage of photographs displaying reptile species recorded by the consultant within the Midvaal-Suikerbosrand area. A:** Common Night Adder (*Causus rhombeatus*) feeding on a Raucous Toad (*Sclerophrys capensis*), **B:** White-throated or Rock Monitor (*Varanus albigularis albigularis*) **C:** Black-headed Centipede Eater (*Aparallactus capensis*), **D:** Flap Necked-Chameleon (*Chamaeleo dilepis*), **E:** Transvaal or Thick-toed Gecko (*Pachydactylus affinis*), **F:** Leopard Tortoise (*Stigmochelys pardalis*), **G:** Herald or Red Lipped Snake (*Crotaphopeltis hotamboeia*), **H:** Water Monitor (*Varanus niloticus*) and **I:** Mole Snake (*Pseudaspis cana*).

**Table 6.** Reptile species recorded from the site (*) and within the Midvaal area by the consultant during previous surveys (2000-2021). Actual species lists for the site will most likely contain far fewer species due to extensive habitat destruction and degradation and high levels of anthropogenic disturbances on and surrounding the site.

| Common Name | Scientific Name | Habitat Requirements |
|---|---|---|
| Marsh or helmeted Terrapin | *Pelomedusa galeata* | Artificially created dams. |
| Peter's Thread Snake | *Leptotyphlops scutifrons* | Fossorial found in soil under rocks or |
| Incognito Worm Snake | *Leptotyphlops incognitus* | Logs, in moribund termite mounds. |
| Jacobsen's Worm Snake | *Leptotyphlops jacobseni* | Fossorial found in soil under rocks |
| *Cape Skink | *Trachylepis capensis* | Terrestrial digging tunnels in loose sand at the base of bushes or boulders, also favours dead trees and fallen Aloes. |
| * Speckled Rock Skink | *Trachylepis punctatissima* | A mostly rock-living diurnal skink the Spotted Skink often occurs in association with man-made structures where it is able to find refuge and food and may be unwittingly translocated in boxes, firewood and other items where it has taken refuge |
| Wahlberg's Snake-eyed skink | *Panapsis wahlbergii* | Amongst grass roots under rotting logs and around stones and old termitaria (Moribund) on broken ground. Eats termites and other small insects. |
| Variable Skink | *Trachylepis varia* | Another terrestrial and diurnal skink, the Variable Skink is widespread although not very frequently recorded from disturbed habitats. It occupies a wide variety of habitats where there is sufficient vegetative cover. It takes refuge in a wide range of shelters including under rocks on soil, in crevices, under building rubble and in the burrows of other animals. |
| Common Rough-scaled Lizard | *Ichnotropis squamulosa* | Active hunters on sandy flat clearings and dig branching burrows in soft sand, usually at the base of *Vachellia* and *Senegalia* trees as well as grass tussocks. |
| Spotted Sand Lizard | *Pedioplanis lineoocellata* | Prefer flat rocky veld. Shelter is small burrows dug underneath a flat rock. |
| *Transvaal Thick-toed gecko | *Pachydactylus affinis* | Rocky outcrops and old termite mounds. |
| Cape Thick-toed Gecko | *Pachydactylus capensis* | Rocky outcrops, under logs and old termite mounds as well as houses. |
| *Cape Dwarf Gecko | *Lygodactylus capensis* | Well-wooded savanna but also thrives in urban areas. |
| *Yellow-throated Plated Lizard | *Gerrhosaurus flavigularis* | A common and widespread terrestrial lizard, usually associated with a dense ground cover. They dig burrows at the base of bushes, |

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| | | under boulders and also under rubbish piles. The often take refuge in the burrows of other animals |
| Transvaal Girdled Lizard | *Cordylus vittifer* | The Transvaal Girdled Lizard is rupicolus and restricted to rocky outcrops, inhabiting fissures between rocks and under rocks. |
| *Distant's Ground Agama | *Agama aculeata distanti* | Terrestrial but will often climb in a low shrub to bask. A short hole dug at the base of a bush or under a rock serves as a retreat. |
| Southern Rock Agama | *Agama atra* | Rupicolus living on rocky outcrops and even shelter under the bark of a tree. |
| Rock Monitor | *Varanus albigularis* | Terrestrial but will often climb trees and may spend a large proportion of their time on rocky outcrops. They usually have a retreat in a rock fissure, a hole in a tree, animal burrows or in a termitarium. |
| Water Monitor | *Varanus niloticus* | Terrestrial semi-aquatic lizards usually found close to water. |
| Flap-necked Chameleon | *Chamaeleo dilepis* | Arboreal species found in moist and dry savannah and woodlands |
| Southern Stiletto Snake or Bibron's Burrowing Asp | *Atractaspis bibronii* | A burrowing (fossorial) species usually found in deserted (moribund) termite mounds, under rotting logs or beneath sun-warmed rocks. |
| Herald or red-lipped Snake | *Crotaphopeltis hotamboeia* | A common and widespread nocturnal snake, the Herald Snake feeds on frogs and toads which it finds around houses and in moister areas. Takes refuge under rocks and in moribund termitaria and in building rubble but may rest up by day in a variety of cover. |
| Rinkhals | *Haemachatus Haemachatus* | The Rinkhals is a widespread snake primarily inhabiting moister areas in Highveld grassland. Although formerly common in parts of its range, its habitat has been depleted by urban expansion. It tends to inhabit the burrows of other animals<br>and is mostly nocturnal although basking in the sun during the day. Feeds mostly on amphibians and rodents |
| Mole Snake | *Pseudapsis cana* | Adults may reach 2m in length but are mostly smaller in this area. A diurnal snake they feed on mice and rats and also African Molerats which are widespread. It takes refuge within the burrows of other animals. |
| Rhombic Night Adder | *Causus rhombeatus* | Favours damp environments in moist savanna where it seeks refuge in old termite mounds, |

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| | | under logs and large flat stones as well as amongst building rubble. |
| Common Egg Eater | *Dasypeltis scabra* | A common and widespread nocturnal snake, the Common Egg-eater is largely dependent on dead termitaria on the Highveld where little other cover is available. It will also shelter under rocks, in crevices, under building rubble and in a variety of other refuges when available. The snake is dependent on bird's eggs as a source of food which they locate by means of a fine sense of smell. |
| Brown House Snake | *Lamprophis fuliginosus* | Frequents human habitation as well as under loosely embedded rocks. |
| Aurora House Snake | *Lamprophis aurora* | Favours moist grassland habitat adjacent to wetlands/valley bottom; often use moribund termite mounds in grassland; loosely embedded rocks |
| Spotted Grass Snake/ Skaapsteker | *Psammophylax rhombeatus* | A common and widespread diurnal snake mostly in highveld grassland it feeds on lizards and small rodents. It is often seen foraging in rocky and moist areas but takes refuge under rocks, in dead termitaria, old building rubble and animal burrows sometimes in the company of other snakes. Feeds mostly on frogs, lizards and rodents |
| Striped Grass Snake/ Skaapsteker | *Psammophylax tritaeniatus* | A common and widespread diurnal snake mostly in highveld grassland it feeds on lizards and small rodents. It is often seen foraging in rocky and moist areas but takes refuge under rocks, in dead termitaria, old building rubble and animal burrows sometimes in the company of other snakes. Feeds mostly on frogs, lizards and rodents |
| Cape or Black-Headed Centipede Eater | *Aparallactus capensis* | A burrowing (fossorial) species usually found in deserted (moribund) termite mounds, under rotting logs or beneath sun-warmed rocks. |
| Spotted Bush-Snake | *Philothamnus semivariegatus* | Moist savannah, forests, urban areas |
| Short-snouted Whip Snake | *Psammophis brevirostris* | Grassland and moist savanna that dashes for cover when disturbed. May also venture into low shrubs to bask. |
| Crossed Whip Snake | *Psammophis crucifer* | Moist savanna seeking refuge under stones or disused termitaria. |
| Common Brown Water Snake | *Lycodonomorphus rufulus* | A nocturnal, aquatic snake confined to damp localities near streams and rivers. |

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| Sundevall's Shovel-snout | *Prosymna sundevalli* | Found in old termite mounds and under rocks |
| Common Slug-eater | *Duberria lutrix* | Grassland species that favours damp localities often found under rocks, logs, grass tufts and vegetation. |
| Common or Cape Wolf Snake | *Lycophidion capense* | Moist savanna and grassland and is fond of damp localities and is often found under stones, logs, piles of thatch grass, rubbish heaps or in deserted termite mounds. |
| Puff Adder | *Bitis arietans* | Rocky areas within grasslands/savanna. |
| Leopard Tortoise | *Stigmochelys pardalis* | Semi-arid savannas to grassland |
| Spekes' Hinged Tortoise | *Kinixys spekii* | Vachellia and Combretum woodlands as well as bushveld |
| Lobatse Hinged Tortoise | *Kinixys lobatsiana* | Savannahs and dry bush with rocky areas. |

***Avifauna/Birds***

A comprehensive bird species list requires intensive surveys compiled over several years. Numbers of bird species in the Midvaal-Nigel areas have declined mainly due to increased levels of human disturbances; extensive habitat transformation due to increased urban sprawl and agricultural activities; as well as severe habitat transformation and degradation of the wetlands as well as severe degradation of the rivers (Rietspruit). Human activity has transformed grasslands in South Africa to a point where few pristine examples exist (Low & Rebelo 1996; Barnes 1998). Factors such as agricultural intensification, increased pasture management (overgrazing), decrease in grassland management due to frequent fires and extensive land-use alteration (urbanisation and land invasion).

Continuing pressure as well as high levels of anthropogenic disturbances on remaining fragmented open Carletonville Dolomite grasslands and sensitive plaustrine wetlands; including pans, seepage wetlands and valley bottom wetlands, are largely responsible for the decline of the threatened avifaunal species in the area.

Two-hundred and thirty-one (231) bird species have been recorded from the 2625_2805 pentad in which the Rietspruit site is situated. Fifty-two (52) bird species were recorded during the brief field survey (total 8 hours). Species recorded during the field survey are common, widespread and typical of fairly uniform grassland and agricultural lands as well as degraded riverine habitat. Bird species observed within the open rocky grasslands on the south-western and south-eastern portions of the site included Northern Black Korhaan, Zitting Cisticola, Black-chested Prinia, Long-tailed Widowbird, Rufous-naped Lark, Cape

Longclaw, Ant-eating Chat, Common Fiscal, Cattle Egret, Hadedah and granivores such as Common Waxbill, Cape Turtle Dove, Laughing Dove, Cape and Southern Masked Weaver.

Species recorded within the fallow agricultural lands included Helmeted Gunieafowls, African Stonechat, Crowned Lapwing, Rufous-naped Lark, Red-capped Lark, African Pipit, Swainson's Spurfowl, Cape Turtle Dove, Laughing Dove, Cape and Southern Masked Weaver and Southern Red Bishop.

A Black-winged Kite was observed hunting within the fallow agricultural lands. Several Amur Falcons were observed foraging from the powerlines along the R550. No large raptor nests were observed within the large *Eucalyptus camaldulensis* on the north-eastern portion of the site

The large irrigation dam provides suitable habitat for certain waterfowl such as Red-nobbed Coot, Reed Commorant, Grey Heron, Sacred Ibis, and Egyptian Goose. No significant reed beds occur for nesting and roosting for weavers and waxbills. No owls were flushed from the hygrophilous grasses below the dam wall. An adult Jackal Buzard was observed flying overhead. A Hamerkop was flushed from the Rietspruit. No kingfishers were observed along the degraded Rietspruit.

***Mammals***

The mammal survey was based primarily from a desktop screening perspective and field verification (8 hours) assessing the habitat availability during daylight hours. No small mammal trapping or camera trapping was conducted during the site visitations. Fieldwork was augmented with previous surveys in similar habitats within the Midvaal area as well as published data. The area was initially traversed on foot to ascertain the presence of available refuges, spoors or droppings within the rocky *Themeda triandra* grasslands*;* secondary *Hyparrhenia hirta-Melinis repens* grasslands and long the macro-channel embankments of the perennial Rietspruit and irrigation dam. For medium and large mammals, visual encounters of the actual animal as well as spoor or tracks, scat, foraging marks were noted and used for species identification.

Antelope species likely to occur in the area include Bush or Common Duiker (*Sylvicapra grimmia*), Southern Reed Buck (*Redunca arundinum*) and Steenbok (*Raphicerus campestris*). The population sizes will depend on the current levels of anthropogenic disturbances as well as illegal poaching within the site and neighbouring properties. High

levels of anthropogenic disturbances are expected within the open grasslands towards the north (Palm Ridge) where hunting with dogs has been observed by the consultant.

The rocky *Themeda triandra- Eragrostis chloromelas* grasslands provide suitable habitat for smaller rodents including Striped mouse (*Rhabdomys pumilio*), Multimammate Mouse (*Mastomys coucha*), Bushveld Gerbil (*Gerbilliscus leucogaster*), Highveld Gerbil (*Gerbilliscus brantsii)*, Grey Climbing Mouse (*Dendromus melanotus*) and Fat Mouse (*Steatomys pratensis*). The scattered termite mounds within the open grasslands provide suitable habitat for Least Dwarf Shrew (*Suncus infinitesimus*). The open grasslands and old agricultural lands offer suitable habitat for Yellow Mongoose (*Cynictis penicillata*), Striped Polecats ((*Ictonyx striatus*) and Black-backed Jackal (*Canis mesomelas)*. A scat of a Slender Mongoose (*Galerella sanguinea*) as well as Black-backed Jackal (*Canis mesomelas)* was observed within the rocky grasslands.

Mammal species observed within the secondary succession degraded *Hyparrhenia hirta-Melinis repens* grasslands on the site included scattered African Molerat (*Cryptomys hottentotus*) mounds as well as possible burrows of Natal Multimammate Mouse (*Mastomys coucha*). A Scrub Hare (*Lepus saxatilis*) was flushed from the dense *Hyparrhenia hirta* grasslands.

The mesic or hydrophilic grasslands below the irrigation dam on the western boundary provides suitable habitat for Striped mouse (*Rhabdomys pumilio*), Veld Rat (*Aethomys chrysophilus*), Greater Canerat (*Thryonomys swinderianus*), Swamp Musk Shrew (*Crocidura mariquensis*), and Vlei Rat (*Otomys sp.*).

**The site was also surveyed for the following wetland associated mammals:**

**Cape Clawless Otters (*Aonyx capensis*)**

The permanent irrigation dam and degraded perennial Rietspruit provides suitable refuge and dispersal habitat for any remaining Cape Clawless Otters. The irrigation dam and degraded Rietspruit contains limited suitable prey items including crabs, frogs, fish and other aquatic life due top extremely poor water quality and degradation of the riparian zones. Limited refuge areas remain along the Rietspruit.. High levels of anthropogenic disturbances to the north of the site as well as major road networks are immediate threat to remaining Cape Clawless Otters. No evidence (scats or spoor) of otters were observed along the riparian zones of the degraded perennial Rietspruit and embankments of artificially created irrigation dam.

**Spotted-necked Otter (*Lutra maculicollis*)**

Spotted-necked otters are adapted ideally to an aquatic life and are confined to the larger river systems, dams, lakes and swamps which have extensive areas of open water. No suitable habitat occurs for this species on the actual site or surrounding area.

**Water or Marsh Mongoose (*Atilax paludinosus*)**

The permanent irrigation dam and degraded perennial Rietspruit provides marginally suitable for Water/ Marsh Mongoose. The reed beds below the dam wall offer suitable refuge habitat for Water Mongooses. The dam contains limited suitable prey items including crabs, frogs, fish and other aquatic life due to limited habitat diversity. High levels of anthropogenic disturbances, deterioration of water quality within the Rietspruit as well as major road networks are immediate threat to remaining Marsh Mongoose. No evidence (scats or spoor) of otters were observed along the riparian zones of the degraded perennial Rietspruit and embankments of artificially created irrigation dam.

**Rough-haired Golden Mole (*Chrysospalax villosus*)**

Extremely limited suitable habitat occurs on the site in the form of the moist seepage areas and sandy soils below the artificially created irrigation dam wall on the western boundary.

**African Marsh Rat or Water Rat (*Dasymys incomtus*)**

No suitable habitat within the irrigation dam or degraded Rietpsruit for Water Rats.

**Vlei Rat (*Otomys irroratus*)**

Suitable habitat exists on the site within the reed beds as well as among the semi-aquatic grasses below the artificially created irrigation dam wall on the western boundary. No runs or saucer shaped nests were observed on higher lying ground or in clumps of grass. No feeding areas were noted (short discarded grass stems) on the site.

No evidence of any wetland/riverine associated mammals were observed within the perennial Rietspruit and around the artificially embanked irrigation dam.

Bat species likely to occur in the area include Egyptian Free-tailed Bat (*Tadarida aegyptiaca*), Rusty Bat (*Pipistrellus rusticus*), Cape serotine bat (*Eptesicus capensis*), Yellow House Bat (*Scotophilus dinganii*), Common Slit-faced Bat (*Nycteris thebaica*). No specialist mammal/ bat surveys were undertaken during the current faunal habitat assessment.


**Figure 8.** **A collage of photographs of smaller mammal species likely to occur on the site.** **A:** Highveld Gerbil (*Gerbilliscus brantsii*) are likely to occur within the open grasslands adjacent to the perennial Rietspruit as well as fallow agricultural lands; **B:** Yellow Mongoose (*Cynictis pencillata*) are likely to occur within the open grasslands and attracted to the increased rodents within the fallow agricultural lands. **C:** Suitable habitat for Striped Mouse (*Rhabdomys pumilio*) occurs within the open grasslands. **D:** Scrub Hares (*Lepus saxatilis*) was flushed from the rank *Hyparrhenia hirta* grasslands on the site.

**Table 7**. Mammal species recorded, or likely to occur, on site and surrounding area using alternative habitats as indicators of possible species present. Actual species lists will most likely contain far fewer species due to extensive habitat destruction and degradation as well as current high levels of anthropogenic activities on and surrounding the site.

| COMMON NAME | SCIENTIFIC NAME |
|---|---|
| Tomb Bat | *Taphozous mauritianus* |
| Transvaal free-tailed Bat | *Tadarida ventralis* |
| Egyptian free-tailed Bat | *Tadarida aegyptiaca* |
| Cape Serotine Bat | *Eptesicus capensis* |
| Yellow House Bat | *Scotophilus dinganii* |
| Lesser Yellow House Bat | *Scotophilus borbonicus* |

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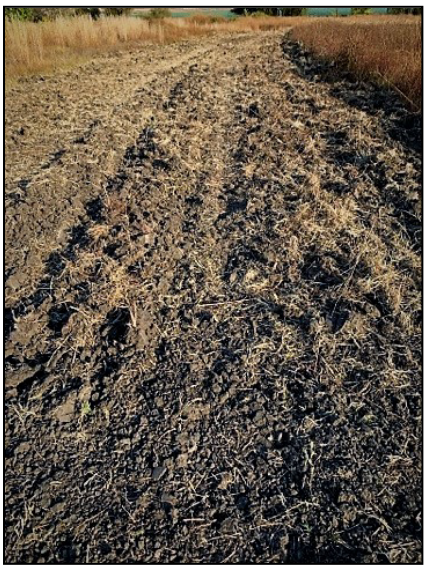
|---|---|
| Reddish-grey Musk Shrew | *Crocidura cyanea* |
| Tiny Musk Shrew | *Crocidura fuscomurina* |
| Swamp Musk Shrew | *Crocidura mariquensis* |
| Least Dwarf Shrew | *Suncus infinitesimus* |
| South African Hedgehog | *Atelerix frontalis* |
| *Scrub Hare | *Lepus saxatilis* |
| House Mouse | *Mus musculus* |
| *Common Molerat | *Cryptomys hottentotus* |
| Angoni Vlei Rat | *Otomys angoniensis* |
| Vlei Rat | *Otomys irroratus* |
| Striped Mouse | *Rhabdomys pumilio* |
| Water Rat | *Dasyymys incomtus* |
| Pygmy Mouse | *Mus minutoides* |
| *Multimammate Mouse | *Mastomys coucha* |
| Namaqua Rock Mouse | *Aethomys namaquensis* |
| Red Veld Rat | *Aethomys chrysophilus* |
| **House Rat | *Rattus rattus* |
| Highveld Gerbil | *Gerbilliscus brantsii* |
| Grey Climbing Mouse | *Dendromus melanotis* |
| Brant's Climbing Mouse | *Dendromus mesomelas* |
| Chestnut Climbing Mouse | *Dendromus mystacalis* |
| Fat Mouse | *Steatomys pratensis* |
| Porcupine | *Hystrix africaeaustralis* |
| African Weasel | *Poecilogale albinucha* |
| Striped Polecat | *Ictonyx striatus* |
| Small-spotted Genet | *Genetta genetta* |
| *Yellow Mongoose | *Cynictis penicillata* |
| *Slender Mongoose | *Galerella sanguinea* |
| Water or Marsh Mongoose | *Atilax paludinosus* |
| *Black-backed Jackal | *Canis mesomelas* |
| Common Duiker | *Sylvicapra grimmia* |
| Steenbok | *Raphicerus campestris* |
| Southern Reed Buck | *Redunca arundinum* |

***** Field observations of mammal species recorded on the site and surrounding vicinity during the brief site visit (27th and 29th April 2021). Identification was determined by visual observation and animal tracks (footprints and droppings).

**** introduced species**

## WATERCOURSE ASSESSMENT

No natural wetland was found to be present within the study area nor is there any wetland areas listed on the SANBI GIS database. Dark clay soil is present in the lower-lying areas of the study area, some of which some are ploughed and planted with crops (see photo right). A moist area with a mixture of moist-loving and terrestrial species were found to be present below the artificial irrigation dam from where water is pumped to the various agricultural fields. This area is however artificial, and the moist/wet conditions have resulted from water leaking from the irrigation dam toward the south. If the dam is laid dry, the soil would become dry again and all hydrophilic vegetation would disappear.



The perennial Rietspruit with associated floodplain occurs in the southern part of the study area (as previously discussed – vegetation unit 4) and flows from east to west through the property as indicated in Figure 9. The stream was assessed for its Ecological Importance and Sensitivity, while its Habitat Integrity was also appraised.

***Ecological Importance and Sensitivity (EIS)***

The EIS and functions for the stream were calculated using DWA guidelines and a model, as developed by M. Rountree, but not yet published. Information was used form the SIBIS and VEGMAP products. A mean score between 0 and 4 is obtained, with 0 as the lowest and 4 as the highest score (0-1 = Low to very low; >1-2 = Moderate; >2-3 = Medium-high: >3-4 = High to very high). The score for the watercourse is indicated in table 8:

The watercourse obtained a score of 1.02 (Table 6) indicating the area to have a **low ecological sensitivity**. This is ascribed to the natural vegetation that originally occurred on the embankment being transformed due to agricultural and anthropogenic influences as well as the presence of alien invasive plants that dominate the vegetation and that have displaced the native species.


**Figure 9**. Spruit edge and embankment/floodplain area

**Table 8.** EIS calculation of the portion of the Rietspruit on the study site

| ECOLOGICAL IMPORTANCE AND SENSITIVITY | Score (0-4) | *Confidence (1-5)* |
|---|---|---|
| **Biodiversity support** | **0.67** | ***4*** |
| No known red data or protected species observed on site and no suitable habitat exists. | | |
| No unique plant or animal populations were observed, comprising alien plants, pioneer weedy with a few indigenous grasses mostly. | | |
| A few bird species were observed in the alien *Salix babylonica* trees within the stream and embankment. | | |
| **Landscape scale** | **1.38** | ***5.00*** |
| The area is not protected at all. The streambank is mostly degraded and overgrown with anien grasses and trees. The area is easily accessed from the northern part of the property. Litter is present on the embankment and vegetation and have been washed here during high rainfall events. | | |
| The stream/wetland and embankment fall within the Temperate Freshwater Wetlands vegetation type, however the vegetation has no resemblance to the natural vegetation and is regarded as being transformed. | | |
| The stream is important in terms of its water channelling function, however the ecosystem in and around the river is extremely degraded and mostly transformed due mostly to human impacts/activities. | | |
| The stream/wetland is dominated by pioneer weedy indigenous and alien plant species present. Little diversity of habitat exists. | | |
| **Sensitivity of the stream** | **1.00** | ***3.67*** |
| The stream is basically channelled, thus water velocity is actually increased and not slowed down in the stream. | | |
| No impact due to degraded condition of streambank and surrounding areas. | | |
| System already influenced. Due to the area being channelled with no vegetation or other ecosystem dependant on the water quality and also since water from various developments upstream are channelled into this system, it is highly unlikely that the system would be highly sensitive to changes in water quality. . | | |
| **ECOLOGICAL IMPORTANCE & SENSITIVITY** | **1.02** | ***4.22*** |

***Habitat Integrity for the Riverine system (HI)***

The Rietspruit (embankment & instream) achieved an HI score of Class D (Table 9). This is a measure indication the degree to which a watercourse has been modified from its natural state. Class D means that the water system has been largely modified with a loss of natural habitat and basic ecosystem functioning. This can mainly be ascribed to the various anthropogenic influences (agriculture, water pollution, abstraction etc.).

**Table 9.** Habitat Integrity for the Rietspruit section on the study site

| | RANK |
|---|---|
| **Habitat integrity (Instream)** | **Rietspruit** |
| Vegetation removal | 6 |
| Exotic vegetation | 22 |
| Bank erosion | 5 |
| Channel modification | 11 |
| Water abstraction | 11 |
| Inundation | 7 |
| Flow modification | 5 |
| Water quality | 18 |
| **INTEGRITY CLASS** | **D** |

# DISCUSSION

## VEGETATION

### Vegetation type

The vegetation of the study is a classified as belonging to the **vulnerable Carletonville Dolomite Grassland vegetation type** (Gh 15) while the Rietspruit falls within the **Temperate Freshwater Wetlands vegetation type** (AZf 3) (Mucina & Rutherford 2006).

Carletonville Dolomite grasslands occurs at altitudes ranging between 1360-1620 m within the Gauteng Province. The shallow Mispah soil is sandy and varies from red to yellow. The vegetation is dominated by the grasses *Digitaria tricholaenoides, Cynodon dactylon, Diheteropogon amplectens, Eragrostis chloromelas, Heteropogon contortus, Loudetia simplex, Setaria sphacelata, Schizachyrium sanguineum, Setaria sphacelata* and *Themeda triandra.* Prominent forbs include *Dianthus mooiensis, Chamaecrista mimosoides, Acalypha angustata, Helichrysum miconiifolium, Helichrysum nudifolium, Kohautia amatymbica* and *Pollichia campestris.* Geophytic forbs include *Boophone disticha, Habenaria mossii,* while low-growing woody species such as *Ziziphus zeyheriana, Parinari capensis, Elephantorrhiza elephantina* and *Searsia magalismontana* are also present.

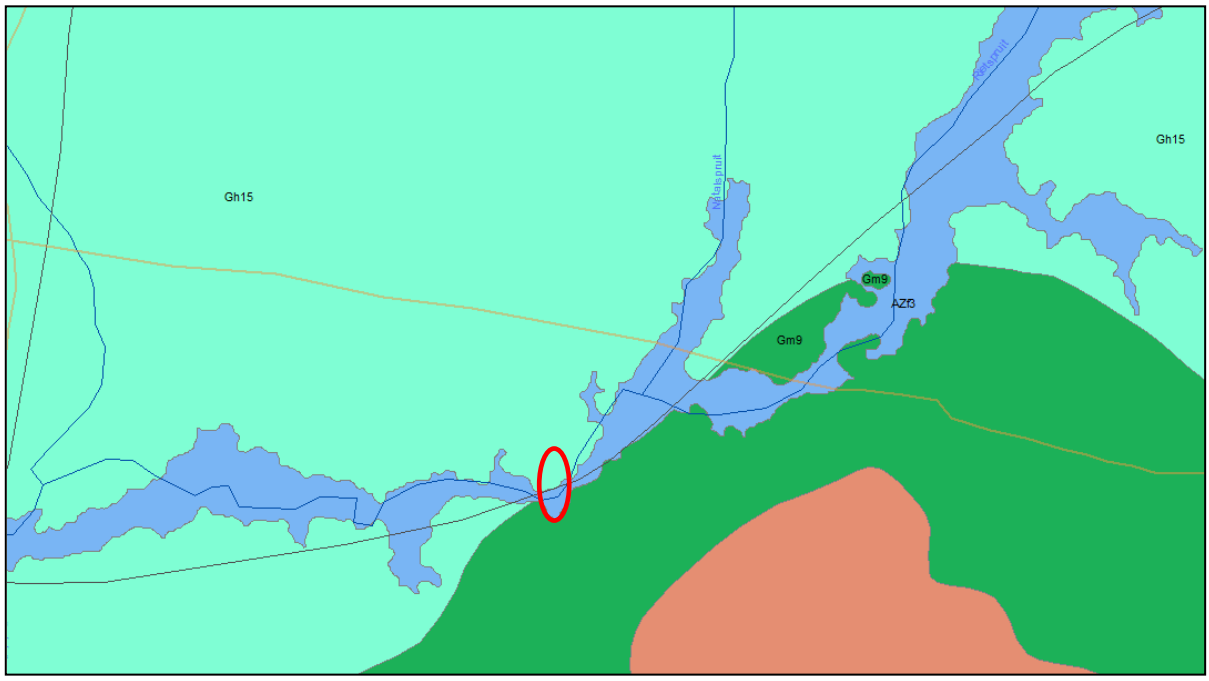



**Figure 10.** Approximate location (black circle) of the study area within the Carletonville Dolomite Grassland (Gh15) and the Temperate Freshwater Wetlands (AZf 3) vegetation types (image obtained Mucina & Rutherford, 2006).

This vegetation type is regarded as being vulnerable and is mainly threatened by cultivation, urbanisation and mining activities. Of the target of 24% only a small fraction is statutorily conserved. Of the target of 24% to be conserved only 3% is statutorily conserved. Several private conservation areas and the Walter Sisulu Botanical Garden contribute to the protection of this vegetation type. It is estimated that more than two thirds of this unit have been transformed by urbanization, cultivation and roads.

Although vegetation unit 1 has affinity with this vegetation type, the vegetation of the larger study area is degraded and shows little resemblance with the original vegetation type due to various anthropogenic influences.

The Temperate Freshwater Wetlands vegetation type (AZf 3) is typical of pans, periodically flooded vleis and the edges of calmly flowing streams and rivers (Mucina & Rutherford, 2006). The vegetation of this vegetation type is dominated by various graminoids that include *Cyperus congestus, Agrostis lachnantha, Carex acutiformis, Eleocharis palustris, Eragrostis plana, Fuirena pubescens, Helictotrichon turgidulum, Leersia hexandra, Hemarthria altissima, Imperata cylindrica, Paspalum dilatatum, P. urvillei, Setaria sphacelata* and *Andropogon appendiculatus*. Various forb species including *Ranunculus multifidum, Berkheya radula, Typha capensis* and *Senecio inornatus* are also present.

Of the target of 24% only 5% of this vegetation type is statutorily conserved with more than 15% already transformed due to anthropogenic influences. As a result, various alien invader species are also present in this vegetation type.

**Regional scale**

On a regional scale the study area is classified as belonging to the Critically Rare Klipriver Highveld Grassland (GP5). This grassland is associated with wetlands and non-perennial rivers as well as the Klipriviersberg ridge system and drainage lines. The Rietspruit system of the study area belongs to this grassland, but has no resemblance to this vegetation unit due to the various anthropogenic influences.

**Vegetation units**

**Vegetation unit 1 (Rocky grassland),** comprises two small sections totalling approximately 9 ha within the study site surrounded by agricultural fields. The vegetation has been impacted on due to agricultural activities in the surrounding areas, while rocks removed from the adjacent fields have also been packed in heaps in these areas. The area

is rocky and consists of small to medium-sized rocks that cover between 15 and 20%. The soil is shallow while moderately deep areas are also present. The grasses *Themeda triandra* and *Eragrostis chloromelas* dominates the vegetation. Due to the various anthropogenic influences (e.g., agriculture, rock packing, annual burning) the vegetation has become degraded resulting in the encroacher shrub *Seriphium plumosum* becoming prominent in many areas in this unit. The vegetation consists of a mixture of climax and secondary successional species while various pioneer/encroacher species are present also. The small moist section below the artificial irrigation dam (see photo right) is similar to the rest of the area except that the constant leaking of water has created moist patches with a mixture of terrestrial and moist-loving species (e.g. *Typha capensis, Berkheya radula, Imperata cylindrica*). These species receive constant water from the dam and have as a result established. If the dam is to be retained, this area could be left as an open space section that connects to the river system. This vegetation unit has a moderate to low species richness with some resemblance to the natural vegetation type that occurred in the area before cultivation started. From a plant ecological and ecosystem functioning point of view this area is regarded as having a **medium conservation value.**

The ***Hyparrhenia hirta*** **grassland (vegetation unit 2)** occurs in patches in the central and eastern sections of the study site. The vegetation of these areas has been previously degraded and are as a result dominated by the anthropogenic grass *Hyparrhenia hirta*. Large sections of this homogeneous vegetation unit are also harvested for thatching grass and other purposes. This vegetation unit has a low species richness with almost 80% of the species present being pioneer/secondary successional species indicating the degraded condition of the vegetation. This vegetation unit has no resemblance to the original natural vegetation and is therefore from a plant ecological and ecosystem functioning point of view as having a **low conservation value and ecosystem functioning.**

**The cultivated fields (vegetation unit 3)** form the largest part of the study area. This unit consists of a number of cultivated fields throughout the site which are actively irrigated. Some of the fields have been left fallow to prepare the soil for the next season's planting. In order to prevent soil erosion and to channel water to various parts of the farm, a number of deep drainage channels have been dug next to the various fields. These drainage channels are in places overgrown with the forb *Typha capensis, Conyza bonariensis* and *Phragmites australis* in the areas where water normally ponds. In spite of the fields being planted and weeded, various pioneer weedy species are present in-between the crops and on the fallow fields. The section close to the stream embankment in the south is totally dominated by the forbs *Bidens pilosa* and the declared alien invasive weed *Ricinus communis.* The vegetation has a low species richness

and has from a plant ecological and ecosystem functioning point of view a **low conservation value.**

The **Stream area (vegetation unit 4)** flows from east to west through the southern section of the study area. The stream is deeply incised and is approximately 6m wide with the embankment to the water level approximately 0.9m deep. It seems as though the stream area along the northern embankment has been built up many years ago with a resulting high embankment area compared to the lower-lying section directly north of the stream edge which has been planted with maize. The embankment is dominated by the alien invasive grass *Pennisetum clandestinum* with large individuals of the alien invader tree *Salix babylonica* present. The embankment and stream area are mostly transformed due to past agricultural activities and not representative of the natural stream vegetation in these areas. There are smaller sections towards the west where the vegetation is less degraded (see photo right) The water seems also to be polluted due to various anthropogenic activities upstream. The area has very little natural vegetation left and has from a vegetation point of view a low conservation value. The area is however regarded as having a **high conservation value** due to its water channeling function.

The **Developed areas (vegetation unit 5)** consists of various areas where houses and outbuildings were built These areas has no resemblance to any natural vegetation and has a **low conservation value and ecosystem functioning.**

**<u>Topography, drainage & connectivity</u>**

The study area comprises level terrain that slopes towards the south (Rietspruit). Surface water from the northern section of the site drains towards the perennial Rietspruit in the south while surface water from the southern section drains towards the Rietspruit in the north (Figure 11).

The study site is surrounded by various agricultural areas in the east, south and west with an open degraded grassland in the north (Figure 11). The stream vegetation is connected

to similar impacted stream vegetation in the east and west, while the Rocky grassland (vegetation unit 1) has no connection with other natural/semi-natural vegetation.

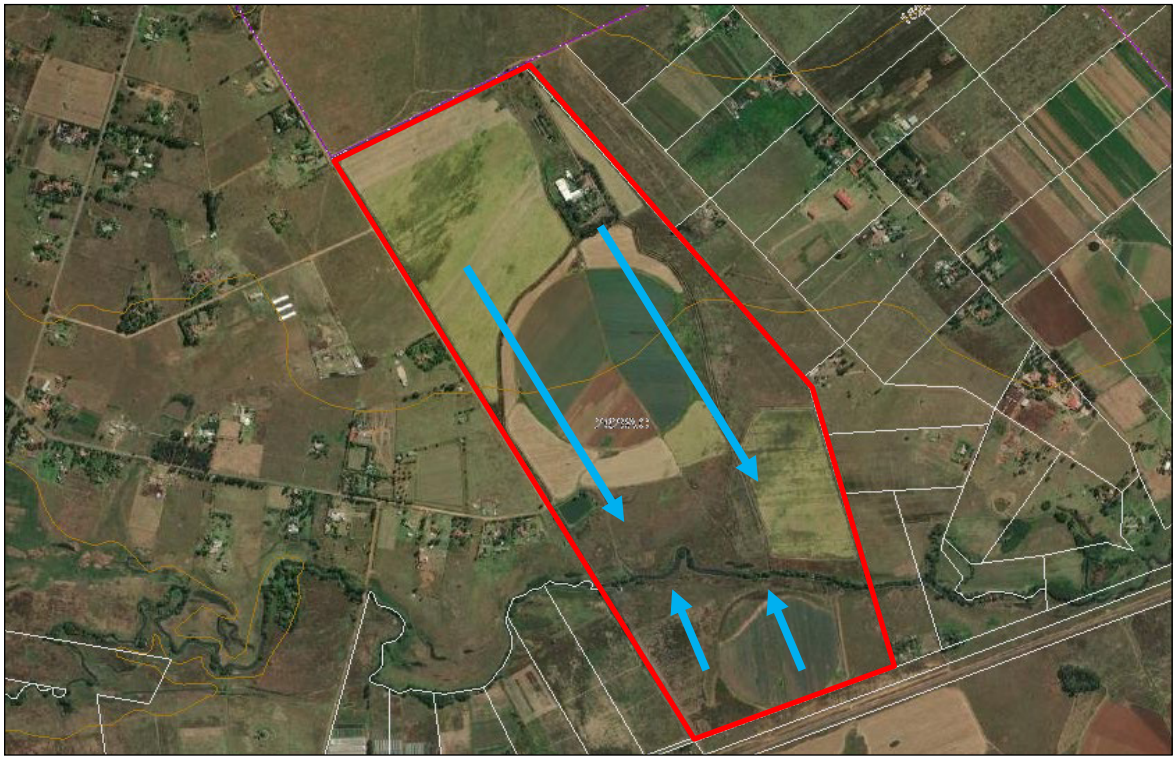


**Figure 11.** Topography, drainage and connectivity of the study site (Image obtained from SANBI 2021).

## Ecosystem classification

### *DEFF Screening tool*

According to the screening tool of the Department of Environment, Forestry & Fishery (DEFF) the study area has a high terrestrial biodiversity theme, while the stream area has a high aquatic biodiversity (Figure 12)

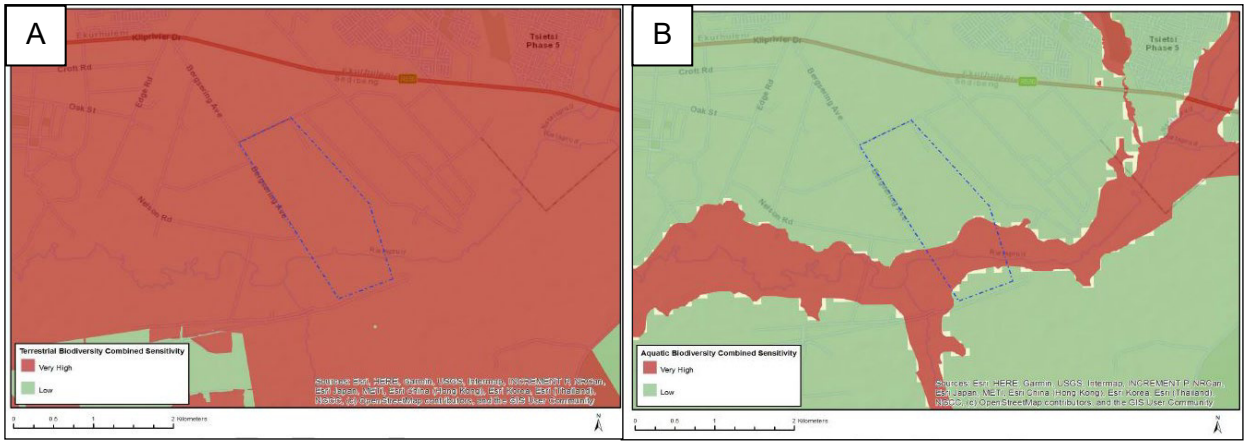



**Figure 12.** Map of terrestrial biodiversity (A) and aquatic biodiversity (B) (Source: DEFF, 2020) .

## Ecosystem classification

*GDARD*

The south-western section as well as the Rietspruit are classiied as Critical Biodiversity (CBA) and Ecologically Support (ESA) areas according to GDARD's C-Plan 3.3. These areas provide habitat to and/or has recordings of red data plants, animals and bird species and consist of primary vegetation. Based on the data of this study, the stream area (vegetation unit 4) corresponds to this classification while the vegetation of the study area does not correspond to the classification.

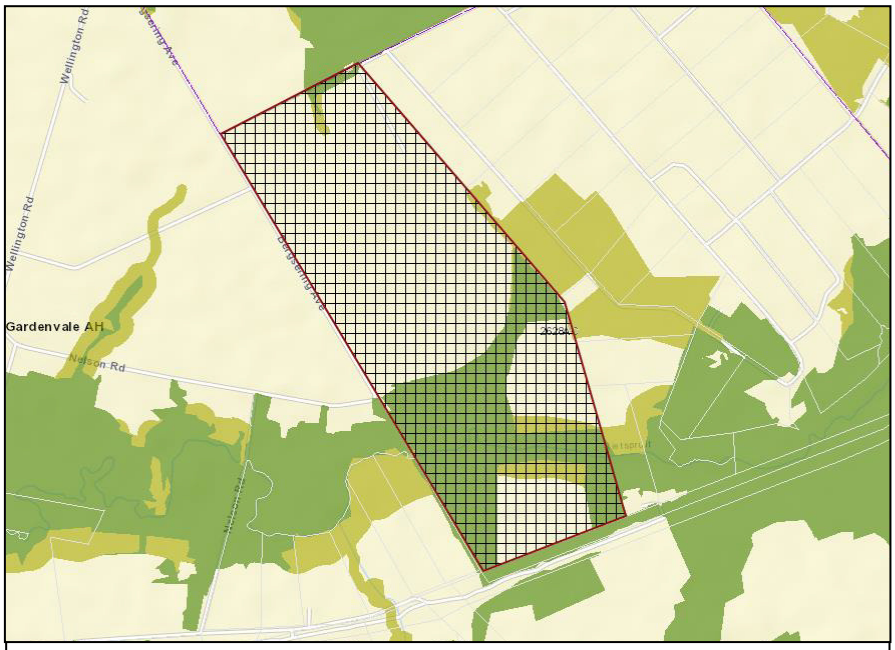



**Figure 13** Ecosystem classification of the study area according to GDARD C-Plan 3.3 (Dark green = CBA; Light green = ESA).

According to LUDS (2021) the site is classified as follows:

**Table 5:** Land Use Decision Support (SANBIGIS, 2019) classification of the site.

| Description | Result |
|---|---|
| Ecosystem name | Klipriver Highveld Grassland (GP5) (CR) |
| Vegetation type | Carletonville Dolomite Grassland (Gh15) Vulnerable<br>Eastern Temperate Freshwater Wetlands (AZf3) |
| National Soil Class | Freely drained, structureless soils. Soil Class: S2 |
| Sub-quaternary catchments | 1 (NFEPA ID: 1508) |
| Wetland Units | Dry Highveld Grassland Group (Artificial) – irrigation dam |
| Wetland clusters | None |
| River name | Rietspruit. Type 11PL; Condition EF (seriously-critically modified); Flagship:No |
| Formal Protected areas | None |
| Informal protected areas | None |
| CBA & ESA units | 9 |

## Red data species

The presence of a subpopulation of a species of conservation concern on a site is used as an indicator amongst other, of the sensitivity of the vegetation ecosystem. If such a species is found to be present, the competent authority may refuse authorisation for the proposed activity or require mitigation measures to be implemented. Lists of red data species are normally acquired via various resources and if no specific recording was made/confirmed on the site, lists obtained from Quarter Degree Grids (QDSG) are used as a broad guideline. At this broad scale, the list will include species that may not necessarily be found on the proposed site since no suitable habitat exists. These lists therefore provide broad guidelines only but are nonetheless useful tools to assess the habitat suitability of the site for these species.

According to the lists obtained from literature and previous studies in the QDGC there is a total of 32 red data plant species that were recorded in the QDGC within which the study are is located. The confidential list is included as Annexure 1. No such species were found within the study area. The habitat of the study site is degraded and transformed with only marginally suitable exiting for five species (Annexure 1).

## Alien plant species

Various declared alien invasive species were noted throughout the area and are listed below:

| | | | Vegetation units | | | | |
|---|---|---|---|---|---|---|---|
| **Species** | **CARA** | **NEMBA** | **1** | **2** | **3** | **4** | **5** |
| *Datura stramonium* L. | 1 | 1b | | | ● | | |
| *Eucalyptus camaldulensis* Dehnh. | 1 | 2 | | | | | ● |
| *Ipomoea purpurea* | 1 | 3 | | | | | ● |
| *Ligustrum lucidum* | 3 | 1b; 3 FS | | | | | ● |
| *Pennisetum clandestinum* Chiov. | 1b | not listed | | | | ● | ● |
| *Salix babylonica L.* | 2 | Not listed | | | | ● | |
| *Verbena bonariensis* L. | | 1b | ● | ● | | ● | |
| *Xanthium strumarium* L. | 1 | 1b | | | | ● | |

## Medicinal plants

Only three (3) medicinal plant species were recorded on the study site and are listed in the table below.

| Plant name | Plant part used | Medicinal use | Vegetation unit |
|---|---|---|---|
| *Gomphocarpus fruticosus* | Leaves, sometimes roots | Headache, stomach pain, tuberculosis. | 2 |
| *Scabiosa columbaria* | Leaves & fleshy roots | Heartburn; wound-healing | 1 |
| *Vernonia oligocephala* | Leaves and twigs, rarely roots. | Stomach bitters, rheumatism Treat abdominal pain, colic, dysentery and diabetes. Roots treat ulcerative colitis. | 1; 2 |

None of these species are threatened while they are regarded as indicative of disturbed conditions and grow abundantly throughout the province and are considered weeds by farmers.

## Sensitivity analysis

A vegetation ecological sensitivity and functioning analysis was done for the vegetation units and is indicated in table 10 below.

**Table 10.** Sensitivity analysis for the vegetation units of the study area.

| | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 |
|---|---|---|---|---|---|
| **Criteria** | Rocky grassland | Hyparrhenia hirta grassland | Cultivated field | Stream area | Developed area |
| Presence of protected / red data species | 4 | 2 | 1 | 4 | 1 |
| Species richness and composition | 6 | 3 | 1 | 4 | 1 |
| Dominant/prominent species ecological status | 7 | 5 | 1 | 2 | 1 |
| Sensitivity to disturbance | 4 | 2 | 1 | 6 | 1 |
| Conservation status and ecological functioning | 6 | 3 | 1 | 8 | 1 |
| Area fragmentation | 1 | 1 | 1 | 8 | 1 |
| Medicinal plants | 2 | 2 | 1 | 2 | 1 |
| Important topographical features (steep slopes, cliffs etc.) | 6 | 1 | 1 | 9 | 1 |
| **TOTAL SCORE** | **47** | **26** | **10** | **53** | **10** |
| **Sensitivity rating** | **Low-medium** | **Low** | **Low** | **Medium** | **Low** |

According to table 10 the Stream area (vegetation unit 4) has a medium sensitivity, with vegetation unit 1 (Rocky grassland) a low-medium sensitivity, while all the other units have a low sensitivity and ecological functioning.

## FAUNA

***Amphibians***

**Figure 14.** The Giant Bullfrog (*Pyxicephalus adspersus*) has been recorded by the consultant within the Nigel-Heidelberg areas. Remaining populations are threatened due to extensive habitat transformation due to increased urban sprawl and degradation to the breeding habitats (endorheic pans) within the area. Large numbers are killed annually after heavy summer downpours migrating towards suitable breeding habitats on the adjacent major road networks (Heidelberg-Nigel R42).

**Threatened species**

The Giant Bullfrog (*Pyxicephalus adspersus*) is a protected frog species whose conservation status has been revised and was previously included as a Red Data Species under the category 'Lower Risk near threatened' (Minter *et al.* 2004). The Giant Bullfrog has been down-graded to 'Least-Concern' (Measey *et. al.* 2010). Giant Bullfrogs historically occurred throughout the south-eastern Highveld region. A major causal factor in the decline in Giant Bullfrog populations in this area is massive habitat destruction by previous and current agricultural activities (draining wetlands, ploughing of grasslands) and within the past twenty-five years by extensive urban sprawl due to high-density residential developments as well as several large informal settlements.

Major road networks bisect suitable breeding and foraging areas resulting in mass road fatalities of migrating adult and juvenile bullfrogs. The consultant has observed several road fatalities (adult males) along the Heidelberg-Nigel R42 to the south-east.

Fences and walls also prevent the natural migration of adult and juveniles from foraging areas and suitable breeding sites (habitat fragmentation). This has become especially prevalent within the small-holdings and plots due to high levels of crime. Habitat deterioration due to changes in the seasonality of wetland sites (damming), deterioration of water quality due to surface water contamination with pesticides and pollutants and reed invasion lead to the disappearance of bullfrog populations. Human predation of adult bullfrogs is another causal factor in population declines. This is especially prevalent in the rural parts of Southern Africa (Hammanskraal, Seshego) as well as around larger informal settlements such as Diepsloot (*pers.obs*. 2008, 2009) as well as Zandspruit (pers. obs. 2005). Bullfrogs are also caught illegally for the local and international pet industry. Removal of large adult males has a detrimental effect on the reproductive success of the small relic populations. The recent increase in the exotic pet trade; especially snakes; results in juvenile bullfrogs been captured for feeding certain captive snakes.

Bullfrog populations have declined dramatically over the past twenty years especially in the Midvaal area. Continual destruction of the open Carletonville dolomite and secondary *Hyparrhenia hirta* grasslands for increased urban development to the north and deterioration of suitable breeding and foraging areas have resulted in the disappearance of several smaller Giant Bullfrog populations.

The open *Themeda-triandra-Eragrostis chloromelas* grasslands within the site and adjacent secondary *Hyparrhenia hirta* grasslands with deeper sandy areas offer favourable aestivation or burrowing areas for remaining Giant Bullfrogs as well as the moist soils below the irrigation dam wall. The adjacent grasslands are utilised currently for intensive irrigated agricultural activities and thus severely restricting suitable foraging and burrowing/aestivation habitat. The artificially created irrigation dam offers no suitable breeding habitat for remaining Giant Bullfrogs. This is due to the steep embankments, deep edges and lack of any marginal vegetation and possible presence of predatory fish. The degraded Rietspruit offers no suitable breeding habitat for Giant Bullfrogs.

***GDARD's Minimum Requirements for Biodiversity Studies: Amphibians***

Under C-Plan version 3 (latest version i.e. version 3.3), no specialist studies for any species of amphibian are requested for consideration in the review of a development application. The Giant Bullfrog (*Pyxicephalus adspersus*) has been removed following re-assessment of the species' status in South Africa. The species is not truly Near-Threatened in South Africa (no quantitative analysis of the Giant Bullfrog distribution against the IUCN criteria can consider them as such) and the most recent evaluation of the status of the Giant Bullfrog in December 2009 did not consider the species sufficiently threatened to be listed as Near Threatened (G. Masterson pers. comm. with Prof. Louis du Preez)*. Given the current objectives of Gauteng's C-plan i.e. to be used to protect representative habitat and generate specialist studies for threatened faunal species, the Giant Bullfrog does not qualify for inclusion as a species-specific layer requiring specialist assessments. Records of *P. adspersus* are known for five of the six provincial protected areas, but the best habitat for *P. adspersus* is found in Abe Bailey Nature Reserve, Merafong City Municipality and Leeuwfontein Collaborative Nature Reserve, Nokeng tsa Taemane Local Municipality (Masterson 2011).

As per the C-Plan approach, the conservation of the Giant Bullfrog and of amphibians in general will be met by the protected area network as well as the designation of priority habitats i.e., pans or quaternary catchments, with associated restrictions on land use.
The wetland and a protective buffer zone, beginning from the outer edge of the wetland temporary zone, must be designated as sensitive (GDARD Requirements for Biodiversity Assessments: Version 2; 2012). The current buffer zones around wetlands (30m for wetlands occurring inside urban areas and 50m for wetlands occurring outside urban areas) are totally inadequate to conserve core terrestrial habitat for the majority of frog species occurring in Gauteng Province; especially the Giant Bullfrog which requires large open grassland areas to forage in.

It is therefore considered the study site contains no suitable breeding habitat and foraging, migratory/dispersal and burrowing habitat of **medium-low** conservation importance for any remaining Giant Bullfrogs. Due to high levels of anthropogenic disturbances on the site and adjacent areas (intensive agricultural activities) it is highly unlikely that significant Giant bullfrog populations remain on the site and adjacent degraded Carletonville dolomite and *Hyparrhenia hirta* grasslands.

* It is the opinion of the specialist consultant that dramatic population declines have occurred within Gauteng Province over the past 30 years and Giant Bullfrogs are worthy of conservation efforts and listing of 'near-threatened'.

***Reptiles***

**Threatened species**

Continual destruction of suitable habitats has resulted in the disappearance of numerous reptile species on the Highveld. No snake species was recorded during the brief field survey. One threatened reptile species have been recorded within the 2628AC QDGC according to ReptiMAP. Three records (2008) of the Striped Harlequin Snake (*Homoroselaps dorsalis*), which is currently listed as Near-Threatened (NT) (Bates et al. 2014) has been recorded from the QDGC. Prefers grassland and are endemic to the highveld of the Free State, Kwazulu-Natal, Swaziland, Limpopo and Gauteng. These snakes are very secretive and are only known from a few specimens. They burrow in loose soil and forage underground in tunnels and cracks, and are usually exposed in abandoned termitaria or under stones. They feed exclusively on thread snakes (*Leptotyphlops*) which they catch underground (Branch 1998).

The low-lying rocky outcrops and limited moribund termite mounds on ther south-western and south-eastern portions of the site offer marginally suitable habitat for Striped Harlequin Snakes. The proposed development of the secondary succession degraded grasslands and current agricultural lands with relatively few termite mounds should not significantly impact on any remaining Striped Harlequin Snakes if the mitigatory measures are implemented throughout all stages of the proposed development. The conservation of the Themeda-triandra- *Eragrostis chloromelas* rocky grasslands should conserve suitable habitat for any remaining Striped Harlequin Snakes if they should possibly occur on the site.

Gauteng represents approximately 10% of the total extent of occurrence for the species, meaning 10 % of 11 populations need to be protected in Gauteng in order to prevent *H. dorsalis* from becoming listed as ‘Vulnerable”, which is effectively 1 population. *Homoroselaps dorsalis* occurs in close proximity to the Egoli Granite Grassland (EGG) Nature Reserve, and if it is found there during surveys or by chance encounters, the local population should also be protected but the recommended minimum target is the protection and conservation of the Suikerbosrand Nature Reserve population. In the literature, Alexander & Marais (2007), Broadley (1983) and Branch (1998) all indicate that the current knowledge of *H. dorsalis* habits and habitat is based on the assumption that it is similar to the more widely distributed and better-known Spotted Harlequin Snake (*H. lacteus*). The model of suitable habitat for *H. dorsalis* within Suikerbosrand Nature Reserve is based on the observations of *H. dorsalis* and the Spotted Harlequin Snake (*H. lacteus*) within the reserve. Four Harlequin Snakes (2 *H. dorsalis* and 2 *H. lacteus*) have been recorded in

Suikerbosrand since 2006. All of the records have occurred on land type Ib43 (Land Type Survey Staff,2006) and all records were associated with ridges or ridge slopes with a soil-rock mix and low clay content (< 35 %).The protection of *H. dorsalis* in Suikerbosrand Nature Reserve, Sedibeng District Municipality will meet the conservation targets for the species in Gauteng (Masterson 2011). Under C-Plan version 3.3, no specialist studies for any species of reptile are requested for consideration in the review of a development application within Gauteng Province (GDARD Requirements for Biodiversity Assessments: Version 3.3).

## ***Avifauna***

**Table 11.** Red Data List bird species previously recorded from the 2625_2805 pentad within which the study area is situated, and that occur or could possibly within or in the vicinity of the study area due to the presence of suitable habitat.

| Species | Conservation status (Taylor 2014/15) | Reporting rate SABAP2 % | Habitat requirements (Chittenden 2005; Hockey *et al* 2005) | Likelihood of occurrence |
|---|---|---|---|---|
| Martial Eagle | Endangered | 0.0 (single incidental observation in 2021) | | **Low-none:** Rare vagrants with marginally suitable habitat for occasional foraging arrays |
| African Marsh-harrier *Circus ranivorus* | Endangered | 0.0 | Large permanent wetlands with dense reed beds. Sometimes forages over smaller wetlands and grassland. | **Low:** Marginally suitable habitat for occasional foraging arrays within the irrigation dam. No suitable breeding habitat within the site. |
| Cape Vulture *Gyps coprotheres* | Endangered | 0.0 | Linked to cliff breeding sites in mountainous areas but ranges widely in surrounding areas. | **Low-none:** Breeding colonies are situated in the Magaliesberg. Recorded throughout the area most likely as vagrants flying over. |
| Yellow-Billed Stork | Endangered | 0.0 | Shoreline of most inland freshwater bodies. | **Low-:** Nomadic, the irrigation dam offers limited suitable habitat for occasional foraging arrays |
| Black Stork *Ciconia nigra* | Vulnerable | 0.0 | Associated with mountainous areas but not restricted to them. Nomadic during the non- | **Low:** Nomadic and the open grasslands and wetland on the eastern boundary offers limited |

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|---|---|---|---|---|
| | | | breeding season. | suitable habitat occasional foraging arrays but no suitable breeding habitat. |
| White-Bellied Korhaan *Eupodotis sengalensis* | Vulnerable | 0.0 | Open grassland with scattered trees, numerous termite mounds and rocky ground. Forages in burned areas. | **Low:** . The high levels of anthropogenic disturbances restricts the likelihood of any extended periods or breeding on the site. Suitable habitat towards south-east (Suikerbosrand NR). |
| Secretarybird *Sagittarius serpentarius* | Vulnerable | 0.0 (single incidental observation in 2021) | Favours open habitat and breeds within *Vachellia* trees. | **Medium:** Limited records based mainly on single observation in 2021. The open grasslands and agricultural lands offer marginally suitable foraging habitat but the high levels of anthropogenic disturbances restricts the likelihood of any extended periods on the site. |
| African Grass-Owl *Tyto capensis* | Vulnerable | 0.0 | Normally associated with pristine, well managed grasslands usually in close proximity of water, but also in alien vegetation structurally resembling tall or rank grassland, and hydrophilic sedges. | **Medium-Low**: Suitable habitat for foraging arrays within the shorter grasslands on the SW and SE portion of the site and marginally suitable nesting habitat within dense Hyparrhenia hirta grasslands and moist grasslands below irrigation dam wall. High levels of anthropogenic disturbances restricts the likelihood of any extended periods or breeding on the site. |
| Lanner Flacon *Flacon biarmicus* | Vulnerable | 4.1 | Favours open grasslands and woodlands near rocky cliffs or electricity poles for nesting. | **Medium-High:** Suitable habitat for occasional foraging arrays within the open grasslands and agricultural land. |

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| Blue Crane *Anthropoides paradiseus* | Near-Threatened | 0.0 | Natural grassland but also wetlands and cultivated pastures and croplands | **Medium-low:** Suitable habitat for occasional foraging arrays within the open grasslands and agricultural lands. High levels of anthropogenic disturbances restricts the likelihood of any extended periods. |
| Greater Flamingo *Phoenicopterus ruber* | Near-Threatened | 93.2 | Greater and Lesser Flamingos are only non-breeding visitors to the former Transvaal (Tarboton *et al.* 1987), but flocks may spend extended periods on the Highveld where they utilize shallow, eutrophic wetlands and temporary pans. | **Low**: The deep artificial irrigation dam offers limited suitable habitat for occasional foraging arrays as well as dispersal habitat but the high levels of anthropogenic disturbances restricts the likelihood of any extended periods. |
| Lesser Flamingo *Phoenicopterus minor* | Near-Threatened | 20.3 | Eutrophic shallow wetlands, especially salt pans | **Low**: The deep artificial irrigation dam offers limited suitable habitat for occasional foraging arrays as well as dispersal habitat but the high levels of anthropogenic disturbances restricts the likelihood of any extended periods. |
| Abdim's Stork | Near-Threatened | 0.0 | Non-breeding intra-African migrant. Occurs in large flocks in grasslands, savanna, woodland and cultivated lands. | **Medium:** The open grasslands and irrigated agricultural lands offer suitable habitat for occasional foraging arrays. The high levels of anthropogenic disturbances restricts the likelihood of any extended periods on the site. |
| Black-winged Pratincole *Glareola normandii* | Near-Threatened | 2.7 | Open grasslands, edges of pans and cultivated fields. | **Medium-High:** The open grasslands and irrigated agricultural lands offer suitable habitat for occasional foraging |

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|---|---|---|---|---|
| | | | | arrays. |
| African Finfoot *Podica senegalensis* | Vulnerable | 0.0 | Mostly along well-vegetated, perennial rivers and dams | **Low-none:** The degraded perennial Rietspruit offers no suitable habitat. |
| Half-collared Kingfisher *Alcedo semitorquata* | Near-Threatened | 0.0 | Mostly along clean, well-vegetated, fast-flowing streams. Recorded around dams. | **Low-none:** The degraded perennial Rietspruit offers no suitable habitat. |
| European Roller | Near-Threatened | 2.7 | Non-breeding migrants. Open woodland perching on open dead branches, telephone and powerlines | **Medium-Low:** Suitable habitat for occasional foraging arrays (grasshoppers and termites) within the open grasslands. |

The site offers marginally to extremely limited suitable habitat for occasional foraging arrays for the larger raptors such as Cape Vulture and Martial Eagle. The open grasslands as well as agricultural lands offer suitable foraging areas for Secretarybirds and the smaller raptors such as Lanner Falcon. The agricultural lands and open grasslands (especially after burning) offer suitable foraging areas for Black-winged Pratincoles. The open grasslands and agricultural lands offers favourable habitat for occasional foraging arrays for Blue Cranes, Secretarybirds and Abdim's Storks. The irrigation dam offers no suitable habitat for both Greater and Lesser Flamingos. The degraded Rietspruit offers no suitable habitat for African Finfoot or Half-collared Kingfishers. No actual evidence of any threatened avifaunal species were observed during the brief field survey. The high levels of anthropogenic disturbances as well as habitat degradation and fragmentations on the site and adjacent open grasslands, agricultural lands, wetlands and drainage lines significantly reduces the likelihood of any secretive bird species remaining on the site for any extended periods. More intensive specialist avifaunal surveys are required over extended periods in order to ascertain the current conservation status of these threatened bird species on the site and adjacent properties.

***Mammals***

**Threatened species**

**Table 12** Red Data List mammal species with confirmed records from the 2628AC QDGC and for

| TAXONOMIC INFORMATION | | | | RED LISTING INFORMATION | | | | |
|---|---|---|---|---|---|---|---|---|
| Order | Family | Scientific name | Common name | 2016 Regional Listing | 2016 Regional listing Criteria | Current global listing | Global listing criteria | TOPS 2007 |
| Artiodactyla | Bovidae | *Pelea capreolus* | Grey Rhebok | Near Threatened | A2bd | Least Concern | None | None |
| Artiodactyla | Bovidae | *Redunca fulvorufula fulvorufula* | Mountain Reedbuck | Endangered | A2b | Least Concern | None | None |
| Carnivora | Felidae | *Leptailurus serval* | Serval | Near Threatened | A2c; C2a(i) | Least Concern | None | Protected |
| Carnivora | Felidae | *Panthera pardus* | Leopard | Vulnerable | C1 | Vulnerable | A2cd | Vulnerable |
| Carnivora | Hyaenidae | *Parahyaena brunnea* | Brown Hyaena | Near Threatened | C2a(i) +D1 | Near Threatened | C1 | Protected |
| Carnivora | Mustelidae | *Aonyx capensis* | Cape Clawless Otter | Near Threatened | C2a(i) | Near Threatened | A2cde+3cde | Protected |
| Erinaceomorpha | Erinaceidae | *Atelerix frontalis* | South African Hedgehog | Near Threatened | A4cde | Least Concern | None | Protected |
| Eulipotyphla | Soricidae | *Crocidura mariquensis* | Swamp Musk Shrew | Near Threatened | B2ab (ii,iii,iv) | Least Concern | None | None |
| Rodentia | Muridae | *Otomys auratus* | Southern African Vlei Rat (Grassland) | Near Threatened | A4c | Not Evaluated | None | None |

Several red listed mammal species have been recorded from the Suikerbosrand Nature Reserve to the south-west of the site including the 'Endangered' Mountain Reed Buck (*Redunca fulvorufula fulvorufula*), "'Vulnerable" Leopard (*Panthera pardus*), Near-Threatened Serval (*Leptailurus serval*), Brown Hyaena (*Parahyaena brunnea*), Cape Clawless Otter (*Aonyx capensis*), Grey Rhebok (*Pelea capreolus*) and South African Hedgehog (*Atelerix frontalis*).

No evidence of any threatened mammal species was recorded during the brief two day site visitation (8 hours). This can be expected due to the short-duration of the field work as well as secretive nature of the threatened mammal species, including Servals, South African Hedgehogs, Vlei Rats and Swamp Musk Shrews. The majority of threatened mammal species occurring in the area are extremely difficult to observe even during intensive field surveys conducted for extended periods.

**Grey Rhebok (*Pelea capreolus*)**

Grey Rhebok are endemic to the sub region and as they only occur where there is suitable habitat their distribution is discontinuous and patchy. They occur in southern North West Province, Gauteng, southern Limpopo Province, western Mpumalanga, the eastern Free State, western and central Kwazulu-Natal, the western Northern Cape, the Western Cape and the Eastern Cape. Throughout the greater part of their distributional range Grey Rhebok are associated with Rocky ridges, rocky mountainous slopes and mountain plateau grassland with good grass cover. Short, burnt veld is favoured for feeding and long grass for cover. They are independent of a water supply, but drink in the dry winter months if water is available (Skinner & Chimimba 2005.). Grey Rhebok occur within the Suikerbosrand Nature Reserve. No suitable habitat for Grey Rhebok within the remnant patches of rocky grassland as well as secondary grasslands.

**Mountain Reed Buck (*Redunca fulvorufula fulvorufula*)**

Formerly widespread in South Africa, they occur in suitable habitat in Limpopo Province, the eastern North-West Province, Gauteng, parts of Mpumalanga, central and southern Free State, western Kwazulu-Natal, the Eastern Cape and narrowly into the Western Cape. Mountain Reedbuck inhabit the dry, grass-covered, stony slopes of hills and mountains, where these provide cover in the form of bushes or scattered trees. They are found infrequently on more open mountainous grassland and tend avoid the bleak open conditions associated with summits of mountainous areas, preferring the lower slopes and occurring in many areas on low stony hills. They move onto flats adjacent to their stony habitat to feed and drink, the availability of water being an essential habitat requirements (Skinner & Chimimba 2005). Mountain Reed Buck have been recorded in the Suikerbosrand Nature Reserve. The secondary *Hyparrhenia hirta* grasslands as well as natural grasslands on the south-west and south-eastern portions of the site provide marginally suitable foraging and restricted dispersal habitat. It **is highly unlikely** that

Mountain Reed Buck will occur within the rocky grasslands on the site or adjacent grasslands due to high levels of anthropogenic disturbances in the area.

**Leopard (*Panthera pardalis*)**

In Kwazulu-Natal they occur primarily in the north-east and are sparsely distributed elsewhere in the central and western parts of the province. They are found throughout Limpopo Province, Mpumalanga, North West and Gauteng, except on the highveld grassland areas in the southern parts of these provinces. They occur sporadically in the Free State. In the Eastern Cape they occur in the mountainous areas along the south coast from about King William's Town district westwards into the Western Cape and then in the northern and north-eastern parts of the Northern Cape. Leopards have a wide habitat tolerance and are generally associated with areas of rocky Koppies and hills, mountain ranges and forest. While they are independent on water supplies, relying on their prey for their moisture requirements, they drink regularly when water is available. Cover to lie up in safety during the daylight hours and from which to hunt is an important requirement. They manage to persist in areas of concentrated development provided they have adequate cover in rocky ridges and forest (Skinner & Chimimba 2005). The site offers limited suitable dispersal or foraging habitat. High levels of habitat destruction as well as anthropogenic activities significantly reduces the likelihood of any leopards occurring in the area.

**Brown Hyaena (*Parahyaena brunnea*)**

They are widely, though discontinuously and sparsely, distributed in Limpopo Province, North West Province, Mpumalanga and Gauteng especially in small nature reserves. Brown Hyaena are associated particularly with the Nama-Karoo and Succulent Karoo Biomes and the drier parts of the Grassland and Savanna biomes. In Gauteng they prefer rocky mountainous areas with bush cover. Cover to lie up during the day is an essential requirement. Water is not a requirement, although they drink when its available. Brown Hyaena have been recorded within the Walter Sisulu National Botanical Garden as well as within Mogale's Gate (pers. obs.) and Magaliesberg to the north and north-west of the study area. The open grasslands, secondary succession grasslands as well as agricultural lands offer marginally suitable habitat for foraging arrays as well as exploratory/dispersal activities for the highly secretive and elusive Brown Hyaena. The high levels of anthropogenic activities on and surrounding the site significantly reduces the likelihood. Major road networks (R550) to the north of the site severely restricts dispersal movements.

**Serval (*Leptailurus serval*)**

Serval occur in dense, well watered grassland and reed beds and are always associated with water. In South Africa they occur from the Eastern Cape northwards into Mpumulanga lowveld and Limpopo Valley. Servals have been recorded in the Drakensberg highlands and inland mountain highlands (Magaliesberg, Soutpansberg, Waterberg). Servals are predominantly nocturnal; with limited activity during the early morning and late afternoon. Diurnal activity is unusual and adequate cover is required during periods of inactivity. Servals have been displaced mainly due to habitat loss through agricultural and forestry activities. Populations are secure within protected areas. The open Themeda triandra rocky grasslands as secondary succession Hyparrhenia hirta grasslands as well as moist grasslands below the irrigation dam on the western boundary of the site offers suitable habitat for occasional foraging arrays as well as exploratory/dispersal activities for the highly secretive and elusive Serval. The high levels of anthropogenic activities on and surrounding the site significantly reduces the likelihood. Major road networks (R550) border the site which severely restricts dispersal movements.

**African Clawless Otter (*Aonyx capensis*)**

The African or Cape Clawless Otter is distributed widely in sub-Saharan Africa where there is suitable aquatic habitat. They occur in Limpopo, Mpumalanga, Gauteng, North West, Kwazulu-Natal, Eastern Cape, Western Cape and Northern Cape provinces. Being predominantly aquatic they don't wander widely from water and throughout their range they occur in rivers, lakes, swamps and dams and up the tributaries of rivers into small streams. The otters feed on crabs, fish, frogs and other aquatic life. As the small streams dry up they move down to more permanent water. If they wander away from water they invariably return to it as it is an essential requirement. The association in which the terrestrial aquatic habitat occurs can range from forest to woodland to open grassland and otters occurrence bears no relation to surrounding terrain provided that the aquatic conditions are suitable and there is adequate cover which to rest. The degraded perennial Rietspruit as well as irrigation dam offer marginally suitable foraging and dispersal habitat for African Clawless Otters. The suitability is reduced due to the poor water quality and habitat degradation of the riparian zones of the Rietspruit (limited vegetative cover) and high levels of anthropogenic disturbances on and surrounding the site. Major road networks (R550) adjacent to the site restrict dispersal movements. The artificially excavated drainage channels may be used for limited dispersal or foraging areas.

**Figure15.** The South African Hedgehog has been recorded in the Suikerbosrand Nature Reserve.

**South African Hedgehog (Atelerix *frontalis*)**

South African Hedgehogs occur in such a wide variety of habitats that it is difficult to assess its habitat requirements. The one factor that is common to all the habitats in which they occur is dry cover, which they require for resting places and breeding purposes. Habitat must provide a plentiful supply of insects and other foods. Suburban gardens provide these requirements and this may explain their occurrence in this type of habitat. South African Hedgehogs are predominantly nocturnal, becoming active after sundown, although, after light rains at the commencement of the wet season, they may be active during daylight hours (Skinner and Smithers, 1991). South African Hedgehogs have been recorded within the Suikerbosrand Nature Reserve. Suitable habitat exists within the open rocky grasslands and secondary grasslands on the site and mesic grasslands below the irrigation dam on the western boundary for South African Hedgehogs. Overgrazing the vegetation around wetlands reduces ground cover and thus leads to decreased small mammal diversity and abundance (Bowland & Perrin 1989, 1993). The presence of dogs will impact on any remaining hedgehogs. Major road networks (R550) to the north of the site severely restricts dispersal movements.

**Swamp Musk Shrew *Crocidura mariquensis***

This species has highly specific habitat requirements, occurring only close to open water with intact riverine and semi-aquatic vegetation such as reedbeds, wetlands and the thick grass along river banks (Monadjem 1999; Skinner & Chimimba 2005). They are found both in the wet substrates and drier grassland away from the water's edge (Taylor 1998). They are often sampled in waterlogged areas, such as inundated grasslands and vleis. Marginally suitable habitat within the hygrophilous grasses and reed beds below the irrigation dam as well as limited sections of the Rietspruit which are dominated by dense *Imperata cylindrica-Hyparrhenia hirta* grasslands.

**Southern African Vlei Rat *Otomys auratus***

This species is associated with mesic grasslands and wetlands within alpine, montane and sub-montane regions (Monadjem et al. 2015), typically occurring in dense vegetation in close proximity to water. Where *Otomys auratus* and *O. angoniensis* co-occur at the same site, the former is associated with sedges and grasses adapted to densely vegetated wetlands with wet soils, while the latter is associated with plant species that typically grow in the drier margins of wetlands. Vlei rats are exclusively herbivorous, with a diet mainly comprised of grasses. The moist or mesic grasslands below the irrigation dam offers suitable habitat for Vlei Rats (Wetland and Grassland type) as well as the drier south-western rocky grasslands offering dense grassland vegetation adjacent to the Rietspriuit.

More intensive specialist mammal surveys will be required in order to ascertain the current conservation status of the above-mentioned threatened mammal species on the site and adjacent grasslands. The surrounding grasslands are all currently being used for agricultural purposes or transformed and degraded due to high levels of anthropogenic disturbances which will significantly reduce the likelihood of any threatened mammal species occurring on the site. Major road networks (R550) as well as high-density residential areas occur to the north (Palm Ridge, Tsietsie) of the site.

## SENSITIVE FAUNAL HABITATS

**Carletonville Dolomite Grassland (Gh15) NATURAL GRASSLAND (vegetation unit 1)**

Carletonville Dolomite Grassland in the Gauteng Province are threatened and are listed as Vulnerbale. More than two thirds of this vegetation unit have already undergone transformation mainly due to urbanization, road construction, industrialisation and agricultural activities (cultivation). Only a small fraction (3%) of this vital habitat has been formerly conserved. Conservation targets are the proposed conservation of 24%. These grassland areas form vital habitats for numerous animal species. The majority of suitable grassland habitat is usually severely fragmented resulting in road fatalities of species migrating between habitats. The natural open rocky *Themeda triandra-Eragrostis chloromelas* grasslands on the south-west and south-eastern portions of the site are regarded as **Medium-High Sensitivity** and **Conservation Value**, the secondary succession *Hyparrhenia hirta-Melinis repens* grasslands are considered as **Medium-low Sensitivity** and **Conservation Value.** The moist grasslands below the irrigation dam are considered as **Medium-High Sensitivity** and **Conservation value**. The current agricultural lands are regarded as **Low sensitivity** and **Conservation value**.

It is imperative that the development is restricted to the transformed agricultural lands as well as secondary *Hyparrhenia hirta* grasslands. The rocky grasslands, moist grasslands below irrigation dam extending towards the perennial Rietspruit should ideally be conserved and adequately managed with a natural fire regime determined by a suitably qualified botanist or grassland ecologist. Activities in all adjacent open rocky grasslands must be restricted. Access to surrounding open rocky grasslands must be strictly managed to prevent possible poaching, harvesting of medicinal plants and disturbances to remaining fauna. No driving of vehicles through open rocky grasslands.

**PERENNIAL RIETSPRUIT AND ASSOCIATED RIPARIAN AREAS (vegetation unit 4)**

The perennial Rietspruit and their associated indigenous grassland/woodland riparian habitats are protected under the National Water Act 36 of 1998. Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas. The perennial Rietspruit and associated degraded riparian zones are considered to be of **HIGH conservation** importance for the following reasons:

- The indigenous vegetation of riverine wetlands within the old Transvaal Province and wetlands in general throughout the Grassland Biome, is in danger of being completely replaced by alien invasive species (Henderson & Musil 1997, Rutherford & Westfall 1994). Any remaining areas of indigenous riparian vegetation or marshland vegetation within Gauteng must therefore be regarded as of high conservation importance.
- Rivers and drainage lines are longitudinal ecosystems, and their condition at any point is a reflection of not only upstream activities, but also of those within adjacent and upstream parts of the catchment (O'Keefe 1986). Any impact on the riverine area within the study area is therefore also likely to impact on upstream and downstream areas.

Riparian zones have the capacity to act as biological corridors connecting areas of suitable habitat in birds (Whitaker & Metevecchi, 1997), mammals (Cockle & Richardson 2003) reptiles and amphibians (Maritz & Alexander 2007). Riparian zones may act as potential refugia for certain fauna and could allow for possible recolonisation of rehabilitated habitats. The riparian vegetation plays a vital role in the re-colonisation of aquatic macro-invertebrates as well as reptiles and amphibians (Maritz & Alexander 2007). The riparian vegetation provides vital refuge, foraging and migratory passages for species migrating to and away from the rivers. The riparian zone comprises plant communities contiguous to and affected by surface and subsurface hydrological features of perennial or intermittent water bodies (rivers and streams). Riparian areas have one or both of the following characteristics:

The riparian vegetation is dependent on the river for a number of functions including growth, temperature control, seed dispersal, germination and nutrient enrichment. Riparian vegetation comprises a distinct composition of species, often different from that of the surrounding terrestrial vegetation. Tree species are positioned according to their dependence or affinity for water, with the more mesic species (water-loving) being located closest to the river channel, often with their roots in the water, and the less water-loving terrestrial species further away from the river.

The riparian zone, of which vegetation is a major component, has a number of important functions including:

- enhancing water quality in the river by the interception and breakdown of pollutants;
- interception and deposition of nutrients and sediments;
- stabilisation of riverbanks and macro-channel floor;
- flood attenuation;
- provision of habitat and migration routes for fauna and flora;
- provision of fuels, building materials and medicines for communities (if done on a sustainable basis); and
- recreational areas (fishing - rod and line not shade or gill nets; bird watching; picnic areas etc.).

No further vegetation clearance except for the removal of alien invasive species. The riparian zone should be appropriately rehabilitated with the planting of indigenous (to the area) vegetation. No roads shall be cut through Rietspruit's banks (riparian vegetation) as this may lead to erosion causing siltation. No developments within the 32m or 100m GDARD buffer from the outer edge of the riparian zones. The buffer zones will require adequate re-vegetation due to current agricultural activities.

## POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE ASSOCIATED FLORA

The following assessment of impacts was done and was guided by the requirements of the NEMA EIA Regulations (2014) and is presented in the tables below:

**Loss of habitat**

Any development will have an impact on the natural vegetation. The vegetation of the different vegetation units are degraded/transformed with only remnants of the original native vegetation present within unit 1. Development in these areas should therefore not result in a large-scale loss of species and diversity and will have a **short-term negative impact** on the environment. Since these areas are degraded/transformed it is thought that the loss of species would not be significant in terms of overall habitat and biodiversity with only few climax species that would be lost. The watercourse area, although degraded, is regarded as an important and sensitive ecosystem where development will also have a **long-term negative impact** on the ecosystem and ecosystems further downstream.

HIGH CONSERVATION UNIT: 4

| Activity | Potential impact | Environmental significance | | | | | | | | | Reversibility | Cumulative impact | Irreplaceble loss | Mitigation measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nature | Extent | Duration | Magnitude | Probability | Rating before mitigation | | Rating after mitigation | | | | | |
| **Environmental Component:** Vegetation, Fauna | | | | | | | | | | | | | | |
| Clearing of vegetation for construction | Loss of plant species | – | 2 | 5 | 8 | 2 | 30 | **Low** | 15 | **Negligible** | Irreversible | High | High | See potential impacts and recommended mitigation measures in report |
| | Loss of rare/medicinal species | – | 1 | 4 | 8 | 2 | 26 | **Low** | 10 | **Negligible** | Irreversible | Moderate | Medium | |
| | Loss of animal species | – | 2 | 4 | 8 | 2 | 28 | **Low** | 14 | **Negligible** | Irreversible | Modeate | High | |
| | Loss of biodiversity | – | 2 | 4 | 8 | 4 | 56 | **Moderate** | 15 | **Negligible** | Irreversible | High | High | |
| | Increased soil erosion | – | 3 | 4 | 8 | 4 | 60 | **Moderate** | 6 | **Negligible** | Reversible | Low | Low | |
| | Alien plant invasion | + | 3 | 5 | 8 | 4 | 64 | **High** | 12 | **Negligible** | Reversible | Low | Low | |

MEDIUM CONSERVATION UNIT: 1

| Activity | Potential impact | Environmental significance | | | | | | | | | Reversibility | Cumulative impact | Irreplaceble loss | Mitigation measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nature | Extent | Duration | Magnitude | Probability | Rating before mitigation | | Rating after mitigation | | | | | |
| **Environmental Component:** Vegetation, Fauna | | | | | | | | | | | | | | |
| Clearing of vegetation for construction | Loss of plant species | – | 2 | 5 | 6 | 2 | 26 | **Low** | 8 | **Negligible** | Irreversible | Low | Low | See potential impacts and recommended mitigation measures in report |
| | Loss of rare/medicinal species | – | 1 | 3 | 6 | 2 | 20 | **Low** | 4 | **Negligible** | Irreversible | Low | Low | |
| | Loss of animal species | – | 1 | 3 | 2 | 1 | 6 | **Neglible** | 4 | **Negligible** | Irreversible | Low | Low | |
| | Loss of biodiversity | – | 2 | 5 | 6 | 2 | 26 | **Low** | 6 | **Negligible** | Irreversible | Low | Low | |
| | Increased soil erosion | – | 2 | 4 | 6 | 2 | 24 | **Low** | 10 | **Negligible** | Reversible | Low | Low | |
| | Alien plant invasion | + | 1 | 4 | 6 | 2 | 22 | **Low** | 4 | **Negligible** | Reversible | Low | Low | |

LOW CONSERVATION UNIT: 2; 3; 5

| Activity | Potential impact | Environmental significance | | | | | | | | | Reversibility | Cumulative impact | Irreplaceble loss | Mitigation measures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nature | Extent | Duration | Magnitude | Probability | Rating before mitigation | | Rating after mitigation | | | | | |
| **Environmental Component:** Vegetation, Fauna | | | | | | | | | | | | | | |
| Clearing of vegetation for construction | Loss of plant species | – | 1 | 5 | 2 | 1 | 8 | **Neglible** | 8 | **Negligible** | Irreversible | Low | Low | See potential impacts and recommended mitigation measures in report |
| | Loss of rare/medicinal species | – | 1 | 1 | 2 | 1 | 4 | **Neglible** | 4 | **Negligible** | Irreversible | Low | Low | |
| | Loss of animal species | – | 1 | 1 | 2 | 1 | 4 | **Neglible** | 4 | **Negligible** | Irreversible | Low | Low | |
| | Loss of biodiversity | – | 1 | 5 | 2 | 1 | 8 | **Neglible** | 6 | **Negligible** | Irreversible | Low | Low | |
| | Increased soil erosion | – | 2 | 3 | 2 | 2 | 14 | **Neglible** | 10 | **Negligible** | Reversible | Low | Low | |
| | Alien plant invasion | + | 1 | 4 | 6 | 1 | 11 | **Neglible** | 4 | **Negligible** | Reversible | Low | Low | |

***Mitigation and recommendations***

No development should be allowed in vegetation unit 4 (Stream area). This area should be fenced off prior to construction and zoned as a no-go area. Only people involved in the removal of alien plans in these areas should be allowed to enter this vegetation unit. During the **CONSTRUCTION** phase for areas approved by development by the authorities, the following is recommended:

To minimise the effect on the vegetation, insects, small mammals, and environment it is recommended that the construction be done within the winter period when most plants are dormant and when little rain is expected that could potentially cause erosion.

Where vegetation of areas not to be developed needs to be "opened" to gain access it is recommended that the herbaceous species are cut short rather than removing them. That will ensure that they regrow during the growing season. If possible "soil saver blankets" could be placed over the vegetation to prevent erosion and unnecessary trampling. These blankets must be removed after construction.

All temporary stockpile areas, litter and dumped material and rubble must be removed during and on completion construction activities. Vegetation clearance should be restricted to the approved development areas allowing remaining animals opportunity to move away from the disturbance. No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site. No hunting with firearms (shotguns, air rifles or pellet guns) or catapults should be permitted on the property as well as neighbouring areas.

A Re-vegetation and Rehabilitation Manual should be prepared for the use of contractors, landscape architects and groundsmen to rehabilitate areas that became degraded due to construction activities.

**Alien vegetation**

Although relatively few, alien species poses a huge threat to the natural environment due to their competitive nature that leads to the displacement of natural indigenous species (plants and animals), and also due to their excessive use of soil water.

Alien and invasive plant species are grouped according to the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) into three categories:

- Category 1 plants are weeds that serve no useful economic purpose and possess characteristics that are harmful to humans, animals or the environment. These plants need to be eradicated using the control methods stipulated in Regulation 15.D of the CARA.
- Category 2 plants are plants that are useful for commercial plant production purposes but are proven plant invaders under uncontrolled conditions outside demarcated areas.
- Category 3 plants are mainly used for ornamental purposes in demarcated areas but are proven plant invaders under uncontrolled conditions outside demarcated areas.

The following categories have been listed by the National Environmental Management: Biodiversity Act (10/2004) (NEMBA):

- Category 1a plants are high-priority emerging species requiring compulsory control. All breeding, growing, moving and selling are banned.
- Category 1b plants are widespread invasive species controlled by a management programme.
- Category 2 plants are invasive species controlled by area. Can be grown under permit conditions in demarcated areas. All breeding, growing, moving, and selling are banned without a permit.
- Category 3 plants are ornamental and other species that are permitted on a property but may no longer be planted or sold.

***Mitigation and recommendations***

All alien vegetation should be eradicated within the study site and invasive species as listed in this report should be given the highest priority. No herbicides are to be used in or near the stream area. The use of herbicides shall only be allowed after a proper investigation into the necessity, the type to be used, the long-term effects and the effectiveness of the agent. Application shall be under the direct supervision of a qualified technician. All surplus herbicides shall be disposed of in accordance with the supplier's specifications and not close to or near the wetland/river areas. Exotic and invasive plant species were categorised according to the framework laid out by The Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983) and National Environmental Management: Biodiversity Act (10/2004) (NEMBA). These acts define weeds as alien plants, with no known useful economic purpose that should be eradicated. Where herbicides are used to clear vegetation, selective and biodegradable herbicides registered for the specific species

should be applied to individual plants only. General spraying and the use of non-selective herbicides (e.g. Roundup, Mamba etc.) should be prohibited at all times.

**Waste Management**

Adequate waste management measures must be implemented preventing possible illegal dumping and littering of adjacent sensitive areas especially the watercourse areas of the study site.

- Adequate toilet facilities must be provided for all staff to prevent pollution of the environment.
- The excavation and use of rubbish pits is forbidden.
- Burning of waste is forbidden.
- A fenced area must be allocated for waste sorting and disposal.
- Individual skips for different types of waste (e.g. 'household' type refuse, building rubble, etc.) should be provided.

**Stormwater Management and pollution of water system**

All stormwater and runoff generated by the development activities must be appropriately managed.

- The stormwater drainage network system must be kept separate from the wastewater (water containing waste) system.
- The storm water system must be designed such that no large amount of water is released at one point only.
- The release of water must be designed such that the force of the water is reduced to prevent unnecessary erosion.

Prior to construction commencement

- It is vitally important that storm water management is properly managed on site both during and after construction.
- Drainage must be controlled to ensure that runoff from the site will not culminate in off-site pollution or result in rill and gully erosion or any erosion of the watercourses.

**Erosion and Surface runoff**

Most development activities are characterised by large areas of sealed surfaces such as roads, footpaths, houses etc. As a result, water infiltration is considerably reduced with an increase in surface run-off. Run-off is generally discharged to surface water systems and often contains pollutants. Pollutants range from organic matter, including sediments, plant

materials and sewage, to toxic substances such as heavy metals, oils and hydrocarbons. Construction activities associated with development can lead to massive short-term erosion unless adequate measures are implemented to control surface run-off. Sheet erosion occurs when run-off surface water carries away successive thin layers of soil over large patches of bare earth. This type of erosion is most severe on sloping soils, which are weakly structured with low infiltration, which promotes rapid run-off. It occurs on the site where vegetation has been destroyed. Continual erosion in sheet-eroded slopes is a common cause of gully erosion. Gully erosion results from increased flow along a drainage area, especially where protective vegetation has been removed and soils are readily transported. A gully has steep, bare sides and is often narrow and deep. Once formed, a gully usually spreads upstream through continual slumping of soil at the gully head. Gully erosion can be associated with salting as the saline sub-soils are readily eroded.

***Mitigation and recommendations***

The timing of clearing activities is of vital importance. Clearing activities and earth scraping should preferably be restricted to the dry season to prevent erosion. The dry months are also the period when most of the plant and animal species are either dormant or finished with their propagation/breeding activities. Soil stockpiling areas must follow environmentally sensitive practices and be situated a sufficient distance away from any stream area. Sufficient measures must be implemented to prevent the possible contamination of the surface water and groundwater. It is recommended that sandbags are placed all along the stream during the wet season to prevent soil erosion into these areas.

**Loss of Faunal Habitats**

Alteration of the current agricultural lands and secondary *Hyparrhenia hirta-Melinis repens* grasslands within the proposed site will directly, and indirectly, impact on the smaller sedentary species (insects, arachnids, reptiles, amphibians and mammals) adapted to their ground dwelling habitats. Larger, more agile species (birds and mammals) will try and re-locate in suitable habitats away from the construction activities. The impacts will be significantly reduced if the open rocky grasslands and moist grasslands below irrigation dam and the perennial Rietspruit (as well as appropriate grassland buffer zones) form a dispersal corridor stretching from the east towards the west; are conserved and adequately managed.

**Mitigation and recommendations**

Development must be restricted to the transformed (agricultural lands) and degraded grasslands on the site. Any animals encountered in the areas could be relocated away from

the development site. During the construction phase, workers must be limited to areas under construction and access to natural undeveloped areas must be strictly regulated, preventing uncontrolled hunting, poaching and gathering of firewood and medicinal plants. Increased pressure on the environment could result in major environmental degradation if environmentally sensitive practices are not followed and maintained. During the construction activities; wherever possible, work should be restricted to one area at a time. This will give smaller birds, mammals, reptiles and amphibians an opportunity to move into undisturbed areas close to their natural habitat.

The Site Manager and ECO must ensure that no faunal species are disturbed, trapped, hunted or killed during the construction phase. All animals unearthed or disturbed should ideally be released in appropriate habitat away from the development. Construction activities should be limited to the daylight hours preventing disturbances to the nocturnal activities of certain species and nearby human populations. This will also minimise disturbances to sensitive and secretive species.

**Migratory Routes (Fencing)**

The migratory movements of several animal (frog, reptile and mammal) species are completely disrupted by numerous walls, fences and road networks, which restrict natural movements between suitable foraging and breeding areas. This is especially prevalent for highly mobile species, such as Giant Bullfrogs, which can migrate up to six kilometres from suitable foraging areas (open grassland) to favourable breeding areas (seasonal pans or ponds). Fencing off of residential areas and private property also plays a critical role in impeding the natural migration of the majority of animal species. A trade off thus exists between safety and security on the one hand and movement of animal species on the other.

**Mitigation and recommendations**

The preservation, maintenance and creation of tracts of natural vegetation (biological corridors) in all stages of ecological succession, interconnected by corridors or green belts for escape, foraging, breeding and exploratory movements between the open rocky grassland and perennial Rietspruit to the west and east needs to be considered. Area of the proposed development should be fenced off, and remain fenced off after the completion of construction. Fencing during construction phase or any other barrier should be low impact, preventing further disturbance of the neighbouring vegetation and disruption of the natural migratory movements of remaining animals towards the lower-lying valley bottom wetland. Fences may also be used during the operational phase to prevent the migration of certain

animals out of the conserved areas into the proposed residential areas. Reverse curbing of approximately 50-70cm should be placed around the housing areas preventing reptiles and amphibians entering into these high-risk areas. The fence or barrier should, however, limit people, livestock and dogs entering the sensitive sites around the site.

## Artificial Lighting

Numerous species will be attracted towards the light sources and this will result in the disruption of natural cycles, such as the reproductive cycle and foraging behaviour. The lights may destabilise insect populations, which may alter the prey base, diet and ultimately the wellbeing of nocturnal insectivorous fauna. The lights may attract certain nocturnal species to the area, which would not normally occur there, leading to competition between sensitive and the more common species.

### Mitigation and recommendations

Artificial lighting should be directed away from the water ways in order to minimize the potential negative effects of the lights on the natural nocturnal activities of certain animals. Where lighting is required for safety or security reasons, this should be targeted at the areas requiring attention. Yellow sodium lights should be prescribed as they do not attract invertebrates at night and will not disturb the existing wildlife. Sodium lamps require a third less energy than conventional light bulbs.

# CONCLUSION & RECOMMENDATIONS

The study site is surrounded by various agricultural and small holdings. The study area is partly fenced (along the western and northern boundary), while a deep trench has been dug along the eastern boundary. The section south of the Rietspruit is not fenced and easily accessible. Various informal roads traverse the study site as well as what seems old water channels that were (are) used to channel water to the various lower-lying cultivated fields.

The largest part of the study area (71%) is used for agricultural purposes comprising a large number of cultivated fields with various crops planted (e.g. maize, vegetables, pasture grasses etc.).

Vegetation unit 1 (Rocky grassland) comprises 11 ha (7%) of the study area. This grassland is rocky with rock cover varying from 30% to 50%. The rocks that were cleared from the adjacent cultivated fields have been packed in places within this vegetation unit. These areas have become overgrown with pioneer weedy species from where they easily spread their seeds into this grassland. The vegetation of this unit consists of a mixture of climax, secondary successional and pioneer species with the latter two the most. The vegetation is however, still dominated by the climax grass *Themeda triandra* although the encroacher dwarf shrub *Seriphium plumosum* is slowly encroaching and displacing the grass vegetation. The co-dominance of the secondary successional grass *Eragrostis curvula* is also an indication of disturbance. This vegetation unit has a low-moderate species richness and only some resemblance to the original native Carletonville Dolomite Grassland vegetation type. This vegetation unit has a **medium ecological sensitivity**.

Vegetation units 2, 3 and 5 (*Hyparrhenia hirta* grassland; Cultivated fields & Developed areas respectively) are all influenced by anthropogenic activities. The *Hyparrhenia hirta* grassland has been ploughed / grazed in the past and as a result has become dominated by this anthropogenic grass. This unit has a low species richness and ecosystem functioning and is very homogeneous dominated by *Hyparrhenia hirta.* The native vegetation of both the Cultivated fields and the Developed area have been totally destroyed and apart from the planted crops consists of pioneer weedy species. These tow units have a low species richness. These three vegetation units are regarded as being transformed with a **low ecological sensitivity.**

The Stream area (vegetation unit 4) consists of a moderately wide perennial stream (Rietspruit) with a narrow riverbank. In some areas there are small floodplain sections while in most the stream is deeply incised with a narrow and steep embankment. Due to the cultivation activities and resultant anthropogenic influences the largest section of the embankment is degraded and the natural vegetation displaced by the invasive alien grass *Pennisetum clandestinum* with a large number of pioneer weeds. Towards the western part of the study area the vegetation along the stream consists of more indigenous (although secondary successional species) grasses with a slightly more natural habitat. The stream vegetation is indicative of disturbance, but due to the area being a water course it has a **high ecological sensitivity.** A 32m buffer zone is recommended around the stream within which no development should take place (Figures 16 & 17).

Although vegetation units 1 and 4 together with sections of vegetation unit 3 are classified as CBA and ESA areas the vegetation of these units ranges from moderately degraded to transformed with little to no resemblance to the natural vegetation that existed in this area. The same applies to the area being listed as “high terrestrial diversity” according to DEFF. Except for a few natural plant species, insects and small mammals the area is devoid of high diversity due to habitat destruction and anthropogenic activities. There is little connectivity with any terrestrial ecosystem and vegetation unit 1 is a small, isolated section that is already degraded to some extent and low in species richness.

No red data species was found to be present within the different vegetation units although marginal habitat exists within vegetation units 1 and 4. The area has relatively few declared alien invasive species with most occurring within the stream area (vegetation unit 4). None of the few medicinal plants found to be present are threatened and they occur abundantly in other areas outside the property, while some are pioneer weeds and declared alien invader weeds.

It is not thought that development of the degraded areas with low ecological sensitivities on the study site should have a negative impact on the environment provided that the mitigation measures as indicated in this report is incorporated into the management plan and adhered to. No development is recommended within the stream area and its associated 32m buffer zone. The vegetation within the buffer zone should be rehabilitated to improve the degraded conditions that exist.

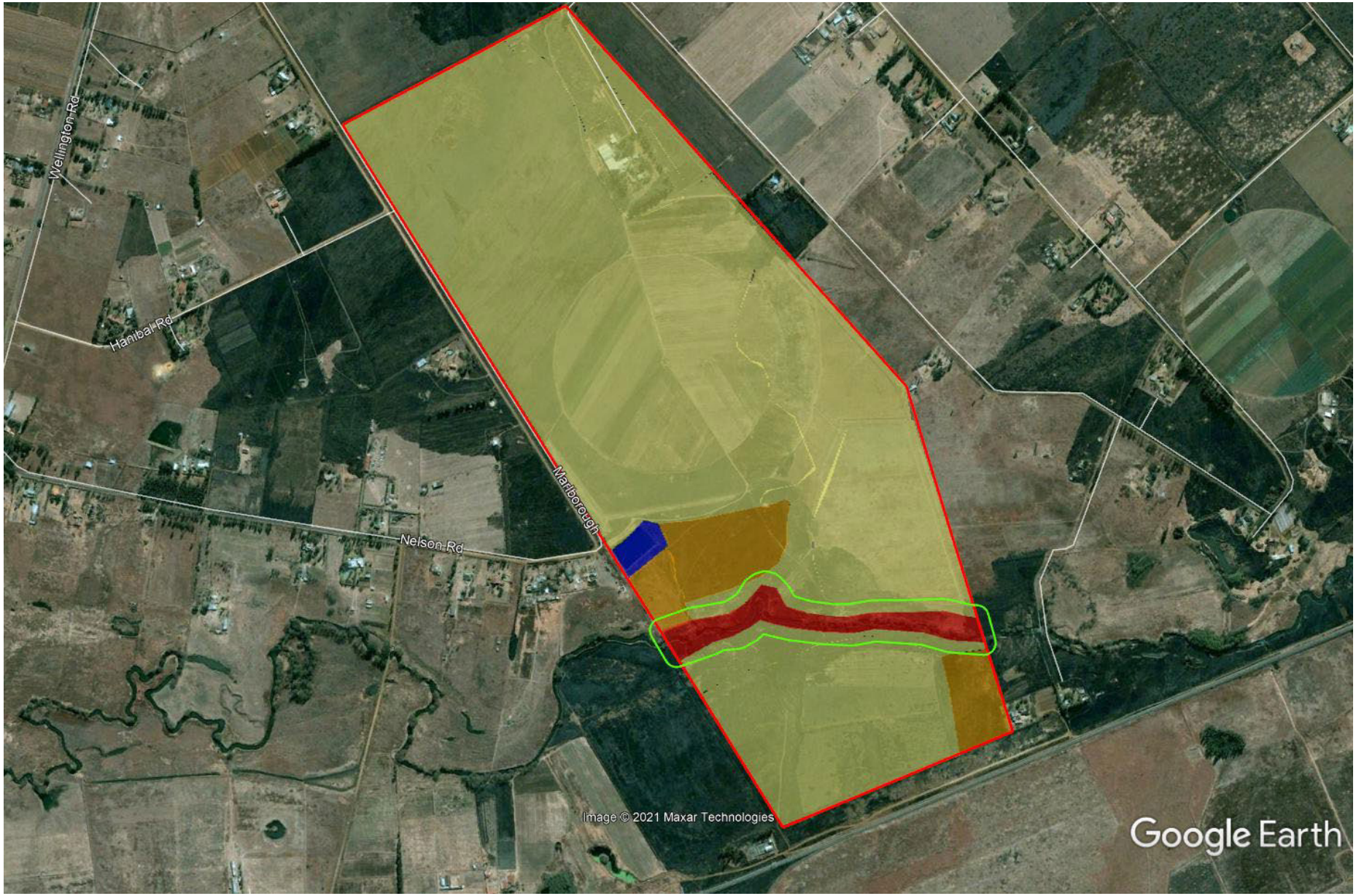


**Figure 16.** Sensitivity map of the different vegetation units of the study area (Yellow = Low; Orange = Medium-high; Red = High; Blue = artificial irrigation dam; Green line = 32m buffer around stream) (Source: Google Earth, 2021).

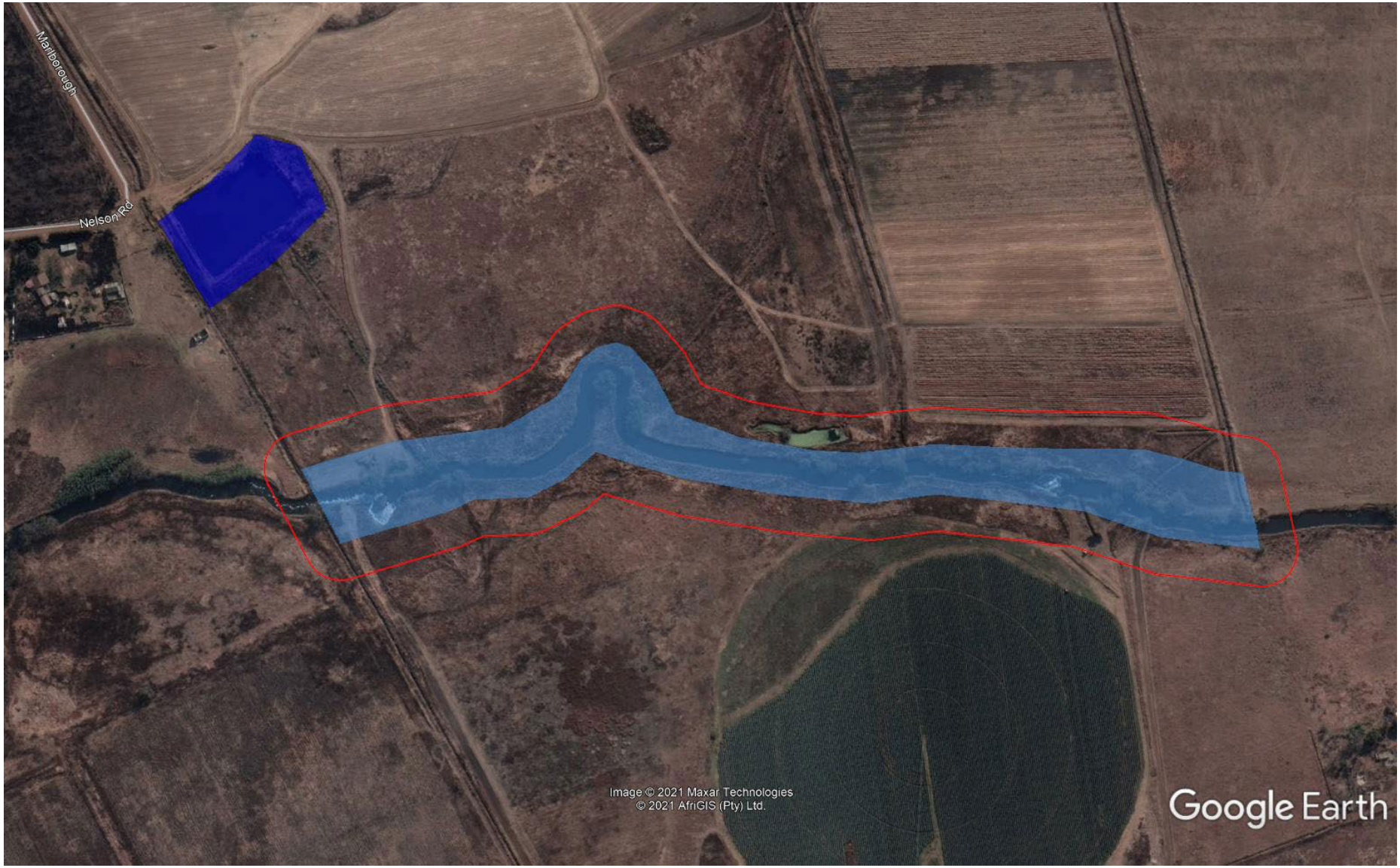


**Figure 17.** Closer image of the edge of the stream and associated floodplain area with a 32m buffer zone (Blue = artificial farm dam; Red line = 32m buffer around stream) (Source: Google Earth, 2021).

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