APPENDIX D: SPECIALIST REPORTS

Annexure A: Wetland Delineation and Risk Assessment

ROOIKRANS BOERDERY (PTY) LTD

STERKSPRUIT 296 JT

EIA Specialist Report:
Aquatic Delineation and Risk Assessment

DRAFT 1.0
22nd March 2020

Transitional Stream, Sterkspruit 296 JT [4th February 2020].

Prepared for:

Steven Henwood
Henwood Environmental Solutions (Pty) Ltd
PO Box 12340
STEILTES
1213

Email: shenWood@mweb.co.za

Prepared by:

Rob Palmer
Nepid Consultants CC
P O Box 4349
WHITE RIVER
1240
SOUTH AFRICA

Tel: +27 13 751 1533
Fax: 08668 28220
e-mail: rob@nepid.co.za
Web: www.nepid.co.za

Disclaimer

This report was based on the author's best scientific and professional knowledge and information available at the time of writing. Although Nepid Consultants has tried to ensure that all information contained within this report is accurate, Nepid does not warrant or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of the information presented in this report.

TERMS OF REFERENCE

Conduct riparian delineation and functionality report for clearing and cultivation

[Email request from Steven Henwood, 2020-01-23].

ACKNOWLEDGMENTS

The following are gratefully acknowledged for assisting with the information presented in this report:

- Duncan McKenzie, Ecorex, Nelspruit

Requirements for Specialist Reports Appendix 6 of Amendments to the environmental impact assessment regulations, 2014 (Government Notice No 326, 7th April 2017), promulgated in terms of National Environmental Management Act, 1998 (Act No. 107 of 1998).	**Reference**
a(i) the specialist who prepared the report	Appendix A
a(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix A
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Chapter 1
(cA) an indication of the quality and age of the base data used for the specialist report	Section 3.3
(cB) a description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change	Section 5.3 Section 6.3
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.3
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Chapter 3
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Chapter 5 (alternatives were not considered)
(g) an identification of any areas to be avoided, including buffers;	Figure 5-3
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 5-3
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.10
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, [including identified alternatives on the environment], or activities	Chapter 6
(k) any mitigation measures for inclusion in the EMPr;	Appendix K
(l) any conditions for inclusion in the environmental authorisation	Appendix K
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 8.2
(n) a reasoned opinion- *(i) as to whether the proposed activity, activities or portions thereof should be authorised;*	Section 8.1
(iA) regarding the acceptability of the proposed activity, activities, and	
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	None
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
(q) any other information requested by the competent authority;	n/a
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	n/a

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

EIA	Environmental Impact Assessment
MTPA	Mpumalanga Tourism & Parks Agency
PES	Present Ecological State
SANBI	South African National Botanical Institute

GLOSSARY OF TERMS

Buffer	*A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted to reduce the impact of adjacent land use on the wetland or riparian area.* *[DWAF 2008].*
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.* [National Water Act (Act No. 36 of 1998)].
Watercourse	*a) a river or spring;* *b) a natural channel or depression in which water flows regularly or intermittently;* *c) a wetland, lake or dam into which, or from which, water flows; and* *d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.* [National Water Act (Act No. 36 of 1998)].
Wetland	*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.* [National Water Act (Act No. 36 of 1998)].

1. INTRODUCTION

1.1 Background

Rooikraans Boerdery intend to develop two fields for cultivation on the Farm Sterkspruit 296 JT, in Schoemanskloof. The proposed development has the potential to impact negatively on the Sterkspruit and associated aquatic ecosystems. This report forms part of the environmental authorisation process for the proposed development and concerns potential impacts of the proposed development on aquatic ecosystems. The report is based on a review of available data and a field survey undertaken on 4th February 2020. The report classifies and delineates aquatic ecosystems and recommends mitigation and monitoring measures, where appropriate.

1.2 Aims and Objectives of This Report

The aims and objectives of this report were:

- to classify and delineate aquatic ecosystems that could be affected by the proposed development;
- assess the risks of the proposed developments on aquatic ecosystems;
- provide a reasoned opinion as to whether the proposed activity should be authorised in terms of potential impacts on aquatic ecosystems; and
- recommend buffer zones and other mitigation and monitoring measures.

1.3 Expertise of the Specialist

This report was prepared by Rob Palmer, PhD (Zoology), with assistance from Felicity Weir. Rob has over 20 years' experience in aquatic systems and specialist knowledge of river regulation and river ecology. He has undertaken numerous environmental assessments throughout Africa, mostly concerning water resource developments and mining. He is a registered Environmental Assessment Practitioner (No 0080/06), a member of the SA Council for Natural Scientific Professions (No 400108/95), and an accredited SASS5 biomonitoring practitioner. His CV is included in Appendix A, and a Declaration of Independence is included in Appendix B.

1.4 Legislation

Legislation	Requirement
National Environmental Management Act (Act No 107 of 1998)	
GNR 984 Listing Notice 1 of 2014 4th Dec 2014	***Activity 27.*** *The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for-* *(i) the undertaking of a linear activity; or* *(ii) maintenance purposes undertaken in accordance with a maintenance management plan.*
National Environmental Management Biodiversity Act (Act No 10 of 2004)	
GNR 151 23rd February 2007, and as amended in GNR 1187 14th December 2007.	List of Critically Endangered, Endangered, Vulnerable, and Protected Species.
GNR 864 Alien invasive species lists 2016 29th July 2016	**Notice 3: National List of Invasive Species in terms of section 70(1)** **List No 1**: National List of Invasive Terrestrial and Freshwater Plant Species. **Notice 4: Prohibited Alien Species in terms of section 67(1)** **List No 1**: Prohibited Terrestrial and Freshwater Plant Species.
Legislation	**Requirement**
Conservation of Agricultural Resources Act (Act No. 43 of 1983	
Government Gazette No. 37885 Alien and Invasive Species Regulations in 2011	Declared weeds and alien invaders in South Africa, which are classified as follows; • Category 1 plants: are prohibited and must be controlled. • Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread. • Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading
GN R1048 7(3)(b) Buffer Zone size for Crops	Land users may not cultivate any land on the farm unit within the flood area of a watercourse or within 10 m horizontally outside the flood area of a watercourse (unless this was prior to 1 June 1984, date of commencement of the Regulations, or with written permission). The flood area is defined as the 1:10 year flood line by the Act.
GN R1048 7(2) Debris in Watercourses	Every land user shall remove vegetation / debris in a watercourse so that it will not cause an obstruction during a flood that could cause excessive soil loss as a result of erosion through the action of water.
National Water Act (Act No 36 of 1998)	
GN 509 General Authorisation for Water Uses Water Use in terms of Section 21(c) or Section 21(i) 26th August 2016	**Exclusions to General Authorisation** *This Notice does not apply—* *(a) to the use of water in terms of section 21 (c) and/or (i) of the Act for the rehabilitation of a wetland as contemplated in General Authorisation 1198 published in Government Gazette 32805 dated 18 December 2009,* *(b) to the use of water in terms of section 21 (c) and/or (i) of the Act within the regulated area of a watercourse where the Risk Class is Medium or High as determined by the Risk Matrix (Appendix A). This Risk Matrix must be completed by a suitably qualified SACNASP professional member;* *(c) in instances where an application must be made for a water use license for the authorisation of any other water use as defined in section 21 of the Act that may be associated with a new activity;*

Legislation	Requirement
	(d) where storage of water results from the impeding or diverting of flow and/or altering the bed, banks, course or characteristics of a watercourse; and *(e) to any section 21 (c) and/or (i) water use associated with construction/installation or maintenance of any sewerage pipelines, pipelines carrying hazardous materials and to raw water and wastewater treatment works. Where the water use falls within paragraph 3 (b)-(e) a water use license will be required.*
Mpumalanga Nature Conservation Act (Act No 10 of 1998)	
Section 60	prohibits the "obstruction or drainage of waters", including "*cutting through, breaking down or otherwise damaging a wall, bank of barrier thereof*".
Section 67	prohibits the pollution of waters and penalties apply to any person who "dumps or deposits in, allows to be dumped or to be deposited in, or in any other manner allows to enter or percolate into water any substance or thing, whether solid, liquid or gaseous, that is or is likely to be or to become injurious to aquatic and associated biota".
Section 68	regulates aquatic weed species, listed in Schedule 10.
Section 69	regulates protected plants and specially protected plants.
Section 80	regulates invader plant species.

2. STUDY AREA

2.1 General

The proposed fields are located in Schoemanskloof on either side of the N4 highway (Figure 2-1 and 2-2). The proposed development comprises two areas totalling 19 hectares (Figure 2-2). The Study Area for this report considered all aquatic ecosystems within 500 m of the proposed development, as required in terms of Government Notice 509 (26th August 2016). The Study Area for this report covered an area of 180 hectares but focussed in the area of the two proposed fields where are referred to here as the:

- upper (southern) field; and
- lower (northern) field

(Figures 2-1; 2-2).

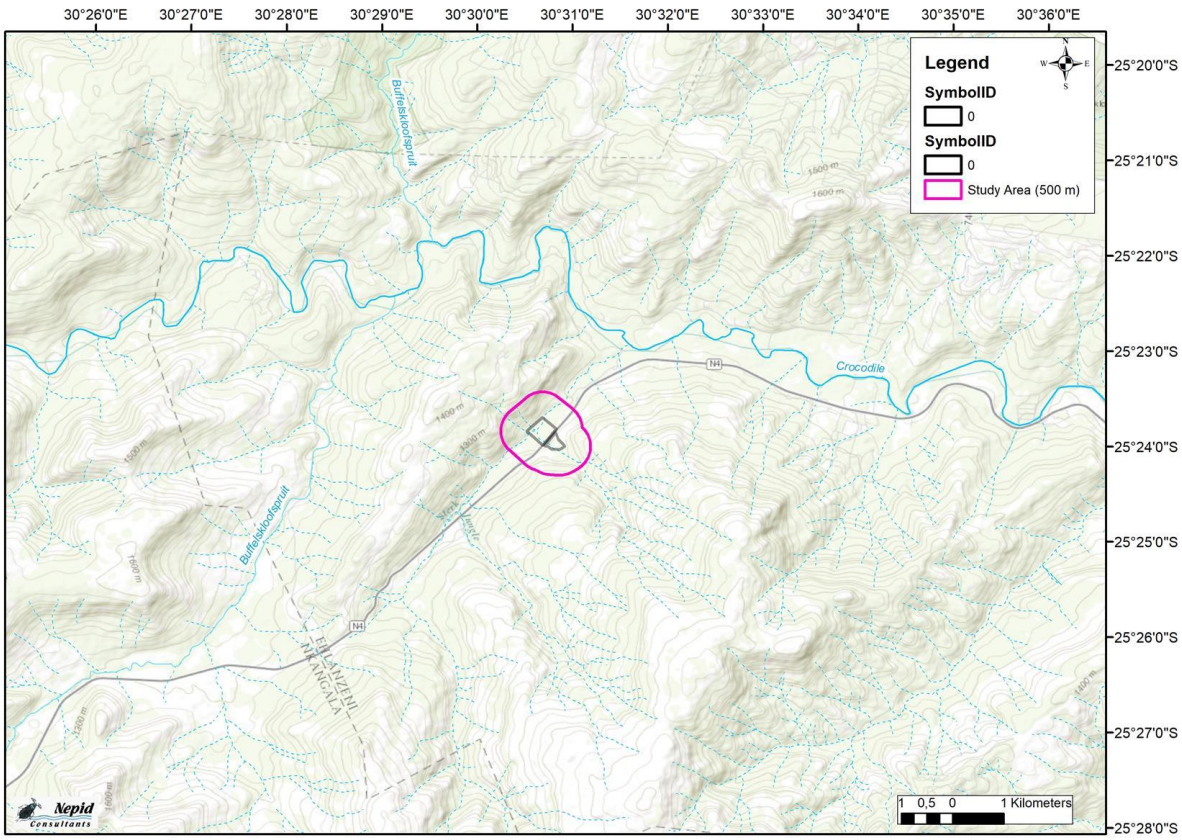


Figure 2-1. General Locality Map.

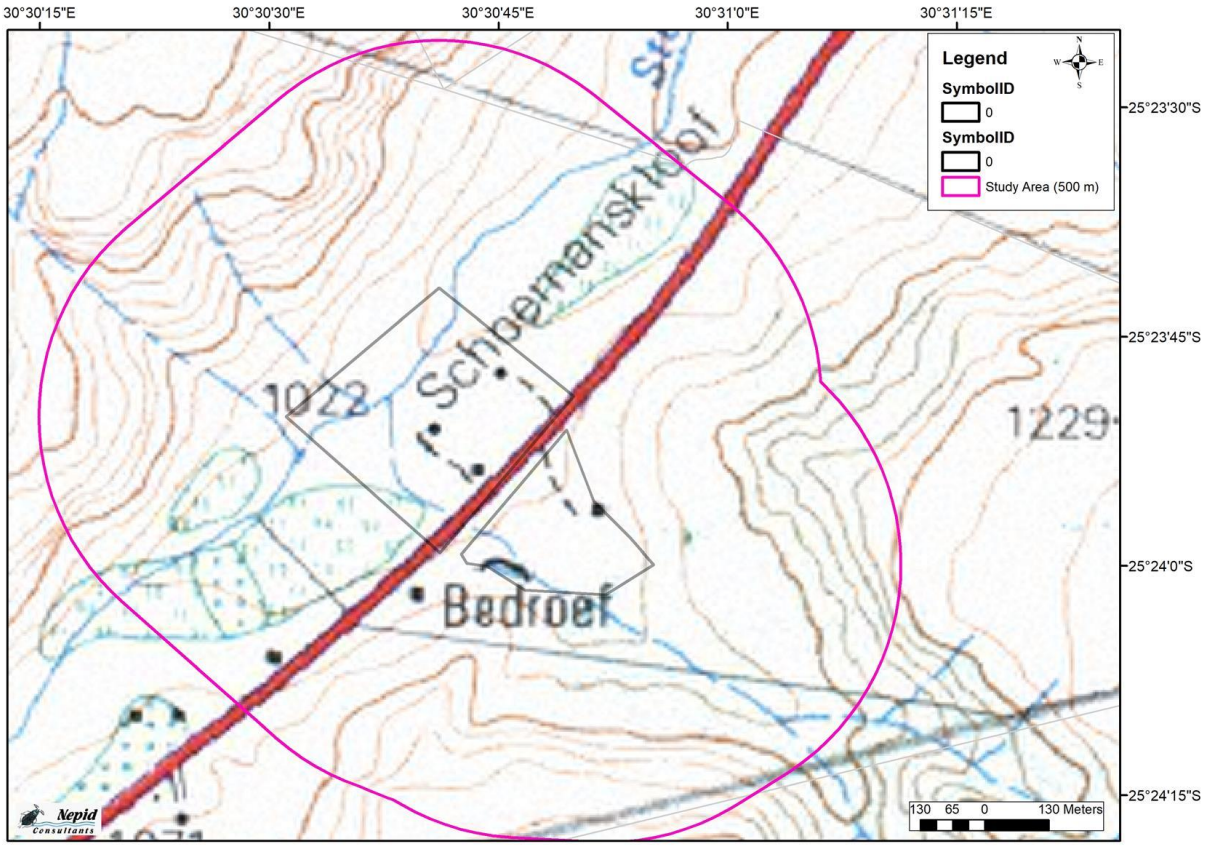


Figure 2-2. Topographical map showing the two proposed fields and 500 m Study Area boundary. [Data extracted from 1: 50 000 scale map 2530BC].

2.2 Survey Sites

Survey sites for this report were as follows:

T1. Unnamed tributary at the N4 highway crossing at S25.399103; E30.511783. This site was surveyed for fish only. Aquatic macroinvertebrates were not sampled at this site because instream habitats were unsuitable and the flow at the time of the survet comprised no more than a trickle;

R1. Sterskpruit at the lower boundary of the proposed lower field at S25.395330; E30.511610. Here fish and aquatic macroinvertebrates were sampled;

S1: low lying area at the lower boundary of the proposed upper field at S25.398314 E30.513129. Here soils were augured to determine potential wetland conditions; and

S2: low lying area at the lower boundary of the proposed lower field at S2: S25.42136 E30.76548. Here soils were augured to determine potential wetland conditions.

(Figure 2-3).

Figure 2-3. Google Earth image dated 30-11-2018, showing the two proposed fields on either side of the N4 highway, plus sites sampled for this report and GPS track logs.

3. METHODS

3.1 Approach

The approach to this report was to review the available ecological information for the Study Area and undertake a short field survey to assess the Ecological Importance and Sensitivity and the Present Ecological State within the potential zone of influence of the proposed development on aquatic ecosystems. Classification and delineation of aquatic ecosystem types formed the spatial framework on which an assessment of potential impacts was assessed. The assessment considered the presence of threatened and protected species and ecosystems, areas of high biodiversity, corridors and other relevant features.

3.2 Review

A desktop review of available ecological data pertaining to the general vicinity of the proposed development revealed the following important sources of information:

- Mpumalanga Biodiversity Sector Plan: Freshwater Assessment (MTPA 2011), Fish Support Areas (MTPA 2014);
- National Freshwater Ecosystem Priority Areas (Nel *et al*. 2011);
- Vegetation of South Africa, Lesotho and Swaziland (Mucina and Rutherford 2006).
- Present Ecological State, Ecological Importance and Ecological Sensitivity per sub Quaternary reaches in South Africa (DWS 2014); and
- Google Earth coverage dated 1st April 2017.

3.3 Field Survey

The field survey for this report was undertaken as follows:

- **4th February 2020** (summer). Baseline data collection focused on the identification, classification and delineation of aquatic ecosystems. Overall, the quality of the data is considered appropriate for the purposes of this report.

3.4 Aquatic Ecosystem Classification

Aquatic ecosystems were classified according to hydrogeomorphic units, as described by Ollis *et al*. (2013).

3.5 Aquatic Ecosystem Delineation

Wetlands and riparian zones were delineated according to the method detailed by the Department of Water Affairs and Forestry (DWAF 2008). The method is based on a combination of plant species composition, landform setting and soil features within 50 cm of the soil surface. A soil auger was used to locate the outer boundaries of the wetlands.

3.6 Ecological and Functional Assessment

The Ecological and Functional Importance of aquatic ecosystems was assessed using a rapid method that considers: 1) Ecological Importance, 2) Hydro-functional Importance and 3) Direct Human Benefits (Rountree 2012). The method involved rating 25 parameters on a numerical scale between 0 (*Zero)* and 4 (*Very High*).

3.7 Present Ecological State

The Present Ecological State of aquatic ecosystems was assessed in terms of aquatic macroinvertebrates, fish, riparian health and wetland health.

3.7.1 Aquatic Macroinvertebrates

Aquatic macroinvertebrates were sampled using the standard SASS5 biomonitoring method (Dickens and Graham 2002). The SASS5 results were classified into one of six Present Ecological State categories, ranging from *Natural* (Category A), to very *Critically Modified* (Category F). The limits for each category varied depending the Level I Ecoregion and the geomorphological zone, according to the method of Dallas (2007).

3.7.2 Fish

Fish were sampled using a battery operated portable electro-fisher (Samus 725M), with a fine-meshed net attached to a 30 cm anode ring. The Present Ecological category of fish at was assessed using the Fish Assemblage Integrity Index (Kleynhans 2003). The index classifies results into one of six Present State Categories, from Category A (*Natural*), to Category F (*Critically Modified*) (Table 3-1).

3.7.3 Riparian Vegetation

The Present Ecological State of the riparian zone within each Management Unit was assessed using the Riparian Health Index (Ground Truth 2016). The method involves rating eight criteria on a numerical scale between 0 (*No Impact)* and 5 (*Critical Impact*). The scores are added and expressed as percentage change and classified into one of six categories, ranging from *Natural* (Category A), to *Critical* (Category F) (Table 3-1).

Table 3-1. Classification of Present Ecological State.

Category	Ecological Condition	Impact	Riparian Score[1]	Percentage Change[1]	Wet-Health Score[2]
A	*Natural*	None	<5	<11	<1
B	*Largely Natural*	Small	5 – 11.5	11 – 29	1-1.9
C	*Moderately Modified*	Moderate	12 – 19.5	30 – 49	2-3.9
D	*Largely Modified*	Large	20 – 27.5	50 – 69	4-5.9
E	*Seriously Modified*	Serious	28 – 35.5	70 – 89	6-7.9
F	*Critically Modified*	Critical	>35.5	>89	8-10

[1]=Ground Truth (2014); [2] = MacFarlane *et al. (*2009).

3.7.4 Wetland Health

The Present Ecological State of wetlands was assessed using the WET-Health Level 1 method (Macfarlane *et al*. 2009). The method involves rating the extent to which various parameters appear to have changed from likely reference (natural) conditions on a numerical scale between 0 (*Natural*) and 10 (*Critically Degraded*). Separate assessments are made for: 1) hydrology; 2) geomorphology; and 3) vegetation (Macfarlane *et al.* 2009). The results were classified into one of six Present Ecological State categories, ranging from *Natural* (Category A), to *Critically Modified* (Category F) (Table 3-1).

3.8 Risk Assessment

Risks of the proposed development on aquatic ecosystems were assessed using the Department of Water Affairs and Sanitation Risk Assessment Matrix, dated September 2016. The method

complies with General Authorisations for impeding or diverting the flow of water in a watercourse (National Water Act Section 21c), and/or altering the bed, banks, course or characteristics of a watercourse (National Water Act Section 21i) (DWA 2016).

3.9 Buffer Zones

Buffer zones were based on assessment of various considerations including Present Ecological State, Ecological Importance and Sensitivity, potential risks, slope, vegetation cover, and soil permeability, *inter alia*, as detailed by Macfarlane *et al*. (2015).

3.10 Assumptions and Limitations

3.10.1 Report Focus

This report focusses on aquatic ecosystem classification, delineation, functional assessment and present ecological state, but does not address various aspects related to aquatic ecosystems, such as hydrology, hydraulics, water quality, amphibians, reptiles or waterbirds. However, the level of detail collected and presented is considered appropriate for the purposes of this report.

3.10.2 Spatial Resolution

The delineation of aquatic ecosystems within the proposed fields was based on primary data collection comprising field observations of topography, soils, plant species composition and the use of a standard, hand-held GPS, and these boundaries are considered accurate to about 5 m. By contrast, the delineation of aquatic ecosystems beyond the proposed fields was based on available Google Earth™ and World Image data and these boundaries are considered accurate to about 15 m. Higher resolution delineation would need more detailed assessment of soils, differential GPS and boundaries pegged in the field, but this is not considered necessary for the purposes of this report.

3.10.3 Temporal Resolution

Baseline data for this report were based on a once-off field survey, so seasonal variation in baseline conditions were not quantified, and some plant species are likely to have been overlooked, particularly geophytes. However, a single survey is considered appropriate for the purposes of this report.

4. REGIONAL CONTEXT

4.1 Geology

The Study Area is underlain by sedimentary rocks comprising siltstones, shales, sands and conglomerates of the Pretoria Group, Vaalian Period.

4.2 Soils

Soils were investigated at two locations for this report as follows:

S1, in a low-lying area at the lower boundary of the upper field and in a potential wetland area (Figure 4-4). Here the soils comprised deep (>50 cm) and uniform dark red brown soils (2.5YR 2.5/3) typical of the Hutton Soil Formation (Figure 2-1a). There was no indication of wetland soil at this location; and

S2, in a low-lying area of the lower field, close to the Sterkspruit and a potential wetland area (Figure 4-4). Here the soils comprised shallow (20 cm) dark brown soils on a lithic substrate, typical of Glenrosa Soil Formation (Figure 4-1b). There was no indication of wetland soil at this location.

Soils within the seepage wetlands were not assessed for this report because here the vegetation indicators were unequivocally hydromorphic.

a) **Hutton Soil Formation** at S1.

b) **Glenrosa Soil Formation** at S2.

Figure 4-1. Soils.

4.3 Erosion

Risk of erosion within the Study Area is classified as *Low* (Schulze and Horan 2006).

4.4 Topography

The topography of the proposed fields comprises foothill slopes with gradient ranging between gently to strongly sloped. Elevation within the proposed fields ranges between 1,019 and 1,070 m amsl.

4.5 Drainage

All runoff from the two proposed fields will enter the Sterkspruit, a tributary of the Crocodile River (Figure 4-2). The proposed fields are located within Quaternary Catchment X21E, in the Nkomati Water Management Area (Figure 4-2).

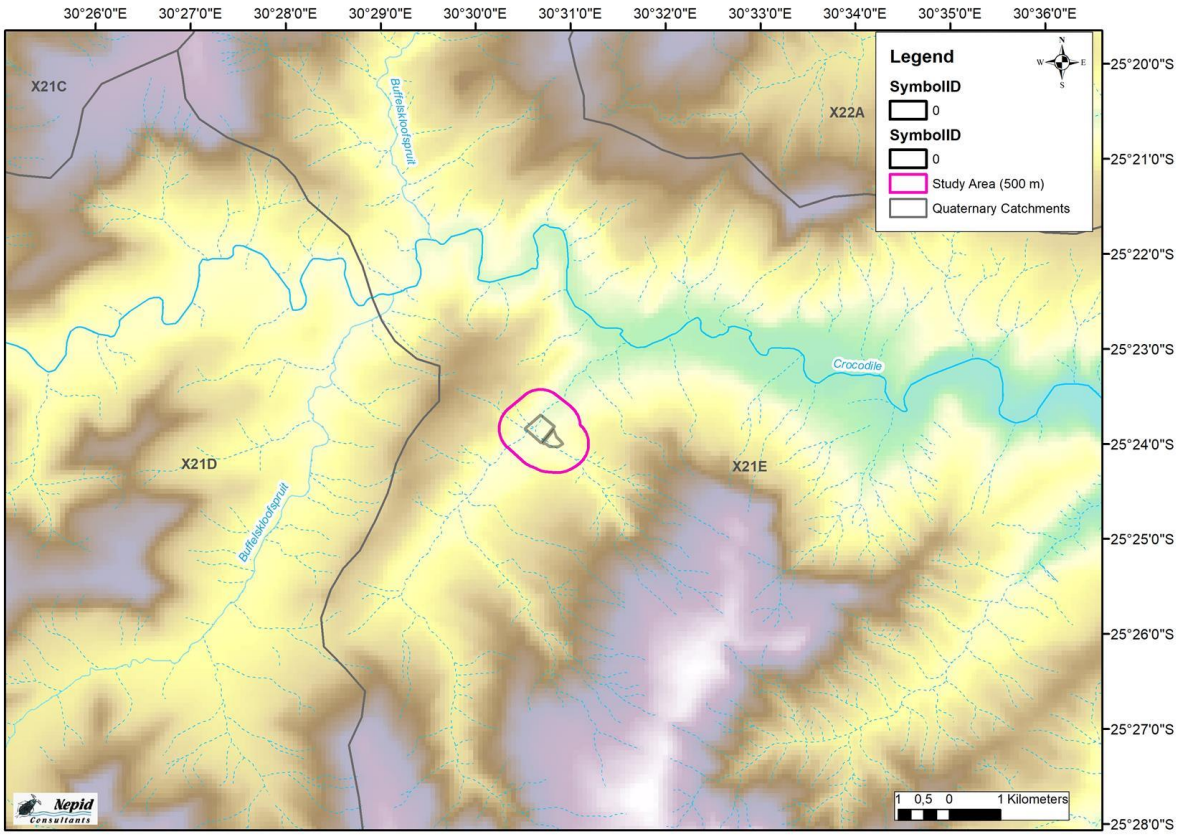


Figure 4-2. Quaternary Catchments.

4.6 Vegetation

Vegetation within the Study Area comprises Legogote Sour Bushveld (SVI 9), which has a conservation status of *Vulnerable* (Notice 1002 of Government Gazette 34809, 9 December 2011).

4.7 Aquatic Ecoregion

The Study Area is located within the Northern Escarpment Mountains Level I Aquatic Ecoregion (*sensu* Kleynhans *et al.* 2005). This ecoregion comprises closed hills and mountains with a well-defined escarpment and vegetation dominated by North-eastern Mountain Grassland and Sour Lowveld Bushveld towards the east (Kleynhans *et al.* 2005).

4.8 Strategic Water Source Areas

The upper field is located on the boundary of a Strategic Water Source Area, which are defined as areas that contribute at least 50% of Mpumalanga's runoff in only 10.2% of surface area (www.bgis.sanbi.org). These areas are recognised as ecologically critically important. Mean annual rainfall in the Study Area is moderate with estimates ranging between 758 mm (Schulze

and Lynch 2006), and 837 mm (Hijmans *et al.* 2005). By contrast, mean annual rainfall in the Barberton Mountains is around 1 500 mm (Hijmans *et al.* 2005). The proposed development area is therefore in the drier portion of the Strategic Water Source Area.

4.9 Freshwater Priority Areas

The Mpumalanga Biodiversity Sector Plan Freshwater Assessment classifies the two proposed fields and most of the Study Area as a *Critical Biodiversity Area* (Figure 4-3). A small portion of the Study Area is classified as *Heavily Modified* (Figure 4-3). The field survey in February 2020 found that the upper (southern) field had been cultivated and was heavily modified, whereas the lower (northern) field was largely natural.

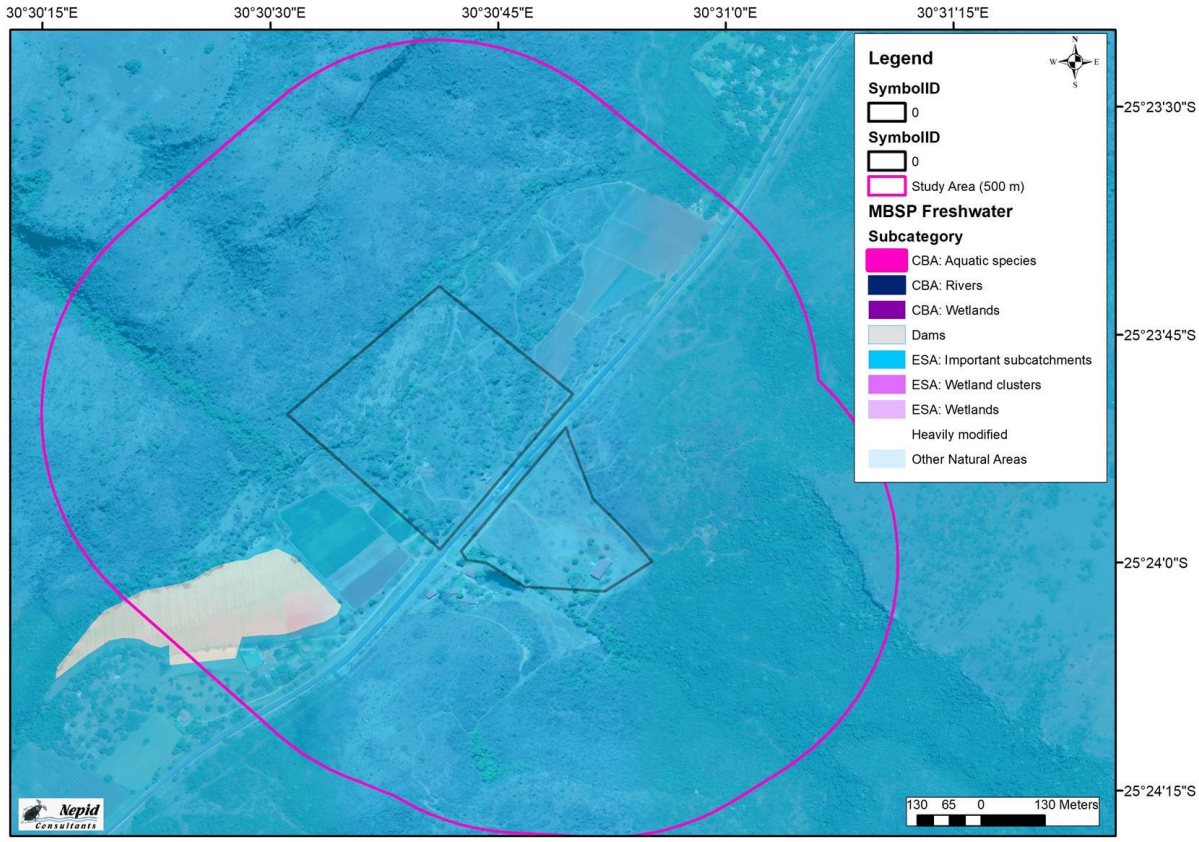


Figure 4-3. Freshwater Assessment (*sensu* MTPA 2011).

4.10 Ecological Importance & Sensitivity

Ecological Importance and Sensitivity (EIS) of the Sterkspruit and associated tributaries within the proposed development area were not assessed by the Department of Water Affairs and Sanitation in 2014 (DWS 2014). However, the EIS is likely to be *High* because the area is classified as a *Critical Biodiversity Area* for aquatic ecosystems and two species of fish of conservation concern have been recorded in the catchment, namely:

- *Kneria sp. nov "South Africa",* classified as *Endangered*. This species has been recorded in the Sterkspruit as well as the Junglespruit tributary, which is a short distance (2 km) from the proposed development area; and
- *Chiloglanis bifurcus*, classified as *Critically Endangered*. This species has been recorded in the lower reaches of the Sterkspruit.

4.11 Present Ecological State

The Present Ecological States of the Sterkspruit and associated tributaries within the proposed development area were not rated by the Department of Water Affairs and Sanitation in 1999 (DWS 2014). However, a biomonitoring survey conducted by Nepid Consultants at three sites in the Sterkspruit in May 2018 found that the Present Ecological State of fish deteriorated from Category B/C in the upper reaches, where the river crosses the N4 highway, to Category E, close to the confluence with the Crocodile River (Palmer unpublished data). The deterioration was attributed to elevated sediments following unauthorised clearing for agricultural development on neighbouring properties bordering the Sterkspruit.

4.12 Land Use

Land use in the two proposed fields in February 2020 were as follows:

Upper Field: mostly fallow lands turned to open grassland used for livestock grazing (Figure 4-4a); plus a farmhouse and farm access roads (Figure 2-3); and

Lower Field: mostly natural bushveld used for livestock grazing (Figure 4-4b), plus a labourer's house and farm access roads (Figure 2-3).

a) Proposed Upper Field - Modified. b) Proposed Lower Field – Largely Natural.

Figure 4-4. Land Use.

5. BASELINE ASSESSMENT

5.1 Aquatic Ecosystem Classification

Three hydro-geomorphic aquatic ecosystem types were identified within the footprint of the proposed fields as follows:

- **Hillslope Seepage Wetlands.** Two permanently saturated Hillslope Seepage Wetlands were located within the proposed lower field and these combined covered an area of 0.6 ha within the proposed development area. The vegetation here was characterised by wetland obligate species such as *Schoenoplectus corymbosus, Miscanthus junceus, Imperata cylindrica, Phragmites mauritianus, Mikania capensis, Pulicaria scabra, Chamaecrista mimosoides* and *Gunnera perpensa.*

- **Mountain Stream.** An unnamed Mountain Stream runs through both proposed fields over a distance of 440 m and joins the Sterkspruit within the proposed lower field. Flow in this stream during the field survey in February 2020 comprised a trickle and the 1:50 000 scale topographical map indicates that this stream is naturally seasonal. The riparian zone was about 16 m wide in the proposed upper field, and increased to about 80 m width in the proposed lower field where the stream joins the Sterkspruit. Riparian vegetation was characterised by woody shrubs and small trees such as *Searsia gerrardii, Annona senegalensis, Brachylaena transvaalensis, Gymnosporia glaucophylla, Maytenus undata, Celtis africana, Trema orientalis, Diospyris lycioides, Diospyros whyteana* and *Dalbergia armata.*

- **Transitional Stream.** The Sterkspruit flows through the proposed lower field over a distance of 420 m and is classified as a Transitional Stream. Flow during the field survey was low but there was suitable instream habitat to support aquatic macroinvertebrates and fish. The stream comprises mostly a single, unconfined channel with a wooded riparian zone about 80 m wide and covers an area of 2.7 hectares within the proposed development area. Soils in the riparian zone comprised mostly alluvial sands. The marginal riparian zone was colonised by species such as *Christella dentata, Commelina erecta, Floscopa glomerata, Carex rhodesiaca, Lipocarpha chinensis, Persicaria decipiens, Juncus exsertus, Ischaemum fasciculatum, Leersia hexandra, Setaria sphacelata var sphacelata, Ludwigia octovalvis, Ludwigia palustris* and *Syzygium cordatum*. The upper riparian zone was colonised a variety of grasses, herbs, shrubs and trees, including *Flueggea virosa, Phyllanthus reticulatus, Ziziphus mucronata, Hippobromus pauciflorus, Olea europaea subsp. cuspidata* and *Pappea capensis.*

(Figures 5-1).

Details of the classification are presented in Appendix C.

a) Hillslope Seepage Wetland.

b) Mountain Stream at T1.

c) Transitional Stream (Sterkspruit) near R1.

Figure 5-1. Aquatic Ecosystem Classification.

Other notable aquatic features within the Study Area were:

- **Farm Dam**. A small, off-channel farm dam that received water diverted from the Mountain Stream was located on the south-western boundary of the proposed upper field. This dam was delineated but not assessed in further detail for the purposes of this report;

- **Drainage Lines**. Several episodic drainage lines run through the Study Area and these were delineated for purposes of stormwater management (Figure 5-3), but they were not assessed in detail for the purposes of this report. The drainage lines were characterised by closed canopy woody species such as *Dallbergia* armata*, Diospyros whyteana*, *Hippobromus pauciflorus, Senegalia ataxycantha* and *Ziziphus mucronata.*

- **Drainage Canals.** Drainage canals were present in the Seepage Wetlands on neighbouring properties on both sides of the proposed development area (Figure 5-2).

5.2 Aquatic Ecosystem Delineation

Delineation of the aquatic ecosystems within the Study Area is shown in Figure 5-2, and within the two proposed fields is shown in Figure 5-3. The dominant aquatic ecosystems comprise the Sterkspruit and associated riparian zone, seasonal tributaries and permanently saturated Hillslope Seepage Wetlands.

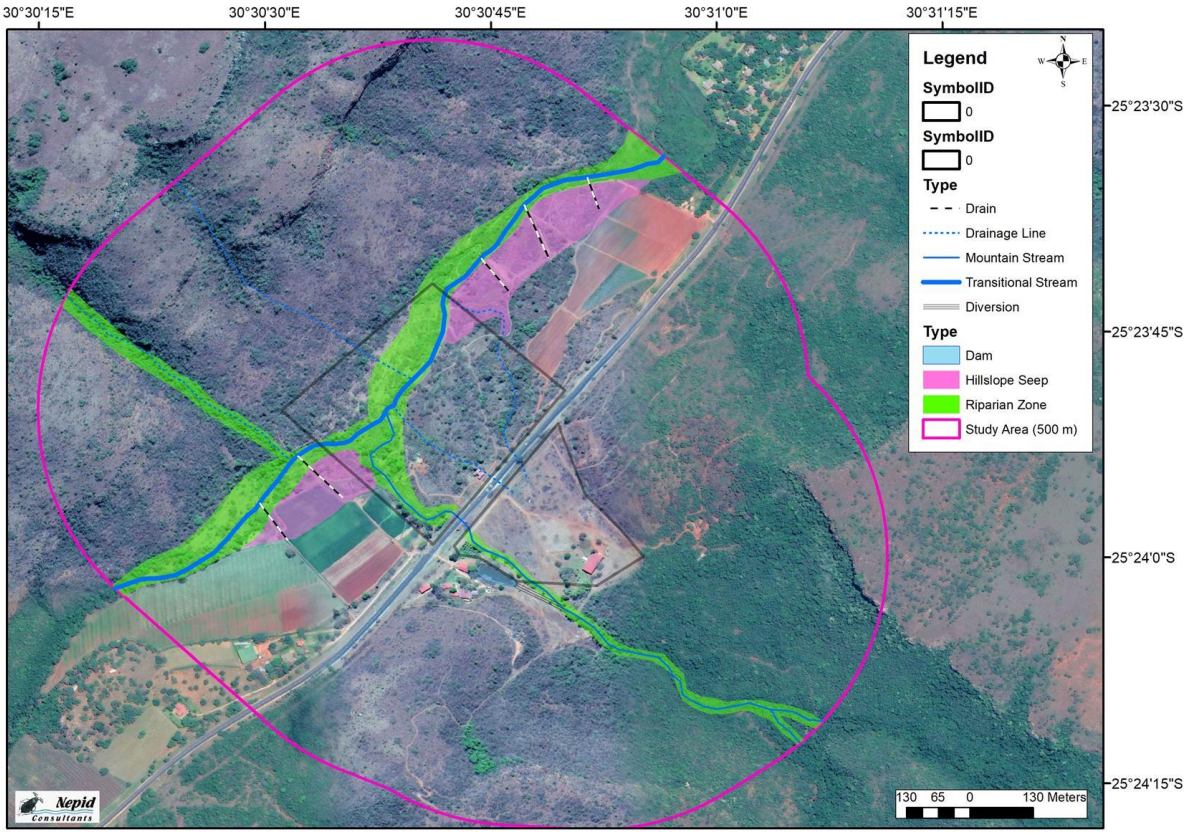


Figure 5-2. Aquatic Ecosystem Classification and Delineation – Study Area.

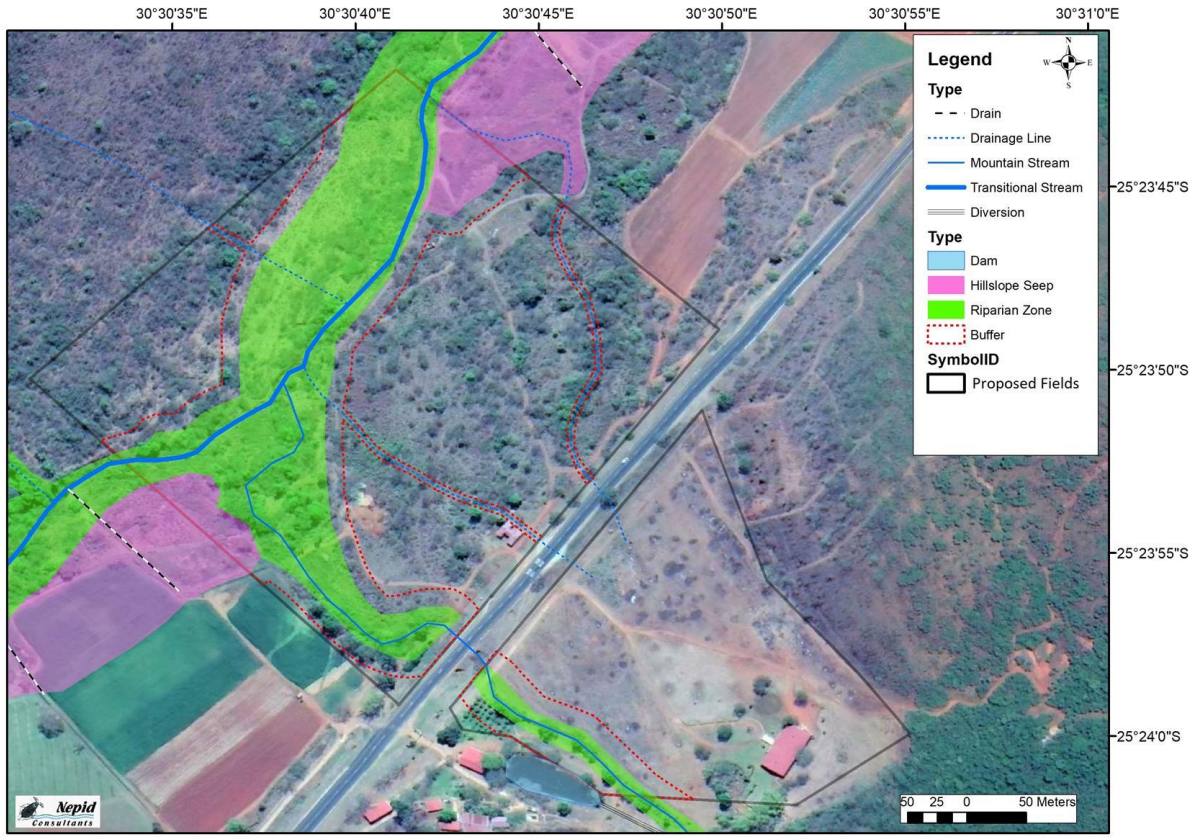


Figure 5-3. Aquatic Ecosystem Classification and Delineation – Proposed Fields.

5.3 Present Ecological State

5.3.1 Aquatic Macroinvertebrates

Transitional Stream (Sterkspruit)

The Present Ecological State of aquatic macroinvertebrates in the Sterkspruit at Site R1 was classified in February 2020 as *Largely Modified* (Category D). The balance of evidence indicates that water quality was excellent, but instream habitats were negatively affected by sedimentation. The flow was low and hydraulic diversity was low, and most bed substrates were embedded in fine sediments and covered in senescent algae, so the suitability of instream habitats for macroinvertebrates was limited (43%). A total of 23 SASS5 taxa was recorded and these gave a Total SASS5 Score of 139 and an Average Score per Taxon of 6.0. Detailed results are presented in Appendix D. Nine sensitive taxa were recorded, which suggest that water quality was excellent. Sensitive taxa included Baetidae (>2 spp), including *Demoreptus* sp., Tricorythidae, Chlorocyphidae, Philopotamidae and Psephenidae. However, sensitive taxa were present in low abundance only (15%), which suggests that the ecological state was unstable. Taxa that were common were all tolerant or highly tolerant of water quality deterioration. The majority of taxa had adult life spans that were short (<1 month) or very short (<1 week), which also suggests that ecological conditions were unstable. The abundance of air-breathing taxa was moderate (32%), which suggests that oxygen may have been partially limiting. The most abundant feeding group were predators (41%), and this also suggests that ecological conditions were unstable. Most taxa had a preference for slow flow (32%), or zero to very slow flow (36%), and this reflects low flow at the time of the survey. The proportion of sediment sensitive taxa was low (30%), and this suggests that the stream was impacted by sedimentation.

5.3.2 Fish

Mountain Stream

The Present Ecological State of fish in the Mountain Stream at T1 was classified in February 2020 as *Critically Modified* (Category F). The flow was a trickle and depth-flow classes comprised shallow pools only. Abundant cover for fish was provided by marginal vegetation. A single Largemouth Bass *Micropterus salmoides* was recorded out of three species expected under natural conditions. .Abundance was very low, with one fish only caught in 15 minutes of e-fishing, which is equivalent to a catch of 4 fish per hour. The three fish species that were notably absent were *Enteromius anoplus, E. cf neefi* and *Kneria sp."South Africa".* Bass were most likely introduced into the farm dam located on the southern boundary of the proposed upper (southern) field, and moved from here into the Mountain Stream. The absence of indigenous fish in the Mountain Stream is attributed to the presence of Largemouth Bass.

a) Largemouth Bass *Micropterus salmoides* (Centrarchidae).

Figure 5-4. Fish Species Recorded in the Mountain Stream at T1.

Transitional Stream (Sterkspruit)

The Present Ecological State of fish in the Sterkspruit at R1 was classified in February 2020 as *Largely Modified* (Category D). The balance of evidence indicates that water quality was excellent, but instream habitats were negatively affected by sedimentation. The flow was low and depth-flow classes were dominated by shallow habitats. Abundant cover for fish was provided by large cobbles and boulders, but marginal vegetation cover was sparse. A total of three species of fish was recorded out of six species expected under natural conditions. Detailed results are presented in Appendix E. Abundance was very low, with 6 specimens caught in 15 minutes of e-fishing, which is equivalent to a catch of 24 fish per hour. The three species caught are sensitive to water quality deterioration, and this indicates that water quality was excellent (Figure XXX). The three fish species that were notably absent were *Enteromius anoplus, E. cf neefi* and *Kneria sp."South Africa".*

a) Amphilius uranoscopus (Amphiliidae).

b) Chiloglanis pretoriae (Mochokidae).

c) Enteromius crocodilensis (Cyprinidae).

Figure 5-5. Fish Species Recorded in the Sterkspruit at R1.

5.3.3 Riparian Vegetation

Mountain Stream

The Present Ecological State of riparian vegetation of the Mountain Stream that runs through the proposed development area was classified in February 2020 as *Largely Modified* (Category D). Detailed results are presented in Appendix F. Photographs of selected plant species recorded during the field survey are presented in Appendix H. Plant species recorded during the field survey are listed in Appendix I. The riparian vegetation was impacted mainly by vegetation removal, farm roads, stream crossings including the N4 highway, bank erosion and a moderate diversity of alien invasive (19 species) vegetation in moderate abundance.

Transitional Stream (Sterkspruit)

The Present Ecological State of riparian vegetation of the Sterkspruit within the proposed development area was classified in February 2020 as *Largely Natural* (Category B). Detailed results are presented in Appendix F. There was no evidence of bank erosion, rubbish dumping or inundation. There was limited removal of vegetation and most of the riparian zone was structurally intact and there were no stream crossings. The diversity of alien invasive vegetation was moderate (17 species), but abundances were low.

5.3.4 Seepage Wetlands

The Present Ecological State of the two Seepage Wetlands within the proposed development area in February 2020 was rated as *Largely Modified* (Category D). A summary of the assessment is shown in Table 5-1, and detailed results are presented in Appendix G. The following sections summarises the main impacts.

Hydrology

The hydrology of the Seepage Wetlands was impacted mainly by agricultural drains located on neighbouring properties, and these are likely to have had a serious impact on wetland functions. Low levels of invasive vegetation may have reduced low flows slightly, while surrounding cultivation is likely to have increased flood peaks.

Geomorphology

Geomorphology of the Seepage Wetlands was modified mainly by agricultural drains, while surrounding cultivation is likely to have increased sedimentation.

Vegetation

Vegetation of the Seepage Wetlands rated as *Moderately Modified* (Category C). The diversity of alien plant species was moderate, but the abundance of alien plant species was low.

Table 5-1. Summary of the Present Ecological State of wetlands within the proposed development area based on the WET-Health Level 1 method.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	-	84	7.5	0	2.8	0	3.0	0
PES Category			E	→	C	→	C	→
Wetland Impact Score			4.87					
Wetland PES			D					

5.4 Ecological and Functional Importance

5.4.1 Hillslope Seepage Wetlands

The overall Ecological and Functional Importance of the Hillslope Seepage Wetlands in the proposed development area was rated as ***Low*****.** Detailed results are presented in Appendix J. The individual components were rated as follows:

- Ecological Importance and Sensitivity was rated as ***Moderate,*** mainly because of the classification of the area as a Critical Biodiversity Area (MTPA 2011); and because seepage wetlands are vulnerable to development because they are easily drained;

- Functional Importance was rated as ***Low***, with the most important functions associated with sediment trapping and phosphate and nitrate assimilation because the wetlands are likely to receive inputs of nutrients from livestock that use these areas for grazing; and

- Direct Human Benefits were rated as ***Very Low***, with the most important function likely to be harvesting of medicinal plants. There was no evidence of subsistence cultivation in the wetlands.

(Figure 5-4).

5.4.2 Mountain Stream

The overall Ecological and Functional Importance of the Mountain Stream within the proposed development area was rated as ***Low*****.** Detailed results are presented in Appendix J. The individual components were rated as follows:

- Ecological Importance and Sensitivity was rated as ***Low.*** Under natural conditions the stream is likely to have supported Southern Kneria, which is classified by the IUCN as *Endangered*, but the current confirmed presence of Largemouth Bass is likely to have eliminated *Kneria* from this stream. Furthermore, the Present Ecological State of the stream is degraded and neither ecologically important nor sensitive;

- Functional Importance was rated as ***Low***, with the most important function being erosion control provided by riparian vegetation; and

- Direct Human Benefits were rated as ***Very Low***. There was no evidence of subsistence cultivation, but medicinal plants may be harvested from the riparian zone.

5.4.3 Transitional Stream (Sterkspruit)

The overall Ecological and Functional Importance of the Sterkspruit within the proposed development area was rated as ***Moderate*****.** Detailed results are presented in Appendix J. The individual components were rated as follows:

- Ecological Importance and Sensitivity was rated as ***High*** because of
  - red data flora and fauna, including the confirmed presence of *Clausena anisata*, which is classified as *Vulnerable*, and the possible presence of *Chiloglanis bifurcus*, which is classified as *Critically Endangered* (Roux and Hoffman 2017);
  - the confirmed presence of several riparian plant species that are protected under the Mpumalanga Biodiversity Act (Act No 10 of 1998), comprising S*cadoxus*

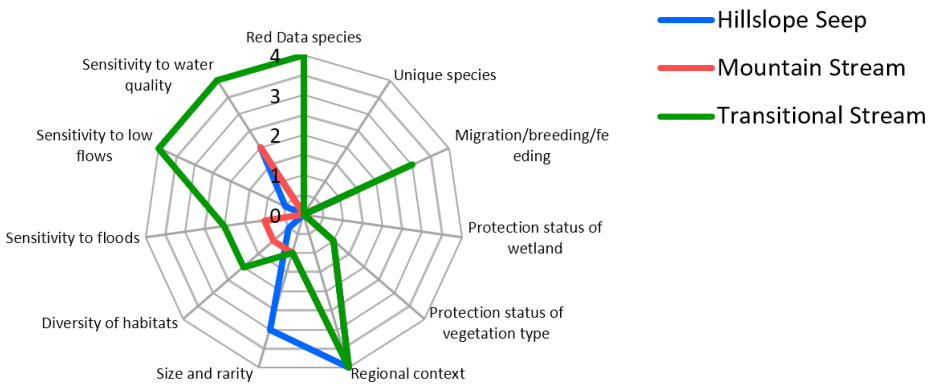
multiflorus, Dioscorea cotinifolia, Dioscorea dregeana, Olea europaea subsp. cuspidata, Adenia gummifera var gummifera and *Berchemia zeyheri;*
  - the Mpumalanga Biodiversity Sector Plan Freshwater Assessment which classifies the Sterkspruit as a Critical Biodiversity Area (MTPA 2011);
  - the sensitivity of the river to changes in low flows because of the high proportion of flow-dependent taxa, such as *Amphilius uranoscopus* and *Chiloglanis pretoriae;* and
  - the sensitivity of the river fauna to changes in water quality because of the high number of macroinvertebrate SASS5 taxa (9) that are sensitive to water quality deterioration, such as *Demoreptus* sp., Tricorythidae, Philopotamidae and Psephenidae.

- Functional Importance was rated as ***Moderate***, with the most important functions being erosion control provided by riparian vegetation, flood attenuation, streamflow regulation and carbon storage provided by woody vegetation.

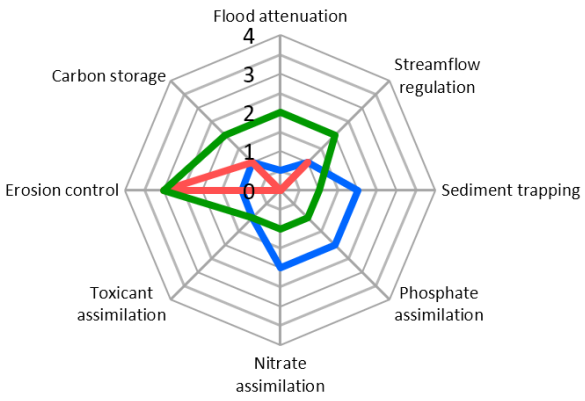
- Direct Human Benefits were rated as ***Low***, with the most important functions being water for human (potable) use and harvestable resources, particularly timber. There was no evidence of subsistence cultivation.

(Figure 5-4).

Ecological Importance



Functional Importance



Direct Human Benefits (Subsistence)

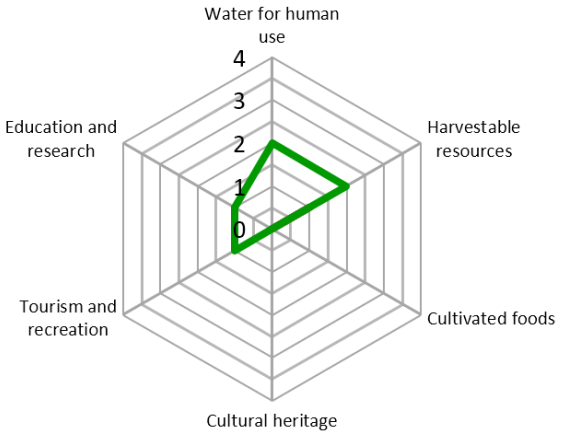


Figure 5-6. Ecological and Functional Importance.

6. RISK ASSESSMENT

Detailed scoring of the Risk Assessment on aquatic ecosystems is included in Appendix K. The following section summarises the key issues.

Construction Phases

6.1 Impact of Land Preparation on Aquatic Habitats

In the absence of mitigation, land preparation, including vegetation clearing and bulk earthworks, is likely to have the following impacts on aquatic ecosystems and drainage lines:

- **Hillslope Seepage Wetlands.** Two Hillslope Seepage Wetlands in the proposed lower field cover an area of 0.6 hectares and support a moderate diversity of obligate wetland plant species and low levels of alien invasive vegetation. Seepage wetlands are threatened because they are easily drained and transformed for other land uses;

- **Mountain Stream.** A seasonal Mountain Stream runs through both proposed fields over a distance of 440 m. The riparian zone provides an important function in terms of erosion control;

- **Transitional Stream.** The Sterkspruit flows through the proposed lower field over a distance of 420 m. There was no nearby stream crossing to access proposed cultivation on the left bank, so cultivation here would need a new culvert or bridge to enable vehicles to access the left bank. A stream crossing could have negative implications for the ecological state of the Sterkspruit and is therefore not recommended, particularly in view of the small size (2.2 hectares) of proposed cultivation on the left bank; and

- **Drainage Lines.** Two episodic drainage lines that carry stormwater run through the proposed lower field (Figure 5-3).

Mitigation

Direct impacts on aquatic ecosystems can be avoided, and indirect impacts can be minimised, by implementing the following:

- **Buffer Zones:** re-alignment of the proposed fields to ensure that no development takes place within 15 m from the edge of the two wetlands and all riparian areas, and within 3 m on either side of the two drainage lines, as shown in Figure 5-3; and

- **Exclusion Zone:** the left bank of the Sterkspruit should be left undeveloped to avoid the need for a stream crossing over the Sterkspruit.

With the proposed buffer zones and exclusion zone in place the proposed cultivation is expected to have no measurable impact on the flow regime, water quality or wetland habitat during construction, so in the Risk Assessment Matrix these aspects were rated as “1” (Appendix K). However, general disturbance in the area is likely to create conditions suitable for further spread of alien invasive vegetation, so the potential impact on biota was rated as “2”. The spatial scale and duration of the potential impacts of land preparation are expected to be zero, so these aspects were rated “1”. The probability that the proposed re-aligned fields will impact negatively on aquatic ecosystems is highly unlikely, so frequency of activity and frequency of impact were rated as “1”. The extent of direct impacts will be easily observed, and so detection was rated as “1”. The overall risk of the re-aligned development on aquatic ecosystems is rated with high confidence, as **Low.**

.

Operational Phase

6.2 Impact of Pesticides on Surface Water Quality

Aerial drift and runoff of pesticides during the Operational Phase could impact negatively on the biodiversity of the Sterkspruit. Taxa sensitive to water quality deterioration recorded in this stream include *Demoreptus sp.,* Psephenidae, Tricorythidae, *Amphilius uranoscopus, Chiloglanis pretoriae* and *C. bifurcus.* With the proposed buffer zones in place the proposed cultivation is expected to have no measurable impact on the flow regime or wetland habitat during operation, so these aspects were rated as "1" (Appendix K). However, aerial drift and runoff of pesticides could impact surface water quality and sensitive taxa, so these aspects were rated as "2". The spatial scale of the potential impacts of pesticides on aquatic ecosystems is expected to be limited to the project area, so this aspect was rated as "1". The duration of this impact could extend between one month to one year, so this aspect was rated as "2". The average frequency of spraying is likely to be monthly, so this aspect was rated as "3". The probability that aerial drift will impact negatively on aquatic ecosystems is unlikely, so frequency of impact was rated as "1". Potential impacts of aerial drift on aquatic ecosystems will need effort to detect, so this aspect was rated as "3". The overall risk of pesticides on aquatic ecosystems during operation is rated with moderate confidence, as **Low.**

6.3 Cumulative Impacts

The most likely developments in the vicinity of Rooikrans in the near future is further clearing of vegetation for cultivation, particularly expansion of macadamia orchards. This is certain to increase water demands and also likely to increase sediment runoff into receiving watercourses. However, sediment runoff is expected to decline once orchards are established, and then the biggest threat to the watercourse is likely to be associated with runoff of pesticides, herbicides and fertilisers. The cumulative impacts on water quality may therefore be significant, and this highlights the need for terrestrial vegetation buffer zones to protect watercourses from runoff from surrounding orchards.

7. CONCLUSIONS

7.1 Aquatic Ecosystem Classification and Delineation

The proposed development could impact negatively on three hydro-geomorphic aquatic ecosystem types namely:

- Hillslope Seepage Wetlands;
- Mountain Stream; and
- Transitional Stream (Sterkspruit).

In addition, two episodic drainage lines that carry stormwater could be affected and without mitigation these could development erosion dongas.

7.2 Sensitive Aquatic Habitats

All wetlands, watercourses, riparian zones and drainage lines within the proposed development area are ecologically sensitive and need protective measures.

7.3 Present Ecological State

The Present Ecological State of the potentially impacted aquatic ecosystems within the proposed development area were rated in February 2020 as follows:

- Hillslope Seepage Wetland
  - Wetland Health: Category D
- Mountain Stream
  - Fish: Category F
  - Riparian Vegetation: Category D
- Transitional Stream (Sterkspruit)
  - Aquatic Macroinvertebrates: Category D
  - Fish: Category D
  - Riparian Vegetation: Category B

The main causes of ecological degradation were associated with draining of hillslope seepage wetlands (on neighbouring properties), clearing of riparian vegetation for agricultural development, colonisation by alien invasive vegetation and Largemouth Bass.

7.4 Ecological and Functional Importance

The overall Ecological and Functional Importance of aquatic ecosystem types within the Study Area were rated as follows:

- Hillslope Seepage Wetlands: *Low*
- Mountain Stream: *Low*
- Transitional Stream (Sterkspruit): *Moderate*

7.5 Ecological Risks

Risks of the proposed development to aquatic ecosystems during land preparation are low and can be avoided by implementing appropriate buffer zones and not developing the left bank of the Sterkspruit. Operational risks of the proposed development to aquatic ecosystems concern aerial drift and runoff of pesticides, and this can be minimised by providing 15 m buffer zones of no development around all wetlands and riparian zones.

8. RECOMMENDATIONS

8.1 Authorisation

Authorisation of the proposed development in relation to potential impacts on aquatic ecosystems is recommended on the grounds that the risks to aquatic ecosystems can be avoided or minimised by adhering to the recommended control measures as detailed in Appendix X.

8.2 Monitoring

Monitoring of aquatic ecosystems is not considered necessary because of the low risks of the proposed development on aquatic biodiversity.

9. REFERENCES

Department of Water Affairs and Forestry (DWAF) 1999a. Floodplain wetland Present Ecological Status (PES) method. Report written by A Duthie. Resource Directed Measures for Protection of Water Resources: Wetland Ecosystems. Appendix W4.

Baily, AK and Pitman, WV 2015, Water resources of South Africa 2012 Study (WR2012). Report to the Water Research Commission by Royal Haskoning DHV (Pty) Ltd. WRC Project No K5/2143/1. Downloaded from www.waterresources2012.co.za

Department of Water Affairs and Forestry (DWAF) 1999b. Comprehensive habitat integrity assessment. Report by CJ Kleynhans. Resource Directed Measures for the Protection of Water Resources - River Ecosystems. Appendix R5.

Department of Water Affairs and Forestry (DWAF) 2008. Updated manual for the identification and delineation of wetlands and riparian areas. prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water and Sanitation (DWS) 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per sub Quaternary reaches for Secondary Catchments in South Africa: Compiled by RQIS-RDM: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.

Department of Water Affairs and Sanitation (DWA) 2016. [Proposed] General authorisations in terms of Section 39 on the National Water Act, 1998 (Act No. 36 of 1998) for water uses as defined in Sections 21(c) and/or Section 21(i). https://www.dwa.gov.za/Documents/.

Dickens, C. W. S. and Graham, P. M. 2002. The South African Scoring System (SASS) Version 5 Rapid bioassessment method for rivers. African Journal of Aquatic Science 27(1): 1-10.

Fey, M. 2010 Soils of South Africa. Cambridge University Press, Cape Town.

Ground Truth 2016. Riparian health audit. Water Research Commission Project No. K5/2350.

Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. Data downloaded from http://www.worldclim.org.

Holness, S.D., Dini, J.A., de Klerk, A., and Oberholster, P. 2016. High risk wetland atlas: Reference guide to the Mpumalanga Mining Decision Support Tool. Water Research Commission Report No TT 659/16.

Kleynhans, C. J., Thirion, C. and Moolman, J. 2005. A Level I River Ecoregion classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

Macfarlane, D.M., Bredin, I.P., Adams, J.B., Zungu, M.M., Bate, G.C. and Dickens, C.W.S. 2015. preliminary guideline for the determination of buffer zones for rivers, wetlands and estuaries. Consolidated report. Water Research Commission Report No. TT 610/14.

Mpumalanga Tourism & Parks Agency (MTPA). 2013. Mpumalanga Biodiversity Sector Plan Handbook. Compiled by Lötter M. C., Cadman, M.J. and Lechmere-Oertel R.G. Mpumalanga Tourism & Parks Agency, Mbombela (Nelspruit).

Mpumalanga Tourism and Parks Agency (MTPA) 2011. MTPA, CSIR, SANBI. MBSP Freshwater Assessment 2011 [Vector] 2011. Available from the Biodiversity GIS website, downloaded on 20 April 2018.

Mpumalanga Tourism and Parks Agency (MTPA) 2014. MTPA , CSIR, SANBI, SAIAB. MBSP Fish Support Areas 2014 [Vector] 2014. Available from the Biodiversity GIS website, downloaded on 20 April 2018.

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

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas Project. WRC Report No. K5/1801.

Ollis, D. J., Snaddon, C. D., Job, N. M., Mbona, N. 2013. Classification system for wetlands and other aquatic ecosystems in South Africa. User manual: Inland systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute.

ProEcoServe 2014. ProEcoServe, CSIR, MTPA. MBSP Strategic Water Source Areas 2014 [Vector] 2014. Available from the Biodiversity GIS website, downloaded on 20 April 2018.

Rountree, M.W., H. Malan and B. Weston (editors). 2012. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study. Water Research Commission, Pretoria.

Roux, F. and Selepe, M. 2013. Ecostatus of the Crocodile River Catchment, Inkomati River System. Report prepared by the Mpumalanga Tourism and Parks Agency and submitted to the Inkomati Catchment Management Agency.

Roux, F. & Hoffman, A. 2017. *Chiloglanis bifurcus*. The IUCN Red List of Threatened Species 2017: e.T4632A100193958. http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T4632A100193958.en. Downloaded on 10 June 2018.

Schulze, R.E. and Horan, M.J.C. 2006. Soils: Hydrological Attributes. In: Schulze, R.E. (Ed). 2006. South African Atlas of Climatology and Agrohydrology. Water Research Commission, Pretoria, RSA, WRC Report 1489/1/06, Section 4.2.

10. APPENDICES

Appendix A: Curriculum Vitae

ROBERT WILLIAM PALMER

Profession:	Aquatic Ecologist
Date of Birth	15 Dec 1961
Name of Firm	Nepid Consultants CC
Position in Firm	Director
Years with Firm	11
Nationality	South African

Qualifications:

• PhD [River Ecology]	Rhodes University, Grahamstown, RSA	1992
• BSc (Hons) [Mammalogy]	Pretoria University, RSA	1985
• BSc [Zoology]	University of Cape Town, RSA	1984

Professional Societies:

- SA Council for Natural Scientific Professions (Biological Science): No 400108/95
- SA Environmental Assessment Practitioner: No 0080/06
- International Association for Theoretical and Applied Limnology
- International Association for Impact Assessment (South Africa)
- Southern African Society of Aquatic Scientists

Languages:

	Speaking	Reading	Writing
English (home):	*Excellent*	*Excellent*	*Excellent*
Afrikaans:	*Good*	*Good*	*Poor*
Xhosa:	*Fair*	*Poor*	*Poor*
Portuguese:	*Poor*	*Fair*	*Poor*

Countries of Work Experience (short-term consultancies)	Angola, Burkina Faso, Cameroon, Democratic Republic of the Congo, Eritrea, Ethiopia, Lesotho, Malawi, Mozambique, Namibia, Sierra Leone, South Africa, Swaziland, Tanzania and Zambia.

KEY QUALIFICATIONS

- Over 20 years' experience of river research and management, baseline aquatic surveys, data analysis and report writing;
- Over 15 years' experience in environmental consulting, project management, including the design of environmental monitoring and mitigation programmes and water resource planning studies;
- Over 15 years' experience in general company administration, including proposal writing, marketing, contract administration and bookkeeping;
- Specialist knowledge of identification and control of pest blackflies (Diptera: Simuliidae);
- Specialist knowledge of river ecology, river regulation, aquatic invertebrates, instream flow requirements and downstream environmental impacts of dams and mines;
- Team leader for various water resource development projects and environmental impact assessments, involving coordination of multi-disciplinary teams.

EMPLOYMENT RECORD

2005 - present	Nepid Consultants CC	Founder Director
1997 – 2004	AfriDev Consultants (Pty) Ltd	Associate from 1997; Director from 2000
1991 – 1997	Onderstepoort Veterinary Institute	Research Fellow
1986 – 1991	Rhodes University	PhD Student

Appendix B: Declaration of Independence

The Specialist Appointed in terms of the Regulations

I, **Robert William Palmer**, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that I:

- in terms of the general requirement to be independent (tick which is applicable):

✓	other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
	am not independent, but another EAP that is independent and meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);

- have expertise in conducting specialist work as required, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- will ensure compliance with the EIA Regulations 2014;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;
- will take into account, to the extent possible, the matters listed in regulation **18** of the regulations when preparing the application and any report, plan or document relating to the application;
- will disclose to the proponent or applicant, registered interested and affected parties and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority or the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority (unless access to that information is protected by law, in which case I will indicate that such protected information exists and is only provided to the competent authority);
- declare that all the particulars furnished by me in this form are true and correct;
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).

R.W.

Signature of the specialist

Nepid Consultants CC

Name of company

2020-03-22

Date

R.M. Indlovena

Signature of the Commissioner of Oaths for project/application:

2020.03.22

Date:

Warrant officer

Designation:

Official stamp (below)

SUID-AFRIKAANSE POLISIEDIENS
CSC
2020 -03- 22
COMMUNITY SERVICE CENTRE
WITRANDSPOORT
SOUTH AFRICAN POLICE SERVICE

Appendix C: Aquatic Ecosystem Classification

Aquatic Ecosystem Classification

Figure A: Seepage Wetland. [4 February 2020].

Level 1: System	✓
Inland	✓
Estuarine	-

Level 3: Landscape	
Valley Floor	-
Slope	✓
Plain	-
Bench - Hilltop	-
Bench - Saddle	-
Bench - Shelf	-

Level 4: HGM Unit	
Channel (River) - Zone	
Source	-
Mountain Headwater	-
Mountain Stream	-
Transitional	-
Upper Foothill	-
Lower Foothill	-
Lowland River	-
Rejuvenated Cascade	-
Rejuvinated Foothill	-
Upland Floodplain	-
Wetland	
Depression	-
Seep	✓
Unchanelled valley-bottom	-
Channelled valley-bottom	-
Floodplain - Channel	-
Floodplain - Depression	-
Floodplain - Flat	-
Floodplain - Meander Cut-off	-
Lake	-
Estuary	-
Artificial	
Dam (in-channel)	-
Dam (off-channel)	-
Dam (WWTW)	-
Canal	-

Level 5: Hydrological Regime	
5a) Flow regime / Inundation	
Permanent	-
Seasonal	-
Intermittent	-
Never	✓
Unknown	-
5b) Saturation	
Permanent	✓
Seasonal	✓
Intermittent	-
Never	
Unknown	-
5c) Depth Class	
Limnetic (≥ 2m max depth)	-
Littoral (≤ 2m max depth)	✓
Unkown	-

Level 2: Regional Setting	
National Ecoregion (DWA)	Northern Escarpment Mountains

Level 6a: Biotopes	(0-6)
Natural	
Waterfall	-
Cascade	-
Rapid	-
Riffle	-
Run	-
Glide	-
Pool	-
Backwater	-
Inundation	-
Spring	-
Seep	6
Artificial	
Canal	-
Dam (in-channel)	-
Dam (off-channel)	-
Excavation	-
Salt Works	-
WWTW pond	-
Irrigated Land	-
Stormwater Pond	-
Other	-

Level 6e: Vegetation Cover	(0-6)
Aquatic	
Floating	-
Submerged	-
Emergent	-
Herbaceous	
Grasses	3
Herbs	3
Geophytes	2
Sedges/Rushes	4
Reeds	-
Restios	-
Palmiet	-
Palms	-
Crops	-
Shrubs	
Shrubs	-
Thicket	-
Trees	
Plantation	-
Riparian Forest - Natural	-
Swamp Forest	-
Alien trees	-

Level 6b: Salinity	✓
Fresh (<500 mS/m)	✓
Brackish (500-3 000 mS/m)	-
Saline (3 000 - 8 000 mS/m)	-
Hypersaline (>8 000 mS/m)	-

Level 6c: pH	
Acidic (<6)	✓
Circum-neutral (6-8)	-
Alkaline (>8)	-

Level 6d: Substrate Types	(0-6)
Organic (>10% organic)	
Leaves/Detritus	2
Organic (<30% organic)	-
Peat (>30% organic)	-
Mineral Soils (<10% organic)	
Salt	-
Clay	-
Loam	1
Silt (<0.125)	2
Sand - Fine (0.125-0.5)	3
Sand - Coarse (0.5-2.0)	5
Other	-
Rocky	
Gravel - F (2-8)	-
Gravel - M (8-16)	-
Gravel - C (16-64)	-
Cobble - Small (64-128)	-
Cobble - Large (128-250)	-
Boulder - Small (250-500)	-
Boulder - Medium (500-1000)	-
Boulder - Large (1000-4000)	-
Bedrock	-
Waterfall	-

Rating categories

0 = not present
1 = rare (>0–5%)
2 = sparse (>5–25%,)
3 = common (>25–50%)
4 = abundant (>50–75%)
5 = predominant (>75–95%)
6 = near-entire (>95–100%)

Reference: Ollis *et al.* (2013).

Aquatic Ecosystem Classification

Figure A: Mountain Stream. [4 February 2020].

Level 1: System	✓
Inland	✓
Estuarine	-

Level 3: Landscape	
Valley Floor	✓
Slope	-
Plain	-
Bench - Hilltop	-
Bench - Saddle	-
Bench - Shelf	-

Level 4: HGM Unit	
Channel (River) - Zone	
Source	-
Mountain Headwater	-
Mountain Stream	✓
Transitional	-
Upper Foothill	-
Lower Foothill	-
Lowland River	-
Rejuvenated Cascade	-
Rejuvinated Foothill	-
Upland Floodplain	-
Wetland	
Depression	-
Seep	-
Unchanelled valley-bottom	-
Channelled valley-bottom	-
Floodplain - Channel	-
Floodplain - Depression	-
Floodplain - Flat	-
Floodplain - Meander Cut-off	-
Lake	-
Estuary	-
Artificial	
Dam (in-channel)	-
Dam (off-channel)	-
Dam (WWTW)	-
Canal	-

Level 5: Hydrological Regime	
5a) Flow regime / Inundation	
Permanent	✓
Seasonal	✓
Intermittent	-
Never	-
Unknown	-
5b) Saturation	
Permanent	✓
Seasonal	-
Intermittent	-
Never	-
Unknown	-
5c) Depth Class	
Limnetic (≥ 2m max depth)	-
Littoral (≤ 2m max depth)	✓
Unkown	-

Level 2: Regional Setting	
National Ecoregion (DWA)	Northern Escarpment Mountains

Level 6a: Biotopes	(0-6)
Natural	
Waterfall	-
Cascade	2
Rapid	3
Riffle	4
Run	2
Glide	1
Pool	1
Backwater	-
Inundation	-
Spring	-
Seep	-
Artificial	
Canal	-
Dam (in-channel)	-
Dam (off-channel)	-
Excavation	-
Salt Works	-
WWTW pond	-
Irrigated Land	-
Stormwater Pond	-
Other	-

Level 6e: Vegetation Cover	(0-6)
Aquatic	
Floating	-
Submerged	-
Emergent	-
Herbaceous	
Grasses	2
Herbs	2
Geophytes	1
Sedges/Rushes	3
Reeds	1
Restios	-
Palmiet	-
Palms	-
Crops	-
Shrubs	
Shrubs	3
Thicket	-
Trees	
Plantation	-
Riparian Forest - Natural	4
Swamp Forest	-
Alien trees	2

Level 6b: Salinity	✓
Fresh (<500 mS/m)	✓
Brackish (500-3 000 mS/m)	-
Saline (3 000 - 8 000 mS/m)	-
Hypersaline (>8 000 mS/m)	-

Level 6c: pH	
Acidic (<6)	-
Circum-neutral (6-8)	✓
Alkaline (>8)	-

Level 6d: Substrate Types	(0-6)
Organic (>10% organic)	
Leaves/Detritus	2
Organic (<30% organic)	-
Peat (>30% organic)	-
Mineral Soils (<10% organic)	
Salt	-
Clay	-
Loam	-
Silt (<0.125)	-
Sand - Fine (0.125-0.5)	-
Sand - Coarse (0.5-2.0)	-
Other	-
Rocky	
Gravel - F (2-8)	-
Gravel - M (8-16)	1
Gravel - C (16-64)	1
Cobble - Small (64-128)	2
Cobble - Large (128-250)	3
Boulder - Small (250-500)	4
Boulder - Medium (500-1000)	2
Boulder - Large (1000-4000)	-
Bedrock	-
Waterfall	-

Rating categories

0 = not present
1 = rare (>0–5%)
2 = sparse (>5–25%,)
3 = common (>25–50%)
4 = abundant (>50–75%)
5 = predominant (>75–95%)
6 = near-entire (>95–100%)

Reference: Ollis *et al.* (2013).

Aquatic Ecosystem Classification

Figure A: Transitional Stream. [4 February 2020].

Level 1: System	✓
Inland	✓
Estuarine	-

Level 3: Landscape	
Valley Floor	✓
Slope	-
Plain	-
Bench - Hilltop	-
Bench - Saddle	-
Bench - Shelf	-

Level 4: HGM Unit	
Channel (River) - Zone	
Source	-
Mountain Headwater	-
Mountain Stream	-
Transitional	✓
Upper Foothill	-
Lower Foothill	-
Lowland River	-
Rejuvenated Cascade	-
Rejuvinated Foothill	-
Upland Floodplain	-
Wetland	
Depression	-
Seep	-
Unchanelled valley-bottom	-
Channelled valley-bottom	-
Floodplain - Channel	-
Floodplain - Depression	-
Floodplain - Flat	-
Floodplain - Meander Cut-off	-
Lake	-
Estuary	-
Artificial	
Dam (in-channel)	-
Dam (off-channel)	-
Dam (WWTW)	-
Canal	-

Level 5: Hydrological Regime	
5a) Flow regime / Inundation	
Permanent	✓
Seasonal	-
Intermittent	-
Never	-
Unknown	-
5b) Saturation	
Permanent	✓
Seasonal	-
Intermittent	-
Never	-
Unknown	-
5c) Depth Class	
Limnetic (≥ 2m max depth)	-
Littoral (≤ 2m max depth)	✓
Unkown	-

Level 2: Regional Setting	
National Ecoregion (DWA)	Northern Escarpment Mountains

Level 6a: Biotopes	(0-6)
Natural	
Waterfall	-
Cascade	-
Rapid	1
Riffle	4
Run	3
Glide	3
Pool	2
Backwater	1
Inundation	-
Spring	-
Seep	-
Artificial	
Canal	-
Dam (in-channel)	-
Dam (off-channel)	-
Excavation	-
Salt Works	-
WWTW pond	-
Irrigated Land	-
Stormwater Pond	-
Other	-

Level 6e: Vegetation Cover	(0-6)
Aquatic	
Floating	-
Submerged	-
Emergent	-
Herbaceous	
Grasses	4
Herbs	3
Geophytes	1
Sedges/Rushes	3
Reeds	1
Restios	-
Palmiet	-
Palms	-
Crops	-
Shrubs	
Shrubs	2
Thicket	-
Trees	
Plantation	-
Riparian Forest - Natural	2
Swamp Forest	-
Alien trees	1

Level 6b: Salinity	✓
Fresh (<500 mS/m)	✓
Brackish (500-3 000 mS/m)	-
Saline (3 000 - 8 000 mS/m)	-
Hypersaline (>8 000 mS/m)	-

Level 6c: pH	
Acidic (<6)	-
Circum-neutral (6-8)	✓
Alkaline (>8)	-

Level 6d: Substrate Types	(0-6)
Organic (>10% organic)	
Leaves/Detritus	2
Organic (<30% organic)	-
Peat (>30% organic)	-
Mineral Soils (<10% organic)	
Salt	-
Clay	-
Loam	-
Silt (<0.125)	-
Sand - Fine (0.125-0.5)	-
Sand - Coarse (0.5-2.0)	-
Other	-
Rocky	
Gravel - F (2-8)	-
Gravel - M (8-16)	2
Gravel - C (16-64)	2
Cobble - Small (64-128)	3
Cobble - Large (128-250)	4
Boulder - Small (250-500)	2
Boulder - Medium (500-1000)	-
Boulder - Large (1000-4000)	-
Bedrock	-
Waterfall	-

Rating categories

0 = not present
1 = rare (>0–5%)
2 = sparse (>5–25%,)
3 = common (>25–50%)
4 = abundant (>50–75%)
5 = predominant (>75–95%)
6 = near-entire (>95–100%)

Reference: Ollis *et al.* (2013).

Appendix D: Detailed Data – SASS5

SASS Version 5 Score Sheet

Version date: 02-Dec-16

Date	04-Feb-2020
Site Code	R1
River	Sterkspruit
Elev (m)	1 019
Grid	S25.395330 E30.511610
Accuracy	GPS
Gradient	-
Zonation	C: Transitional
Quat	X21E
Ecoregion	10: Northern Escarpment Mountains

Project	Rooikrans
Collector	Rob Palmer
Flow	Low
Clarity (NTU)	6
Turbidity	Low
Colour	Clear
Benthic Algae (%)	5
Temp (°C)	26.5
pH	7.7
Cond (mS/m)	22
DO (mg/ℓ)	-
Disturbance	-

Biotopes	(0-5)	Weight
Stones In Current	3	22.0
Stones Out Current	3	8.0
Bedrock	0	8.0
Aquatic Veg	0	0.5
Marg Veg In Current	3	1.0
Marg Veg Out Of Current	3	1.0
Gravel	0	3.0
Sand	0	1.0
Mud	3	0.5
Visual observation	Yes	
BIOTOPE SUITABILITY	43%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1			A	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1	1		A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	1	1		A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			A	
Baetidae > 2 sp	12	B	B		B
Caenidae (Squaregills/Cainfles)	6	A			A
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A			A
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10			1	1
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	1			1
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			A	A
Libellulidae (Darters/Skimmers)	4		A		A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3		A	B	B
Gerridae* (Pond skaters/Water striders)	5		B		B
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		B		B
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	B			B
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		A	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	1			1
Gyrinidae* (Whirligig beetles)	5		B		B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	1			1

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	A	A		B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A	A		B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score					139
No. of Taxa					23
ASPT					6.0
Present Ecological State (A-F)					D

Other biota:

Demoreptus sp.

Comments/Observations:

Appendix E: Detailed Data – Fish

Species	Senitivity Rating	FROC	Expected	Observed
				R1
Depth-Flow Classes (0-4)				
Shallow-Slow				4
Deep-Slow				1
Shallow-Fast				3
Deep-Fast				0
Overall				**50%**
[Slow = <0.3m/s; Shallow = >0.5m]				
Cover (0-4)				
Marginal Vegetation				2
Macrophytes				0
Undercut Banks & Roots				0
Woody Debris				0
Bed Substrate				4
Overall				**30%**
Cover Rating: 1=rare (1-5%); 2=sparse (5-25%); 3=common (25-75%); 4=abundant (>75%)				

Species				
Amphilius natalensis	4.9		-	-
Amphilius uranoscopus	4.8		*Yes*	2A
Anguilla mossambica	2.5		-	-
Chiloglanis bifurcus	4.9		-	-
Chiloglanis pretoriae	4.5		*Yes*	1J; 2A
Enteromius anoplus	2.6		*Yes*	-
Enteromius crocodilensis	4.1		*Yes*	1J
Enteromius neefi	3.4		*Yes*	
Kneria sp ("South Africa")	4.1		*Yes*	-
Pseudocrenilabrus philander	1.4		-	-
Tilapia sparrmanii	1.4		-	-
			-	-
Sample Size			-	6
Effort (min)			-	15
Catch per Unit Effort (Number/hr)			-	24
Number of Species			6	3
Fish Assemblage Integrity Index (Total			23.5	13
Fish Assemblage Integrity Index			-	**57%**
PES (A-F)			-	**D**

J=Juvenile; A=Adult

Appendix F: Riparian Health

Mountain Stream

Description

A Mountain Stream runs through the proposed fields for a distance of 440 m. The stream and associated riparian zone cover an area of 1.5 hectares within the propsoed development area. The stream was impacted by clearing of riparian vegetation on both banks, erosion, stream crossings, the N4 highway, and invasion of alien invasive flora in moderate abundance.

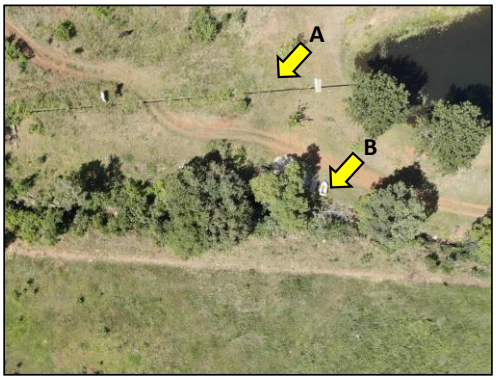


Figure A. Aerial photograph - proposed Upper Field [2020-02-04].

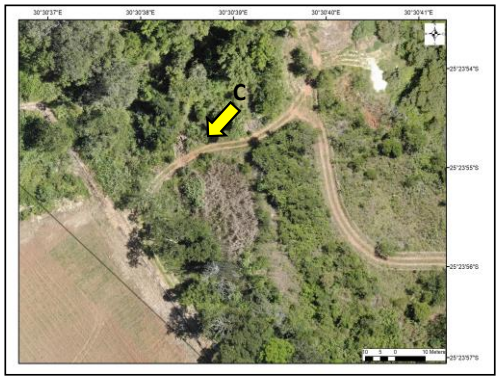


Figure B. Aerial photograph - proposed Lower Field [2020-02-04].

Figure C. Proposed Upper Field [2020-02-04].

Figure D. Proposed Lower Field [2020-02-04].

Key Issues

1 Stream diversion into farm dam (A).
2 Clearing of riparian vegetation (B).
3 Stream crossing causing inundation (C)
4 Alien Invasive Vegetation.

Other Issues

N4 highway

Riparian Health Index

	Criteria	Rating	Comment
1	Alien Vegetation	3.0	19 alien plant species; Moderate abundance
2	Rubbish Dumping	0.0	None
3	Bank Erosion	3.0	Incised channel
4	Inundation	2.0	Upstream of road crossing
5	Flow Modification	3.0	Low flows diverted into farm dam
6	Water Quality	3.0	Sediments
7	Vegetation Removal	4.5	Riparian cleared on both banks
8	Channel Modification	2.0	N4 highway
	Score:	**20.5**	Ecological Condition
	% Modified:	**51%**	**D: Poor**

Alien Flora	Rating
Agave sisalana *2	1
Musa acuminata *#	2
Cynodon nlemfuensis *	3
Paspalum dilatatum *	2
Bambusa balcooa *1b	2
Ageratum conyzoides *1b	2
Bidens pilosa *1b	2
Jacaranda mimosifolia *	3
Ricinus communis *2	3
Melia azedarach *1b	3
Psidium guajava *2	2
Ligustrum lucidum *1b	2
Populus x canescens *2	2
Physalis peruviana *	2
Solanum mauritianum * 1b	3
Lantana camara complex *1b	3
Verbena bonariensis * 1b	2

Transitional Stream (Sterkspruit)

Description

The Sterkspruit runs through the proposed lower field for a distance of 420 m. The stream and associated riparian zone cover an area of 2.7 hectares within the proposed development area. The riparian zone was largely natural, but impacted slightly by farm roads and low levels of alien invasive flora.

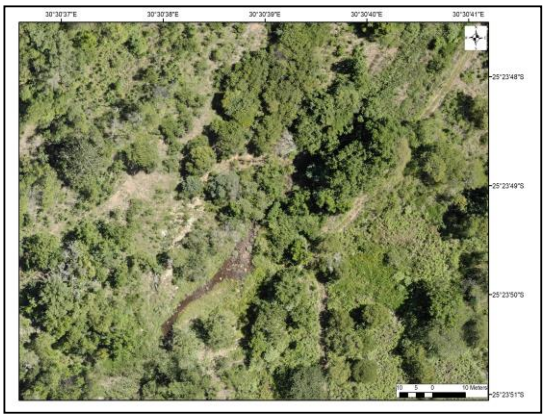


Figure A. Aerial photograph 2020-02-04.

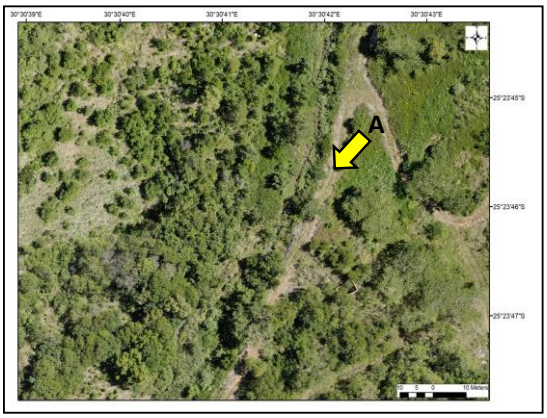


Figure B. Aerial photograph 2020-02-04.

Figure C. [2020-02-04].

Figure D. [2020-02-04].

Key Issues

1 Road within riparian zone (A).
2 Alien Invasive Vegetation.

Other Issues

None

Riparian Health Index

	Criteria	Rating	Comment
1	Alien Vegetation	1.5	17 alien plant species; Low abundance
2	Rubbish Dumping	0.0	None
3	Bank Erosion	0.0	None
4	Inundation	0.0	None
5	Flow Modification	0.5	Stormwater slightly elevated
6	Water Quality	1.5	Sediments
7	Vegetation Removal	1.0	Riparian cleared right bank only
8	Channel Modification	0.0	None
	Score:	**4.5**	Ecological Condition
	% Modified:	**11%**	**B: Good**

Alien Flora	Rating
Cynodon nlemfuensis *	2
Paspalum dilatatum *	2
Ageratum conyzoides *1b	2
Bidens pilosa *1b	2
Jacaranda mimosifolia *	1
Ricinus communis *2	1
Senna septemtrionalis *1b	2
Sesbania punicea *1b	2
Melia azedarach *1b	1
Psidium guajava *2	2
Ligustrum lucidum *1b	2
Physalis peruviana *	2
Solanum mauritianum * 1b	1
Lantana camara complex *1b	2
Verbena bonariensis * 1b	2

Appendix G: Wet-Health

STEP 2: ASSESS HYDROLOGICAL HEALTH OF THE WETLAND

Hydrological Assessment				Magnitude of impact	Comments
Catchment Impacts	**Alteration Class**				
Reduced inputs				-8.00	Drains
Increased inputs				0.00	
Change in quantity of inflows				**-8.00**	
Reduced floodpeaks				0.00	
Increased floodpeaks				2.00	Cultivation likely to increase flood peaks
Alteration to floodpeaks				**2.00**	
Overall catchment impacts				***3.00***	
Onsite impacts	**Dominant impact**	**Extent (%)**	**Intensity (Average)**	**Magnitude of impact**	**Comments**
Gullies and artificial drainage channels	Erosion features & drains	70.0%	4.0	2.80	Agricultural drains
Modifications to existing channels	Channel modification	0.0%	0.0	0.00	-
Drainage & reduced roughness	Crop lands	20.0%	7.0	1.40	
Impeding features – upstream effects	Dams – upstream effects	0.0%	0.0	0.00	
	Roads - upstream effects	0.0%	0.0	0.00	
Impeding features – downstream effects	Dams - downstream effects	0.0%	0.0	0.00	
	Roads - downstream effects	0.0%	0.0	0.00	
Increased on-site water use	Alien vegetation	10.0%	2.0	0.20	Low alien infestation
	Commercial plantations	0.0%	0.0	0.00	
Deposition/infilling or excavation	Sediment deposition	70.0%	4.0	2.80	Cultivation likely to increase sediment deposition
	Infilling & excavation	0.0%	0.0	0.00	
	Urban infrastructure	0.0%	0.0	0.00	
Untransformed areas	Untransformed areas	0.0%	0.0	0.00	
Overall on-site impacts				***7.20***	
Hydrology Impact Score				**7.5**	
Health Category				**E**	
Anticipated trajectory of change				**0.0**	

STEP 3: ASSESS GEOMORPHOLOGICAL HEALTH OF THE WETLAND

Geomorphology assessment	Extent (%)	Intensity (0 - 10)	Magnitude of impact	Comments
Diagnostic component				
Upstream dams	0.0%	0.0	0.00	
Stream diversion/shortening	0.0%	0.0	0.00	
Infilling	0.0%	0.0	0.00	
Increased runoff	70.0%	4.0	2.80	
Indicator-based component				
Erosional features	0.0%	0.0	0.00	
Depositional features	70.0%	4.0	0.00	
Loss of organic sediment	0.0%	0.0	0.00	
Geomorphology impact score			**2.80**	
Health Category			**C**	
Anticipated trajectory of change			**0.0**	

STEP 4: ASSESS VEGETATION HEALTH OF THE WETLAND

Disturbance units	Extent (%)	*Typical intensity scores*	Intensity (- 10)	Magnitude of impact	Comments
Alien vegetation	100		3	3	
Vegetation impact score				**3.00**	
Health Category				**C**	
Anticipated trajectory of change				**0.0**	

Appendix H: Photographs - Selected Plant Species

a) *Floscopa glomerata* (Commelinaceae).

b) *Dioscorea dregeana* (Dioscoreaceae).

c) *Ischaemum fasciculatum* (Poaceae).

d) *Miscanthus junceus* (Poaceae).

e) *Panicum deustum* (Poaceae).

f) *Nidorella aegyptiaca* (Asteraceae).

g) *Senecio gerrardii* (Asteraceae).

h) *Wahlenbergia undulata* (Campanulaceae).

i) *Gunnera perpensa* (Gunneraceae).

j) *Heteropyxis canescens* (Heteropyxidaceae).

k) *Mentha aquatica* (Lamiaceae).

l) *Ludwigia palustris* (Onagraceae).

Appendix I: Plant Species List

Plant species recorded in the proposed development area in February 2020.

Family	Species
Ferns	
Dennstaedtiaceae	*Pteridium aquilinum subsp capense*
Equisetaceae	*Equisetum ramosissimum subsp ramosissimum*
Sinopteridaceae	*Cheilanthes viridis*
Thelypteridaceae	*Christella dentata*
Monocots	
Agavaceae	*Agave sisalana* *2
Agavaceae	*Beschorneria yuccoides*
Amaryllidaceae	*Scadoxus multiflorus*
Asparagaceae	*Asparagus africanus*
Commelinaceae	*Commelina africana*
Commelinaceae	*Commelina erecta*
Commelinaceae	*Floscopa glomerata*
Cyperaceae	*Carex rhodesiaca*
Cyperaceae	*Cyperus albostriatus*
Cyperaceae	*Cyperus cyperoides ssp cyperoides*
Cyperaceae	*Cyperus esculentus*
Cyperaceae	*Cyperus obtusiflorus var obtusiflorus*
Cyperaceae	*Fimbristylis dichotoma*
Cyperaceae	*Fuirena pubescens*
Cyperaceae	*Kyllinga melanosperma*
Cyperaceae	*Lipocarpha chinensis*
Cyperaceae	*Pycreus polystachyos var polystachyos*
Cyperaceae	*Schoenoplectus corymbosus*
Cyperaceae	*Scleria sp.*
Dioscoreaceae	*Dioscorea cotinifolia*
Dioscoreaceae	*Dioscorea dregeana*
Hyacinthaceae	*Ledebouria cooperi*
Hypoxidaceae	*Hypoxis rigidula*
Iridaceae	*Dietes iridioides*
Iridaceae	*Freesia laxa subsp laxa*
Juncaceae	*Juncus exsertus*
Musaceae	*Musa acuminata* *#
Poaceae	*Chloris virgata*
Poaceae	*Cynodon dactylon*
Poaceae	*Cynodon nlemfuensis* *
Poaceae	*Digitaria eriantha*
Poaceae	*Eleusine coracana ssp africana*
Poaceae	*Eragrostis curvula*
Poaceae	*Hemarthria altissima*
Poaceae	*Heteropogon contortus*
Poaceae	*Hyperthelia dissoluta*
Poaceae	*Imperata cylindrica*
Poaceae	*Ischaemum fasciculatum*
Poaceae	*Leersia hexandra*
Poaceae	*Melinis repens subsp repens*
Poaceae	*Miscanthus junceus*
Poaceae	*Oplismenus hirtellus*
Poaceae	*Panicum deustum*
Poaceae	*Panicum maximum*
Poaceae	*Paspalum dilatatum* *
Poaceae	*Perotis patens*
Poaceae	*Phragmites mauritianus*
Poaceae	*Setaria megaphylla*
Poaceae	*Setaria sphacelata var sphacelata*
Poaceae	*Sorghum arundinaceum*

Family	Species
Poaceae	*Sporobolus africanus*
Poaceae	*Themeda triandra*
Poaceae	*Urochloa mosambicensis*
Poaceae-Bambuseae	*Bambusa balcooa *1b*
Smilacaceae	*Smilax anceps*
Typhaceae	*Typha capensis*
Dicots	
Acanthaceae	*Barleria elegans*
Acanthaceae	*Crossandra greenstockii*
Acanthaceae	*Thunbergia alata*
Acanthaceae	*Thunbergia atriplicifolia*
Amaranthaceae	*Achyranthes aspera **
Amaranthaceae	*Amaranthus hybridus **
Anacardiaceae	*Lannea edulis*
Anacardiaceae	*Sclerocarya birrea subsp caffra*
Anacardiaceae	*Searsia chirindensis*
Anacardiaceae	*Searsia gerrardii*
Anacardiaceae	*Searsia gueinzii*
Anacardiaceae	*Searsia pyroides*
Annonaceae	*Annona senegalensis ssp senegalensis*
Apiaceae	*Centella asiatica*
Apiaceae	*Hydrocotyle verticillata*
Apocynaceae	*Gomphocarpus physocarpus*
Araliaceae	*Cussonia spicata*
Asteraceae	*Ageratum conyzoides *1b*
Asteraceae	*Artemisia afra*
Asteraceae	*Athrixia phylicoides*
Asteraceae	*Bidens pilosa *1b*
Asteraceae	*Brachylaena transvaalensis*
Asteraceae	*Erigeron bonariensis **
Asteraceae	*Geigeria burkei*
Asteraceae	*Helichrysum nudifolium var nudifolium*
Asteraceae	*Helichrysum rugulosum*
Asteraceae	*Hypochaeris radicata **
Asteraceae	*Laggera crispata*
Asteraceae	*Mikania capensis*
Asteraceae	*Nidorella aegyptiaca*
Asteraceae	*Nidorella ivifolia*
Asteraceae	*Pulicaria scabra*
Asteraceae	*Schkuhria pinnata **
Asteraceae	*Senecio deltoideus*
Asteraceae	*Senecio gerrardii*
Asteraceae	*Senecio madagascariensis*
Asteraceae	*Senecio polyanthemoides*
Asteraceae	*Senecio venosus*
Asteraceae	*Symphyotrichum squamatum **
Asteraceae	*Tagetes minuta **
Asteraceae	*Tenrhynea phylicifolia*
Asteraceae	*Zinnia peruviana **
Bignoniaceae	*Jacaranda mimosifolia **
Campanulaceae	*Wahlenbergia undulata*
Celastraceae	*Gymnosporia glaucophylla*
Celastraceae	*Maytenus undata*
Celtidaceae	*Celtis africana*
Celtidaceae	*Trema orientalis*
Combretaceae	*Combretum collinum*
Combretaceae	*Combretum erythrophyllum*
Ebenaceae	*Diospyros lycioides subp. guerkei*
Ebenaceae	*Diospyros whyteana*

Family	Species
Ebenaceae	*Euclea crispa subsp crispa*
Ebenaceae	*Euclea natalensis subsp natalensis*
Ebenaceae	*Euclea undulata*
Euphorbiaceae	*Acalypha brachiata*
Euphorbiaceae	*Clutia pulchella*
Euphorbiaceae	*Euphorbia tirucalli*
Euphorbiaceae	*Ricinus communis *2*
Fabaceae	*Abrus precatorius subsp africanus*
Fabaceae	*Argyrolobium transvaalense*
Fabaceae	*Bauhinia galpinii*
Fabaceae	*Chamaecrista mimosoides*
Fabaceae	*Dalbergia armata*
Fabaceae	*Dichrostachys cinerea*
Fabaceae	*Erythrina lysistemon*
Fabaceae	*Flemingia grahamiana*
Fabaceae	*Indigofera colutea var colutea*
Fabaceae	*Mucuna coriacea subsp irritans*
Fabaceae	*Peltophorum africanum*
Fabaceae	*Senegalia ataxacantha*
Fabaceae	*Senna septemtrionalis *1b*
Fabaceae	*Sesbania punicea *1b*
Fabaceae	*Zornia capensis subsp capensis*
Gunneraceae	*Gunnera perpensa*
Heteropyxidaceae	*Heteropyxis canescens*
Heteropyxidaceae	*Heteropyxis natalensis*
Lamiaceae	*Mentha aquatica*
Lamiaceae	*Plectranthus spicatus*
Lamiaceae	*Rotheca myricoides*
Lamiaceae	*Salvia coccinea **
Lamiaceae	*Volkameria glabra*
Lobeliaceae	*Lobelia flaccida subsp flaccida*
Maesaceae	*Maesa lanceolata*
Malvaceae	*Dombeya pulchra*
Malvaceae	*Dombeya rotundifolia*
Melastomataceae	*Argyrella canescens*
Meliaceae	*Melia azedarach *1b*
Menispermaceae	*Cissampelos torulosa*
Moraceae	*Ficus sur*
Myrtaceae	*Psidium guajava *2 or 0*
Myrtaceae	*Syzygium cordatum*
Oleaceae	*Ligustrum lucidum *1b (see regs)*
Oleaceae	*Olea europaea subsp cuspidata*
Onagraceae	*Ludwigia octovalvis*
Onagraceae	*Ludwigia palustris*
Oxalidaceae	*Oxalis corniculata **
Passifloraceae	*Adenia gummifera var gummifera*
Pedaliaceae	*Ceratotheca triloba*
Phyllanthaceae	*Flueggea virosa*
Phyllanthaceae	*Phyllanthus reticulatus*
Plantaginaceae	*Plantago longissima*
Polygonaceae	*Persicaria decipiens*
Ranunculaceae	*Clematis brachiata*
Ranunculaceae	*Ranunculus multifidus **
Rhamnaceae	*Berchemia zeyheri*
Rhamnaceae	*Helinus integrifolius*
Rhamnaceae	*Ziziphus mucronata*
Rubiaceae	*Richardia brasiliensis **
Rubiaceae	*Rubia cordifolia ssp. conotricha*
Rutaceae	*Clausena anisata*

Family	Species
Salicaceae	*Populus x canescens* *2
Sapindaceae	*Hippobromus pauciflorus*
Sapindaceae	*Pappea capensis*
Solanaceae	*Datura stramonium* *1b
Solanaceae	*Physalis peruviana* *
Solanaceae	*Solanum mauritianum* * 1b
Solanaceae	*Solanum panduriforme*
Solanaceae	*Solanum sisymbriifolium* * 1b
Thymelaeaceae	*Dais cotinifolia*
Urticaceae	*Obetia tenax*
Verbenaceae	*Lantana camara complex* *1b
Verbenaceae	*Lippia javanica*
Verbenaceae	*Verbena aristigera* *
Verbenaceae	*Verbena bonariensis* * 1b
Vitaceae	*Cyphostemma woodii*
Vitaceae	*Rhoicissus tomentosa*
Vitaceae	*Rhoicissus tridentata*

** = Alien species; # = cultivated*

Appendix J: Ecological Importance and Sensitivity

Ecological Importance

Parameter	Hillslope Seep	Mountain Stream	Transitional Stream
Biodiversity support	**0.3**	**0.5**	**2.3**
Red Data species	0.0	0.0	4.0
Unique species	0.0	0.0	0.0
Migration/breeding/feeding	1.0	1.5	3.0
Landscape scale	**1.7**	**1.4**	**1.6**
Protection status of wetland	0.0	0.0	0.0
Protection status of vegetation type	1.0	1.0	1.0
Regional context	4.0	4.0	4.0
Size and rarity	3.0	1.0	1.0
Diversity of habitats	0.5	1.0	2.0
Sensitivity of the wetland	**0.8**	**1.0**	**3.3**
Sensitivity to floods	0.0	1.0	2.0
Sensitivity to low flows	0.5	0.0	4.0
Sensitivity to water quality	2.0	2.0	4.0
Average	**1.7**	**1.4**	**3.3**

Scoring: 0=None; 1=Low; 2=Moderate; 3=High; 4 = Very High

Functional Importance

Parameter	Hillslope Seep	Mountain Stream	Transitional Stream
Flood attenuation	0.5	0.0	2.0
Streamflow regulation	1.0	1.0	2.0
Sediment trapping	2.0	0.0	1.0
Phosphate assimilation	2.0	0.0	1.0
Nitrate assimilation	2.0	0.0	1.0
Toxicant assimilation	1.0	0.0	1.0
Erosion control	1.0	3.0	3.0
Carbon storage	1.0	1.0	2.0
Average	**1.3**	**0.6**	**1.6**

Scoring: 0=None; 1=Low; 2=Moderate; 3=High; 4 = Very High

Direct Human Benefits

Parameter	Hillslope Seep	Mountain Stream	Transitional Stream
Water for human use	0.0	0.0	2.0
Harvestable resources	1.0	1.0	2.0
Cultivated foods	0.0	0.0	0.0
Cultural heritage	0.0	0.0	0.0
Tourism and recreation	0.0	0.0	1.0
Education and research	0.0	0.0	1.0
Average	**0.2**	**0.2**	**1.0**

Scoring: 0=None; 1=Low; 2=Moderate; 3=High; 4 = Very High

Summary

Parameter	Hillslope Seep	Mountain Stream	Transitional Stream
Ecological Importance	1.7	1.4	3.3
Hydro-Functional Importance	1.3	0.6	1.6
Direct Human Benefits	0.2	0.2	1.0
Average	**1.1**	**0.7**	**2.0**

Scoring: 0=None; 1=Low; 2=Moderate; 3=High; 4 = Very High

Appendix K: Risk Assessment

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: RW Palmer Reg no. 400108/95

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity															
No.	Phases	Activity	Aspect	Impact	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	PES AND EIS OF WATERCOURSE
1	Construction	Clearing of vegetation and associated bulk earthworks; Stream crossing construction	Vegetation removal; Land preparation; Draining; Soil disturbance; Compaction; Culvert or bridge construction	Impact of Land Preparation on Aquatic Habitats	1	1	1	2	1.3	1	1	3.3	1	1	5	1	8.0	26	Low	80	• **Buffer Zones.** A buffer zone of no development within 15 m from the outer edge of both wetlands and all riparian zones is recommended, and a buffer zone of 3 m on either side of the two episodic drainage lines is recommended. • **Exclusion Zone.** The left bank of the Sterkspruit should be left undeveloped to avoid the need for a stream crossing over the Sterkspruit. • **Alien Invasive Vegetation**. Alien invasive vegetation within wetlands and proposed buffer zones must be controlled. Personnel tasked to control alien invasive vegetation should receive appropriate training in the following: methods and control measures; equipment and techniques; types of herbicides and dosages applied; mixing techniques; storage of chemicals and equipment; health and safety issues; plant identification; procedures for equipment washing; equipment maintenance; record keeping, inter alia.	EIS = Various PES = Various
2	Operation	Aerial Spraying	Aerial drift and runoff of pesticides	Impact of Pesticides on Surface Water Quality	1	1	1	2	1.3	1	2	4.3	3	1	5	3	12.0	51	Low	60	• **Buffer Zones.** As above.	EIS = Various PES = Various

Annexure B: Ecological Sensitivity Assessment

STERKSPRUIT

TERRESTRIAL ECOLOGICAL ASSESSMENT

MARCH 2020

Prepared for: Steven Henwood
Henwood Environmental Solutions
PO Box 12340
Steiltes
Mbombela
1213

Prepared by: ECOREX Consulting Ecologists CC
Postnet Suite #192,
Private Bag X2
Raslouw 0109

Author: Duncan McKenzie

Reviewer: Warren McCleland (ECOREX)

ECOREX

TABLE OF CONTENTS

List of Tables

List of Figures

EIA REGULATIONS SPECIALISTS REPORT CHECKLIST

(1) A specialist report prepared in terms of the 2014 Environmental Impact Assessment Regulations (as ammended in 2017) must contain-

	(a) details of-	
✓	(i) the specialist who prepared the report; and	page 07
✓	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	page 73
✓	(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	page 74
✓	(c) an indication of the scope of, and the purpose for which, the report was prepared;	page 07
✓	(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	page 11
✓	(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	page 11
✓	(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	page 49
✓	(g) an identification of any areas to be avoided, including buffers;	page 54
✓	(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	page 51
✓	(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	page 18
✓	(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	page 52
✓	(k) any mitigation measures for inclusion in the EMPr;	page 54
✓	(l) any conditions for inclusion in the environmental authorisation;	page 54
✓	(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	page 54
	(n) a reasoned opinion-	
✓	(i) as to whether the proposed activity or portions thereof should be authorised; and	page 55
✓	(ii) if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	page 55
X	(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
X	(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
✓	(q) any other information requested by the competent authority.	none

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

Abbreviations

DEA	Department of Environmental Affairs
EST	Environmental Screening Tool
IBA	Important Bird & Biodiversity Area
IUCN	International Union for Conservation of Nature
mamsl	Metres above mean sea level
MBSP	Mpumalanga Biodiversity Sector Plan
MNCA	Mpumalanga Nature Conservation Act (No. 10 of 1998)
NEMBA ToPS	National Environmental Management: Biodiversity Act Threatened or Protected Species (No. 10 of 2004)
NFA	National Forest Act (No. 30 of 1998)
PRECIS	National Herbarium Pretoria (PRE) Computerised Information System
QDGS	Quarter-Degree Grid Square, for example 2431 AB
SABAP2	Southern African Bird Atlas Project 2
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern

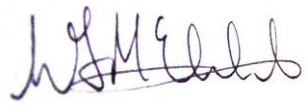
Terminology

Alien	Introduced from elsewhere: neither endemic nor indigenous.
Biodiversity	The diversity of living organisms, including the terrestrial and aquatic ecosystems they inhabit; this can be measured at gene, species or ecosystem level.
Geophyte	Plants that produce their growth points from organs stored below the ground, an adaption to survive frost, drought and / or fire.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

Declaration of Independence

We declare that we have been appointed as independent consulting ecologists with no affiliation with or vested financial interests in the proponent, other than for work performed under the 2014 Environmental Impact Assessment Regulations (as amended in 2017). We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. Remuneration for our services by the proponent is not linked to approval by any decision-making authority responsible for authorising this development.



W.L. McCleland *20 March 2020*

D.R. McKenzie *20 March 2020*

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

1. INTRODUCTION

Steven Henwood of Henwood Environmental Solutions appointed ECOREX Consulting Ecologists CC to perform an ecology survey for terrestrial ecosystems (flora, mammals, birds, reptiles and frogs) for proposed agricultural activities on a farm 50 km west of Mbombela, Mpumalanga Province, South Africa (Figure 1). This study will provide a basis for assessing potential impacts of the proposed project on terrestrial ecology, provide a baseline description of untransformed vegetation and guide the design and location of planned infrastructure. The two key objectives for this study were to conduct a baseline terrestrial ecology survey and assess the Ecological Importance of the terrestrial habitats represented.

The study team was as follows:

Duncan McKenzie (Terrestrial Ecologist). Duncan has been involved in biodiversity assessments for ECOREX for twelve years and countries of work experience include Lesotho, Swaziland, Mali, Mozambique, Guinea, Sierra Leone, South Africa, Tanzania and Democratic Republic of the Congo. Duncan has previously worked as a Regional Coordinator for the Mondi Wetlands Project and lectures on many aspects of conservation in Mbombela and the Kruger National Park. He is currently the Mpumalanga Regional Co-ordinator for the South African Bird Atlas Project, formerly sat on the KZN Bird Rarities Committee and is a co-author on the Birds of Mbombela book and Wildflowers of the Kruger National Park project. A more detailed CV is presented in Appendix 3.

Linda McKenzie (GIS Specialist). Linda is a GIS Specialist/GIS Analyst with over 14 years' experience in the industry. For the last six years she has operated her own GIS Consultancy called Digital Earth. She has extensive experience in both the private and public sector, and has worked on a wide variety of projects and GIS applications. Most recently, these include vegetation and sensitivity mapping, landcover data capture, municipal roads master planning, hydroelectric scheme and wind farm feasibility mapping and town planning, land surveyor and engineering support services. Linda has served as Vice Chairperson and Treasurer for GISSA Mpumalanga and is a registered Professional GISc Practitioner (PGP0170).

2. OBJECTIVES

The objectives of the Ecology Survey are to:

- Provide a baseline ecological assessment of the terrestrial ecosystems that are likely to be impacted by the proposed development;
- Provide an assessment of the ecological importance of potentially affected ecosystems; this would incorporate an assessment of the conservation value of the ecosystems;
- Provide an overview of key potential impacts of the project on terrestrial ecosystems;
- Make recommendations regarding infrastructure layout, where appropriate.

The primary deliverable will be a report on Terrestrial Ecosystems, including:

- Biodiversity Baseline Description;
- Ecological Importance Assessment;
- Broad-scale Vegetation Map;
- Ecological Importance Map;
- Overview of the key potential impacts on the environment;
- Recommendations regarding infrastructure layout, where relevant.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

3. STUDY AREA & PROJECT DESCRIPTION

The study took place within the Schoemanskloof on Portion 65 and the Remainder of Portion 1 of the farm Sterkspruit 296 JT, approximately 50 km west of Mbombela, Ehlanzeni District, Mpumalanga Province (Figure 1). Two sections totaling just under 20 ha were surveyed; one section lying to the north of the N4 road which mostly contains natural vegetation, and another to the south which had formerly been cleared of woody vegetation for tourism /recreational purposes. The perennial Sterkspruit River bisects the northern portion and drains into the Crocodile River *c.* 2 km downstream of the study area. Most of the surrounding valleys are transformed through agriculture, rural housing and tourism-related activities while the steeper slopes are untransformed. Current activities taking place within the study area include small-scale cattle and horse grazing and tourism, including a wedding venue and staff housing. The study area is situated within the quarter-degree grid 2530 BC within an altitude range of between 1020 mamsl and 1080 mamsl.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

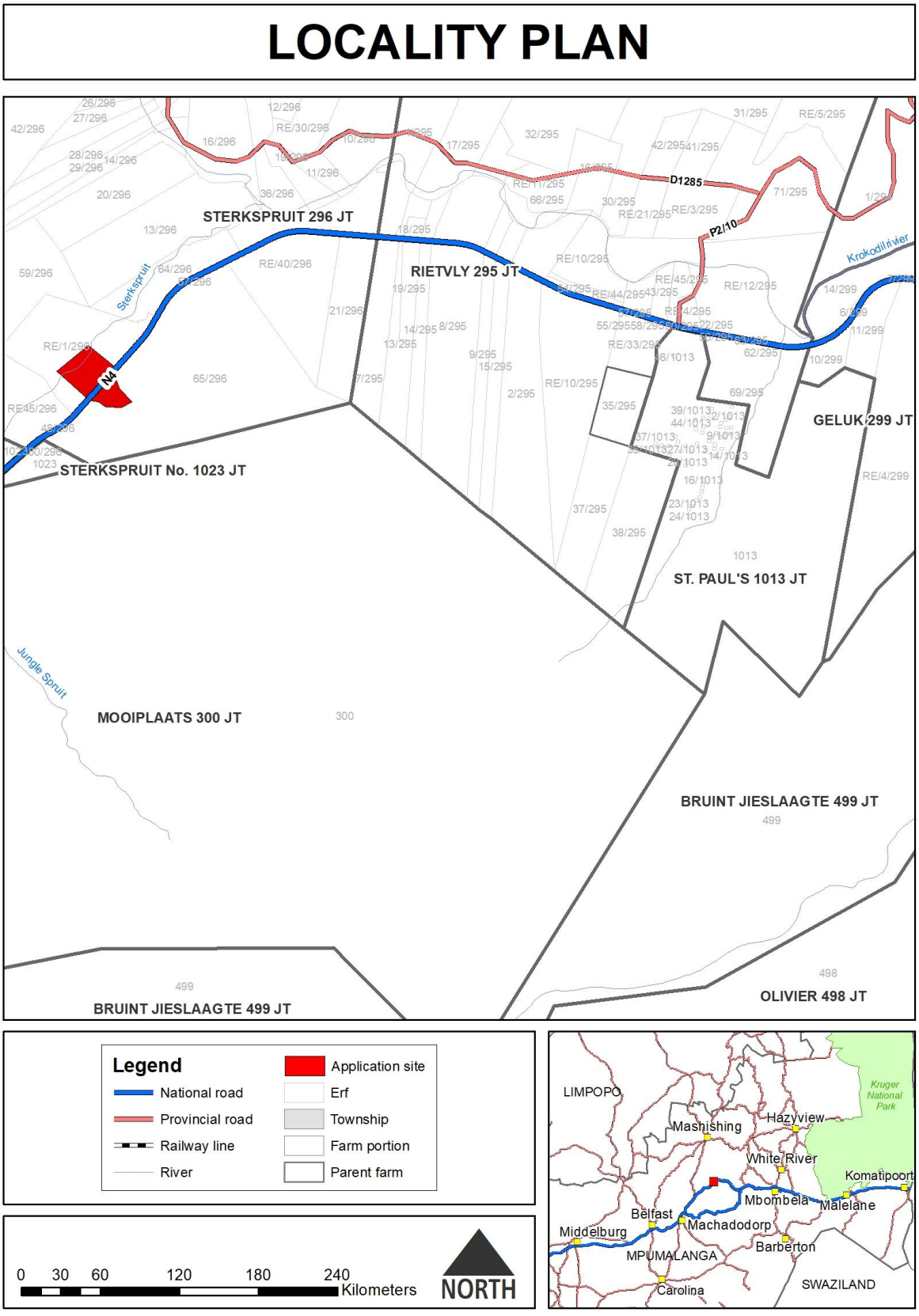


Figure 1. Location of Study Area

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

4. METHODS

An initial screening of the study area was undertaken using the Environmental Screening Tool (EST) of the Department of Environmental Affairs (DEA). This indicated that the study area had a Very High Terrestrial Biodiversity theme. More detail in this regard is provided in section 5.3.2 of this report.

4.1 Flora

Desktop

Vegetation communities were identified prior to fieldwork using satellite imagery supplied by Digital Earth. Red Data plant species listed for the QDGS 2530 BC in the threatened species database of the Mpumalanga Tourism & Parks Agency (MTPA), as well as PRECIS data from the South African National Biodiversity Institute (SANBI), were used to produce a list of the most likely threatened species, which were searched for during fieldwork.

Fieldwork

Vegetation communities identified in the desktop phase were ground-truthed over a single day in late January 2020. The boundaries of the two proposed land parcels were supplied by HES and pre-loaded onto a Samsung S10 phone using LocusMap Pro™ software. These areas were surveyed on foot and all visible plant species were recorded. The locations of any Species of Conservation Concern (SCC[1]) and additional species of conservation-importance were loaded onto the Samsung S10 phone using LocusMap Pro™ software. These include species listed under SANBI's Red List of South African Plants, as well as the website of the International Union for the Conservation of Nature (IUCN). The following relevant South African legislation was referred to with regard to protected species:

- Mpumalanga Nature Conservation Act (No. 10 of 1998) (MNCA)
- National Forests Act (No. 30 of 1998) (NFA)
- National Environmental Management: Biodiversity Act (No. 10 of 2004) Threatened and Protected Species Lists (GG Notice 256, 2015) (NEMBA ToPS)

[1] Raimondo *et al*. (2009), includes those with a status of Critically Rare, Rare, Near Threatened and Data Deficient as well as threatened species (Vulnerable, Endangered and Critically Endangered)

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

4.2 Fauna

Desktop

Lists of mammal, bird, reptile and frog SCC[1] potentially occurring within the study area were prepared using data from the MTPA's threatened species database, Child *et al*. (2016), the Southern African Bird Atlas Project 2 http://sabap2.adu.org.za/, Taylor *et al.* (2016), Minter *et al*. (2004), Bates *et al*. (2014) and the IUCN Red List of Threatened Species. In addition, the protected status of fauna species was provided by the following two relevant Acts:

- National Environmental Management: Biodiversity Act (No. 10 of 2004) Threatened and Protected Species Lists (GG Notice 256, 2015)
- Mpumalanga Nature Conservation Act (No. 10 of 1998)

The above data were captured mostly at a quarter-degree spatial resolution, but were refined by excluding species unlikely to occur within the study area due to unsuitable habitat characteristics (e.g. altitude and land-use). Bat species thought to only forage over the study area (i.e. mostly cave-roosting species) were not included in the assessment due to the lack of suitable caves within the study area. Potential occurrence of fauna in the study area was predicted based on the specialist's knowledge of habitat requirements of local fauna species.

Fieldwork

Birds were identified audially and visually using Nikon 10x42 binoculars. Observations were made incidentally during the time that the vegetation survey was conducted, and limited to birds seen and heard within the study area and immediate surrounds. Specific attention was paid to the potential presence of nesting SCC as well as raptors. Mammals, reptiles and frogs were recorded incidentally as they were encountered during the survey through direct evidence (sightings) and indirect evidence (spoor, dung).

[1] The same approach as Raimondo *et al*. (2009) has been followed here regarding species of conservation concern (i.e. those with a status of Near Threatened and Data Deficient) and threatened species (Vulnerable, Endangered and Critically Endangered)

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

4.3 Method for the determination of Site Ecological Importance (SEI)

A standardised method for assessing site-specific ecological importance in relation to a proposed project (including the project footprint and project activities) is currently in draft format and will form part of the future guidelines for biodiversity specialists in ESIAs (Enviro-Insight, 2019). This assessment does not replace the output of the National Web-based Environmental Screening Tool but is complementary to it, providing a more site-specific assessment that is linked to the proposed project footprint / activities.

SEI is one of the most important outcomes of a specialist ecological study and provides a basis for assessing the significance of impacts that a project may have on the receiving environment. SEI is a function of the Biodiversity Importance (BI) of the receptor (e.g. the species of conservation concern, vegetation/fauna community or habitat type) and its resilience to impacts (Receptor Resilience) as follows:

$$SEI = BI + RR$$

BI in turn is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor as follows:

$$BI = CI + FI$$

Conservation Importance is defined as “the importance of a site for supporting biodiversity features of conservation concern present e.g. populations of IUCN Threatened and Near-Threatened species (CR, EN, VU & NT), Rare, Range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes” (Enviro-Insight, 2019). The fulfilling criteria for CI are presented in Table 1.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

Table 1. Criteria for Determining Conservation Importance of a Receptor

Conservation Importance	Fulfilling Criteria
Very High	Confirmed or highly likely occurrence of CR, EN, VU or Extremely Rare or Critically Rare species Any area of natural habitat of a CR ecosystem type or large area (> 0.1 % of the total ecosystem type extent) of natural habitat of EN ecosystem type Globally significant populations of congregatory species (>10% of global population)
High	Confirmed or highly likely occurrence of CR, EN, VU species that have a global Extent of Occurrence of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. Small area (>0.01% but < 0.1 % of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1 %) of natural habitat of VU ecosystem type Presence of Rare species Globally significant populations of congregatory species (>1% but <10% of global population)
Medium	Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under A criterion only and which have more than 10 locations or more than 10 000 mature individuals. Any area of natural habitat of threatened ecosystem type with status of VU Presence of range-restricted species > 50 % natural habitat with potential to support SCC
Low	No confirmed or highly likely populations of Species of Conservation Concern No confirmed or highly likely populations of range-restricted species < 50 % of natural habitat with limited potential to support SCC
Very Low	No confirmed and highly unlikely populations of SCC No confirmed and highly unlikely populations of range-restricted species No natural habitat remaining

Functional Integrity (FI) of the receptor (e.g. the vegetation/fauna community or habitat type) is defined here as "a measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts". Fulfilling criteria for determining FI are given in Table 2.

Table 2. Criteria for Determining Functional Integrity of a Receptor

Functional Integrity	Fulfilling Criteria
Very High	Very large (>100 ha) intact area for any conservation status of regional vegetation type or >5 ha for CR regional vegetation types High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches No or minimal current ecological impacts with no signs of major past disturbance (e.g. ploughing)
High	Large (>20 ha but <100 ha) intact area for any conservation status of regional vegetation type or >10 ha for EN regional vegetation types Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches Only minor current ecological impacts (e.g. few livestock utilising area) with no signs of major past disturbance (e.g. ploughing) and good rehabilitation potential
Medium	Medium (>5 ha but <20 ha) semi-intact area for any conservation status of regional vegetation type or > 20 ha for VU regional vegetation types Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches Mostly minor current ecological impacts with some major impacts (e.g. established population of alien and invasive flora) and a few signs of minor past disturbance; moderate rehabilitation potential
Low	Small (>1 ha but <5 ha) area Almost no habitat connectivity but migrations still possible across some transformed or degraded natural habitat; a very busy used road network surrounds the area. Low rehabilitation potential Several minor and major current ecological impacts
Very Low	Very small (<1 ha) area No habitat connectivity except for flying species or flora with wind-dispersed seeds. Several major current ecological impacts

BI can be derived from a simple matrix of CI and FI as indicated in Table 3.

Table 3. Biodiversity Importance Two-way Matrix

Biodiversity Importance		**Conservation Importance**				
		Very High	High	Medium	Low	Very Low
Functional Integrity	Very High	Very High	Very High	High	Medium	Low
	High	Very High	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very Low
	Low	Medium	Medium	Low	Low	Very Low
	Very Low	Medium	Low	Very Low	Very Low	Very Low

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2 Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

Receptor Resilience (RR) is defined as "*the intrinsic capacity of the receptor to resist major damage from disturbance and / or to recover to its original state with limited or no human intervention".* The fulfilling criteria for RR are presented in Table 4.

Table 4. Criteria for Determining Receptor Resilience

Receptor Resilience	Fulfilling Criteria
Very High	Habitat that can recover rapidly (~ less than 5 years) to restore > 70 % of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of returning to a site once the disturbance or impact has been removed
High	Habitat that can recover relatively quickly (~ 5-10 years) to restore > 70 % of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of returning to a site once the disturbance or impact has been removed
Medium	Will recover slowly (~more than 10 years) to restore > 70 % of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed
Low	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~less than 50 % of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed
Very Low	Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed

Once BI and RR have been calculated through the use of the above two matrices, SEI can be determined using the matrix in Table 5.

Table 5. Site Ecological Importance Two-way Matrix

SEI		Biodiversity Importance				
		Very High	High	Medium	Low	Very Low
Receptor Resilience	Very Low	Very High	Very High	High	Medium	Low
	Low	Very High	High	Medium	Low	Low
	Medium	High	Medium	Medium	Low	Very Low
	High	Medium	Low	Low	Low	Very Low
	Very High	Low	Low	Very Low	Very Low	Very Low

Guidelines for how to interpret SEI of a project in terms of impact mitigation are given in Table 6.

Table 6. Guidelines for interpreting Site Ecological Importance of Receptors in terms of project impacts

Site Ecological Importance	Interpretation in relation to proposed development activities
Very High	Avoidance mitigation - No destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/unique species assemblages. Destructive impacts for species/ecosystems where <persistence target remains.
High	Avoidance mitigation wherever possible. Minimization mitigation – Changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimization & restoration mitigation - Development activities of medium impact acceptable followed by appropriate restoration activities
Low	Minimization & restoration mitigation - Development activities of medium to high impact acceptable followed by appropriate restoration activities
Very Low	Minimization mitigation - Development activities of medium to high impact acceptable and restoration activities may not be required

The Site Ecological Importance values for each vegetation community are indicated spatially in Figure 9.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2 Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

4.4 Assumptions, Limitations and Knowledge Gaps

4.4.1 Seasonality

The assessment was based on fieldwork covering one day in the wet season only. It is highly likely that plants which flower at other times of the year are underrepresented although this is not seen as a limitation that could affect the Record of Decision as the specialist has extensive experience of local flora and has assessed habitat suitability for potentially occurring threatened plant species.

4.4.2 Overlooked Species

Certain plant species, particularly geophytes, will only flower in seasons when conditions are optimal and may thus remain undetected, even over a survey that encompasses several seasons. Other plant species may be overlooked because of very small size and / or extreme rarity. A sampling strategy will always represent merely a subset of the true diversity of the study area. However, the level of sampling effort for this study was appropriate for the objectives of the study.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

5. BIODIVERSITY BASELINE DESCRIPTION

5.1 Flora

5.1.1 Regional Context

5.1.1.1 National Vegetation Types

According to Mucina & Rutherford (2006), the study area is situated within the western-most tract of Legogote Sour Bushveld. This vegetation type is virtually endemic to Mpumalanga Province, marginally extending into the Limpopo Province. It occurs on the granite and quartzite foothills of Mpumalanga and Limpopo Provinces below the escarpment west of the Kruger National Park, extending from Mariepskop in the north down through Mbombela to Barberton in the south. Legogote Sour Bushveld originally covered about 352 314 ha, of which 57.5% has been transformed, mostly through cultivation and urbanisation[1].

Typical Legogote Sour Bushveld is characterised by open to dense woodland on gently to moderately undulating terrain with a high diversity of trees and shrubs. Typical canopy species include *Parinari curatellifolia, Pterocarpus angolensis, Sclerocarya birrea* subsp. *caffra, Acacia sieberiana* var. *woodii, Combretum molle* and *C. zeyheri*. The shrub layer contains amongst others *Bauhinia galpinii, Acacia ataxacantha, Diospyros lycioides* subsp. *sericea, Searsia pentheri, Erythroxylon emarginatum* and *Dichrostachys cinerea* subsp. *nyassana*. Common herbs include *Agathisanthemum bojeri, Gerbera ambigua, Waltheria indica* and *Hibiscus sidiformis*. Grasses are strongly dominated by *Hyperthelia dissoluta* but other commonly recorded species include *Panicum maximum* and *Schizachyrium sanguineum*. Succulents are represented by *Aloe petricola, Euphorbia vandermerwei* and *Stapelia gigantea*[2].

5.1.1.2 Centres of Plant Endemism

The project area is situated within the Wolkberg centre of plant endemism, as defined by Van Wyk & Smith (2001). These are areas that contain a high number of locally endemic plant species, although this is more applicable to the surrounding, higher-lying vegetation than that occurring within the study area.

[1] Lötter *et al*., 2014b
[2] Mucina & Rutherford, 2006

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

5.1.1.3 Threatened Ecosystems

Legogote Sour Bushveld has been listed as a Threatened Ecosystem (Notice 1002 of Government Gazette 34809, 9 December 2011), and classified as **Vulnerable**.

5.1.2 Local Context – Plant Species Richness and Vegetation Assemblages

SANBI's Botanical Database of Southern Africa (BODATSA) lists 756 plant species from 135 families for a 20 km radius of the project area. This relatively high species list reflects the high diversity and sampling effort in the general area. January 2020 fieldwork yielded 212 plant species from 73 families, representing 28% of the BODATSA total. The true plant species diversity of the study area is likely to be slightly higher, particularly with regard to bulbous and herbaceous species that flower during the pre-rains period. The full list of plant species confirmed to occur in the study area during fieldwork is provided in Appendix 1. The dominant plant families are Poaceae (32 spp.), Asteraceae (24 spp.) and Fabaceae (23 spp.).

Two untransformed and one degraded vegetation communities were identified within the study area on the basis of distinctive vegetation structure (grassland, woodland, thicket, etc.), floristic composition (dominant and diagnostic species) and position in the landscape (mid-slopes, terrace, crest, etc.). These vegetation communities are described in detail below (alien plant species are indicated by an asterisk):

5.1.2.1 *Combretum erythrophyllum – Acacia natalitia – Phragmites mauritianus* Riparian Forest /Wetland Mosaic

This vegetation community occurs along the main Sterkspruit channel, as well as along two smaller tributaries (Figure 6). This is a complex community containing a mosaic of forest and grassland/ reedbed habitats driven by the high water table. The eastern-most riparian forest appears to be drier than in historical times due to diversion of water by the adjacent N4 road. A small dam occurs within the western-most tributary, while the central tributary appears to have dried up in recent times and is not mapped as riparian forest. The main channel along the Sterkspruit supports a higher diversity of herbs and grasses, while the two tributaries contain a higher diversity of woody species. Riparian Forest / Wetland Mosaic covers 5.5 ha which equates to 28% of the area surveyed.

Vegetation structure varies from Tall Forest to Tall Grassland (sensu Edwards, 1983) (Figure 2) with a moderately high diversity of woody species dominating the canopy and grasses

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

and herbs on the ground level. Dominant canopy trees are *Combretum erythrophyllum, Celtis africana, Syzygium cordatum, Acacia natalitia, Ficus burkei, F. sur, Salix mucronata* and *Ziziphus mucronata*, with less common trees including *Acacia sieberiana, A. ataxacantha, Maytenus undata, Combretum krausii, Brachylaena transvaalensis* and *Cussonia spicata*. Shrubs and dwarf shrubs present include *Diospyros lycioides* subsp. *sericea, Asparagus virgatus, * Psidium guajava, * Lantana camara, Artemisia afra* and * *Solanum mauritianum*. Large tracts of vegetation are covered by the highly invasive * *Rubus cuneifolius*. Herbs found include *Laggera crispata, Desmodium setigerum, * Ageratum conyzoides* and * *Bidens pilosa*. Grasses are dominated by the reed *Phragmites mauritianus, Miscanthus junceus, Panicum maximum, Setaria megaphylla* and *Imperata cylindrica.*

A total of 144 species (68% of the entire list) was recorded from Riparian Forest / Wetland Mosaic (Appendix 1) during fieldwork, the highest of the three communities present. Species fidelity is understandably high, with 76 species (53% of the community list) not shared with the other two communities.

Four conservation-important species were recorded from this community, but none are considered to be threatened or Near Threatened (NT) as defined by Raimondo *et al*. (2009). The tree *Sclerocarya birrea* is protected under the NFA while the tree *Berchemia zeyheri* and the climbers *Dioscorea cotinifolia* and *D. dregeana* are protected under the MNCA (Table 7).

Figure 2. Photographs of Riparian Forest / Wetland Mosaic in the Study Area

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

5.1.2.2 *Acacia sieberiana – Panicum maximum* Disturbed Closed Woodland

Acacia sieberiana – Panicum maximum Disturbed Closed Woodland occurs over most of the study area, away from drainage lines, on the northern portion of the study area (Figure 6). Disturbed Closed Woodland covers 8 ha or 41% of the study area. Vegetation structure is mostly Closed Woodland, approaching Tall Thicket on the northern bank of the Sterkspruit (*sensu* Edwards, 1983) (Figure 3). Disturbance to the vegetation occurs through dumping of building rubble, the presence of a few buildings including a small staff village, many tracks and alien plant infestation. The canopy contains a moderate number of woody species, with *Acacia sieberiana* and *A. natalitia* found in greatest abundance. Other woody species found in lower numbers include *A. ataxacantha*, *A. caffra, Dichrostachys cinerea* subsp. *nyassana, Vangueria madagascariensis*, *Diospyros lycioides* subsp*. sericea, Ziziphus mucronata, Dombeya rotundifolia, Searsia pentheri, Cussonia spicata, Heteropyxis natalensis, Sclerocarya birrea* and *Peltophorum africanum.* Herb diversity is relatively high but contains many pioneer and alien species. Those encountered most frequently include *Acalypha vilicaulis, Commelina africana, * Erigeron sumatrensis, * Richardia brasiliensis, * Verbena bonariensis, Zornia capensis* and *Waltheria indica*. Grasses dominate the ground layer and include *Urochloa mossambicensis, Eragrostis curvula, Themeda triandra, Melinis repens, Heteropogon contortus*, *Panicum maximum* and *Sporobolus africanus.*

A total of 116 species (55% of the entire list) was recorded from Secondary Woodland, the second highest species richness of the three vegetation communities in the study area (Appendix 1). Species fidelity is high, with 42 species (36% of the community list) occurring nowhere else in the study area. However, many of these are alien or pioneer species reflecting the disturbed state of this community.

Five conservation-important species were recorded in this vegetation community, namely the trees *Sclerocarya birrea* and *Pterocarpus angolensis* which are protected under the NFA, and the tree *Berchemia zeyheri*, the succulent *Aloe barbertoniae* and the climber *Dioscorea cotinifolia,* which are protected under the MNCA (Table 7).

Figure 3. Photographs of Disturbed Closed Woodland in the Study Area

5.1.2.3 Degraded Grassland

Selected parts of the northern and most of the southern portions of the study area are best described as being Degraded (Figure 6). These are areas that have been impacted by significant anthropogenic influences but are still predominantly covered with vegetation, often of a different structure to what was present historically. Degraded areas cover approximately 5 ha which equates to 25% of the area surveyed. Vegetation structure is mostly Short Closed Grassland becoming Short to Tall Sparse Woodland (*sensu* Edwards, 1983) in places where indigenous trees have been previously cut and have formed coppice shrubs (Figure 4). The grasses *Eragrostis curvula, Cynodon dactylon* and *Sporobolus pyramidalis* are dominant on the ground layer, with additional species including *Heteropogon contortus, Digitaria eriantha, Sporobolus africanus, Melinis repens* and *Aristida congesta* subsp*. barbicollis*. Herbs are relatively poorly represented, and include many alien or pioneer species such as * *Ageratum conyzoides,* * *Euphorbia hirta,* * *Verbena bonariensis,* * *Schkuhria pinnata,* * *Oxalis corniculata,* * *Erigeron sumatrensis* and *Zornia capensis*. Scattered shrubs located include *Acacia ataxacantha, A. natalitia,* * *Lantana camara, Lippia javanica* and *Dichrostachys cinerea* subsp*. nyassana*.

A total of 59 species (28% of the entire list) was recorded from Degraded areas, the lowest species richness for the three vegetation communities present in the study area (Appendix 1). Species fidelity is moderate, with 15 species (25% of the community list) occurring nowhere else in the study area. However, many of these include herbaceous alien invasive species or pioneer grasses.

No SCC or protected species were recorded from this community.

Figure 4. Photographs of Degraded Grassland areas in the Study Area

Transformed areas make up the remainder of the study area, and include a homestead and a wedding venue (Figure 5).

Figure 5. Photographs of Transformed areas in the Study Area

5.1.3 Conservation-Important Flora

A total of 212 plant species was recorded during fieldwork (Appendix 1), none of which are regarded as threatened (i.e. Vulnerable, Endangered or Critically Endangered), or as NT by the IUCN or Raimondo *et al.* (2009). Two trees are protected under the NFA, namely *Pterocarpus angolensis* and *Sclerocarya birrea,* and four plants by the MNCA, namely *Aloe barbertoniae, Dioscorea cotinifolia*, *D. dregeana* and *Berchemia zeyheri*. *Aloe barbertoniae* is endemic to Mpumalanga (Table 7).

Ten plant species of conservation concern potentially occur within the general vicinity of the study area (Table 8). These plants have either been recorded from similar habitat within the quarter-degree grid 2530 BC and surrounding grids or are widespread in Legogote Sour Bushveld. None of these were confirmed during fieldwork, and none are expected to occur within the study area due to unsuitable habitat or altitude and / or regional rarity.

The co-ordinates of the conservation-important plants located during fieldwork are presented in Table 9. These localities represent the larger and main clusters of plants and should not be seen as a complete inventory of all individual plants present as some may have been missed during fieldwork and for others a general point was placed at the centre of a large copse or grove of plants. These localities are meant to guide the developers during the planning and construction phases. These points are spatially presented in Figure 6.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

5.1.4 Endemic Species

One species located is endemic to Mpumalanga, namely *Aloe barbertoniae* (Table 7). This is a common species within the foothills of the Crocodile River valley (*pers. obs*.). No plants endemic to the Wolkberg centre of plant endemism were located during fieldwork.

5.1.5 Invasive Alien Species

A high total of 36 alien plant species were recorded during fieldwork, 19 of which are invasive species as listed in the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983, CARA), emphasizing the degraded state of the study area (Appendix 1). Many of these, such as * *Rubus cuneifolius* and * *Lantana camara*, often occur in high densities throughout the study area.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

Table 7. Conservation-important plant species confirmed during fieldwork

Taxa	Growth Form	Protected	MPU Endemic	Vegetation Communities		
				Riparian Forest / Wetland Mosaic	Disturbed Closed Woodland	Degraded Grassland
Family Anacardiaceae						
Sclerocarya birrea subsp. *caffra* (Sond.) Kokwaro	tree	NFA		r	u	
Family Asphodelaceae						
Aloe barbertoniae Pole-Evans	succulent	MNCA	E		r	
Family Dioscoreaceae						
Dioscorea cotinifolia Kunth	climber	MNCA		r	u	
Dioscorea dregeana (Kunth) T.Durand & Schinz	climber	MNCA		r		
Family Fabaceae						
Pterocarpus angolensis DC.	tree	NFA			r	
Family Rhamnaceae						
Berchemia zeyheri (Sond.) Grubov	tree	MNCA		r	u	
TOTAL	**6**	**6**	**1**	**4**	**5**	**0**

NFA = National Forests Act	u = uncommon
MNCA = Mpumalanga Nature Conservation Act	r = rare

Table 8. Potentially occurring plant SCC

Species	Red Data Status	Habitat Preference	Optimal Survey Time	Likelihood of Occurrence	Justification
Adenia wilmsii	EN	Dolerite outcrops in montane grassland	Oct-April, deciduous species	Very low	Unsuitable altitude and habitat type present
Ansellia africana	VU (IUCN)	Savanna	Throughout the year (even when sterile)	Low	None located during fieldwork
Bowiea volubilis subsp. *volubilis*	VU	Scree slopes, rocky thickets	Oct-April, deciduous species	Very low	No suitable habitat present
Curtisia dentata	NT	Forest	Throughout the year (even when sterile)	Very Low	Unsuitable altitude and habitat type present
Dioscorea sylvatica	VU	Wooded and relatively mesic places, such as the moister bushveld areas, coastal bush and wooded mountain kloofs	Usually throughout the year (even when sterile) although deciduous in dry environments	Low	None located during fieldwork
Elaeodendron transvaalense	NT	Woodland	Throughout the year (even when sterile)	Low	Very rare in the Schoemanskloof, prefers drier areas
Encephalartos humilis	VU	Montane grassland	Throughout the year (even when sterile)	Very Low	Although confirmed from the adjacent QDGS, the altitude and habitat in the study area is unsuitable for this species
Faurea macnaughtonii	Rare	Mistbelt and scarp forest	Throughout the year (even when sterile)	Very Low	Unsuitable altitude and forest type present
Merwilla plumbea	NT	Open grassland, wetlands, rocky ridges	Oct-April, deciduous species	Very low	No suitable habitat present
Prunus africana	VU	Mistbelt and scarp forest	Throughout the year (even when sterile)	Very Low	Unsuitable altitude and forest type present

EN = Endangered
VU = Vulnerable
NT = Near Threatened
IUCN = International Union for the Conservation of Nature

Table 9. Co-ordinates of protected plant species confirmed during fieldwork

Species	No. of Plants	Protected Status	GPS Co-ordinates	
			Latitude	Longitude
Aloe barbertoniae	1	MNCA	-25.397240	30.512196
Aloe barbertoniae	1	MNCA	-25.397666	30.513018
Berchemia zeyheri	1	MNCA	-25.397412	30.509707
Berchemia zeyheri	1	MNCA	-25.397182	30.510030
Berchemia zeyheri	1	MNCA	-25.396296	30.510253
Berchemia zeyheri	1	MNCA	-25.398087	30.512232
Berchemia zeyheri	1	MNCA	-25.396897	30.512615
Dioscorea cotinifolia	1	MNCA	-25.396720	30.513309
Dioscorea cotinifolia	1	MNCA	-25.396901	30.512423
Dioscorea dregeana	1	MNCA	-25.396324	30.511437
Pterocarpus angolensis	1	NFA	-25.398040	30.512734
Pterocarpus angolensis	1	NFA	-25.397498	30.512366
Sclerocarya birrea	1	NFA	-25.398520	30.511135
Sclerocarya birrea	1	NFA	-25.398212	30.511052
Sclerocarya birrea	1	NFA	-25.395872	30.510912
Sclerocarya birrea	1	NFA	-25.396204	30.510640
Sclerocarya birrea	1	NFA	-25.398085	30.512590
Sclerocarya birrea	1	NFA	-25.397591	30.512658
Sclerocarya birrea	1	NFA	-25.396756	30.513296
Sclerocarya birrea	1	NFA	-25.397960	30.511679
Sclerocarya birrea	1	NFA	-25.397512	30.512042
Sclerocarya birrea	1	NFA	-25.397467	30.512513
Sclerocarya birrea	1	NFA	-25.397126	30.511949
Sclerocarya birrea	1	NFA	-25.397010	30.512483

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2 Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

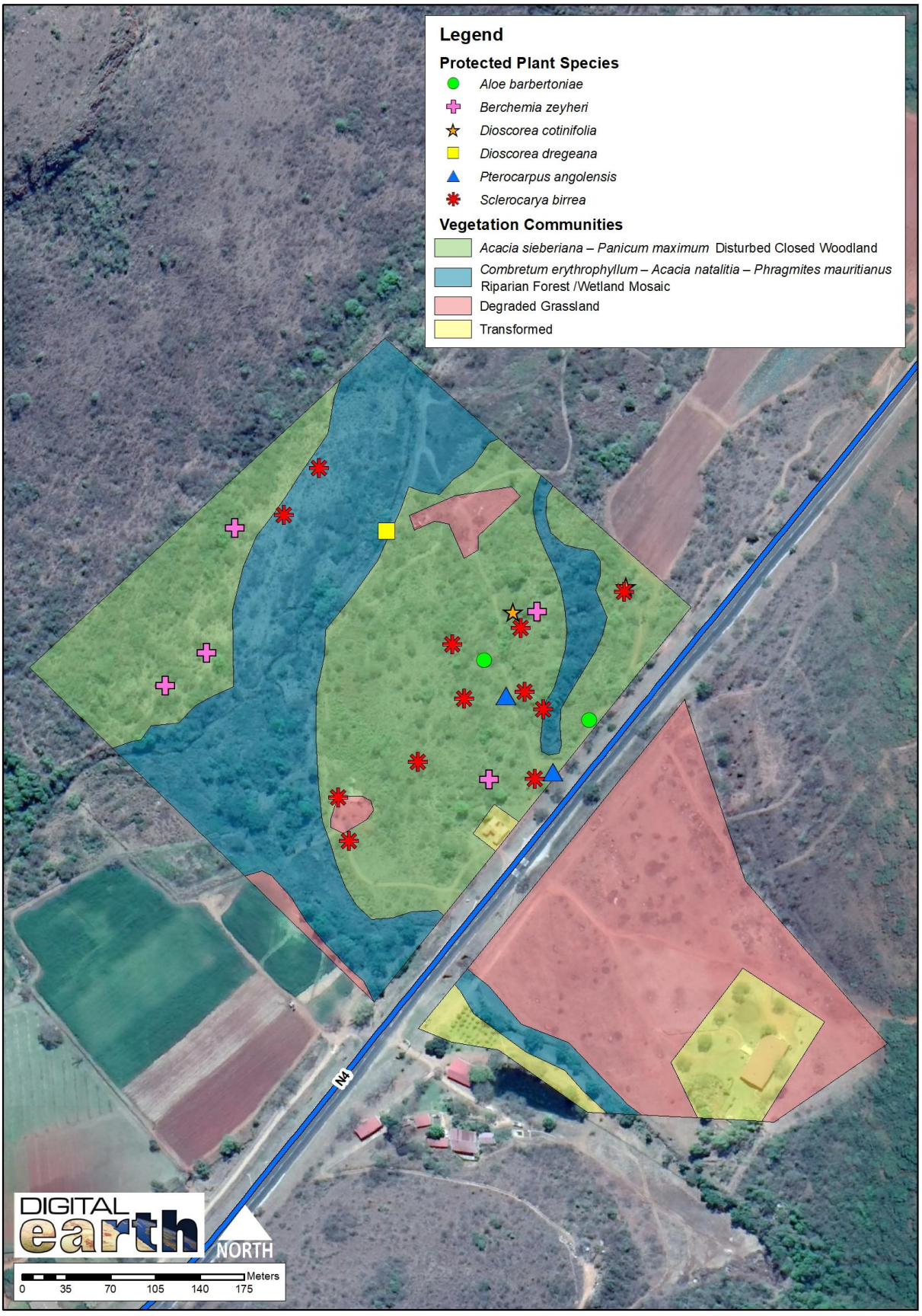


Figure 6. Vegetation communities identified within the Study Area

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

5.2 Terrestrial Fauna

5.2.1 Mammals

5.1.2.1 Regional Overview

The study area is situated within the savanna biome in the Schoemanskloof between the Lowveld to the east and the Escarpment to the north, south and west. The surrounding areas are mostly developed and include roads, cultivation, tourism ventures or dwellings. This local loss of habitat and constant human presence has resulted in a reduction of larger mammals, although many would probably have occurred historically. Human movement through the area is frequent in the northern section and constant in the southern, and a number of tracks are located within the study area. No snares or other evidence of poaching were located during fieldwork although small-scale hunting possibly takes place. Thirty-seven mammal species have been recorded to date for the grid 2530 BC in the Animal Demography Unit's Virtual Museum's database[1], although this total includes at least 20 species of widespread small mammals and very few larger species.

5.2.2.2 Confirmed Species

Only four mammal species were confirmed to occur within the study area during fieldwork. Three each were recorded from Forest and Woodland and one from Degraded areas. These are Cape Porcupine *Hystrix africaeaustralis*, Chacma Baboon *Papio ursinus*, Bushpig *Potamochoerus larvatus* and Grey Duiker *Sylvicapra grimmea*. All four are considered to be common and widespread in the area[2] (Appendix 2).

5.1.2.3 Conservation-Important Species

An estimated 16 mammal SCC potentially occur within the vicinity of the study area (Table 10). Several cave-roosting bat species of conservation concern are highly likely to occur overhead but these species are only likely to feed over the site because of the shortage of suitable roosting sites and have been excluded from this assessment.

No SCC were confirmed during fieldwork, and no threatened species potentially occur. Four species considered to be NT have a moderate or higher likelihood of occurring within the study area (Table 10). These four are discussed briefly below:

[1] http://vmus.adu.org.za/vm_sp_list.php accessed 07/01/2020
[2] Skinner & Chimimba, 2013

African Clawless Otter *Aonyx capensis*

This small, widespread carnivore in the Mustelidae family is assessed as NT due to wide scale habitat destruction and pollution of rivers[1]. This species has a high likelihood of regularly occurring along the Sterkspruit and tributaries, although no evidence of its occurrence was found.

Swamp Musk Shrew *Crocidura mariquensis*

Although frequently occurring in high abundance in some areas, the Swamp Musk Shrew is assessed as NT due to habitat degradation and fragmentation[2]. It occurs in wetlands throughout northern and eastern South Africa and has a Moderate chance of being a resident species within the wetlands in the study area.

African Marsh Rat *Dasymys incomtus*

Widespread in sub-Saharan Africa, the African Marsh Rat is listed as NT due to wetland degradation, invasion of habitat by alien plant species and poor dispersal abilities[3]. Similar to the previous species, it may occur within any of the wetlands within the study area.

Natal Red Duiker *Cephalophus natalensis*

Although locally common (*pers.obs.*), the Natal Red Duiker is nationally assessed as NT due to significant habitat loss and persecution for the bushmeat industry[4]. It is potentially a regularly occurring species within the riparian forests within the study area.

The remaining potentially occurring SCC are unlikely to occur within the study area due to a lack of suitable habitat, regional rarity or high human disturbance levels (Table 10).

Thirteen potentially occurring species are protected under either the MNCA or the NEMBA ToPS (Table 10).

[1] Child *et al*., 2016
[2] Child *et al*., 2016
[3] Friedman & Daly, 2004
[4] Child *et al*., 2016

Table 10. Potentially occurring mammal SCC and protected species within the study area

Species	Scientific Name	Red Data	Protected	Habitat	Likelihood	Reason
Mammals						
African Clawless Otter	*Aonyx capensis*	NT	MNCA	Rivers and streams	High	Suitable habitat present along the Sterkspruit
Natal Red Duiker	*Cephalophus natalensis*	NT	MNCA	Forest and thicket	High	Suitable habitat present
Samango Monkey, inland subsp. *schwarzi*	*Cercopithecus albogularis schwarzi*	EN	MNCA	Escarpment forest	Low	No suitable habitat present
Swamp Musk Shrew	*Crocidura mariquensis*	NT		Wetland habitats	Moderate	Some suitable habitat present
African Marsh Rat	*Dasymys incomtus*	NT		Wetland habitats	Moderate	Some suitable habitat present
Hippopotamus	*Hippopotamus amphibius*	VU#	MNCA	Wetland	Low	Although suitable habitat is present, this species usually occurs further east within the Crocodile River
Spotted-necked Otter	*Hydrictis maculicollis*	VU	MNCA	Medium to high altitude wetlands, including rivers	Low	Suitable habitat present but prefers higher altitudes in Mpumalanga
Serval	*Leptailurus serval*	NT	NEMBA (PR)	Grassland, wetlands	Low	Limited suitable habitat present
Aardvark	*Orycteropus afer*		MNCA	Wide variety of habitats	Low	Rare in the general area
Greater Galago	*Otolemur crassicaudatus*		MNCA	Thicket, closed woodland	High	Suitable habitat present
Oribi	*Ourebia ourebi*	EN	MNCA	Upland plains grassland	Very Low	No suitable habitat present
Leopard	*Panthera pardus*	VU	NEMBA (PR)	Wide variety of habitats	Low	Anecdotal records from the surrounding mountains only
African Weasel	*Poecilogale albinucha*	NT		Wide variety of habitats	Very Low	Very rare in Mpumalanga
Aardwolf	*Proteles cristatus*		MNCA	Wide variety of habitats	Low	Very rare in the general area
Steenbok	*Raphicerus campestris*		MNCA	Open woodland, grassland	Low	No suitable habitat present
Mountain Reedbuck	*Redunca fulvorufula*	EN	MNCA	Hilly grassland and open woodland	Low	No suitable habitat present
TOTAL	16	12	13			

# = IUCN assessment
EN = Endangered
VU = Vulnerable
NT = Near-threatened
MNCA = Mpumalanga Nature Conservation Act
NEMBA = National Environmental Management: Biodiversity Act
PR = Protected

5.2.2 Birds

5.2.2.1 Regional Overview

The QDGS 2530 BC, within which the study area is situated, supports a moderately diverse avifauna with a total of 289 species recorded during the second Southern African Bird Atlas Project (SABAP2)[1], which is currently in progress. At a finer scale, data from SABAP2 indicate that 218 bird species from 24 full protocol lists have already been recorded from the pentad (mapping unit) in which the study area is situated (2520_3030)[2]. A pentad covers an area of approximately 77 km^2, which is considerably smaller than a QDGS (approximately 694 km^2) and thus a better indication of which species occur in the study area. Although this is a reasonably high species list, considering that the pentad supports birds from both the savanna and grassland biomes, it does indicate that the area is somewhat under-sampled and the species list could potentially be higher.

The study area does not fall within any Important Bird and Biodiversity Areas (IBA's), with the closest being the Steenkampsberg IBA which is situated 20 km to the west of the study area[3].

5.2.2.2 Local Avifaunal Assemblages

A total of 102 bird species were confirmed to occur within the study area during fieldwork, representing a high proportion (47%) of the 218 species recorded within the pentad to date during SABAP2 (Appendix 2). Sufficient sampling was undertaken for assessing habitat suitability for potentially occurring threatened species, the primary objective of the ornithological component of this study, and to describe broad bird assemblages. Additional fieldwork is likely to increase the species richness of each assemblage but is unlikely to identify additional assemblages. Three broad assemblages or species-habitat associations were identified, each of which is briefly described below:

I. Forest / Thicket Assemblage

This assemblage is found along the Sterkspruit and adjacent tributaries where forest and thicket habitats occur. Common species located include Red-capped Robin-Chat *Cossypha natalensis*, African Firefinch *Lagonosticta rubricata*, Olive Woodpecker *Dendropicos*

[1] http://sabap2.adu.org.za/coverage/qdgc/2530bc accessed 07/01/2020
[2] Data accessed from http://sabap2.adu.org.za/pentad_info.php?pentad=2520_3030#menu_top on 07/01/2020
[3] Marnewick *et al*., 2015

griseocephalus, Cape Batis *Batis capensis*, Green-backed Camaroptera *Camaroptera brachyura* and Greater Double-collared Sunbird *Cinnyris afer*. Rarer species include Southern Tchagra *Tchagra tchagra*, Swee Waxbill *Coccopygia melanotis,* Narina Trogon *Apaloderma narina* and Knysna Turaco *Tauraco corythaix.* The reclusive Red-chested Flufftail *Sarothrura rufa* was recorded from vegetation within the small dam in the western-most drainage line. Forty-nine species (47% of the entire list) were recorded from the Forest / Thicket assemblage, the joint-highest of the three assemblages (Appendix 2).

II. Woodland Assemblage

Woodland habitat is present across much of the northern portion of the study area, and provides habitat to a number of common and widespread woodland species such as Yellow-fronted Canary *Crithagra mozambica*, Orange-breasted Bushshrike *Chlorophoneus sulfureopectus*, Brubru *Nilaus afer*, Brown-hooded Kingfisher *Halcyon albiventris*, Crested Barbet, *Trachyphonus vaillantii*, Chinspot Batis *Batis molitor*, Arrow-marked Babbler *Turdoides jardineii* and White-bellied Sunbird *Cinnyris talatala*. Locally uncommon species located included Brown-backed Honeybird *Prodotiscus regulus* and Bearded Woodpecker *Chloropicus namaquus*. A total of 49 species (47% of the entire species list) were recorded from the Woodland assemblage, the joint-highest of the three assemblages (Appendix 2).

III. Grassland / Degraded Assemblage

The open parts of the study area south of the N4 support a number of grassland and degraded habitat-favouring species such as Red-collared Widowbird *Euplectes ardens*, Yellow-throated Longclaw *Macronyx croceus,* Pin-tailed Whydah *Vidua macroura,* Groundscraper Thrush *Turdus litsitsirupa*, Speckled Pigeon *Columba guinea* and House Sparrow *Passer domesticus*. Thirty species (29% of the entire list) were recorded from the Grassland / Degraded assemblage, the lowest of the three assemblages (Appendix 2).

5.2.2.3 Conservation-Important Species

An estimated thirteen bird SCC potentially occur within the general vicinity of the study area (Table 11). None of these species were confirmed to occur during fieldwork and only three have a moderate or high likelihood of occurring and are described below. The remaining SCC have a low likelihood due to a lack of suitable habitat, regional scarcity or high human disturbance levels within the study area.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

Crowned Eagle *Stephanoaetus coronatus*

The greater Mbombela area supports one of the highest known densities of this large raptor in South Africa (Garth Batchelor *pers. comm*.). Crowned Eagle is listed as VU due to ongoing habitat destruction, direct persecution from small-stock farmers and due to having a low total population in South Africa[1]. This species is also protected under the NEMBA ToPS. Although suitable foraging and nesting habitat is present, no birds or nests were located. It is likely to occasionally forage along the riparian forest strips but, due to the moderate to high human disturbance levels present, is unlikely to breed. The closest known nest site is located approximately 6 km north of the study area[2].

Half-collared Kingfisher *Alcedo semitorquata*

This small kingfisher is a riparian specialist favouring well-wooded or forested streams or rivers throughout Sub-Saharan Africa[3]. It is listed as NT due to habitat loss and human disturbance[4]. Suitable breeding and foraging habitat is present along the Sterkspruit, although no birds were located during fieldwork.

Lanner Falcon *Falco biarmicus*

South Africa's largest falcon is assessed as VU by Taylor *et al.* (2015) due to a number of factors such as habitat loss and persecution. This aerial predator forages over any habitat but breeding is mostly restricted to sheer cliffs, as are present within the Schoemanskloof. Although it has not been recorded from within the pentad 2520_3030, it is easy to overlook and has a moderate likelihood of occurring as a resident breeding species within the general area.

Three confirmed species are endemic to South Africa, Lesotho and eSwatini, namely Southern Tchagra, Knysna Turaco and Greater Double-collared Sunbird (Appendix 2).

[1] Taylor *et. al*., 2015
[2] Garth Batchelor (*pers. comm*.)
[3] Hockey *et al*., 2006
[4] Taylor *et. al*., 2015

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

Table 11. Potentially occurring bird SCC and protected species within the study area

Species	Scientific Name	Red Data	Protected	Habitat	SABAP2 Pentad Reporting Rate (%) for 2520_3030	Likelihood	Reason
Birds							
Half-collared Kingfisher	*Alcedo semitorquata*	NT		Forested rivers and streams	12,5	High	Suitable habitat present
Verreaux's Eagle	*Aquila verreauxii*	VU		Mountainous areas	-	Low	No suitable habitat present
Black Stork	*Ciconia nigra*	VU		Pans, pools in rivers, nests on cliffs	-	Low	Although aquatic habitats are present, this species does not favour fast-flowing streams with dense riparian vegetation
European Roller	*Coracias garrulus*	NT		Open woodland	-	Low	No suitable habitat present
Lanner Falcon	*Falco biarmicus*	VU		Wide variety of habitats	-	Moderate	Suitable foraging habitat present, suitable nesting cliffs situated in adjacent areas
Southern Bald Ibis	*Geronticus calvus*	VU	NEMBA (VU)	Montane grassland, ploughed lands	16,7	Low	Some suitable habitat present but disturbance levels are high
White-backed Night Heron	*Gorsachius leuconotus*	VU		Forested rivers and streams	-	Low	Unrecorded from the area
Cape Vulture	*Gyps coprotheres*	EN		Wide variety of habitats	4,2	Low	Human disturbance levels high, lack of suitable food
African Finfoot	*Podica senegalensis*	VU		Well wooded streams and rivers	-	Low	Resident along the nearby Crocodile River but drainage lines throughout the study area too narrow /fast flowing or ephemeral to support this species
Martial Eagle	*Polemaetus bellicosus*	EN	NEMBA (EN)	Woodland, savannah	-	Low	Very rare in the general area
Secretarybird	*Sagittarius serpentarius*	VU		Open woodland, grassland	-	Low	Very rare in the general area, no suitable habitat present

Crowned Eagle	*Stephanoaetus coronatus*	VU		Forest	8,3	Moderate	Suitable foraging and nesting habitat is present, but disturbance levels are high with much surrounding agriculture, residential and tourism-related infrastructure present as well as an adjacent busy highway. No nests located, closest known nest is more than 5km to the north of the site
African Grass Owl	*Tyto capensis*	VU		Extensive tracts of open grassland and wetland	-	Very Low	Very rare in the general area, no suitable habitat present
TOTAL	13	13	2				

EN = Endangered
VU = Vulnerable
NT = Near-threatened
NEMBA = National Environmental Management: Biodiversity Act

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

5.2.3 Reptiles

5.2.3.1 Regional Overview

The Lowveld and Foothills of eastern Mpumalanga support a very high diversity of reptile species, with diversity levels ranking in the top 10% of all areas in South Africa[1]. The two reptile groups showing the highest diversity include the lizards (20-41 species recorded) and snakes (20-44 species recorded) (Bates *et al.*, 2014). However, reptile endemicity is low, which is to be expected as the area lies in fairly close proximity to Mozambique within the widespread savannah biome (Bates *et al.,* 2014). Ninety-two reptile species have already been recorded from the degree grid 2530 since 1980[2], and, at a finer scale, 51 species have been recorded from the QDGS 2530 BC, in which the study area is situated, as listed on the Reptile Atlas of Southern Africa website (http://vmus.adu.org.za/) and in Bates *et al*. (2014).

5.2.3.2 Confirmed Species

Only two reptiles were recorded during fieldwork, namely Striped Skink *Trachylepis striata* and Variable Skink *T. varia* (Appendix 2), both of which were located in Closed Woodland and are common and widespread in the foothills of eastern Mpumalanga[3]. Dedicated reptile surveys, including trapping, would have produced additional species but are unlikely to have produced data that would change the recommendations in this report.

5.2.3.3 Conservation-Important Species

Two reptile species confirmed to occur in 2530 have been nationally assessed as threatened, namely Nile Crocodile *Crocodylus niloticus* and Breyer's Long-tailed Seps *Tetradactylus breyeri*, both of which are listed as VU[4]. Nile Crocodile is also protected under the NEMBA ToPS (Table 12). Both species have a very low likelihood of occurring within the study area due to high human pressure or lack of suitable habitat present. Nile Crocodile typically occurs further east along the warmer sections of the Crocodile River (*pers.obs*.) while Breyer's Long-tailed Seps is a high-altitude grassland specialist. Four SCC have been assessed as provincially threatened in the MTPA threatened species database[5], one of which is considered to be EN (Haacke's Flat Gecko *Afroedura multiporus haackei*), and

[1] Bates *et al*., 2014
[2] http://vmus.adu.org.za/vm_sp_list.php accessed 09/02/2020
[3] Bates *et al*., 2014
[4] Bates *et al*. 2014
[5] MTPA Biobase, 2002

three of which are assessed as VU (Wolkberg Dwarf Chameleon, Wilhelm's Flat Lizard *Platysaurus intermedius wilhelmi* and Barberton Girdled Lizard *Smaug warreni barbertonensis*). All four species have a low likelihood of occurring within the study area due to a lack of suitable rocky habitat (the three lizards) or forest type present (Wolkberg Dwarf Chameleon).

Four additional species are classified as NT but all have a low likelihood of occurring within the study area due to local rarity or incorrect habitat and altitude present (Table 12). Southern African Python *Python natalensis* is protected under the NEMBA ToPS and is likely to be resident within the study area.

Table 12. Potentially occurring reptile SCC and protected species within the study area

Species	Scientific Name	Red Data	Protected	Habitat	Likelihood	Reason
Reptiles and Frogs						
Many-spotted Snake	*Amplorhinus multimaculatus*	NT*		Grassland and open woodland at mid to high altitudes	Low	Unsuitable altitude
Wolkberg Dwarf Chameleon	*Bradypodion transvaalensis*	VU*		Forest and forest edge	Low	Unsuitable altitude
Large-scaled Grass Lizard	*Chamaesaura macrolepis*	NT		Grassland and open woodland	Low	Rare, little known species
Nile Crocodile	*Crocodylus niloticus*	VU	NEMBA (VU)	Wetlands	Very Low	Human disturbance, no recent records
Southern Brown Egg-eater	*Dasypeltis inornata*	NT*		Grassland and open woodland	Low	Unsuitable altitude
Striped Harlequin Snake	*Homoroselaps dorsalis*	NT		Mostly high altitude grasslands in Mpumalanga	Low	Unsuitable habitat and altitude
Haacke's Flat Gecko	*Pachydactylus haackei*	EN*		Large rocky outcrops with adjacent woodland and thicket	Low	No suitable habitat present
Wilhelm's Flat Lizard	*Platysaurus intermedius wilhelmi*	VU*		Granite outcrops and sheetrock	Low	No suitable habitat present
Southern African Python	*Python natalensis*		NEMBA (PR)	Wide variety of habitats, but usually near water or rocky outcrops	High	Suitable habitat present
Barberton Girdled Lizard	*Smaug warreni barbertonensis*	VU*		Large rocky outcrops with adjacent woodland and thicket	Low	No suitable habitat present
Breyer's Long-tailed Seps	*Tetradactylus breyeri*	VU		High-altitude grassland	Very Low	No suitable habitat present
TOTAL	11	10	2			

* = Provincial assessment
EN = Endangered

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2 Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

VU = Vulnerable
NT = Near-threatened
MNCA = Mpumalanga Nature Conservation Act
NEMBA = National Environmental Management: Biodiversity Act

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

5.2.4 Frogs

5.2.4.1 Regional Overview

The foothills of eastern Mpumalanga supports a high diversity of frog species, with >20 species per QDGS[1]. However, frog endemicity is very low with no potentially occurring endemic species present in the area (Minter *et al.,* 2004). Forty-one frog species have been recorded from the degree grid 2530[2] and, on a finer scale, 16 have been recorded from the QDGS 2530 BC[3], within which the study area is situated.

5.2.4.2 Conservation-Important Species

None of the 16 species of frogs recorded in 2530 BC have Red Data or protected status. No frogs were recorded during fieldwork although dedicated trapping and nocturnal surveys would result in confirmation of at least few species in the aquatic habitats present within the study area.

[1] Minter *et. al*., 2004
[2] http://vmus.adu.org.za/vm_sp_list.php accessed 09/02/2020
[3] http://vmus.adu.org.za/vm_sp_list.php accessed 09/02/2020

5.3 Ecological Importance

5.3.1 Mpumalanga Biodiversity Sector Plan

Most of the northern and western portions of the study area are classified as **Critical Biodiversity Area (CBA): Irreplaceable** (Figure 7). These are areas that are the most important in Mpumalanga for meeting biodiversity targets outside of formally protected areas and for conserving critical biodiversity ecosystems. CBA areas should be maintained in a natural state with no further loss of natural habitat. The desired management objective in these areas is conservation management which includes, for example, low-intensity livestock or game farming[1]. Any development should be carried out under the provisions of the National Environmental Management Act (NEMA, Act 107 of 1998). The drivers for the CBA assessments within the study area are as follows:

- Legogote Sour Bushveld – Vulnerable Vegetation Type;
- Strategic water source area;
- Modelled distribution – *Adenia wilmsii;*
- Core and Supporting Corridor;
- Forest

Some of these drivers, such as the presence of *Adenia wilmsii* and presence of typical Legogote Sour Bushveld, are not relevant to the entire study area. This is discussed in greater detail in Section 7 of this report.

The southern and eastern portions of the study area are classified as **Ecological Support Areas (ESA) – Local Corridor** in the Mpumalanga Biodiversity Sector Plan (MBSP, Lötter *et al.*, 2014). ESA's are "areas that are not essential for meeting (conservation) targets, but play an important role in supporting the functioning of CBA's and that deliver important ecosystem services". The desired management objectives for ESA's include maintaining the vegetation in a natural state and implementing low-impact, biodiversity-sensitive land uses (Lötter *et al.*, 2014).

Smaller areas within the proposed development are classified as **Heavily** or **Moderately Modified** by the the MBSP (Figure 7). These areas show the greatest flexibility in terms of management objectives and permissible land-uses[2].

[1] Lötter *et al*., 2014
[2] Lötter *et al*., 2014

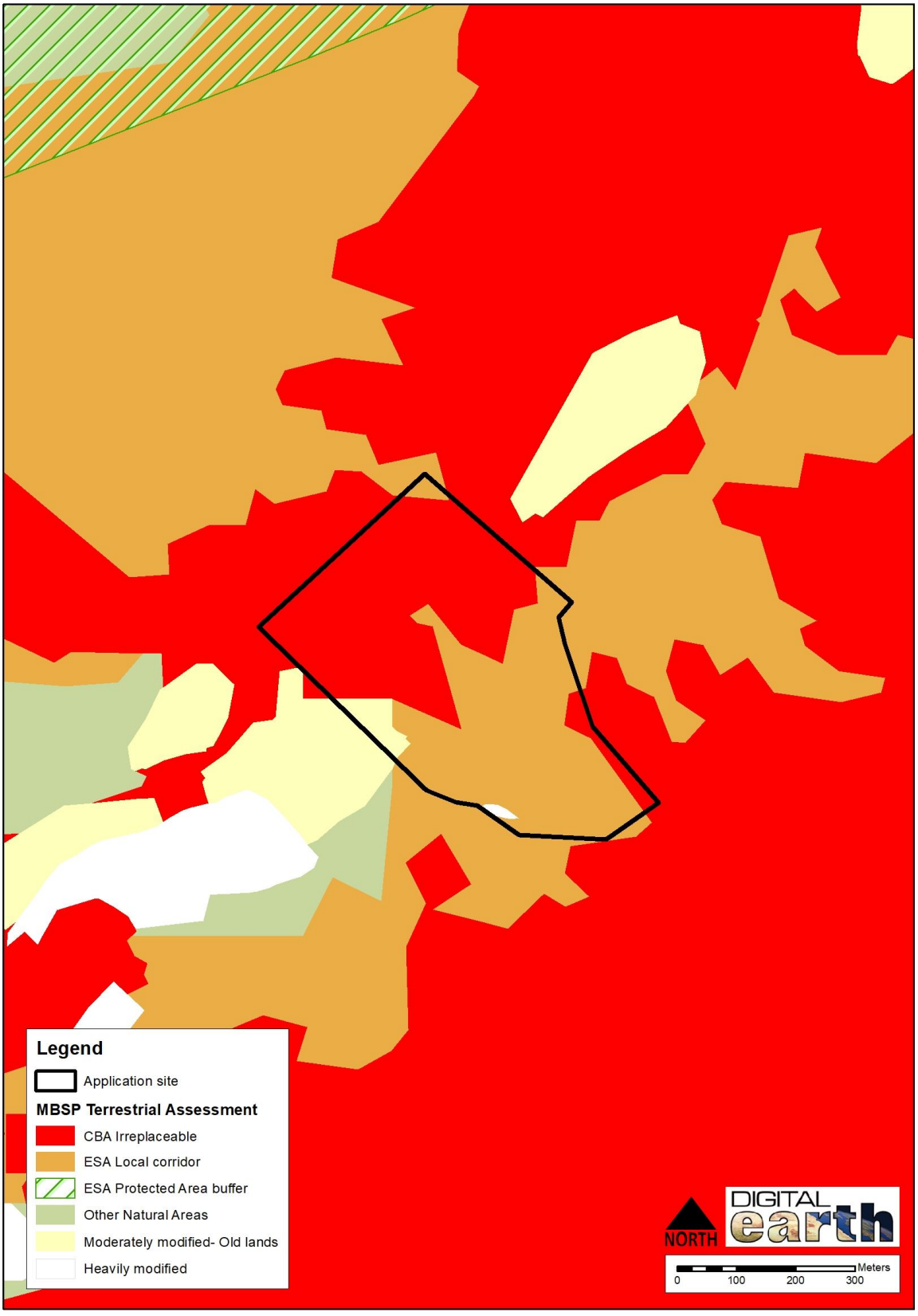


Figure 7. MBSP CBA Map of the Study Area

5.3.2 Environmental Screening Tool

The EST of the DEA indicates that the study area and surrounding areas have a Very High Terrestrial Biodiversity theme (Figure 8) due to it being classified as being located within the following:

1. CBA: Irreplaceable 1 area;
2. Vulnerable Ecosystem;
3. Ecological Support Area 1;
4. Focus Areas for land-based protected areas expansion;
5. Forest;
6. Modelled distribution – Samango Monkey *Cercopithecus albogularis schwarzi*
7. Strategic Water Source Area.

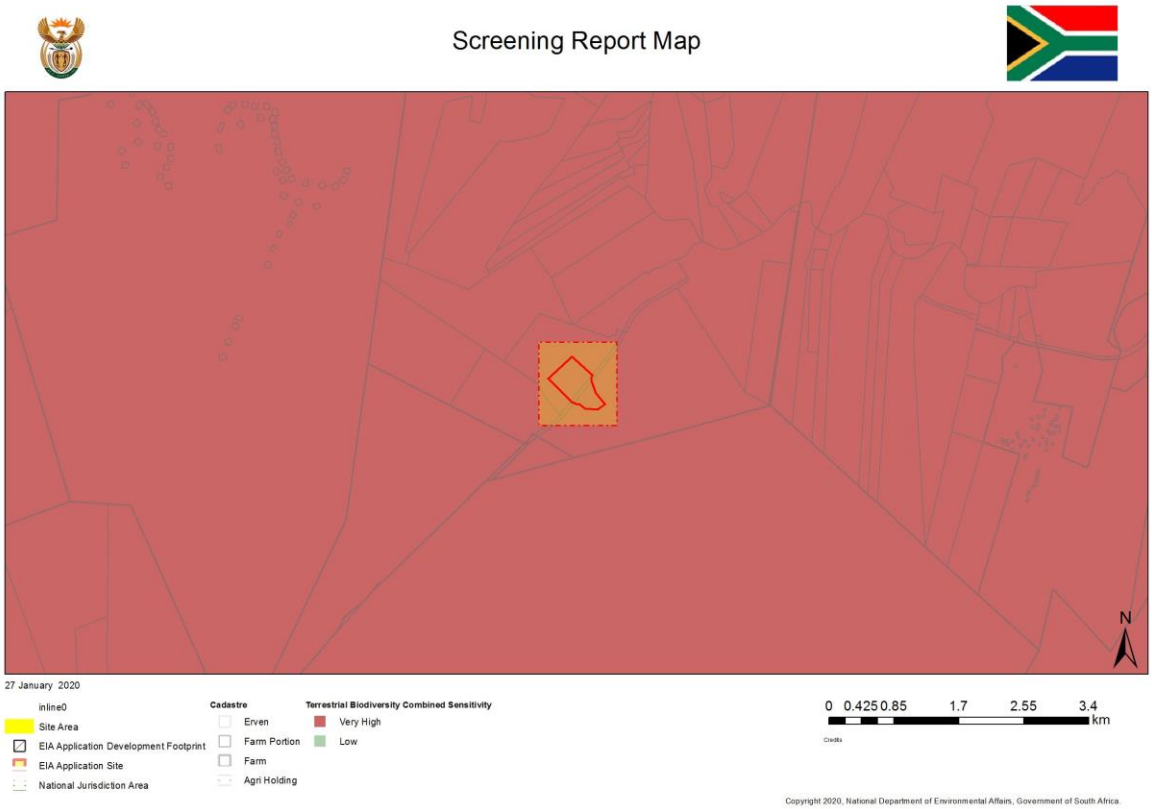


Figure 8. Environmental Screening Tool assessment of Terrestrial Biodiversity Features in the study area

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2 Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

5.3.3 Site-specific Ecological Importance Analysis

A Site Ecological Importance (SEI) analysis of the three vegetation communities and the Transformed areas represented in the study area was undertaken using the methodology described in Section 4.3. **Table** 13 shows the calculation of the Site Ecological Importance of the study area, which is displayed in Figure 9 below.

The Riparian Forest / Wetland Mosaic community is representative of Legogote Sour Bushveld, a nationally Threatened Ecosystem (VU). It is also situated within an area assessed as CBA: Irreplaceable by the MBSP, and potentially holds a number of NT mammal and bird species. Conservation Importance (CI) is therefore High. Functional Integrity is High, and most of the community only contains low levels of alien plant infestation. The combination of High CI and High FI results in a BI of **High**. Receptor Resilience (RR) is assessed as **Low** as the riparian zone would be slow to rehabilitate after degradation. When the High BI is integrated with a Low RR it results in a Site Ecological Importance (SEI) of **High** (Table 13).

The Disturbed Closed Woodland vegetation community is mapped as occurring within a VU vegetation type (Legogote Sour Bushveld). However, the community has only has Medium CI as it is not fully representative of Legogote Sour Bushveld due to high levels of alien plant infestation and disturbance. Additionally, certain areas contain piles of building rubble and a large compost heap. The FI is rated as Medium as a result which, when combined with the Medium CI results in a BI of **Medium**. The Receptor Resilience (RR) is assessed as Medium as savanna reverts back relatively quickly. When integrated with the Medium BI the SEI of the vegetation community is assessed as **Medium** (Table 13).

The Degraded Grassland community is not representative of Legogote Sour Bushveld as it had been extensively modified by overgrazing, bush clearing and other factors, but is still situated within an ESA. It therefore has Medium CI. The FI is Low due to the degradation present. When these two are combined it results in a BI of **Low**. RR is rated as Medium as, given time, this community would revert back to savanna. When the RR and BI assessments are combined, the SEI is **Low** (Table 13).

Table 13. Overview of the calculation of Site Ecological Importance of Vegetation Communities in the Study Area

Assessment Criteria	Vegetation Communities / Habitats			
	Riparian Forest / Wetland Mosaic	Disturbed Closed Woodland	Degraded Grassland	Transformed
Conservation Importance	High	Medium	Medium	Very Low
Functional Integrity	High	Medium	Low	Very Low
Biodiversity Importance	High	Medium	Low	Very Low
Receptor Resilience	Low	Medium	Medium	High
SITE ECOLOGICAL IMPORTANCE	High	**Medium**	Low	Very Low

Figure 9. Site Ecological Importance of the Vegetation Communities in the Study Area

6. KEY POTENTIAL IMPACTS

This section details the expected impacts of the proposed agricultural developments within the study area on terrestrial ecosystems. Impacts are not arranged in any order of overall significance, and this not a detailed impact assessment as this was not part of the terms of reference for this report. The following are potentially significant impacts on untransformed vegetation communities:

- **Destruction of a Critical Biodiversity Area** – most of the untransformed vegetation within the study area is classified as being situated within a CBA: Irreplaceable area;
- **Degradation of a Vulnerable vegetation type** – Legogote Sour Bushveld is classified as VU in the National List of Threatened Ecosystems. Representative Legogote Sour Bushveld occurs within the Riparian Forest / Wetland Mosaic community;
- **Loss or damage of plant species of conservation importance** – ten species could be impacted during the construction phase. The trees *Pterocarpus angolensis* and *Sclerocarya birrea* are protected under the NFA, while the the tree *Berchemia zeyheri*, the succulent *Aloe barbertoniae (*also endemic to Mpumalanga) and the climbers *Dioscorea cotinifolia* and *D. dregeana* are protected under the MNCA;
- **Degradation of watercourses** – a number of drainage systems occur within the study area, including the perennial Sterkspruit. These could be sensitive to any negative impacts from agricultural-related activities, such as road building, eutrophication, sedimentation, pesticide drift and dumping of topsoil. Long-term changes in surface and subsurface runoff could also negatively affect the structure and function of these systems, particularly with respect to channel erosion caused by increased stormwater runoff;
- **Invasion of natural habitat by alien plants** – at least 19 CARA-listed alien invasive plant species were located within the study area during fieldwork, and additional invasion is possible as clearing activities introduce seeds which may thrive in bare soil resulting from agricultural activities;
- **Loss of habitat for conservation-important fauna** – at least four NT mammal species and one VU and one NT bird species potentially occur within the study area;
- **Increase in poaching activities** – unsupervised workers may participate in small-scale poaching through setting snares or traps for bushmeat. Medicinal plants such as *Dioscorea cotinifolia* may also be harvested for muthi.

7. DISCUSSION AND RECOMMENDATIONS

An ecological assessment was performed in approximately 20 ha as part of a potential agricultural development on the farm Sterkspruit 296 JT, 50 km west of Mbombela, Ehlanzeni District, Mpumalanga. The general area is classified as having Very High Terrestrial Biodiversity theme and is situated within a listed Threatened Vegetation Type (Legogote Sour Bushveld). Most of the untransformed vegetation portions within the study area have been assessed by the MBSP as CBA: Irreplaceable which they recommend be maintained in a natural state and used for low-intensity livestock or game farming. This assessment, as well as the EST's assessment, is based on a number of drivers, some of which are not well represented within the study area. These are elaborated on below:

Legogote Sour Bushveld – Vulnerable Vegetation Type.

Representative tracts of this community are only found along the riparian areas as the remaining portions are disturbed through alien plant infestation, bush clearing for tourism activities, dumping of building rubble, presence of a large compost heap and presence of many tracks.

Modelled distribution – Samango Monkey *Cercopithecus albogularis schwarzi*

The local race of Samango Monkey is assessed as EN but prefers Escarpment forests, not riparian forest, and is therefore unlikely to occur within the study area.

Modelled distribution – *Adenia wilmsii*

Adenia wilmsii is listed as EN, but occurs in dolerite outcrops in montane grassland, a habitat which is absent from the study area.

Strategic water source area

Applicable to the riparian areas within the study area.

Focus Areas for land-based protected areas expansion

Applicable to the areas of natural vegetation within the study area only.

Core and Supporting Corridors

Probably mostly applicable to the riparian areas within the study area.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

Forest

Only riparian forest is present within the study area, no Afromontane Forest as is modelled. This forest type occurs higher up on the surrounding steep slopes.

Other portions are assessed as CBA – Local Corridor and smaller portions are assessed as being Moderately or Heavily Modified. However, much of the study area is either disturbed or degraded due to alien plant infestation, dumping, residential development and a tourism development (wedding venue and guest lodge).

Three vegetation communities were surveyed during fieldwork, in addition to Transformed areas. Riparian Forest / Wetland Mosaic is assessed as having High SEI due to being representative of Legogote Sour Bushveld, potentially supporting at least a few NT mammal and bird species and being located within perennial or ephemeral watercourses. However, no plant SCC were recorded during fieldwork and none potentially occur. No nests of raptors or other bird SCC were located. Disturbed Closed Woodland is assessed as having Medium SEI due to high levels of alien plant infestation, many tracks, rubble and high human disturbance levels. Degraded Grassland is assessed as having Low SEI, and Transformed Areas have Very Low SEI.

Two trees located are protected under the NFA, while four plants confirmed are protected under the MNCA. No faunal SCC were recorded during fieldwork.

Some preliminary recommendations and mitigation measures regarding the proposed activities on Sterkspruit 296 JT are listed below.

- In order to comply with the National Environmental: Management Act (Act 107 of 1998) as well as the Water Act (Act 36 of 1998) and the Conservation of Agricultural Resources Act (Act 43 of 1983), and due to the High SEI assessment, no development is to take place within Riparian or Wetland areas, and a conservation buffer of 15 m from the boundary of all perennial watercourses and a buffer of 3 m from ephemeral drainage lines is recommended.
- No development is recommended on the northern bank of the Sterkspruit. Access to this side would require the construction of a fairly significant bridge over sensitive riparian vegetation, and would probably lead to an increase of alien plant infestation as many seeds are spread by vehicle tyres.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

- All protected trees larger than 6 m or with a breast diameter of more than 30 cm should remain undisturbed. This includes the larger protected trees such as *Sclerocarya birrea, Pterocarpus angolensis* and *Berchemia zeyheri*, as listed in Table 9.
- Natural areas where orchards are to be planted should be checked by a suitably experienced botanist prior to construction to locate any conservation-important species. These species should be translocated into adjacent untransformed vegetation.
- All existing and proposed roads should contain adequate stormwater drainage and erosion control measures.
- In order to comply with the Conservation of Agricultural Resources Act (Act 43 of 1983), all listed invasive exotic plants as indicated in Appendix 1 should be targeted and controlled. This may necessitate the compilation of an alien plant control plan as at least 19 declared invasive species were recorded during fieldwork. Species such as * *Rubus cuneifolius* occur in particularly large colonies.
- Weeds will inevitably establish around the proposed agricultural lands and it is important that weed control, if involving herbicides, be managed correctly so as to reduce the impact on the adjacent natural vegetation. Regular inspections should be made to determine if any additional alien plants have established.
- Poaching of plant or animal resources could be a threat. If any external labour teams are used during construction, then these teams should preferably be accommodated off site; if this is not possible then teams should be carefully monitored to ensure that no unsupervised access to plant and animal resources takes place.

Provided the recommendations suggested in this report are followed, and the developer complies with all relevant legislation pertaining to the development activities (such as the NEMBA), there is no objection to the proposed developments in terms of the terrestrial ecosystems of the study area. However, if the development was to proceed without the implementation of the recommendations given above then we would object to the development application.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

8. REFERENCES

Animal Demography Unit. n.d. The Southern African Bird Atlas Project http://sabap2.adu.org.za/index.php accessed on 07/01/2020.

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

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

DEA. 2014. National Environmental Management: Biodiversity Act 2004 (Act 10 of 2004) Threatened or Protected Species Lists, 2015 Ammendment. Government Gazette.

DEAT. 2011. *National List of Threatened Terrestrial Ecosystems in South Africa.* National Environmental Management: Biodiversity Act (Act 10 of 2004). Government Gazette.

Department of Agriculture. 2001. Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), Regulations: Amendment. Government Gazette, 30 March 2001.

Department of Water Affairs and Sanitation (DWA) 2016. [Proposed] General authorisations in terms of Section 39 on the National Water Act, 1998 (Act No. 36 of 1998) for water uses as defined in Sections 21(c) and/or Section 21(i). https://www.dwa.gov.za/Documents/.

Edwards, D. 1983. A broad-scale structural classification of vegetation for practical purposes. *Bothalia* 14:705-712.

Enviro-Insight (2019). Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for environmental impact assessments in South Africa. Version 1.0. Draft for comment. Produced for the Department of Environmental Affairs by the South African National Biodiversity Institute and BirdLife South Africa, Pretoria.

Lötter, M.C., Cadman, M.J. and Lechmere-Oertel, R.G. 2014. *Mpumalanga Biodiversity Sector Plan*. Mpumalanga Tourism & Parks Agency, Mbombela.

Marnewick M.D., Retief E.F., Theron N.T., Wright D.R., Anderson T.A. 2015. *Important Bird and Biodiversity Areas of South Africa*. Johannesburg: BirdLife South Africa.

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. & Kloepfer, D.2004. *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland*. SI/MAB Series No.9. Smithsonian Institution, Washington, DC.

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2
Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

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

Skinner, J.D. & Chimimba, C.T. (eds). 2013. *The Mammals of the Southern African Subregion.* Cambridge University Press.

South African National Biodiversity Institute . 2018 Vegetation Map App [Carry Map] 2018. Available from the Biodiversity GIS website, downloaded on 09 April 2019.

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

Van Wyk, A. E. & Smith, G. F. 2001. *Regions of floristic endemism in southern Africa: A review with emphasis on succulents*. Umdaus Press, Pretoria.

9. APPENDICES

Appendix 1. Checklist of Flora recorded during fieldwork

Taxa	Growth Form	Protected	MPU Endemic	CARA Category	Vegetation Communities		
					Riparian Forest / Wetland Mosaic	Disturbed Closed Woodland	Degraded
Family Acanthaceae							
Chaetacanthus burchellii Nees	herb					r	
Crossandra greenstockii S.Moore	herb					r	
Hypoestes aristata (Vahl) Sol. ex Roem. & Schult. var. *aristata*	dwarf shrub				r		
Hypoestes forskaolii (Vahl) R.Br.	herb				r		
Ruellia cordata Thunb.	herb					r	
Thunbergia alata Bojer ex Sims	climber				r		
Thunbergia neglecta Sond.	climber					u	
Family Agavaceae							
* *Agave sisalana* Perrine	succulent			1b			r
Family Amaranthaceae							
* *Achyranthes aspera* L. var. *aspera*	herb					r	
* *Guilleminea densa* (Willd. ex Schult.) Moq.	herb						u
Pupalia lappacea (L.) A.Juss. var. *lappacea*	herb					r	
Family Anacardiaceae							
Lannea edulis (Sond.) Engl.	dwarf shrub					r	
Sclerocarya birrea subsp. *caffra* (Sond.) Kokwaro	tree	NFA			r	u	
Searsia chirindensis (Baker f.) Moffett	tree				u	r	
Searsia dentata (Thunb.) F.A.Barkley	tree				r		
Searsia pentheri (Zahlbr.) Moffett	tree				r	f	r
Searsia pyroides (Burch.) Moffett var. *pyroides*	shrub				r		
Searsia transvaalensis (Engl.) Moffett	shrub				r	u	

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2 Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632 warren@ecorex.co.za

Family Annonaceae							
Annona senegalensis Pers. subsp. *senegalensis*	tree					u	
Family Apocynaceae							
Gomphocarpus physocarpus E.Mey.	dwarf shrub				r		
Raphionacme procumbens Schltr.	herb					r	
Family Araliaceae							
Cussonia spicata Thunb.	tree				u	f	
Family Asparagaceae							
Asparagus virgatus Baker	shrub				f	u	
Family Asphodelaceae							
Aloe barbertoniae Pole-Evans	succulent	MNCA	E			r	
Family Asteraceae							
* *Ageratum conyzoides* L.	herb				u	r	r
Artemisia afra Jacq. ex Willd.	dwarf shrub				r		
Berkheya setifera DC.	herb					r	
* *Bidens pilosa* L.	herb				r	r	u
Brachylaena transvaalensis Hutch. ex E.Phillips & Schweick.	tree				u		
* *Campuloclinium macrocephalum* (Less.) DC.	herb			1b			r
Conyza sp.	herb				r		
* *Erigeron sumatrensis* Retz.	herb				r	r	u
Euryops chrysanthemoides (DC.) B.Nord.	dwarf shrub				r		
Euryops laxus (Harv.) Burtt Davy	herb					r	
Geigeria burkei Harv.	herb					r	
Gerbera ambigua (Cass.) Sch.Bip.	herb					r	
Helichrysum kraussii Sch.Bip.	shrub					r	
Helichrysum nudifolium (L.) Less. var. *pilosellum* (L.f.) Beentje	herb					u	
Helichrysum rugulosum Less.	herb				r	r	
Laggera crispata (Vahl) Hepper & J.R.I.Wood	herb				u	r	
Nidorella auriculata DC.	herb				r		r
* *Schkuhria pinnata* (Lam.) Kuntze ex Thell.	herb						u
Senecio deltoideus Less.	climber				u		
Senecio latifolius DC.	herb					r	
Senecio madagascariensis Poir.	herb						r
Senecio microglossus DC.	dwarf shrub				u	r	
* *Tagetes minuta* L.	herb				r	u	u
* *Zinnia peruviana* (L.) L.	herb				r	r	r

Family Bignoniaceae							
* *Jacaranda mimosifolia* D.Don	tree			1b	u	u	r
Family Campanulaceae							
Wahlenbergia undulata (L.f.) A.DC.	herb				r		
Family Cannabaceae							
Celtis africana Burm. f.	tree				f	r	
Trema orientalis (L.) Blume	tree				r		
Family Celastraceae							
Gymnosporia buxifolia (L.) Szyszyl.	tree				r	r	
Maytenus undata (Thunb.) Blakelock	tree				r		
Family Combretaceae							
Combretum erythrophyllum (Burch.) Sond.	tree				d		
Combretum kraussii Hochst.	tree				u		
Combretum molle R.Br. ex G.Don	tree					r	
Family Commelinaceae							
Commelina africana L.	herb					u	
Commelina diffusa subsp. *scandens* (Welw. ex C.B.Clarke) Oberm.	herb				r		
Commelina sp.	herb					r	r
Family Convolvulaceae							
Cuscuta sp.	climber				r		
Ipomoea obscura (L.) Ker Gawl. var. *obscura*	climber					r	
Family Cucurbitaceae							
Cucumis zeyheri Sond.	creeper					r	
Family Cyperaceae							
Cyperus distans L.f.	sedge				u		
Cyperus niveus var. *leucocephalus* (Kunth) Fosberg	sedge					r	
Cyperus sp.	sedge				r		
Kyllinga alba Nees	sedge					r	
Kyllinga erecta Schumach.	sedge				u		
Pycreus polystachyos (Rottb.) P.Beauv.	sedge				u		
Schoenoplectus corymbosus (Roth ex Roem. & Schult.) J.Raynal	sedge				u		
Family Dennstaedtiaceae							
Pteridium aquilinum (L.) Kuhn	fern				u		
Family Dioscoreaceae							
Dioscorea cotinifolia Kunth	climber	MNCA			r	u	

Dioscorea dregeana (Kunth) T.Durand & Schinz	climber	MNCA			r		
Family Ebenaceae							
Diospyros lycioides Desf. subsp. *sericea* (Bernh.) De Winter	shrub				r	f	
Diospyros whyteana (Hiern) F.White	shrub				r		
Euclea crispa (Thunb.) Gürke	tree				r	u	
Euclea natalensis A.DC. subsp. *angustifolia* F.White	tree				r		
Family Euphorbiaceae							
Acalypha villicaulis Hochst.	herb				r	r	
Clutia pulchella L. var. *pulchella*	dwarf shrub					r	
* *Euphorbia hirta* L.	herb						r
* *Ricinus communis* L.	dwarf shrub			2	r		r
Family Fabaceae							
Acacia ataxacantha DC.	climber				f	f	u
Acacia caffra (Thunb.) Willd.	tree				r	u	
Acacia natalitia E.Mey.	tree				d	d	u
Acacia sieberiana DC. var. *woodii* (Burtt Davy) Keay & Brenan	tree				u	d	u
Bauhinia galpinii N.E.Br.	climber				r	r	
Chamaecrista mimosoides (L.) Greene	herb				r		
Crotalaria cf. *capensis*	dwarf shrub				r		
Dalbergia armata E.Mey.	climber				r	r	
Desmodium setigerum (E.Mey.) Harv.	herb				u		
Dichrostachys cinerea (L.) Wight & Arn. subsp. *nyassana* (Taub.) Brenan	tree				r	f	u
Eriosema psoraleoides (Lam.) G.Don	dwarf shrub					r	r
Erythrina lysistemon Hutch.	tree				r		
Flemingia grahamiana Wight & Arn.	dwarf shrub					r	r
Indigofera hendecaphylla Jacq.	herb						r
Indigofera tristoides N.E.Br.	shrub				r		
Neonotonia wightii (Wight & Arn.) J.A.Lackey	climber				r		
Peltophorum africanum Sond.	tree				r	u	
Rhynchosia caribaea (Jacq.) DC.	climber					r	
Rhynchosia minima (L.) DC.	climber				r	r	
* *Senna septemtrionalis* (Viv.) H.S.Irwin & Barneby	shrub			1b	r		
Stylosanthes fruticosa (Retz.) Alston	herb					r	
Pterocarpus angolensis DC.	tree	NFA				r	
Zornia capensis Pers.	herb				r	r	r
Family Gunneraceae							

Gunnera perpensa L.	herb				r		
Family Heteropyxidaceae							
Heteropyxis natalensis Harv.	tree				r	f	
Family Hyacinthaceae							
Ledebouria sp. (no flowers)	bulb					r	
Family Hypoxidaceae							
Hypoxis rigidula Baker var. *pilosissima* Baker	geophyte					r	
Family Icacinaceae							
Apodytes dimidiata E.Mey. ex Arn.	tree				r		
Family Iridaceae							
Freesia laxa (Thunb.) Goldblatt & J.C.Manning	bulb				r		
Family Lamiaceae							
Rotheca myricoides (Hochst.) Steane & Mabb.	shrub				r		
Stachys natalensis Hochst. var. *natalensis*	herb					r	
Volkameria glabra (E.Mey.) Mabb. & Y.W.Yuan	tree				u		
Family Loranthaceae							
Erianthemum dregei (Eckl. & Zeyh.) Tiegh.	epiphyte				r		
Family Malvaceae							
Dombeya pulchra N.E.Br.	dwarf shrub				u	r	
Dombeya rotundifolia (Hochst.) Planch. var. *rotundifolia*	tree				r	f	
Grewia occidentalis L.	shrub				r	r	
Hibiscus micranthus L.f. var. *micranthus*	dwarf shrub					r	
Pavonia burchellii (DC.) R.A.Dyer	dwarf shrub				r		
Sida dregei Burtt Davy	dwarf shrub						r
Waltheria indica L.	herb					r	r
Family Melastomataceae							
Dissotis canescens (E. Mey. ex Graham) Hook. f.	herb				r		
Family Meliaceae							
* *Melia azedarach* L.	tree			1b	u		
Family Menispermaceae							
Cissampelos torulosa E.Mey. ex Harv.	climber				r		
Family Moraceae							
Ficus burkei (Miq.) Miq.	tree				u		
Ficus sur Forssk.	tree				f	r	
* *Morus alba* L.	tree			3	r		

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2 Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632
warren@ecorex.co.za

Family Musaceae							
* *Musa* sp.	dwarf shrub				r		
Family Myrtaceae							
* *Psidium guajava* L.	shrub			2/3	r	r	r
Syzygium cordatum Hochst. ex C.Krauss subsp. *cordatum*	tree				f	r	
Family Olacaceae							
Ximenia caffra Sond. var. *natalensis* Sond.	tree					r	
Family Orobanchaceae							
* *Striga asiatica* (L.) Kuntze	herb						r
Family Oxalidaceae							
* *Oxalis corniculata* L.	creeper						u
Family Passifloraceae							
* *Passiflora subpeltata* Ortega	climber			1b	r		
Family Phyllanthaceae							
Flueggea virosa (Roxb. ex Willd.) Royle	shrub					r	
Phyllanthus reticulatus Poir.	shrub				r		
Phyllanthus sp.	herb				r		
Family Poaceae							
Aristida congesta Roem. & Schult. subsp. *barbicollis* (Trin. & Rupr.) De Winter	grass						u
* *Bambusa balcooa* Roxb.	reed			1b	r		r
* *Bambusa multiplex* (Lour.) Raeusch. ex Schult.f.	reed						r
Cynodon dactylon (L.) Pers.	grass				u	r	d
Dactyloctenium aegyptium (L.) Willd.	grass						r
Digitaria eriantha Steud.	grass						f
Eragrostis curvula (Schrad.) Nees	grass				u	f	d
Eragrostis racemosa (Thunb.) Steud.	grass						r
Hemarthria altissima (Poir.) Stapf & C.E.Hubb.	grass				f		
Heteropogon contortus (L.) Roem. & Schult.	grass					r	f
Hyperthelia dissoluta (Nees ex Steud.) Clayton	grass				r		r
Imperata cylindrica (L.) Raeusch.	grass				f	r	r
Ischaemum polystachyum J.Presl	grass				r		
Leersia hexandra Sw.	grass				f		
Melinis repens (Willd.) Zizka subsp. *repens*	grass					u	u
Miscanthus junceus (Stapf) Pilg.	grass				d		
Oplismenus hirtellus (L.) P.Beauv.	grass				r		
Panicum deustum Thunb.	grass				r	u	

ECOREX Consulting Ecologists CC Postnet Suite #192, Private Bag X2 Raslouw 0109 Tel: (012) 6601160 Cell: (083) 231-5632
warren@ecorex.co.za

Panicum maximum Jacq.	grass				u	d	
* *Paspalum urvillei* Steud.	grass				f		
* *Pennisetum clandestinum* Hochst. ex Chiov.	grass				u		
Perotis patens Gand.	grass					r	r
Phragmites australis (Cav.) Trin. ex Steud.	reed				r		
Phragmites mauritianus Kunth	reed				f		
Pogonarthria squarrosa (Roem. & Schult.) Pilg.	grass					r	r
Setaria megaphylla (Steud.) T.Durand & Schinz	grass				u	r	
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss monstr. myuros de Wit	grass					r	r
Sorghum bicolor (L.) Moench	grass				r		
Sporobolus africanus (Poir.) Robyns & Tournay	grass				r	u	f
Sporobolus pyramidalis P.Beauv.	grass				r	f	d
Themeda triandra Forssk.	grass				r	r	r
Urochloa mosambicensis (Hack.) Dandy	grass				f	f	r
Family Polygonaceae							
Persicaria decipiens (R.Br.) K.L.Wilson	herb				r		
Family Primulaceae							
Maesa lanceolata Forssk.	tree				r		
Family Pteridaceae							
Cheilanthes viridis (Forssk.) Sw. var. *viridis*	fern				r	r	
Family Ranunculaceae							
Clematis brachiata Thunb.	climber					r	
Family Rhamnaceae							
Berchemia zeyheri (Sond.) Grubov	tree	MNCA			r	u	
Helinus integrifolius (Lam.) Kuntze	climber				u	r	
Ziziphus mucronata Willd. subsp. *mucronata*	tree				f	f	r
Family Rosaceae							
* *Rubus cuneifolius* Pursh	shrub			1b	u	u	r
Family Rubiaceae							
Afrocanthium mundianum (Cham. & Schltdl.) Lantz	tree					r	
Canthium inerme (L.f.) Kuntze	tree				r	r	
Coddia rudis (E.Mey. ex Harv.) Verdc.	shrub					r	
Cordylostigma virgatum (Willd.) Groeninckx & Dessein	herb					r	
Vangueria infausta Burch. subsp. *infausta*	tree					r	
Family Rutaceae							
Clausena anisata (Willd.) Hook.f. ex Benth. var. *anisata*	shrub				r		

Vepris reflexa I.Verd.	tree				r		
Zanthoxylum capense (Thunb.) Harv.	tree				r	r	
Family Salicaceae							
* *Populus x canescens* (Aiton) Sm.	tree			2	u		
Salix mucronata Thunb.	tree				f		
Trimeria grandifolia (Hochst.) Warb. subsp. *grandifolia*	tree				u		
Family Santalaceae							
Thesium sp.	herb					r	
Family Sapindaceae							
* *Cardiospermum grandiflorum* Sw.	climber			1b	r		
Cardiospermum halicacabum L.	climber				r		
Hippobromus pauciflorus (L.f.) Radlk.	tree				u	u	
Pappea capensis Eckl. & Zeyh.	tree				r		
Family Sapotaceae							
Englerophytum magalismontanum (Sond.) T.D.Penn.	tree				r		
Englerophytum natalense (Sond.) T.D.Penn	tree				u		
Family Sinopteridaceae							
Pellaea calomelanos (Sw.) Link var. *calomelanos*	fern					r	
Family Smilacaceae							
Smilax anceps Willd.	climber				u	u	r
Family Solanaceae							
* *Datura stramonium* L.	herb			1b		r	
* *Physalis angulata* L.	herb					r	u
Solanum campylacanthum A. Rich.subsp. *panduriforme*	dwarf shrub				r	u	u
* *Solanum mauritianum* Scop.	shrub			1b	u	r	r
* *Solanum seaforthianum* Andrews var. *disjunctum* O.E.Schulz	climber			1b	r		
* *Solanum* sp.	herb					r	
Thelypteridaceae							
Thelypteris confluens (Thunb.) C.V. Morton	fern				u		
Family Thymelaeaceae							
Dais cotinifolia L.	shrub				r		
Family Typhaceae							
Typha capensis (Rohrb.) N.E.Br.	rush				u		
Family Verbenaceae							
* *Lantana camara* L.	dwarf shrub			1b	u	f	f

Lippia javanica (Burm.f.) Spreng.	dwarf shrub				u	f	f
Priva cordifolia (L.f.) Druce	herb				r	r	r
* *Verbena bonariensis* L.	herb			1b	r	u	u
* *Verbena rigida* Spreng.				1b			r
Family Vitaceae							
Rhoicissus tomentosa (Lam.) Wild & R.B.Drumm.	climber				u		
Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. *tridentata*	climber				r	u	
TOTAL	**212**	**6**	**1**	**19**	**145**	**116**	**59**

NFA = National Forests Act	d = dominant
MNCA = Mpumalanga Nature Conservation Act	f = frequent
* = exotic species	u = uncommon
CARA = Conservation of Agricultural Resources Act	r = rare

Appendix 2. Checklist of Fauna recorded during fieldwork

Species	Family	Endemic	Assemblages		
			Forest / Thicket	Woodland	Grassland / Degraded
Mammals					
ORDER: RODENTIA					
Family Hystricidae (Old World porcupines)					
Cape Porcupine	*Hystrix africaeaustralis*			x	
ORDER: PRIMATES					
Family Cercopithecidae (Old World monkeys)					
Chacma Baboon	*Papio ursinus*		x	x	
ORDER: CETARTIODACTYLA					
Family Suidae (pigs)					
Bushpig	*Potamochoerus larvatus*		x		
Family Bovidae (cattle & antilopes)					
Grey Duiker	*Sylvicapra grimmea*		x	x	x
Subtotal	4	0	3	3	1
Birds					
ORDER: ANSERIFORMES					
Family Anatidae (ducks, geese and swans)					
Egyptian Goose	*Alopochen aegyptiaca*				x
ORDER: GALLIFORMES					
Family Phasianidae (pheasants, fowl and allies)					
Natal Spurfowl	*Pternistis natalensis*		x		
ORDER: PELECANIFORMES					
Family Threskiornithidae (ibises and spoonbills)					
Hadeda Ibis	*Bostrychia hagedash*		x		
Family Ardeidae (herons and bitterns)					
Western Cattle Egret	*Bubulcus ibis*				x

ORDER: ACCIPITRIFORMES					
Family Accipitridae (kites, hawks & eagles)					
Common Buzzard	Buteo buteo				x
ORDER: GRUIFORMES					
Family Sarothruridae (flufftails)					
Red-chested Flufftail	*Sarothrura rufa*		x		
ORDER: COLUMBIFORMES					
Family Columbidae (pigeons, doves)					
Speckled Pigeon	*Columba guinea*				x
African Green Pigeon	*Treron calvus*		x		
Red-eyed Dove	*Streptopelia semitorquata*		x		
Laughing Dove	*Spilopelia senegalensis*			x	
Tambourine Dove	Turtur tympanistria		x		
ORDER: MUSOPHAGIFORMES					
Family Musophagidae (turacos)					
Knysna Turaco	*Tauraco corythaix*	E	x		
Purple-crested Turaco	*Tauraco porphyreolophus*		x		
ORDER: CUCULIFORMES					
Family Cuculidae (cuckoos)					
Black Cuckoo	*Cuculus clamosus*		x		
Red-chested Cuckoo	*Cuculus solitarius*		x		
Diederik Cuckoo	*Chrysococcyx caprius*			x	x
Klaas's Cuckoo	*Chrysococcyx klaas*			x	
Burchell's Coucal	*Centropus burchellii*				x
ORDER: APODIFORMES					
Family Apodidae (swifts)					
African Palm Swift	*Cypsiurus parvus*		over	over	over
African Black Swift	*Apus barbatus*		over	over	over
Horus Swift	*Apus horus*		over	over	over
Little Swift	*Apus affinis*		over	over	over
ORDER: COLIIFORMES					
Family Coliidae (mousebirds)					
Speckled Mousebird	*Colius striatus*		x	x	
ORDER: TROGONIFORMES					
Family Trogonidae trogons)					
Narina Trogon	*Apaloderma narina*		x		

ORDER: CORACIIFORMES					
Family Alcedinidae (kingfishers)					
Brown-hooded Kingfisher	*Halcyon albiventris*			x	
Family Meropidae (bee-eaters)					
European Bee-eater	*Merops apiaster*				x
ORDER: PICIFORMES					
Family Lybiidae (African barbets)					
Black-collared Barbet	*Lybius torquatus*			x	
Yellow-rumped Tinkerbird	*Pogoniulus bilineatus*		x		
Yellow-fronted Tinkerbird	*Pogoniulus chrysoconus*			x	
Family Indicatoridae (honeyguides)					
Lesser Honeyguide	*Indicator minor*		x		
Scaly-throated Honeyguide	*Indicator variegatus*		x		
Brown-backed Honeybird	*Prodotiscus regulus*			x	
Family Picidae (woodpeckers)					
Golden-tailed Woodpecker	*Campethera abingoni*		x	x	
Bearded Woodpecker	*Chloropicus namaquus*			x	
Cardinal Woodpecker	*Dendropicos fuscescens*			x	
Olive Woodpecker	*Dendropicos griseocephalus*		x		
ORDER: PASSERIFORMES					
Family Malaconotidae (bushshrikes)					
Black-backed Puffback	*Dryoscopus cubla*			x	
Southern Boubou	*Laniarius ferrugineus*		x		
Brubru	*Nilaus afer*			x	
Olive Bushshrike	*Chlorophoneus olivaceus*		x		
Orange-breasted Bushshrike	*Chlorophoneus sulfureopectus*			x	
Grey-headed Bushshrike	*Malaconotus blanchoti*			x	
Gorgeous Bushshrike	*Telophorus viridis*		x		
Southern Tchagra	*Tchagra tchagra*	E	x		
Family Campephagidae (cuckooshrikes)					
Black Cuckooshrike	*Campephaga flava*			x	
Family Platysteiridae (wattle-eyes and batises)					
Cape Batis	*Batis capensis*		x		
Chinspot Batis	*Batis molitor*			x	
Family Oriolidae (figbirds and orioles)					
Black-headed Oriole	*Oriolus larvatus*			x	

Family Dicruridae (drongos)						
Fork-tailed Drongo	*Dicrurus adsimilis*			x		
Family Monarchidae (monarchs)						
African Paradise Flycatcher	*Terpsiphone viridis*		x			
Family Pycnonotidae (bulbuls)						
Dark-capped Bulbul	*Pycnonotus tricolor*		x	x	x	
Sombre Greenbul	*Andropadus importunus*		x			
Family Hirundinidae (swallows and martins)						
Black Saw-wing	*Psalidoprocne pristoptera*		over	over	over	
Lesser Striped Swallow	*Cecropis abyssinica*		over	over	over	
Rock Martin	*Ptyonoprogne fuligula*		over	over	over	
Common House Martin	*Delichon urbicum*		over	over	over	
Family Phylloscopidae (leaf warblers and allies)						
Willow Warbler	*Phylloscopus trochilus*			x		
Family Acrocephalidae (reed warblers and allies)						
Marsh Warbler	*Acrocephalus palustris*		x			
Family Cisticolidae (cisticolas & allies)						
Yellow-breasted Apalis	*Apalis flavida*		x	x		
Bar-throated Apalis	*Apalis thoracica*		x			
Green-backed Camaroptera	*Camaroptera brachyura*		x			
Tawny-flanked Prinia	*Prinia subflava*			x	x	
Lazy Cisticola	*Cisticola aberrans*			x		
Red-faced Cisticola	*Cisticola erythrops*				x	
Neddicky	*Cisticola fulvicapilla*				x	
Family Zosteropidae (white-eyes)						
Cape White-eye	*Zosterops virens*		x	x		
Family Sturnidae (starlings)						
Violet-backed Starling	*Cinnyricinclus leucogaster*			x		
Red-winged Starling	*Onychognathus morio*				x	
Family Turdidae (thrushes)						
Kurrichane Thrush	*Turdus libonyanus*			x		
Groundscraper Thrush	*Turdus litsitsirupa*				x	
Family Muscicapidae (chats & Old World flycatchers)						
Spotted Flycatcher	*Muscicapa striata*			x		
Ashy Flycatcher	*Muscicapa caerulescens*		x			
Southern Black Flycatcher	*Melaenornis pammelaina*		x			

White-browed Scrub Robin	*Erythropygia leucophrys*			x		
Cape Robin-Chat	*Cossypha caffra*		x			
Red-capped Robin-Chat	*Cossypha natalensis*		x			
White-browed Robin-Chat	*Cossypha heuglini*		x			
Family Nectariniidae (sunbirds)						
Amethyst Sunbird	*Chalcomitra amethystina*			x		
Greater Double-collared Sunbird	*Cinnyris afer*	E	x			
White-bellied Sunbird	*Cinnyris talatala*			x		
Family Passeridae (Old World sparrows)						
House Sparrow	*Passer domesticus*				x	
Southern Grey-headed Sparrow	*Passer diffusus*			x		
Family Ploceidae (weavers & widowbirds)						
Thick-billed Weaver	*Amblyospiza albifrons*		x		x	
Southern Masked Weaver	*Ploceus velatus*			x		
Spectacled Weaver	*Ploceus ocularis*		x			
Cape Weaver	*Ploceus capensis*				x	
Village Weaver	*Ploceus cucullatus*			x		
Red-collared Widowbird	*Euplectes ardens*				x	
White-winged Widowbird	*Euplectes albonotatus*				x	
Family Estrildidae (waxbills, mannikins)						
African Firefinch	*Lagonosticta rubricata*		x			
Swee Waxbill	*Coccopygia melanotis*		x			
Common Waxbill	*Estrilda astrild*				x	
Green Twinspot	*Mandingoa nitidula*		x			
Bronze Mannikin	*Lonchura cucullata*			x		
Family Viduidae (indigobirds and whydahs)						
Dusky Indigobird	*Vidua funerea*			x		
Pin-tailed Whydah	*Vidua macroura*				x	
Family Motacillidae (wagtails and pipits)						
Yellow-throated Longclaw	*Macronyx croceus*				x	
Family Fringillidae (finches, canaries & allies)						
Yellow-fronted Canary	*Crithagra mozambica*			x	x	
Brimstone Canary	*Crithagra sulphurata*			x		
Streaky-headed Seedeater	*Crithagra gularis*			x		
Family Emberizidae (buntings and New World sparrows)						
Cinnamon-breasted Bunting	*Emberiza tahapisi*			x		

Golden-breasted Bunting	*Emberiza flaviventris*			x	
Subtotal	102	3	49	49	30
Reptiles					
ORDER: SQUAMATA					
Family Scincidae (skinks)					
Variable Skink	*Trachylepis varia*			x	
Striped Skink	*Trachylepis striata*			x	
Subtotal	2	0	0	2	0
TOTAL	**108**	**3**	**52**	**54**	**31**

E = Endemic

Appendix 3. Curriculum Vitae of Duncan McKenzie

Name: Duncan Robert McKenzie
Profession: Terrestrial Ecologist
Date of Birth: 9 Nov 1977
Name of Firm: ECOREX Consulting Ecologists cc
Position in Firm: Ecologist
Years with firm: 12
Nationality: South African
Qualifications:

• N.Dip. [Nature Conservation]	UNISA, RSA	2007
• N.Cert. [Nature Guiding]	Drumbeat Academy, RSA	2004

Membership in Professional Societies:

- BirdLife South Africa
- Animal Demography Unit, University of Cape Town

Languages :

	Speaking	Reading	Writing
English (home):	Excellent	Excellent	Excellent
Afrikaans:	Good	Good	Good
isiZulu:	Good	Fair	Fair

Countries of Work Experience: Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zimbabwe (Guiding). South Africa, Mozambique, DRC, Mali, Guinea, Lesotho, Tanzania, Swaziland, Sierra Leone (Consulting Ecologist)

OVERVIEW OF EXPERIENCE

- 12 years' experience in specialist species identification, conducting baseline surveys, data analysis and report writing in various biomes in southern Africa, particularly savannah, forest and grassland biomes
- 2 years' experience game reserve management (KwaZulu-Natal)
- 5 years' experience (part time) of wetland delineation and management
- 2 years' experience of plant propagation and use for rehabilitation
- Specialist knowledge of identification of vascular plants
- Specialist knowledge of identification of mammals, birds, reptiles and amphibians
- SABAP2 Regional Co-ordinator: Mpumalanga
- Member of the Kwa-Zulu-Natal Bird Rarities Committee

Employment Record:

2007 - present	ECOREX	Ecologist
2005 - 2006	Iglu (London, UK)	Specialist Travel Agent
1997 - 2005	Duncan McKenzie Bird Tours	Owner, Specialist Guide
2001	KZN Wildlife	District Conservation Officer, Reserve Manager
1999 - 2001	Institute of Natural Resources	Part-time Horticulturalist and Rehabilitation Officer
1997-2001	Mondi Wetlands Project	Part-time Field Assistant and Regional Co-ordinator
1996-1997	Natal Parks Board	Ranger

Appendix 4. Specialists Declaration

10.4 The Specialist

Note: Duplicate this section where there is more than one specialist.

I …Duncan McKenzie…, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that I:

- in terms of the general requirement to be independent (tick which is applicable):

X	other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or

	am not independent, but another EAP that is independent and meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);

- have expertise in conducting specialist work as required, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- will ensure compliance with the EIA Regulations 2014;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;
- will take into account, to the extent possible, the matters listed in regulation **18** of the regulations when preparing the application and any report, plan or document relating to the application;
- will disclose to the proponent or applicant, registered interested and affected parties and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority or the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority (unless access to that information is protected by law, in which case I will indicate that such protected information exists and is only provided to the competent authority);
- declare that all the particulars furnished by me in this form are true and correct;
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist

ECOREX Consulting Ecologists CC

Name of company

20/03/2020

Date

Annexure D: Historical Impact Assessment

Phase 1 Archaeological and Heritage Impact Assessment on the farm Sterkspruit 296 JT in respect of proposed agricultural development, Mpumalanga Province.

Compiled by:

KUDZALA antiquity cc

For **Henwood Environmental Solutions**

Surveyor: Mr JP Celliers

29 May, 2020

I, Jean-Pierre Celliers as authorized representative of Kudzala Antiquity CC , hereby confirm my independence as a specialist and declare that neither I or the Kudzala Antiquity CC have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which I was appointed as Heritage Consultant, other than fair remuneration for work performed on this project.

SIGNATURE: 

Table of Contents

Executive summary

Site name and location: Appoximately 15.5 ha area on the farm Sterkspruit 296 JT, of which suitable areas will be cleared of vegetation for agricultural development.
Purpose of the study: An archaeological and heritage study in order to identify cultural heritage resources in respect of proposed vegetation clearing for the establishment of agricultural activity.

Topographical Maps: 1:50 000 2530 BC (1969, 1984, 2010); 1:250 000 2530 (1942).

EIA Consultant: Henwood Environmental Solutions

Client:

Heritage Consultant: Kudzala Antiquity CC.
Contact person: JP Celliers
E-mail: kudzala@lantic.net

Report date: 29 May 2020

Description and findings:

An Archaeological and Heritage Impact Assessment was undertaken by Kudzala Antiquity CC in respect of the proposed clearing of vegetation for the establishment of orchards on suitable portions of an area of approximately 15,5 hectares on the farm Sterkspruit 296 JT in the Schoemanskloof near Mbombela, Mpumalanga Province. The study was done with the aim of identifying sites which are of heritage significance on the identified project areas and assess their current preservation condition, significance and possible impact of the proposed action. This forms part of legislative requirements as appears in section 38 of the National Heritage Resources Act (Act No. 25 of 1999). This report can be submitted in support of the National Environmental Management Act (Act 25 of 1998).
The survey was conducted on foot and with the aid of a motor vehicle in an effort to locate archaeological remains and historic sites, structures and features. Background historical information including scrutiny of previous heritage surveys of the area formed the baseline against which the survey was conducted. Three sites (RS 1-3) was recorded during the field survey. Site RS 1 consists of a 3 meter long poorly defined stone-packed feature which is possibly either the ruined remains of a dwelling or a heap of stones removed to clear a field for agricultural purposes. The vegetation here is very dense and surface visibility poor. It is recommended that an Archaeologist monitor vegetation clearing activities at this location. The structure is not regarded as being of archaeological or heritage significance (also see section 6, Summary of findings and recommendations). Site RS 2 is an existing building currently used as farm staff quarters. It is not older than 60 years as evidenced by historical maps, therefore not

under the ambit of the Act (25 of 1999). The structure is not regarded as being of archaeological or heritage significance.

Site RS 3 is an existing building which is currently used as a functions venue. It is not older than 60 years as evidenced by historical maps and aerial photos, therefore not under the ambit of the Act.

In terms of section 34 of the National Heritage Resources Act (NHRA, 25 of 1999), no significant buildings or structures were located.

In terms of section 35 of the NHRA, no archaeological sites were located.

In terms of section 36 of the NHRA, no graves or gravesites and burial grounds were located. Due to certain areas of the study area having fairly long grass it is possible that some unmarked graves may have been overlooked during the survey.

A total of six (6) survey orientation locations were documented (SO 1-6) which includes a GPS location and photographs of the landscape at that particular location.

It is not within the expertise of this report or the surveyor to comment on possible palaeontological remains which may be located in the study area.

Disclaimer: *Although all possible care is taken to identify all sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the study. Kudzala Antiquity CC will not be held liable for such oversights or for costs incurred as a result of such oversights.*

Introduction

1.1. Terms of reference

Kudzala Antiquity CC was commissioned to conduct an archaeological and heritage resources survey in respect of proposed vegetation clearing in order to commence with agricultural activities on an 15,5 hectare area of the farm Sterkspruit 296 JT in the Schoemanskloof near Mbombela, Mpumalanga Province. The survey was conducted in order to assess the potential impact that the proposed activity may have on archaeological and heritage resources. The survey was conducted for Henwood Environmental Solutions.

1.1.1 Project overview

The client is in the process of obtaining environmental authorization to clear virgin Legogote Sour Bushveld on an area of approximately 15 hectares for farming purposes. Suitable pieces of land within this identified area is earmarked for this activity pending environmental authorization.

1.1.2. Constraints and limitations

Surface visibility and access was reduced in some portions of the study area due to very dense bush and undergrowth and dense thick grass cover. This limited exploration and surface visibility of portions of the study area.

1.2. Legislative Framework

The National Heritage Resources Act (NHRA) (Act No. 25, 1999) require that individuals or institutions have specialist heritage impact assessment studies undertaken whenever development activities are planned and such activities trigger activities listed in the legislation. This report is the result of an archaeological and heritage study in accordance with the requirements as set out in Section 38 (3) of the NHRA in an effort to ensure that heritage features or sites that qualify as part of the national estate are properly managed and not damaged or destroyed.

The study aims to address the following objectives:

- Analysis of heritage issues;

- Assess the cultural significance of identified places including archaeological sites and features, buildings and structures, graves and burial grounds within a specific historic context;
- Identifying the need for more research;
- Surveying and mapping of identified places including archaeological sites and features, buildings and structures, graves and burial grounds;
- A preliminary assessment of the feasibility of the proposed development or construction from a heritage perspective;
- Identifying the need for alternatives when necessary; and
- Recommending mitigation measures to address any negative impacts on archaeological and heritage resources.

Heritage resources considered to be part of the national estate include those that are of archaeological, cultural or historical significance or have other special value to the present community or future generations.

The national estate may include:

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living
- heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and paleontological sites;
- graves and burial grounds including:
    - (i) ancestral graves;
    - (ii) royal graves and graves of traditional leaders;
    - *(iii)* graves of victims of conflict;
    - (iv) graves of individuals designated by the Minister by notice in the *Gazette;*
    - (v) historical graves and cemeteries; and other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- sites of significance relating to slavery in South Africa;
- movable objects including:

(i) objects recovered from the soil or waters of South Africa, including archaeological and paleontological objects and material, meteorites and rare geological specimens;
(ii) objects to which oral traditions are attached or which are associated with living heritage
(iii) ethnographic art and objects;
(iv) military objects

(v) objects of decorative or fine art;

(vi) objects of scientific or technological interest; and

(vii) books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1 of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

Cultural resources are unique and non-renewable physical phenomena (of natural occurrence or made by humans) that can be associated with human (cultural) activities (Van Vollenhoven 1995:3). These would be any man-made structure, tool, object of art or waste that was left behind on or beneath the soil surface by historic or pre-historic communities. These remains, when studied in their original context by archaeologists, are interpreted in an attempt to understand, identify and reconstruct the activities and lifestyles of past communities. When these items are removed from their original context, any meaningful information they possess is lost, therefore it is important to locate and identify such remains before construction or development activities commence.

1.3. Approach and statutory requirements

The SAHRA Minimum standards of 2007 and 2016 guideline documents, forms the background against which the survey was planned and the report compiled. An Archaeological Impact Assessment (AIA) consists of three phases. This document deals with the first phase. This (phase 1) investigation is aimed at getting an overview of cultural resources in the project area, assigning significance to these resources, assessing the possible impact that the proposed activity may have on these resources, making recommendations pertaining to the management of heritage resources and putting forward mitigation measures where applicable.

When the archaeologist or heritage specialist encounters a situation where the planned project will lead to the destruction or alteration of an archaeological/ heritage site or feature, a second phase investigation is normally recommended. During a phase two investigation mitigation measures are put in place and detailed investigation into the nature of the cultural material is undertaken. Often at this stage, archaeological excavation and detailed mapping of a site is carried out in order to document and preserve the cultural heritage.

Phase three consists of the compiling of a management plan for the safeguarding, conservation, interpretation and utilization of cultural resources (Van Vollenhoven, 2002).

Continuous communication between the developer and heritage specialist after the initial assessment has been carried out may result in the modification of a planned route or development to incorporate or protect existing archaeological and heritage sites.

2. Description of surveyed area

The study area falls within the Mbombela Local Municipality, Mpumalanga Province.
The survey was carried out on a project footprint consisting of approximately 15 hectares of Legogote Sour Bushveld vegetation which, in some portions of the study area, limits surface visibility making it difficult to see or find archaeological and heritage sites and features.

Veld type: The vegetation forms part of the Savanna Biome and classed as Legogote Sour Bushveld. This veld type occurs in Mpumalanga and Limpopo Provinces on the lower eastern slopes and hills or the north-eastern escarpment from Mariepskop in the north through White River to the Nelspruit area and extending westwards up valleys of the Crocodile, Elands and Houtbosloop Rivers and terminating in the south in the Barberton area. Altitude is 600-1000 m and sometimes higher. The landscape is characterised by gently to moderately upper pediment slopes with dense woodland including many medium to large shrubs, short thicket occurs on less rocky sites (Mucina and Rutherford, 2009).

Geology and soils: The larger part of the area is underlain by gneiss and migmatite of the Nelspruit Suite but the southern part occurs on the potassium-poor rocks of the Kaap Valley Tonalite. Pretoria Group shale and quartzite occur in the westernmost areas. Archaean granite plains with granite inselbergs and large granite boulders also occur (Mucina and Rutherford, 2009).

Limiting factors: As mentioned under Constraints and Limitations above, in some parts of the project areas dense undergrowth and impenetrable thicket limited the exploration of certain areas.

3. Methodology

This study consists of a detailed archival study in order to understand the study area in a historical timeframe, an archaeological background study which include scrutiny of previous archaeological reports of the area, obtained through the SAHRIS database, and published as well as unpublished written sources on the archaeology of the area, social consultation with people who live nearby and a lastly a physical survey of the affected and immediate area.

The South African Heritage Resources Agency (SAHRA) and the relevant legislation (NHRA) require that the following components be included in an archaeological impact assessment:

- Archaeology;
- Shipwrecks;
- Battlefields;

- Graves;
- Structures older than 60 years;
- Living heritage;
- Historical settlements;
- Landscapes;
- Geological sites; and
- Paleontological sites and objects.

All the above-mentioned heritage components are addressed in this report, except shipwrecks, geological sites and paleontological sites and objects.

The ***purpose*** of the archaeological, archival and heritage study is to establish the whereabouts and nature of cultural heritage sites should they occur on project area. This includes settlements, structures and artefacts which have value for an individual or group of people in terms of historical, archaeological, architectural and human (cultural) development.

The ***aim*** of this study is to locate and identify such objects or places in order to assess and rate their significance and establish if further investigation is needed. Mitigation measures can then be suggested and put in place when necessary.

3.1. Archaeological and Archival background studies

The purpose of the desktop study is to compile as much information as possible on the heritage resources of the area. This helps to provide an historical context for located sites. Sources used for this study include published and unpublished documents, archival material and maps. Information obtained from the following institutions or individuals were consulted:

- Published and unpublished archaeological reports and articles;
- Published and unpublished historical reports and articles;
- Archival documents from the National Archives in Pretoria;
- Historical maps; and
- South African Heritage Resource Information System (SAHRIS) database.

3.1.1. Previous archaeological studies in the area

Some archaeological impact assessments (AIA's) and heritage impact assessments have been done in the vicinity of the proposed development area.

In 2007 Mr JA van Schalkwyk conducted a “Heritage Impact and scoping report for the planned Hendrina-Marathon Powerline, Mpumalanga Province”. He identified a range of cultural heritage sites including initiation sites, industrial and farming related sites and cemeteries.

In 2008 Mr JP Celliers conducted an “Archaeological Impact Assessment for the proposed development on Portion 3 of the farm Geluk 299 JT, and Portions 6, 35, 35 and 68 of the farm Rietvly 295 JT in Schoemanskloof”. In this study a total of eleven heritage sites were located ranging from formal graveyards to stone-walled enclosures and terraces associated with the BaKoni (1650’s-1820’s) and some historical ruins.

In 2017 Mr JP Celliers conducted a “Phase 1 Archaeological and Heritage Impact Assessment on the farm Bruintjieslaagte 465 JT in respect of the proposed construction of an irrigation dam, Mpumalanga Province”. A number of LIA stone-walled sites and features, associated with BaKoni occupation, were recorded.

3.1.2. Historic maps

Historical maps were scrutinized and features that were regarded as important in terms of heritage value were identified and if they were located within the boundaries of the project area they were physically visited in an effort to determine:

(i) whether they still exist;
(ii) their current condition; and
(iii) significance.

3.1.3. Physical survey

- The survey of the proposed dam location was conducted on 6 May 2020
- The survey took one day to complete.
- The documented sites were numbered sequentially.
- Sites were recorded by using a handheld Garmin Oregon 450 GPS unit and the unit was given time to reach an accuracy of at least 5 metres.
- Sites were plotted on 1:50 000 topographical maps which are geo-referenced (WGS 84) and also on Google Earth.
- Three sites were documented and numbered RS 1-3. A number of survey orientation sites were mapped for survey purposes.

3.2. Social Consultation

Social consultation forms an important part of identifying sites which may be of heritage significance. Farm owner Mr Francois Rall was consulted about the presence of heritage sites within the project area and he stated that to his knowledge there are no heritage sites or graves present within the proposed project area.

3.3. Heritage site significance

The South African Heritage Resources Agency (SAHRA) formulated guidelines for the conservation of all cultural resources (sections 6 and 7 of the NHRA, 1999) and therefore also divided such sites into three main categories. These categories might be seen as guidelines that suggest the extent of protection a given site might receive. They include sites or features of local (Grade 3) provincial (Grade 2) national (Grade 1) significance, grades of *local significance* and *generally protected* sites with a variety of degrees of significance.

For practical purposes the surveyor uses his own classification for sites or features and divides them into three groups, those of low or no significance, those of medium significance and those of high significance **(*Also see table 5.2.Significance rating guidelines for sites*).**

Values used to assign significance and impact characteristics to a site include:

- **Types of significance**

The site's scientific, aesthetic and historic significance or a combination of these is established.

- **Degrees of significance**

The archaeological or historic site's rarity and representative value is considered. The condition of the site is also an important consideration.

- **Spheres of significance**

Sites are categorized as being significant in the international, national, provincial, regional or local context. Significance of a site for a specific community is also taken into consideration.

To arrive at the specific allocation of significance of a site or feature, the specialist considers the following:

- Historic context;
- Archaeological context or scientific value;

- Social value;
- Aesthetic value; and
- Research value.

More specific criteria used by the specialist in order to allocate value or significance to a site include:

- The unique nature of a site;
- The integrity of the archaeological deposit;
- The wider historic, archaeological and geographic context of the site;
- The location of the site in relation to other similar sites or features;
- The depth of the archaeological deposit (when it can be determined or is known);
- The preservation condition of the site;
- Quality of the archaeological or historic material of the site; and
- Quantity of sites and site features.

Archaeological and historic sites containing data, which may significantly enhance the knowledge that archaeologists currently have about our cultural heritage, should be considered highly valuable. In all instances these sites should be preserved and not damaged during construction activities. However, when development activities jeopardize the future of such a site, a second and third phase in the Cultural Resource Management (CRM) process is normally advised. This entails the excavation or rescue excavation of cultural material, along with a management plan to be drafted for the preservation of the site or sites.

Graves are considered very sensitive sites and should never under any circumstances be jeopardized by development activities. Graves and burial grounds are incorporated in the NHRA under section 36 and in all instances where graves are found by the surveyor, the recommendation would be to steer clear of these areas. If this is not possible or if construction activities have for some reason damaged graves, specialized consultants are normally contacted to aid in the process of exhumation and re-interment of the human remains.

4. History and Archaeology

4.1. Historic period

4.1.1. Early History

In Southern Africa the domestication of the environment began only a couple of thousands of years ago, when agriculture and herding were introduced. At some time during the last half of the first millennium BC, people living in the region where Botswana, Zambia and Angola are today, started moving southward, until they reached the Highveld and the Cape in the area of modern South Africa. As time passed and the sub-continent became fully settled, these agro-pastoralists, who spoke Bantu languages, started dominating all those areas which were ecologically suitable for their way of life. This included roughly the eastern half of modern South Africa, the eastern fringe of Botswana and the north of Namibia. Historians agree that the earliest Africans to inhabit in the Lowveld in Mpumalanga were of Sotho, or more particularly Koni-origin.

Up until the 1930s, malaria would have occurred sporadically in the study area during the rainy season. During the first half of the nineteenth century, Tsetse flies also thrived in this area. Pastoralists would have avoided the moist low-lying valleys and thickly wooded regions where these insects preferred to congregate. It is unlikely that populations would be dense in areas where malaria and the “sleeping sickness” transferred by Tsetse flies was a constant threat to humans and their stock (Bergh 1999: 3; Shillington 1995: 32).

In a few decades, the course of history in the old Transvaal province would change forever. The Difaqane (Sotho), or Mfekane (“the crushing” in Nguni) was a time of bloody upheavals in Natal and on the Highveld, which occurred around the early 1820s until the late 1830s. It came about in response to heightened competition for land and trade, and caused population groups like gun-carrying Griquas and Shaka’s Zulus to attack other tribes.

During the time of the Difaqane, a northwards migration of white settlers from the Cape was also taking place. Some travellers, missionaries and adventurers had gone on expeditions to the northern areas in South Africa – some as early as the 1720’s. One such an adventurer was Robert Schoon, who formed part of a group of Scottish travellers and traders who had travelled the northern provinces of South Africa in the late 1820s and early 1830s. Schoon had gone on two long expeditions in the late 1820’s and once again ventured eastward and northward of Pretoria in 1836 (Bergh, 1999: 13, 116-121).

By the late 1820s, a mass-movement of Dutch speaking people in the Cape Colony started advancing into the northern areas. This was due to feelings of mounting dissatisfaction caused by economical and other circumstances in the Cape. This movement later became known as the Great Trek. This migration resulted in a massive increase in the numbers of people of European descent.

As can be expected, the movement of whites into the Northern provinces would have a significant impact on the local farmer – herders who populated the land.

By 1860, the population of Europeans in the central Transvaal was already very dense and the administrative machinery of their leaders was firmly in place. Many of the policies that would later be entrenched as legislation during the period of apartheid had already been developed (Ross 2002: 39; Bergh, 1999: 170).

However, relations were at times also interdependent in nature. After the Great Trek, when European farmers had settled at various areas in the northern provinces, wealthier individuals were often willing to lodge needy white families on their property in exchange for odd jobs and commando service. These “bywoners” often arrived with a family and a few cows. He would till the soil and pay a minimal rent to the farmer from the crops he grew. The farmer did not consider him a labourer, but mostly kept native workers for hard labour on the farm.

The discovery of gold in South Africa had a major impact in the region. In 1873 gold was discovered in Pilgrims Rest, 80 kilometres north of Nelspruit. This drew scores of prospectors into the region. The establishment of Barberton in 1884, after the discovery of the Sheba gold reef, also brought about greater activity in the area. The Nelspruit settlement first received official recognition in August 1884 (South African History Online 2013).

A large Homeland was located a small distance to the east of Nelspruit, and later became known as Kangwane. This area was proclaimed by the Land Act of 1936. In the Surplus People Project Report, the forced removal of people to the Kangwane area, or homeland, is discussed. According to this source the area could be regarded as a “dumping ground” allocated to South Africa’s Swazis, consisting of two blocks of land. The first of these, the Nsikazi reserve, was a finger of land stretching along the western boundary of the Kruger National Park, and had been under black occupation for over 50 years. The second block was adjacent to the western and northern boundaries of Swaziland, and consisted of the Nkomazi and Mswati/Mlondozi reserves released under the 1935 Land Act. (Bergh 1999: 42; Surplus people project 1983: 59)

4.1.2. The Voortrekkers

The Groot Trek of the Voortrekkers started with the Tregardt- van Rensburg trek in 1835. The two men met where Tregardt and his followers crossed the Orange River at Buffelsvlei (Aliwal North). Here van Rensburg joined the trek northwards. On August 23, 1837 the Tregardt trek left for Delagoabay from the Soutpansberg. They travelled eastwards alongside the Olifants River to the eastern foothills of the Drakensberg. From here they travelled through the Lowveld and the current Kruger National Park where they eventually crossed the Lebombo mountains in March 1838. They reached the Fortification at Lourenço Marques on 13 April 1838 (Bergh, 1998:124-125).

Permanent European (Voortrekker) settlement of the eastern areas of Mpumalanga can be traced back to a commission under the leadership of A.H. (Hendrik) Potgieter who negotiated with the Portuguese Governor at Delagoabaai in 1844 for land. It was agreed that these settlers could settle in an area that was four days journey from the east coast of Africa between the 10˚ and 26˚ south latitudes. Voortrekkers started migrating into the area in 1845. Andries-Ohrigstad was the first town established in this area in July 1845 after the Voortrekkers successfully negotiated for land with the Pedi Chief Sekwati. Farms were given out as far west as the Olifants River. The western boundary was not officially defined but at a Volksraad meeting in 1849 it was decided that the Elands River would be the boundary between the districts of Potchefstroom and Lydenburg as this eastern portion of the Transvaal was then known (Bergh, 1998).

Due to internal strife and differences between the various Voortrekker groups that settled in the broader Transvaal region, the settlers in the Ohrigstad area now governed from the town of Lydenburg decided to secede from the Transvaal Republic in 1856. The Republic of Lydenburg laid claim to a large area that included not only the land originally obtained from the Pedi Chief Sekwati in 1849 but also other areas of land negotiated for from the Swazis. The Republic of Lydenburg was a vast area and stretched from the northern Strydpoort mountains to Wakkerstroom in the south and Bronkhortsspruit in the west to the Swazi border and the Lebombo mountains east.

As can be expected, the migration of Europeans into the north would have a significant impact on the indigenous people who populated the land. This was also the case in Mpumalanga. In 1839 Mswati succeeded Sobhuza (also known as Somhlomo) as king of the Swazi. Threatened by the ambitions of his half brothers, including Malambule, who had support from the Zulu king Mpande, he turned to the Ohrigstad Boers for protection. He claimed that the land that the Boers had settled on was Swazi property. The Commandant General of the Ohrigstad settlement, Andries Hendrik Potgieter, responded that the land was ceded to him by the Pedi leader Sekwati, in return for protection of the Pedi from Swazi attacks (Giliomee, 2003).

However, in reaction to the increasingly authoritarian way in which Potgieter conducted affairs at Ohrigstad, the Volksraad of Ohrigstad saw Mswati's offer as a means to obtain more respectable title deeds for the property (Bonner, 1978). According to a sales contract set up between the Afrikaners and the Swazi people on 25 July 1846, the whites were the rightful owners of the land that had its southern border at the Crocodile River, which stretched out in a westerly direction up to Elandspruit; of which the eastern border was where the Crocodile and Komati rivers joined and then extended up to Delagoa bay in the north (Van Rooyen, 1951). The Europeans bought the land for a 100 heads of cattle (Huyser).

4.1.3. History of the Anglo Boer War (1899-1902) in the area

The discovery of diamonds and gold in the Northern provinces had very important consequences for South Africa. After the discovery of these resources, the British, who at the time had colonized the Cape and Natal, had intensions of expanding their territory into the northern Boer republics. This eventually led to the Anglo-Boer War, which took place between 1899 and 1902 in South Africa, and which was one of the most turbulent times in South Africa's history.

Even before the outbreak of war in October 1899 British politicians, including Sir Alfred Milner and Mr. Chamberlain, had declared that should Britain's differences with the Z.A.R. result in violence, it would mean the end of republican independence. This decision was not immediately publicised, and as a consequence republican leaders based their assessment of British intentions on the more moderate public utterances of British leaders. Consequently, in March 1900, they asked Lord Salisbury to agree to peace on the basis of the status quo ante bellum. Salisbury's reply was, however, a clear statement of British war aims (Du Preez, 1977).

During the British advance between February to September 1900, Lord Roberts replaced Genl. Buller as the supreme commander and applied a different tactic in confronting the Boer forces instead of a frontal attack approach he opted to encircle the enemy. This proved successful and resulted for instance in the surrender of Genl. Piet Cronje and 4000 burghers at Paardeberg on 27 February 1900.

This was the start of a number of victories for the British and shortly after they occupied Pretoria on 5 June 1900, a skirmish at Diamond Hill resulted in the Boer forces under command of Louis Botha, retreated alongside the Delagoa Bay railway to the east. Between the 21-27 August, Botha and 5000 burghers defended their line at Bergendal but were overwhelmed by superior numbers and artillery. This resulted in the Boer forces retreating even further east and three weeks later the British reached Komatipoort and thus the whole of the Eastern Transvaal south of the Delagoa Bay railway line was now occupied by British Forces.

General Louis Botha, with his Boer forces, marched through Nelspruit on 11 September 1900. A week later, on 18 September 1900, the British battalion of Lieutenant General F. Roberts arrived in Nelspruit. No major skirmishes in the war took place near Nelspruit, but a concentration camp for black people was established a small distance to the north of the town. Another event of import in the area was the arrival of the President of the Transvaal, Paul Kruger, in Nelspruit on 29 May 1900, where he received a message saying Lord Roberts had annexed the Transvaal. Kruger declared the annexation illegitimate on 3 September 1900, the same day that Nelspruit was proclaimed as the administrative capital of the Transvaal Republic. Kruger left Nelspruit in June of that year in order to board a ship to Swaziland (Bergh, 1999: 51; 54).

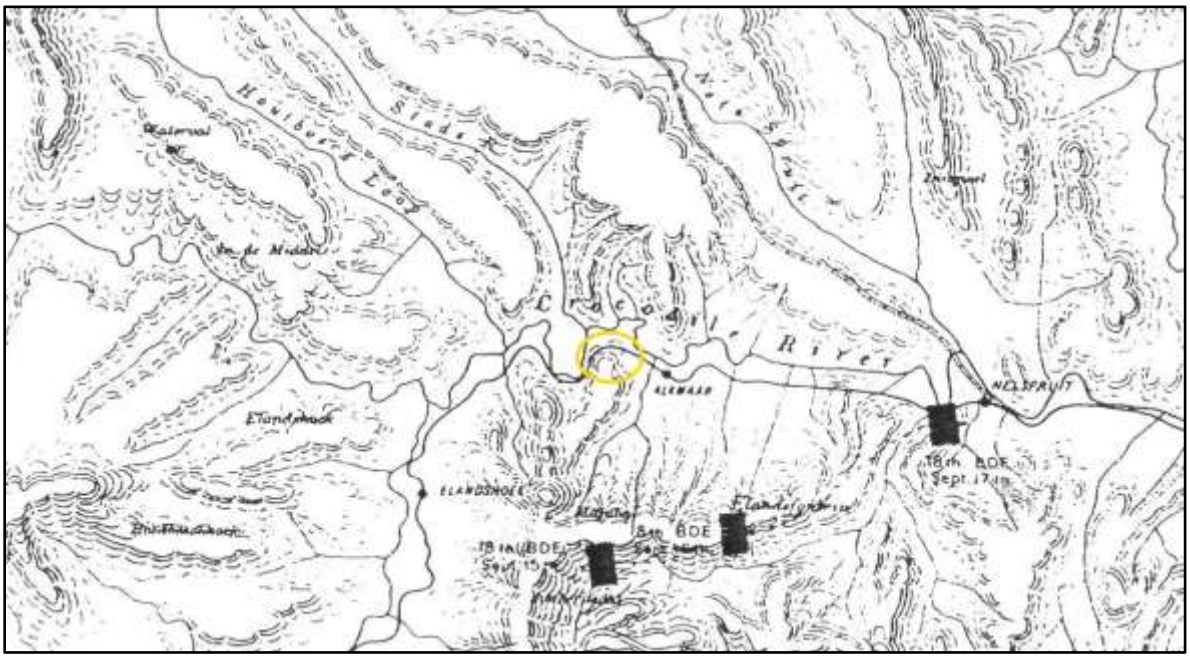


Fig. 4.1. Anglo Boer War map showing "The second stage of the combined advance on Koomati Poort, Sept. 3rd -24th 1900. The approximate location of the study area is encircled in yellow.

During the Battle of Helvetia, ZAR forces succeeded in capturing "The Lady Roberts" British naval gun after an attack on enemy fortifications located at Helvetia between Lydenburg and Machadodorp on 28 December 1900. It was the only gun captured during the War and later destroyed by the ZAR forces to prevent the British claiming it back. The largest portions of the gun are at the National Museum in Pretoria but an inscribed piece which comes from the breech of the gun is part of the Lydenburg Museum collection.

4.1.4. Historic maps of the study area

Since the mid-1800s up until the present, South Africa has been divided and re-divided into various districts. Since 1845, Nelspruit and the farms to the west thereof, including the property under investigation, formed part of the Lydenburg district. This remained the case up until 1902, when the Barberton district was proclaimed. The farm area fell under the jurisdiction of the White River ward in the Barberton district. In 1930 the Nelspruit district was proclaimed and in 1977 the area was reclassified as the Nelspruit magisterial district. By 1994 the farm area was still located within this district (Bergh,1999: 17, 20-27).

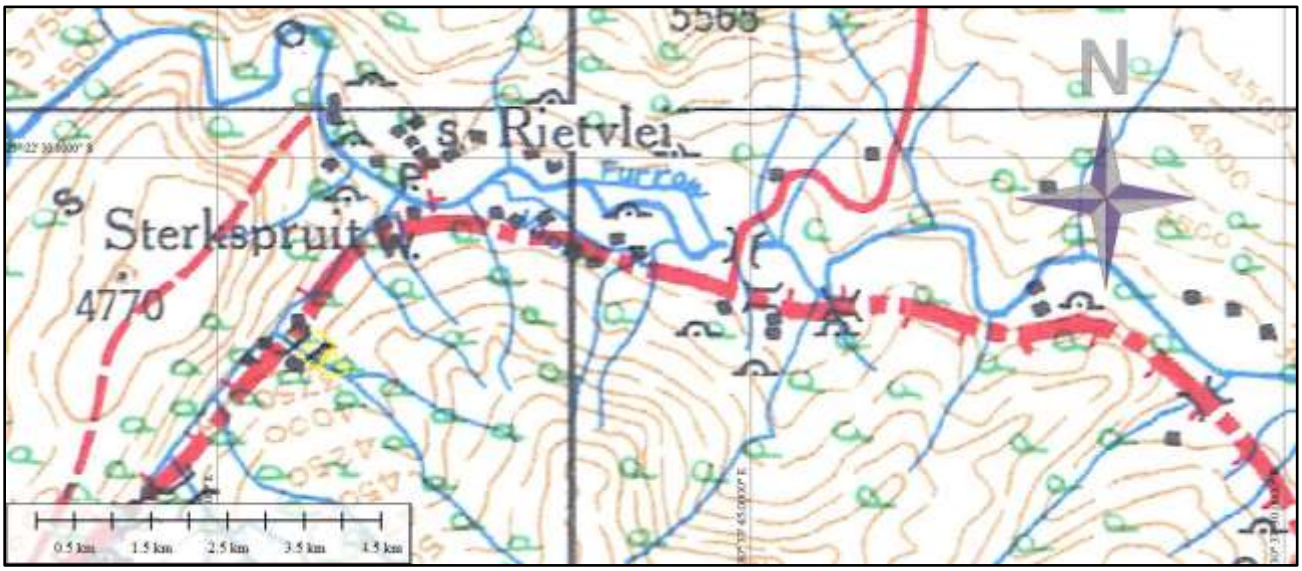


Fig. 4.2. A topographical Map with scale 1:250 000, dated 1942. The study area is indicated with a yellow border. A house or building is indicated to the south-west and the Sterkspruit flows past the property to the north-west (Topographical Map, 1942).

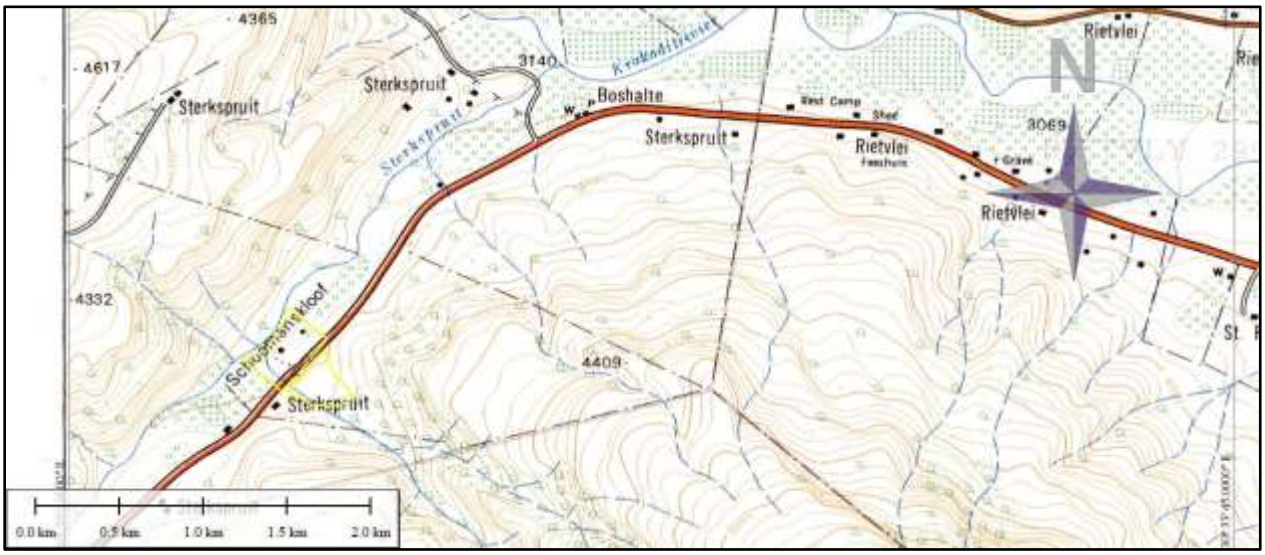


Fig. 4.3. A topographical Map with scale 1:50 000 (2530 BC) dated 1969. The study area is indicated with a yellow border. Two buildings are indicated in the north-western part of the study area. The National Road (N4) passes through the property.

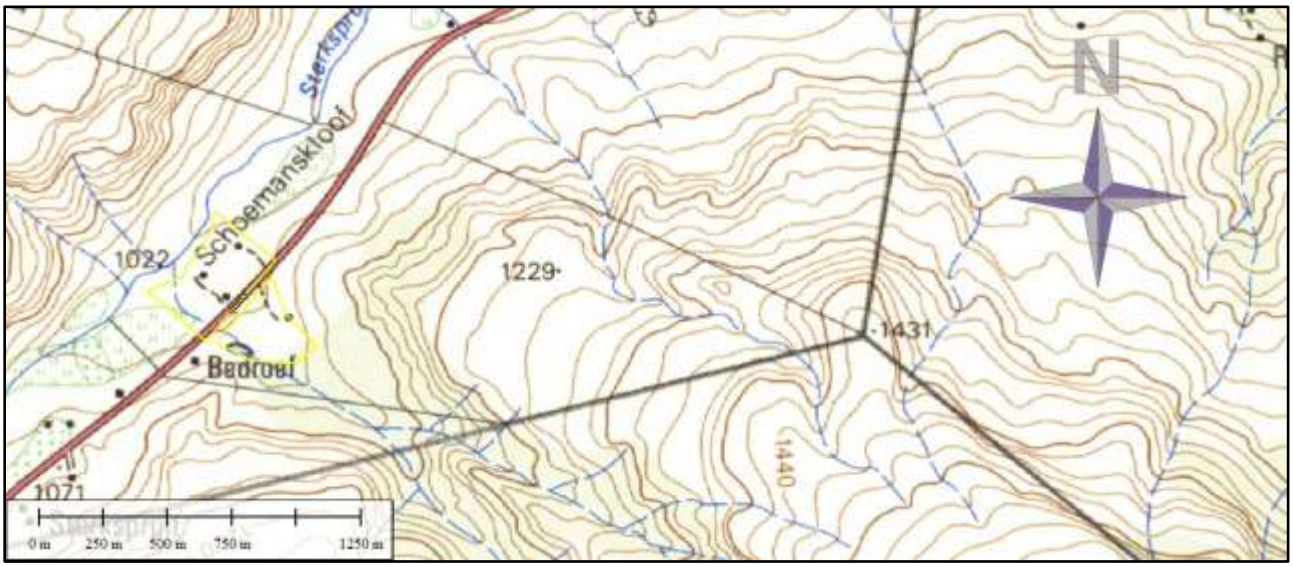


Fig. 4.4. A topographical Map with scale 1:50 000 (2530 BC) dated 1984. The study area is indicated with a yellow border. Three buildings are indicated in the north-western part of the study area. The easternmost one near the road was recorded as site RS 2. The others were probably demolished after 1984. The National Road (N4) passes through the property.

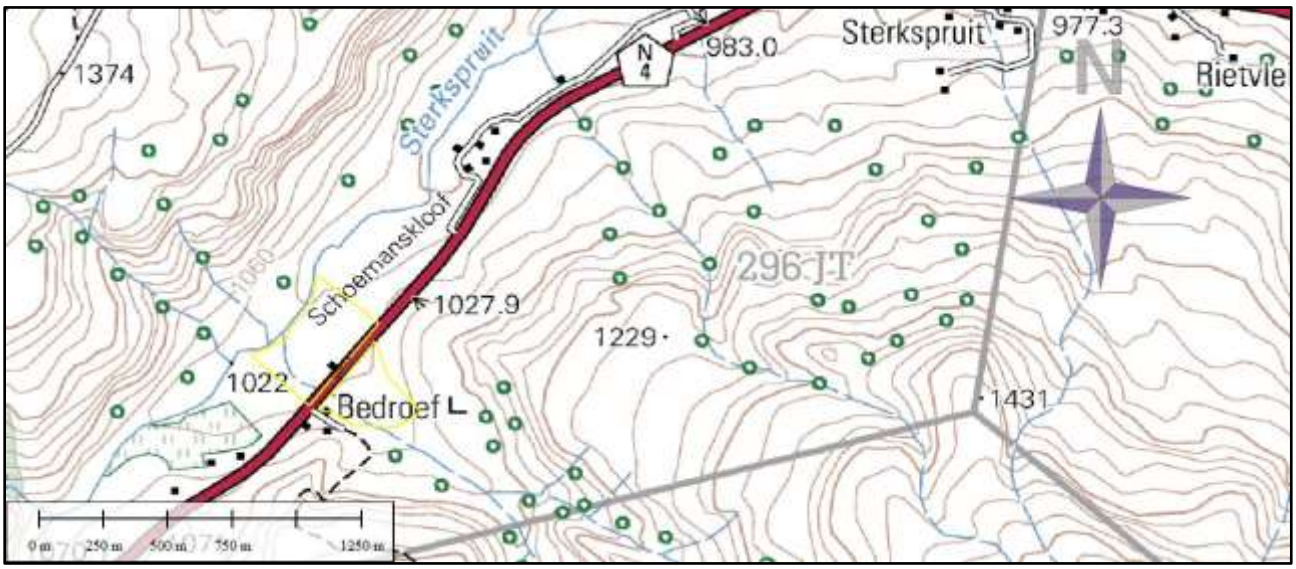


Fig. 4.5. A topographical Map with scale 1:50 000 (2530 BC) dated 2010. The study area is indicated with a yellow border. A single building is indicated in the north-western part of the study area. This building was recorded during the physical survey as site RS 2. The National Road (N4) passes through the property.

Fig. 4.6. An aerial view, Google Earth image, of the study area and located sites in 2012. The black arrow shows that the building recorded at site RS 3 have not been built yet.

Fig. 4.7. An aerial view, Google Earth image, of the study area and located sites in 2013. The black arrow shows that the building recorded at site RS 3 have been built. This building is 7 years old now.

4.2. Archaeology

4.2.1. Stone Age

In Mpumalanga Province the Drakensberg separates the interior plateau also known as the Highveld from the low-lying subtropical Lowveld, which stretches to the Indian Ocean. A number of rivers amalgamate into two main river systems, the Olifants River and the Komati River. This fertile landscape has provided resources for humans and their predecessors for more than 1.7 million years (Esterhuizen & Smith in Delius, 2007).

The initial attraction of abundant foods in the form of animals and plants eventually also led to the discovery of and utilisation of various minerals including ochre, iron and copper. People also obtained foreign resources by means of trade from the coast. From 900 AD this included objects brought across the ocean from foreign shores.

The Early Stone Age (ESA)

In South Africa the ESA dates from about 2 million to 250 000 years ago, in other words from the early to middle Pleistocene. The archaeological record shows that as the early ancestors progressed physically, mentally and socially, bone and stone tools were developed. One of the most influential advances was their control of fire and diversifying their diet by exploitation of the natural environment (Esterhuizen & Smith in Delius, 2007).

The earliest tools used by 19odellin date to around 2.5 million years ago from the site of Gona in Ethiopia. Stone tools from this site shows that early hominids had to cognitive ability to select raw material and shape it for a specific application. Many bones found in association with stone tools like these have cut marks which lead scientists to believe that early hominids purposefully chipped cobblestones to produce flakes with a sharp edge capable of cutting and butchering animal carcasses. This supplementary diet of higher protein quantities ensured that brain development of hominids took place more rapidly.

Mary Leaky discovered stone tools like these in the Olduwai Gorge in Tanzania during the 1960s. The stone tools are named after this gorge and are known as relics from the Oldowan industry. These tools, only found in Africa, are mainly simple flakes, which were struck from cobbles. This method of manufacture remained for about 1.5 million years. Although there is continuing debate about who made these tools, two hominids may have been responsible. The first of these was an early form of *Homo* and the second was *Paranthropus robustus*, which became extinct about 1 million years ago (Esterhuizen & Smith in Delius, 2007).

Some time later, around 1.7 million years ago, more specialised tools known as Acheulean tools, appeared. These are named after tools from a site in France by the name of Saint Acheul, where they were first discovered in the 1800s. It is argued that these tools had their origin in Africa and then spread towards Europe and Asia with the movement of hominids out of Africa. These tools had longer and sharper edges and shapes, which suggest that they could be used for a larger range of activities, including the butchering of animals, chopping of wood, digging roots and cracking bone. *Homo ergaster* was probably responsible for the manufacture of Acheulean tools in South Africa. This physical type was arguably physically similar to modern humans, had a larger brain and modern face, body height and proportion very similar to modern humans. *Homo ergaster* was able to flourish in a variety of habitats in part because they were dependent on tools. They adapted to drier, more open grassland settings. Because these early people were often associated with water sources such as rivers and lakes, sites where they left evidence of their occupation are very rare. Most tools of these people have been washed into caves, eroded out of riverbanks and washed downriver. An example in Mpumalanga is Maleoskop on the farm Rietkloof where Early Stone Age (ESA) tools have been found. This is one of only a handful such sites in Mpumalanga.

Middle Stone Age (MSA)

A greater variety of tools with diverse sizes and shapes appeared by 250 000 before present (BP). These replaced the large hand axes and cleavers of the ESA. This technological advancement introduces the Middle Stone Age (MSA). This period is characterised by tools that are smaller in size but different in manufacturing technique (Esterhuizen & Smith in Delius, 2007).

In contrast to the ESA technology of removing flakes from a core, MSA tools were flakes to start with. They were of a predetermined size and shape and were made by preparing a core of suitable material and striking off the flake so that it was flaked according to a shape which the toolmaker desired. Elongated, parallel-sided blades, as well as triangular flakes are common finds in these assemblages. Mounting of stone tools onto wood or bone to produce spears, knives and axes became popular during the MSA. These early humans not only settled close to water sources but also occupied caves and shelters. The MSA represents the transition of more archaic physical type (*Homo)* to anatomically modern humans, *Homo sapiens.*

The MSA has not been extensively studied in Mpumalanga but evidence of this period has been excavated at Bushman Rock Shelter, a well-known site on the farm Klipfonteinhoek in the Ohrigstad district. This cave was excavated twice in the 1960s by Louw and later by Eloff. The MSA layers show that the cave was repeatedly visited over a long period. Lower layers have been dated to over 40 000 BP while the top layers date to approximately 27 000 BP (Esterhuizen & Smith in Delius, 2007; Bergh, 1998).

Later Stone Age (LSA)

Early hunter gatherer societies were responsible for a number of technological innovations and social transformations during this period starting at around 20 000 years BP. Hunting of animals proved more successful with the innovation of the bow and link-shaft arrow. These arrows were made up of a bone tip which was poisoned and loosely linked to the main shaft of the arrow. Upon impact, the tip and shaft separated leaving the poisoned arrow-tip imbedded in the prey animal. Additional innovations include bored stones used as digging stick weights to uproot tubers and roots; small stone tools, mostly less than 25mm long, used for cutting of meat and scraping of hides; polished bone tools such as needles; twine made from plant fibres and leather; tortoiseshell bowls; ostrich eggshell beads; as well as other ornaments and artwork (Esterhuizen & Smith in Delius, 2007).

At Bushman Rock Shelter the MSA is also represented and starts at around 12 000 BP but only lasted for some 3 000 years. The LSA is of importance in geological terms as it marks the transition from the Pleistocene to the Holocene, which was accompanied by a gradual shift from cooler to warmer temperatures. This change had its greatest influence on the higher-lying areas of South Africa. Both Bushman Rock Shelter and a nearby site, Heuningneskrans, have revealed a greater use in plant foods and fruit during this period (Esterhuizen & Smith in Delius, 2007; Bergh, 1998).

Faunal evidence suggests that LSA hunter-gatherers trapped and hunted zebra, warthog and bovids of various sizes. They also diversified their protein diet by gathering tortoises and land snails *(Achatina*) in large quantities.

Ostrich eggshell beads were found in most of the levels at these two sites. It appears that there is a gap of approximately 4 000 years in the Mpumalanga LSA record between 9 000 BP and 5 000 BP. This may be a result of generally little Stone Age research being conducted in the province. It is, however, also a period known for rapid warming and major climate fluctuation, which may have led people to seek out protected environments in this area. The Mpumalanga Stone Age sequence is visible again during the mid-Holocene at the farm Honingklip near Badplaas in the Carolina district (Esterhuizen & Smith in Delius, 2007; Bergh, 1998).

At this location, two LSA sites were located on opposite sides of the Nhlazatshe River, about one kilometre west of its confluence with the Teespruit. These two sites are located on the foothills of the Drakensberg, where the climate is warmer than the Highveld but also cooler than the Lowveld (Esterhuizen & Smith in Delius, 2007; Bergh, 1998).

Nearby the sites, dated to between 4 870 BP and 200 BP are four panels, which contain rock art. Colouring material is present in all the excavated layers of the site, which makes it difficult to determine whether the rock art was painted during the mid- or later Holocene. Stone walls at both

sites date from the last 250 years of hunter gatherer occupation and they may have served as protection from predators and intruders (Esterhuizen & Smith in Delius, 2007; Bergh, 1998).

4.2.2. Early Iron Age

The period referred to as the Early Iron Age (AD 200-1500 approx.) started when presumably Karanga (north-east African) herder groups moved into the north eastern parts of South Africa. It is believed that these people may have been responsible for making of the famous Lydenburg Heads, ceramic masks dating to approximately 600AD.

Ludwig von Bezing was a boy of more or less 10 years of age when he first saw pieces of the now famous Lydenburg heads in 1957 while playing in the veld on his father's farm near Lydenburg. Five years later von Bezing developed an interest in archaeology and went back to where he first saw the shards. Between 1962 and 1966 he frequently visited the Sterkspruit valley to collect pieces of the seven clay heads. Von Bezing joined the archaeological club of the University of Cape Town when he studied medicine at this institution.

He took his finds to the university at the insistence of the club. He had not only found the heads, but potsherds, iron beads, copper beads, ostrich eggshell beads, pieces of bones and millstones. Archaeologists of the University of Cape Town and WITS Prof. Ray Innskeep and Dr Mike Evers excavated the site where von Bezing found the remains. This site and in particular its unique finds (heads, clay masks) instantly became internationally famous and was henceforth known as the Lydenburg Heads site.

Two of the clay masks are large enough to probably fit over the head of a child, the other five are approximately half that size. The masks have both human and animal features, a characteristic that may explain that they had symbolic use during initiation- and other religious ceremonies. Carbon dating proved that the heads date to approximately 600 AD and was made by Early Iron Age people. These people were Bantu herders and agriculturists and probably populated Southern Africa from areas north-east of the Limpopo river. Similar ceramics were later found in the Gustav Klingbiel Nature Reserve and researchers believe that they are related to the ceramic wares (pottery) of the Lydenburg Heads site in form, function and decorative motive. This sequence of pottery is formally known as the Klingbiel type pottery. No clay masks were found in a context similar to this pottery sequence.

Two larger heads and five smaller ones make up the Lydenburg find. The Lydenburg heads are made of the same clay used in making household pottery. It is also made with the same technique used in the manufacture of household pottery. The smaller heads display the 22odelling of a curved forehead and the back neck as it curves into the skull. Around the neck of each of the heads, two or three rings are engraved horizontally and are filled in with hatching marks to form a pattern. A ridge

of clay over the forehead and above the ears indicates the hairline. On the two larger heads a few rows of small clay balls indicate hair decorations. The mouth consists of lips – the smaller heads also have teeth. The seventh head has the snout of an animal and is the only head that represents an animal.

Some archaeological research was done during the 1970's at sites belonging to the Early Iron Age (EIA), location Plaston, a settlement close to White River (Evers, 1977). This site is located on a spur between the White River and a small tributary. It is situated on holding 119 at Plaston.

The site was discovered during house building operations when a collection of pottery sherds was excavated. The finds consisted of pottery shards both on the surface and excavated.

Some of the pottery vessels were decorated with a red ochre wash. Two major decoration motifs occurred on the pots:

- Punctuation, using a single stylus; and
- Broad line incision, the more common motif.

A number of EIA pottery collections from Mpumalanga and Limpopo may be compared to the Plaston sample. They include Silver Leaves, Eiland, Matola, Klingbiel and the Lydenburg Heads site. The Plaston sample is distinguished from samples of these sites in terms of rim morphology, the majority of rims from Plaston are rounded and very few bevelled. Rims from the other sites show more bevelled rims (Evers, 1977:176).

Early Iron Age pottery was also excavated by archaeologist, Prof. Tom Huffman during 1997 on location where the Riverside Government complex is currently situated (Huffman, 1998). This site is situated a few km north of Nelspruit next to the confluence of the Nelspruit and Crocodile River. It was discovered during the course of an environmental impact assessment for the new Mpumalanga Government complex offices. A bulldozer cutting exposed storage pits, cattle byres, a burial and midden on the crest of a gentle slope. Salvage excavations conducted during December 1997 and March 1998 recovered the burial and contents of several pits.

One of the pits contained, among other items, pottery dating to the eleventh century (AD 1070 ± 40 BP). This relates the pottery to the Mzonjani and Broederstroom phases. The early assemblage belongs to the Kwale branch of the Urewe tradition.

During the early 1970s Dr Mike Evers of the University of the Witwatersrand conducted fieldwork and excavations in the Eastern Transvaal. Two areas were studied: the first area was the Letaba area south of the Groot Letaba River, west of the Lebombo Mountains, east of the great escarpment and north of the Olifants River. The second area was the Eastern Transvaal escarpment area between Lydenburg and Machadodorp.

These two areas are referred to as the Lowveld and escarpment respectively. The earliest work on Iron Age archaeology was conducted by Trevor and Hall in 1912. This revealed prehistoric copper-, gold- and iron mines. Schwelinus (1937) reported smelting furnaces, a salt factory and terraces near Phalaborwa. In the same year D.S. van der Merwe located ruins, graves, furnaces, terraces and soapstone objects in the Letaba area.

Mason (1964, 1965, 1967, 1968) started the first scientific excavation in the Lowveld, followed by N.J. van der Merwe and Scully. M. Klapwijk (1973, 1974) also excavated an EIA site at Silverleaves and Evers and van den Berg (1974) excavated at Harmony and Eiland, both EIA sites.

Research by the National Cultural History Museum resulted in the excavation of an EIA site in Sekhukuneland, known as Mototolong (Van Schalkwyk, 2007). The site is characterized by four large cattle kraals containing ceramics, which may be attributed to the Mzonjani and Doornkop occupational phases.

4.2.3. Late Iron Age

The later phases of the Iron Age (AD 1600-1800's) are represented by various tribes including Ndebele, Swazi, BaKoni, and Pedi, marked by extensive stonewalled settlements found throughout the escarpment and particularly around Machadodorp, Lydenburg, Badfontein, Sekhukuneland, Roossenekal and Steelpoort. The BaKoni were the architects of a unique archaeological stone building complex who by the 19th century spoke seKoni which was similar to Sepedi. The core elements of this tradition are stone-walled enclosures, roads and terraces. These settlement complexes may be divided into three basic features: homesteads, terraces and cattle tracks. Researchers such as Mike Evers (1975) and David Collett (1982) identified three basic settlement layouts in this area. Basically these sites can be divided into simple and complex ruins. Simple ruins are normally small in relation to more complex sites and have smaller central cattle byres and fewer huts. Complex ruins consist of a central cattle byre, which has two opposing entrances and a number of semi-circular enclosures surrounding it. The perimeter wall of these sites is sometimes poorly visible. Huts are built between the central enclosure and the perimeter wall. These are all connected by track-ways referred to as cattle tracks. These tracks are made by building stone walls, which forms a walkway for cattle to the centrally located cattle byres.

5. Site descriptions, locations and impact significance assessment

Three sites (RS 1-3) was recorded during the field survey. Site RS 1 consists of a 3 meter long poorly defined stone-packed feature which is possibly either the ruined remains of a dwelling or a heap of stones removed to clear a field for agricultural purposes. The vegetation here is very dense and surface visibility poor. The structure is not regarded as being of archaeological or heritage significance. Site RS 2 is an existing building currently used as farm staff quarters. It is not older than 60 years as evidenced by historical maps, therefore not under the ambit of the Act (25 of 1999). The structure is not regarded as being of archaeological or heritage significance.

Site RS 3 is an existing building which is currently used as a functions venue. It is not older than 60 years as evidenced by historical maps and aerial photos, therefore not under the ambit of the Act.

A total of six survey orientation locations were documented (SO 1-6) which includes a GPS location and photographs of the landscape at that particular location. Both the located sites and survey orientations are tabled in Appendix B and their photos in Appendix D. A map of their location is also provided in Appendix C.

Tables indicate the ***site significance rating scales and status*** in terms of possible impacts of the proposed actions on any located or identified heritage sites (**Table 5.5 & 5.6).**

Table 5.1. Summary of located sites and their heritage significance

Type of site	**Identified sites**	**Significance**
Graves and graveyards	None	N/A
Late Iron Age	None	N/A
Early Iron Age	None	N/A
Historical buildings or structures	None	N/A
Historical features and ruins	None	N/A
Stone Age sites	None	N/A

Table 5.2. Significance rating guidelines for sites

Field Rating	Grade	Significance	Recommended Mitigation
National Significance (NS)	Grade 1	High Significance	Conservation, nomination as national site
Provincial Significance (PS)	Grade 2	High Significance	Conservation; Provincial site nomination
Local significance (LS 3A)	Grade 3A	High Significance	Conservation, No mitigation advised
Local Significance (LS 3B)	Grade 3B	High Significance	Mitigation but at least part of site should be retained
Generally Protected A (GPA)	GPA	High/ Medium Significance	Mitigation before destruction
Generally Protected B (GPB)	GPB	Medium Significance	Recording before destruction
Generally Protected C (GPC)	GPC	Low Significance	Destruction

5.1. Description of located sites

Sites:

5.1.1. Site RS 1.

Location: See Appendix B and D (fig. 1, 2).

Description: Site RS 1 consists of a 3 meter long poorly defined stone-packed feature which is possibly either the ruined remains of a dwelling or a heap of stones removed to clear a field for agricultural purposes. The vegetation here is very dense and surface visibility poor.

Impact of the proposed development/ activity:

The site may suffer impact or destruction during clearing activities for the establishment of agricultural fields or orchards.

Recommendation:

The site or feature is not regarded as being historically significant. It is possible that the remains of the structure may have been a dwelling for farm workers or stones heaped together after historic field clearing activities. It has been recorded that infant burials do occur under or near old dwellings (Anton Pelser, Jaco vd Walt personal communication). Therefore it is recommended that any earthmoving

activities within a 20m buffer around this site be monitored, considered in the EMPr. In the event that any skeletal remains are exposed, all activity should be halted immediately and an archaeologist contacted to assess the finding/s.

5.1.2 Site RS 2.

Location: See Appendix B and D (fig. 3).

Description: Site RS 2 is an existing building currently used as farm staff quarters. It is not older than 60 years as evidenced by historical maps, therefore not under the ambit of the Act (25 of 1999). The structure is not regarded as being of archaeological or heritage significance.

Impact of the proposed development/ activity:

The site may suffer indirect impact during clearing activities for the establishment of agricultural fields or orchards.

Recommendation:

The site or feature is not regarded as being historically significant. No recommendations necessary.

5.1.3. Site RS 3.

Location: See Appendix B and D (fig. 4).

Description: Site RS 3 is an existing building which is currently used as a functions venue. It is not older than 60 years as evidenced by historical maps and aerial photos, therefore not under the ambit of the Act (25 of 1999).

Impact of the proposed development/ activity:

The site may suffer indirect impact during clearing activities for the establishment of agricultural fields or orchards.

Recommendation:

The site or feature is not regarded as being historically significant. No recommendations necessary.

Survey orientations:

5.1.4. Site SO 1.

Location: See Appendix B and D (fig. 5, 6).

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A

Photo south

5.1.5. Site SO 2.

Location: See Appendix B and D (fig. 7, 8).

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A


Photo north

5.1.6. Site SO 3.

Location: See Appendix B and D (fig. 9, 10).

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A


Photo west

5.1.7. Site SO 4.

Location: See Appendix B and D (fig.11).

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A


Photo north

5.1.8. Site SO 5.

Location: See Appendix B and D (fig. 12, 13).

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A


Photo south-west

5.1.9. Site SO 6.

Location: See Appendix B and D (fig. 14, 15).

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A

 **Photo east**

TABLE 5.3. General description of located sites and field rating.

Site No.	Description	Type of significance	Degree of significance	NHRA heritage resource & rating
RS 1	Remains of a dwelling	Buildings & structures	Archaeological: None Historic: Poor	Structures (Sect. 34). Low. **GP C**
RS 2	Staff quarters	Buildings & structures	Archaeological: None Historic: Poor	Structures (Sect. 34). Low. **GP C**
RS 3	Functions venue	Buildings & structures	Archaeological: None Historic: Poor	Structures (Sect. 34). Low. **GP C**
SO1	Survey orientation location	N/A	Archaeological: N/A Historic: N/A	None
SO2	Survey orientation location	N/A	Archaeological: N/A Historic: N/A	None
SO3	Survey orientation location	N/A	Archaeological: N/A Historic: N/A	None
SO4	Survey orientation location	N/A	Archaeological: N/A Historic: N/A	None
SO5	Survey orientation location	N/A	Archaeological: N/A Historic: N/A	None
SO6	Survey orientation location	N/A	Archaeological: N/A Historic: N/A	None

TABLE 5.4. Site condition assessment and management recommendations.

Site no.	Type of Heritage resource	Integrity of cultural material	Preservation condition of site	Relative location	Quality of archaeological/ historic material	Quantity of site features	Recommended conservation management
RS 1	Built environment	Poor	Poor	Sterkspruit 296 JT	Archaeology: N/A Historically: Poor	1	Avoid if possible or monitor earth moving activities
RS 2	Built environment	Poor	Poor	Sterkspruit 296 JT	Archaeology: N/A Historically: Poor	1	None
RS 3	Built environment	Poor	Poor	Sterkspruit 296 JT	Archaeology: N/A Historically: Poor	1	None
SO 1	N/A	N/A	N/A	Sterkspruit 296 JT	Archaeology: N/A Historically: N/A	-	N/A
SO 2	N/A	N/A	N/A	Sterkspruit 296 JT	Archaeology: N/A Historically: N/A	-	N/A
SO 3	N/A	N/A	N/A	Sterkspruit 296 JT	Archaeology: N/A Historically: N/A	-	N/A
SO 4	N/A	N/A	N/A	Sterkspruit 296 JT	Archaeology: N/A Historically: N/A	-	N/A
SO 5	N/A	N/A	N/A	Sterkspruit 296 JT	Archaeology: N/A Historically: N/A	-	N/A
SO 6	N/A	N/A	N/A	Sterkspruit 296 JT	Archaeology: N/A Historically: N/A	-	N/A

TABLE 5.5. Significance Rating Scales of Impact

Site No.	Nature of impact	Type of site	Extent	Duration	Intensity	Probability	Score total
RS 1	Vegetation clearing	Built environment	Site	Short term	Moderate-High	Possible	5
RS 2	Vegetation clearing	Built environment	Site	Short term	Low-Moderate	Possible	4
RS 3	Vegetation clearing	Built environment	Site	Short term	Low	Improbable	1
SO 1	Vegetation clearing	N/A	N/A	Short term	Low	Improbable	2
SO 2	Vegetation clearing	N/A	N/A	Short term	Low	Improbable	2
SO 3	Vegetation clearing	N/A	N/A	Short term	Low	Improbable	2
SO 4	Vegetation clearing	N/A	N/A	Short term	Low	Improbable	2
SO 5	Vegetation clearing	N/A	N/A	Short term	Low	Improbable	2
SO 6	Vegetation clearing	N/A	N/A	Short term	Low	Improbable	2

***Notes:** Short term ≥ 5 years, Medium term 5-15 years, Long term 15-30 years, Permanent 30+ years

Intensity: Very High (4), High (3), Moderate (2), Low (1)

Probability: Improbable (1), Possible (2), Highly probable (3), Definite (4)

TABLE 5.6. Site current status and future impact scores

Site No.	Current Status	Low impact (4-6 points)	Medium impact (7-9 points)	High impact (10-12 points)	Very high impact (13-16 points)	Score Total
RS 1	Neutral	-	-	High (10)	-	10
RS 2	Neutral	Low (4)	-	-	-	4
RS 3	Neutral	Low (4)	-	-	-	4
SO 1	Neutral	-	-	-	-	-
SO 2	Neutral	-	-	-	-	-
SO 3	Neutral	-	-	-	-	-
SO 4	Neutral	-	-	-	-	-
SO 5	Neutral	-	-	-	-	-
SO 6	Neutral	-	-	-	-	-

5.2. Cumulative impacts on the heritage landscape

Cumulative impacts can occur when a range of impacts which result from several concurrent processes have impact on heritage resources. The importance of addressing cumulative impacts is that the total impact of several factors together is often greater than one single process or activity that may impact on heritage resources. Site RS 1 is not regarded as being historically significant. It is possible that the remains of the structure may have been a dwelling for farm workers even though it is only a single building. Site MF 1 may suffer direct impact during clearing activities for the establishment of fields or orchards. It has been recorded that infant burials do occur under or near huts (Anton Pelser, Jaco vd Walt personal communication). Therefore it is recommended that any earthmoving activities within a 20m buffer around this site be monitored, considered in the EMPr. In the event that any skeletal remains are exposed, all activity should be halted immediately and an archaeologist be on site to assess the situation.

6. Summary of findings and recommendations

Three sites (RS 1-3) was recorded during the field survey. Site RS 1 consists of a 3 meter long poorly defined stone-packed feature which is possibly either the ruined remains of a dwelling or a heap of stones removed to clear a field for agricultural purposes. The vegetation here is very dense and surface visibility poor. It is possible that the remains of the structure may have been a dwelling for farm workers or stones heaped together after historic field clearing activities. It has been recorded that infant burials do occur under or near old dwellings (Anton Pelser, Jaco vd Walt personal communication). Therefore it is recommended that any earthmoving activities within a 20m buffer around this site be monitored, considered in the EMPr. In the event that any skeletal remains are exposed, all activity should be halted immediately and an archaeologist contacted to assess the finding/s. Site RS 2 is an existing building currently used as farm staff quarters. It is not older than 60 years as evidenced by historical maps, therefore not under the ambit of the Act (25 of 1999). The structure is not regarded as being of archaeological or heritage significance.

Site RS 3 is an existing building which is currently used as a functions venue. It is not older than 60 years as evidenced by historical maps and aerial photos, therefore not under the ambit of the Act. A total of six survey orientation locations were documented (SO 1-6) which includes a GPS location and photographs of the landscape at that particular location. Surface visibility and access in certain areas was reduced due to very dense bush and undergrowth which included Lantana and sickle bush and dense thick grass cover.

In terms of the archaeological component of the Act (25 of 1999, section 35) no sites were located or recorded in the study area.

In terms of the built environment in the project area (section 34 of the Act) a single site was documented (site MF 1) and is of low significance.

In terms of burial grounds and graves (section 36 of the Act) no graves or gravesites were identified in the study area.

It is not within the expertise of this report or the surveyor to comment on possible palaeontological remains which may be located in the study area.

The bulk of archaeological remains are normally located beneath the soil surface. It is therefore possible that some significant cultural material or remains were not located during this survey and will only be revealed when the soil is disturbed. Should excavation or large scale earth moving activities reveal any human skeletal remains, broken pieces of ceramic pottery, large quantities of sub-surface charcoal or any material that can be associated with previous occupation, a qualified archaeologist should be notified immediately. This will also temporarily halt such activities until an

archaeologist has assessed the situation. It should be noted that if such a situation occurs it may have further financial implications.

6.1. Recommended management measures

Management objectives include not to impact on sites of heritage significance. Monitoring programmes which should be followed when a “chance find” of a heritage object or human remains occur, include the following:

- The contractors and workers should be notified that archaeological sites might be exposed during the construction work.
- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;
- All discoveries shall be reported immediately to a museum, preferably one at which an archaeologist is available, so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999).

7. Bibliography

1. Amery, L.S. (ed),1909. ***The times history of the war in South Africa 1899-1902*****,** Vol VI. London,

2. Barnard, C. 1975**.** ***Die Transvaalse Laeveld. Komee van 'n Kontrei.***

3. Bergh, J.S. (ed.) 1998. ***Geskiedenisatlas van Suid-Afrika. Die vier noordelike provinsies***. (J.L. van Schaik, Pretoria).

4. Bornman, H. 1995. ***Pioneers of the Lowveld***.

5. Breutz, P.L. 1985. ***Pre-Colonial Africa: The South-Eastern Bantu Cultural Province.***

6. Celliers, JP. 2008. *Phase 1 Archaeological Impact Assessment for the proposed development on Portion 3 of the farm Geluk 299 JT and Portion 6, 35, 36 and 68 of the farm Rietvly 295 JT in Schoemanskloof.* An unpublished report by Kudzala Antiquity on file at SAHRA as: 2008-SAHRA-0120.

7. Celliers, JP. 2017. Phase 1 Archaeological and Heritage Impact Assessment on the farm Bruintjieslaagte 465 JT in respect of the proposed construction of an irrigation dam, Mpumalanga Province. SAHRA ref. Case 11112.

8. Delius, P. 2007. ***Mpumalanga History and Heritage.*** University of KwaZulu-Natal Press.

9. Du Preez, S. J. ***Peace attempts during the Anglo Boer War until March 1901.*** Magister Artium thesis in History. Pretoria: University of Pretoria.

10. Evers, T.M. in Voight, E.A. 1981. ***Guide to Archaeological Sites in the Northern and Eastern Transvaal.*** Transvaal Museum, Pretoria.

11. Hall, H.L. 1938 (1990). ***I Have Reaped my Mealies. An Autobiography***. Whitnall Simonsen.

12. Huffman, T. N. 2007. ***Handbook to the Iron Age: The Archaeology of Pre-Colonial Farming Societies in Southern Africa***. Kwa-Zulu Natal Press.

13. Jones, H. M. & Jones G. M. 1999. ***A Gazetteer of the Second Anglo-Boer War. 1899-1902.*** Buckinghamshire: The Military Press.

14. Mason, R. 1962. ***Prehistory of the Transvaal: a record of human activity.*** Witwatersrand University Press, Johannesburg.

15. Massie, R.H. 1905. **The Native tribes of Transvaal. Prepared for the general staff war office.** Harrison and Sons, London.

16. Myburgh, A.C. 1956. ***Die Stamme van die Distrik Carolin*****a.** Staatsdrukker. Pretoria.

17. Packard, P. 2001. ***"Malaria blocks development" revisited: the role of disease in the history of agricultural development in the Eastern and Northern Transvaal Lowveld. 1890-1960.***

Journal of Southern African Studies 27 (3), September 2001.

18. Ross, R. 1999. ***A concise history of South Africa*.** Cambridge University Press. Cambridge.

19. Surplus people project: forced removal in South Africa. Volume 5: *Transvaal*. Cape Town. 1983.

20. Union of South Africa. 1918. *Majority Report of the Eastern Transvaal Natives Land Committee.* Cape Town.

21. Van Schalkwyk, J.A. 2007. *Heritage Impact Scoping Report for the Planned Hendrina-Marathon Power Line, Mpumalanga Province.* An unpublished report by the National Cultural History Museum on file at SAHRA as: 2007-SAHRA-0402.

22. Van Vollenhoven, A.C. 2002. ***Die Metodiek van Kultuurhulpbronbestuur (KHB).*** S.A. Tydskrif vir Kultuurgeskiedenis 16(2).

23. Van Vollenhoven, A.C. 1995. ***Die bydrae van Argeologie tot Kultuurhulpbronbestuur.*** Referaat gelewer voor die Suid-Afrikaanse Vereniging vir Kultuurgeskiedenis, Transvaal Streektak, Sunnyside.

24. Van Vollenhoven, A. C. & Pelser, A. J. 2004. Steinaecker's Horse: Its role during the Anglo Boer War and in the establishment of the Kruger National Park. *SA Journal of Cultural History, Vol. 18(2), Nov. 2004, pp. 1-30.*

ELECTRONIC SOURCES:

1. South African History Online. 2013. 1999. *Nelspruit Timeline 1815-1996*. [Online]. Available: http://www.sahistory.org.za/topic/nelspruit-timeline-1815-1996?page=2. [Cited 26 March 2017]

MAPS

1. Topographical Map. 1942. South Africa. 1:250 000 Sheet. 2530 Barberton. First Edition Pretoria: Government Printer.
2. Topographical Map. 1969. South Africa. 1:50 000 Sheet. 2530BC Boshalte. First Edition Pretoria: Government Printer.
3. Topographical Map. 1984. South Africa. 1:50 000 Sheet. 2530BC Boshalte. Second Edition Pretoria: Government Printer.
4. Topographical Map. 2010. South Africa. 1:50 000 Sheet. 2530BC Magushede. Third Edition Pretoria: Government Printer.

Appendix A

Terminology

"Alter" means any action affecting the structure, appearance or physical properties of a place or object, whether by way of structural or other works, by painting, plastering or other decoration or any other means.

"Archaeological" means –

- Material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artifacts, human and hominid remains and artificial features or structures;
- Rock Art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- Wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artifacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation; and
- Features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found;

"Conservation", in relation to heritage resources, includes protection, maintenance, preservation and sustainable use of places or objects so as to safeguard their cultural significance;

"Cultural significance" means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance;

"Development" means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of a heritage authority in any way result in a change to the nature, appearance or physical nature of a place, or influence its stability and future well-being, including –

- construction, alteration, demolition, removal or change of use of a place or a structure at a place;
- carrying out any works on or over or under a place;

- subdivision or consolidation of land comprising, a place, including the structures or airspace of a place;
- constructing or putting up for display signs or hoardings;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil;

"Expropriate" means the process as determined by the terms of and according to procedures described in the Expropriation Act, 1975 (Act No. 63 of 1975);

"Foreign cultural property", in relation to a reciprocating state, means any object that is specifically designated by that state as being of importance for archaeology, history, literature, art or science;

"Grave" means a place of internment and includes the contents, headstone or other marker of such a place, and any other structure on or associated with such place;

"Heritage resource" means any place or object of cultural significance;

"Heritage register" means a list of heritage resources in a province;

"Heritage resources authority" means the South African Heritage Resources Agency, established in terms of section 11, or, insofar as this Act (25 of 1999) is applicable in or in respect of a province, a provincial heritage resources authority (PHRA);

"Heritage site" means a place declared to be a national heritage site by SAHRA or a place declared to be a provincial heritage site by a provincial heritage resources authority;

"Improvement" in relation to heritage resources, includes the repair, restoration and rehabilitation of a place protected in terms of this Act (25 of 1999);

"Land" includes land covered by water and the air space above the land;

"Living heritage" means the intangible aspects of inherited culture, and may include –

- cultural tradition;
- oral history;
- performance;
- ritual;
- popular memory;
- skills and techniques;
- indigenous knowledge systems; and
- the holistic approach to nature, society and social relationships;

"Management" in relation to heritage resources, includes the conservation, presentation and improvement of a place protected in terms of the Act;

"Object" means any moveable property of cultural significance which may be protected in terms of any provisions of the Act, including –

- any archaeological artifact;
- palaeontological and rare geological specimens;
- meteorites;
- other objects referred to in section 3 of the Act;

"Owner" includes the owner's authorized agent and any person with a real interest in the property and –

- in the case of a place owned by the State or State-aided institutions, the Minister or any other person or body of persons responsible for the care, management or control of that place;
- in the case of tribal trust land, the recognized traditional authority;

"Place" includes –

- a site, area or region;
- a building or other structure which may include equipment, furniture, fittings and articles associated with or connected with such building or other structure;
- a group of buildings or other structures which may include equipment, furniture, fittings and articles associated with or connected with such group of buildings or other structures;
- an open space, including a public square, street or park; and
- in relation to the management of a place, includes the immediate surroundings of a place;

"Site" means any area of land, including land covered by water, and including any structures or objects thereon;

"**Structure"** means any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith.

Appendix B

List of sites

Three sites were recorded during the survey and named RS 1-3 representing the farm name and numbered 1-3. A total of six survey orientation sites were recorded. The sites were named SO 1-6.

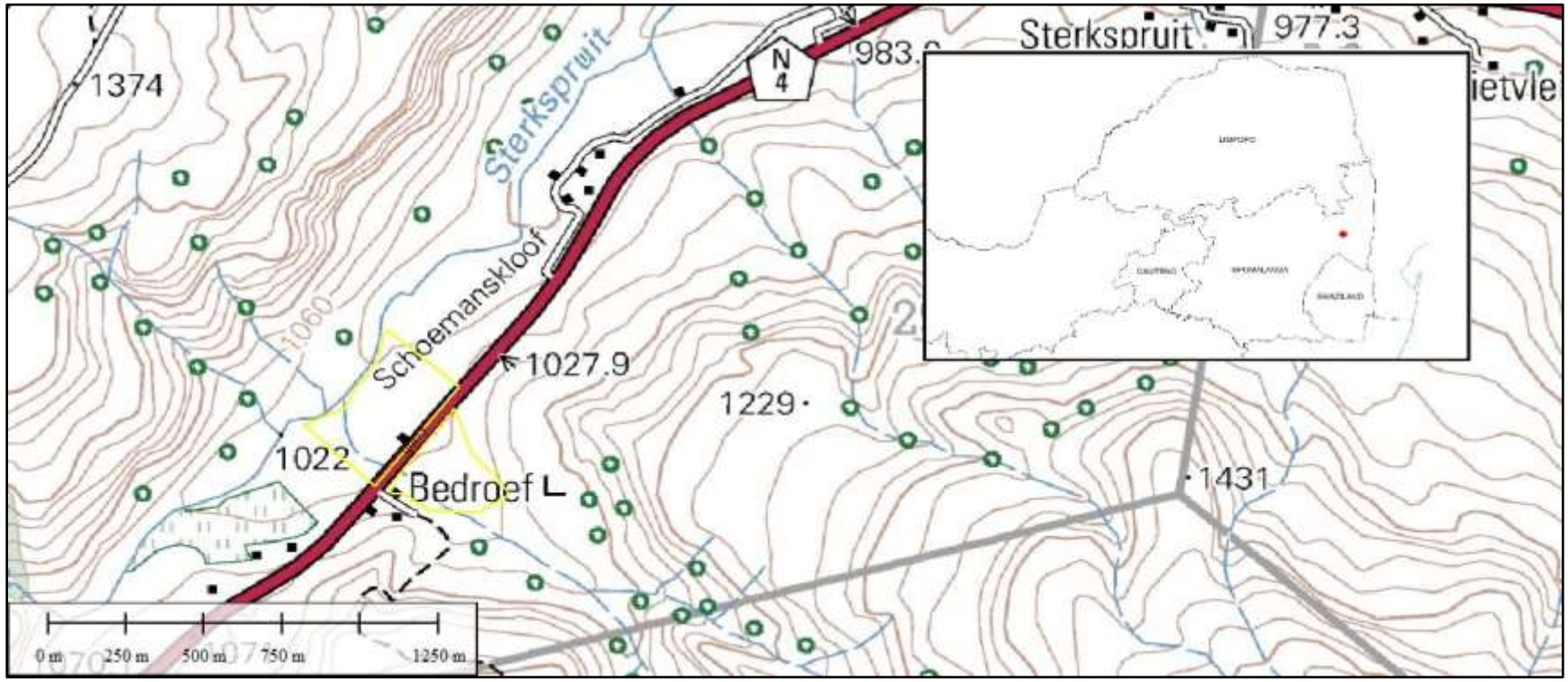
Table A. Located sites.

Site Name	Date of compilation	GPS Coordinates		Photo figure No.
RS 1	06/05/2020	S25°23'51,07"	E030°30'45,05"	1, 2
RS 2	06/05/2020	S25°23'53,98"	E030°30'44,68"	3
RS 3	06/05/2020	S25°23'59,92"	E030°30'51,29"	4

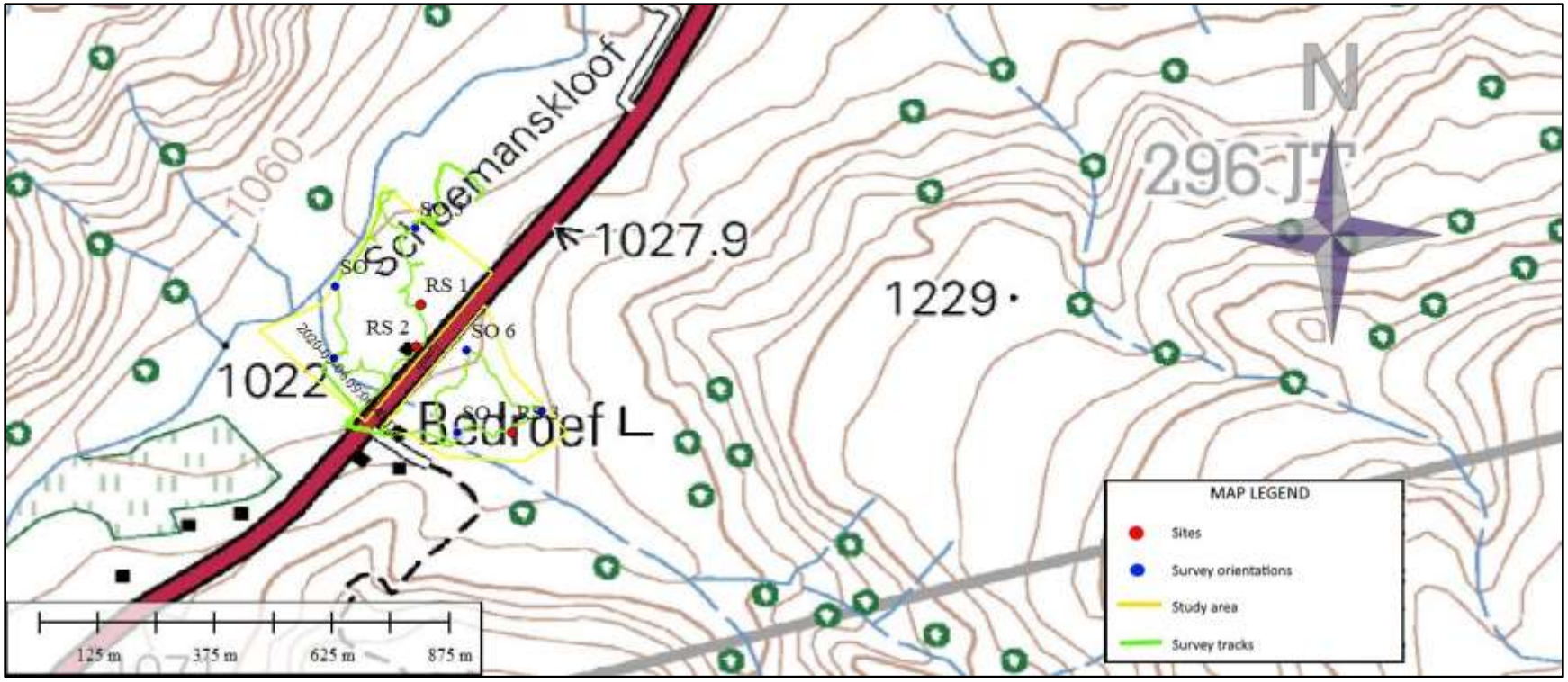
Table B. Survey Orientation Locations.

Site Name	Date of compilation	GPS Coordinates		Photo figure No.
SO 1	06/05/2020	S25°23'54,78"	E030°30'39,05"	5, 6
SO 2	06/05/2020	S25°23'49,80"	E030°30'39,08"	7, 8
SO 3	06/05/2020	S25°23'45,80"	E030°30'44,58"	9, 10
SO 4	06/05/2020	S25°23'59,91"	E030°30'47,51"	11
SO 5	06/05/2020	S25°23'58,42"	E030°30'53,38"	12, 13
SO 6	06/05/2020	S25°23'54,24"	E030°30'48,14"	14, 15

Appendix C



Regional Map, 1:50 000 Topographical Map 2530 BC (2010)



1:50 000 Topographical Map 2530 BC (2010)

Aerial image (Google Earth, 2020)

Appendix D

Site Photos

Fig. 1. Site RS 1. The small stone-built or heaped remains. Photo taken south.

Fig. 2. Site RS 1. The vegetation at site RS 1 is very dense making surface visibility poor. Photo taken east.

Fig. 3. Site RS 2. The dwelling is currently used for staff accommodation.

Fig. 4. Site RS 3. The building was built between 2012 and 2013 as evidenced by aerial photos (see figures 4.6 & 4.7). It is a functions venue.

Survey Orientation Photos

Fig. 5. Site SO1. Photo taken in a south-western direction.

Fig. 6. Site SO1. Photo taken in a north-western direction. Note dense vegetation.

Fig. 7. Site SO2. Photo taken in an eastern direction.

Fig. 8. Site SO 2. Photo taken in a north-eastern direction. Note dense vegetation.

Fig. 9. Site SO 3. Photo taken in an eastern direction.

Fig. 10. Site SO 3. Photo taken in a southern direction.

Fig. 11. Site SO 4. Photo taken in a western direction.

Fig. 12. Site SO 5. Photo taken in a western direction.

Fig. 13. Site SO 5. Photo taken in a south-eastern direction. Tall thick grass under bunched typical bushveld trees.

Fig. 14. Site SO 6. Photo taken in a northern direction.

Fig. 15. Site SO 6. Photo taken in a southern direction.

Annexure E: Palaeontological Report

Palaeontological Impact Assessment for the proposed Clearing for agriculture on Farm Sterkspruit 296JT, west of Nelspruit, Mpumalanga Province

Desktop Study (Phase 1)

For

Steven Henwood Consulting

10 April 2020

Prof Marion Bamford
Palaeobotanist
P Bag 652, WITS 2050
Johannesburg, South Africa
Marion.bamford@wits.ac.za

Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 31 years research; 23 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Steven Henwood Consulting, Mbombela, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A palaeontological Impact Assessment was requested for the proposed clearing of natural vegetation for agricultural development on Portion 1 of Farm Sterkspruit JT, west of Nelspruit and east of Schoemanskloof, Mpumalanga Province. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed project and is presented herein.

The proposed site lies on Dwaalheuwel quartzite in the north, then Hekpoort basaltic andesite parallel to the main road. To the south of the road is a band of Strubenkop Formation mudrock and sandstone. The Sahris palaeosensitivity map indicates that the Hekpoort formation is moderately sensitive but this is incorrect. Volcanic rocks do not preserve fossils. The map correlates with the Palaeotechnical Report for Mpumalanga that is incorrect.

Assuming that the geological mapping of the area at a resolution of 1:50 000 and the published literature, are correct, the area has insignificant to zero chance of preserving fossils. Based on this information it is recommended that no palaeontological site visit is required and the project may proceed on the piece of land that is already disturbed by natural vegetation. It is also recommended that SAHRA updates the Palaeotechnical Report and the SAHRIS map for this area.

Table of Contents

1. Background

The owners of the property Farm Sterkspruit 296 JT propose to clear a section on Portion 1 of the land of the natural vegetation so that they can develop it for agricultural purposes. The farm lies on both sides of the main road between Schoemanskloof and Nelspruit, and the portion to be cleared is on both sides of the main road that runs SW-NE (Figure 1).

A Palaeontological Impact Assessment was requested for the agricultural clearing project. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA). A desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 2017)

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report	Appendix A
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5

j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	N/A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	N/A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

Figure 1: Google Earth map of the proposed agricultural clearing on Farm Sterkspruit 296 JT, west of Nelspruit, shown in the black outline. The road is the main tarred road between Schoemanskloof and Nelspruit. Map supplied by S Henwood.

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

The rocks in this region are of the Lower Pretoria Group, in the upper Transvaal Supergroup. They comprise a number of sequences of sediments infilling a tectonically active inland basin. At least three cycles have been recognised in this basin, with the Timeball Hill Formation representing the second shallow embayment and the other four formations unconformably overlying the Timeball Hill Formation (Eriksson et al., 2012). The latter represents a shallow to deep marine environment. There is a disconformity and then the four other formations, from the basal Boeshoek, Hekpoort, Dwaalheuwel to Strubenkop Formations, represent the shallow lacustrine alluvial fan and braided stream deposits in the extensional subsidence of the basin. There is also some volcanic input in the sediments (ibid).

The project site is on several of the formations, with a band of Dwaalheuwel quartzite in the north, then Hekpoort basaltic andesite parallel to the main road. To the south of the road is a band of Strubenkop Formation mudrock and sandstone. The southern section is on diabase with two small outcrops (southeast and southwest corners) of Dwaalheuwel quartzite (Figure 2, Table 2). The rocks have been well mapped and dated in this region (Eriksson et al., 2006, 2012; Lenhardt et al., 2012; Schroder et al., 2016). None of the geological references consulted mention dolomite, limestone or stromatolites in the four formations above the Timeball Hill Formation. Stromatolites have been found in the overlying Daspoort and Silverton Formations (Eriksson et al., 2012).

Along some of the river channels there is a covering of alluvium and soils of Quaternary age.

Figure 2: Geological map of the area around Farm Sterkspruit 296 JT. The location of the proposed project is indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2530 Barberton.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006, 2012; Johnson et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Quaternary, ca 2.5 Ma to present
Vdi	Diabase	Intrusive volcanic diabase	Post Transvaal SG
Vs	Strubenkop Fm, Pretoria Group, Transvaal SG	Shale, sandstone, hornfels	Ca 2224 – 2180 Ma
Vdw	Dwaalheuwel Fm, Pretoria Group, Transvaal SG	Quartzite, shale	Ca 2224 – 2180 Ma
Vha	Hekpoort Fm, Pretoria Group, Transvaal SG	Basaltic andesite, lava	Ca 2224 – 2180 Ma
Vb	Boeshoek Fm, Pretoria Group, Transvaal SG	Quartzite, subgreywacke, conglomerate, siltstone	Ca 2224 – 2180 Ma
Vt	Timeball Hill Fm, Pretoria Group, Transvaal SG	Laminated shales, diamictites; with red dots	Ca 2300 - 2230 Ma

Symbol	Group/Formation	Lithology	Approximate Age
		= Klapperkop Mbr – ferruginous quartzite	

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for development is in the Hekpoort, Dwaalheuwel and Strubenkop Formations. Since the Hekpoort Formation is composed of basaltic andesite and lava it does not preserve any fossils because these are volcanic rocks. The Dwaalheuwel Formation represents alluvial fan and braided stream facies, i.e. medium to high energy settings and they do not preserve fossils. The only forms of life present at this time, over 2000 million years ago, were microscopic forms such as bacteria and algae (Plumstead, 1969; McCarthy and Rubidge, 2005).

The Strubenkop Formation is composed of shale, sandstone and hornfels representing a shallow marine environment. While trace fossils such as stromatolites have been recorded from the Malmani Subgroup (Eriksson et al., 2006, 2012), they have not been recorded from the Dwaalheuwel or Strubenkop Formations. The volcanic Hekpoort Formation certainly does not preserve stromatolites. In the Mpumalanga Palaeotechnical Report (Groenewald et al., 2014; page 23), however, this formation is indicated as moderately sensitive (gree) even though they state that no fossils have been found. Based on this report the Hekpoort Formation is mapped as moderately sensitive (green) and this is incorrect.

Ignoring the palaeosensitivity map and assuming that the geological map is accurate, originally having been mapped in detail at a higher resolution of 1:50 000 (see information on the 1:250 000), and that more recent work by geologists on the various formations, including dating and fieldwork, is also accurate, then the location should be indicated as low or zero significance for palaeontology.

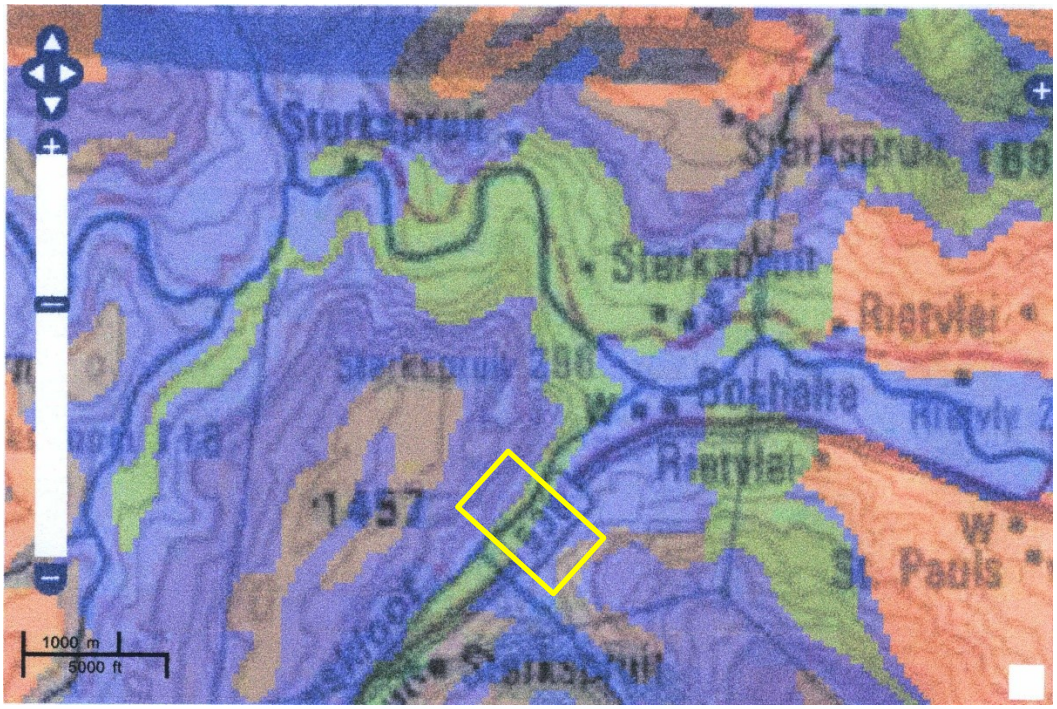


Figure 3: SAHRIS palaeosensitivity map for the site for the proposed section for clearing for agriculture on Farm Sterkspruit 296JT shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as moderately sensitive (green) parallel to the main road, on the north side, but this is incorrect, and should be indicated as low or zero. The project site is on three formations and none of these is fossiliferous. Furthermore, the site is on soils that are well vegetated and not on rocks. Soils are naturally weathered sediments with an organic component and do not preserve fossils.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

TABLE 3A: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.

	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

TABLE 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	**H**	-
	M	-
	L	Volcanic rocks and quartzites do not preserve trace fossils; the rocks are too old for body fossils. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	The rocks are too old and of the wrong type to preserve fossils. The spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is extremely unlikely that any fossils would be found in the volcanic rocks of the Hekpoort Fm.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are much too old to contain body fossils and of the wrong type, being volcanic rocks and quartzites or shales from relatively deep lacustrine settings. Furthermore, the site has a covering of soils that have already been highly disturbed by the natural vegetation and roots.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the, basaltic andesites, sandstones, shales and quartzites are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material. The uncertainty is the validity of the Mpumalanga Palaeotechnical

Report that provides no evidence for the presence of any fossils in the Hekpoort Formation. Furthermore, these are volcanic rocks and do not preserve fossils of any kind. Because the SAHRIS map is based on the palaeotechnical report for Mpumalanga, the sensitivity is incorrect.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, there is no chance or it is extremely unlikely that any fossils would be preserved in the Hekpoort Formation (Pretoria Group, Transvaal Supergroup) although the SAHRIS palaeosensitivity map indicates that the area is moderately sensitive. The geology does not support this interpretation. Assuming that the geological mapping is accurate then there is no chance of fossils occurring on the site and the project may proceed.

7. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodromus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 237-260.

Eriksson, P.G., Bartman, R., Catuneanu, O., Mazumder, R., Lenhardt, N., 2012. A case study of microbial mats-related features in coastal epeiric sandstones from the Palaeoproterozoic Pretoria Group, Transvaal Supergroup, Kaapvaal craton, South Africa; the effect of preservation (reflecting sequence stratigraphic models) on the relationship between mat features and inferred palaeoenvironment. Sedimentary Geology 263, 67-75.

Groenewald, G., Groenewald, D., Groenewald, S., 2014. SAHRA Palaeotechnical Report. Palaeontological Heritage of Mpumalanga. 20 pages.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

Lenhardt, N., Eriksson, P.G., Catuneanu, O., Bumby, A.J., 2012. Nature of and controls on volcanism in the ca. 2.32–2.06 Ga Pretoria Group, Transvaal Supergroup, Kaapvaal Craton, South Africa. Precambrian Research 214– 215, 06– 123.

Schröder, S., Beukes, N.J., Armstrong, R.A., 2016. Detrital zircon constraints on the tectonostratigraphy of the Paleoproterozoic Pretoria Group, South Africa. Precambrian Research 278, 362 – 393.

Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
January 2020

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
Present employment	:	Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-
Telephone	:	+27 11 717 6690
Fax	:	+27 11 717 6694
Cell	:	082 555 6937
E-mail	:	marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	7	0
Masters	10	4
PhD	12	5
Postdoctoral fellows	10	3

viii) Undergraduate teaching
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 2-8 students per year.

ix) Editing and reviewing
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Cretaceous Research: 2014 –
Journal of African Earth Sciences: 2020 -

Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration

- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
-

xi) Research Output

Publications by M K Bamford up to December 2019 peer-reviewed journals or scholarly books: over 140 articles published; 5 submitted/in press; 8 book chapters.

Scopus h-index = 27; Google scholar h-index = 32; -i10-index = 80
Conferences: numerous presentations at local and international conferences.

xii) NRF Rating

NRF Rating: B-2 (2016-2020)
NRF Rating: B-3 (2010-2015)
NRF Rating: B-3 (2005-2009)
NRF Rating: C-2 (1999-2004)

Annexure F: Soils

Vormnommer	344857

omnia
NUTRIOLOGY • NUTRILOGIE*
*the science of growing • wetenskap vir groei

LABORATORIUM
ONTLEDINGSVERSLAG

Kliënt	FRANCOIS RALL	**Landdrosdistrik**	NELSPRUIT
Verteenwoordiger	S W NEETHLING 0834527525	**Landboukundige**	Johan Campher 0795007514
Monster Datum	2017/03/20	**Verslag Datum**	2017/04/07

NIE-ROETINE GRONDONTLEDING

Plaasnaam		SCHOEMANSKL	SCHOEMANSKL	SCHOEMANSKL	SCHOEMANSKL
Landnommer		1	2	3	4
Lab nommer		15695	15696	15697	15698
Gewas		Kool (Winter)	Pampoen	Kool (Winter)	Skorsies
Hektaar		1.0	1.0	1.0	1.0
Monsterdiepte		Bo-grond	Bo-grond	Bo-grond	Bo-grond
Tot-N	($mg \cdot kg^{-1}$)	-	-	-	-
N	(%)	-	-	-	-
NO_3-N	($mg \cdot kg^{-1}$)	-	-	-	-
NH_4-N	($mg \cdot kg^{-1}$)	-	-	-	-
Sand	(%)	-	-	-	-
Slik	(%)	-	-	-	-
Klei	(%)	-	-	-	-
Volumetriese klipfraksie	(%)	-	-	-	-
Elektriese geleiding	($mS \cdot m^{-1}$)	-	-	-	-
Organiese C	(% m/m)	1.96	1.06	0.85	0.74
Organiese Materiaal	(% m/m)	3.37	1.82	1.46	1.27
Cl	($mg \cdot kg^{-1}$)	-	-	-	-
Zn	($mg \cdot kg^{-1}$)	0.5	0.7	**0.4**	1.1
Mn	($mg \cdot kg^{-1}$)	21.35	7.53	8.95	10.46
Fe	($mg \cdot kg^{-1}$)	7.7	69.0	57.0	46.0
Cu	($mg \cdot kg^{-1}$)	12.0	3.7	3.3	1.8
B	($mg \cdot kg^{-1}$)	-	-	-	-
P (Truog)	($mg \cdot kg^{-1}$)	-	-	-	-
FSI		-	-	-	-
Ni	($mg \cdot kg^{-1}$)	0.10	0.20	0.10	0.10
Si	($mg \cdot kg^{-1}$)	-	-	-	-

Die interpretasie van hierdie analise is na gelang van algemene norme en plek/gewas-spesifieke interpretasie word aanbeveel.

Hierdie laboratorium neem deel aan die gehalteversekeringskema van ALASA en voldoen aan hierdie assosiasie se standaarde. Hierdie laboratorium is ISO 9001:2000 gesertifiseer.

Ekstraksiemetodes	Tot-N - 0.1N K_2SO_4	Cl – 0.1N KNO_3	Organiese C - Walkley-Black metode
	Fe,Mn,Zn,Cu,Ni - DTPA	B - Warm waterekstrak	P - Truog

Vormnommer	344857

omnia
NUTRIOLOGY • NUTRILOGIE*
*the science of growing • wetenskap vir groei

LABORATORIUM ONTLEDINGSVERSLAG

Kliënt	FRANCOIS RALL	Landdrosdistrik	NELSPRUIT
Verteenwoordiger	S W NEETHLING 0834527525	Landboukundige	Johan Campher 0795007514
Monster Datum	2017/03/20	Verslag Datum	2017/04/07

NIE-ROETINE GRONDONTLEDING

Plaasnaam		SCHOEMANSKL
Landnommer		5
Lab nommer		15701
Gewas		Algemeen -
Hektaar		1.0
Monsterdiepte		Bo-grond
Tot-N	($mg \cdot kg^{-1}$)	-
N	(%)	-
NO_3-N	($mg \cdot kg^{-1}$)	-
NH_4-N	($mg \cdot kg^{-1}$)	-
Sand	(%)	-
Slik	(%)	-
Klei	(%)	-
Volumetriese klipfraksie	(%)	-
Elektriese geleiding	($mS \cdot m^{-1}$)	-
Organiese C	(% m/m)	0.59
Organiese Materiaal	(% m/m)	1.01
Cl	($mg \cdot kg^{-1}$)	-
Zn	($mg \cdot kg^{-1}$)	2.0
Mn	($mg \cdot kg^{-1}$)	31.26
Fe	($mg \cdot kg^{-1}$)	20.0
Cu	($mg \cdot kg^{-1}$)	1.4
B	($mg \cdot kg^{-1}$)	-
P (Truog)	($mg \cdot kg^{-1}$)	-
FSI		-
Ni	($mg \cdot kg^{-1}$)	0.01
Si	($mg \cdot kg^{-1}$)	-

Die interpretasie van hierdie analise is na gelang van algemene norme en plek/gewas-spesifieke interpretasie word aanbeveel.

Hierdie laboratorium neem deel aan die gehalteversekeringskema van ALASA en voldoen aan hierdie assosiasie se standaarde. Hierdie laboratorium is ISO 9001:2000 gesertifiseer.

Ekstraksiemetodes	Tot-N - 0.1N K_2SO_4	Cl – 0.1N KNO_3	Organiese C - Walkley-Black metode
	Fe,Mn,Zn,Cu,Ni - DTPA	B - Warm waterekstrak	P - Truog

Vormnommer	344857

omnia
NUTRIOLOGY • NUTRILOGIE*
*the science of growing • wetenskap vir groei

LABORATORIUM
ONTLEDINGSVERSLAG

Kliënt	FRANCOIS RALL	Landdrosdistrik	NELSPRUIT
Verteenwoordiger	S W NEETHLING 0834527525	Landboukundige	Johan Campher 0795007514
Monster Datum	2017/03/20	Verslag Datum	2017/04/07

ROETINE GRONDONTLEDING

Plaasnaam		SCHOEMANSKL	SCHOEMANSKL	SCHOEMANSKL	SCHOEMANSKL
Landnommer		1	2	3	4
Lab nommer		15695	15696	15697	15698
Gewas		Kool (Winter)	Pampoen	Kool (Winter)	Skorsies
Hektaar		1.0	1.0	1.0	1.0
Monsterdiepte		Bo-grond	Bo-grond	Bo-grond	Bo-grond
Kleur		Ro Br	Dnker Br	Dnker Br	Dnker Br
Brutodigtheid	($kg \cdot m^{-3}$)	1153	1113	1198	1168
pH	(KCl)	4.9	5.0	5.3	5.5
Uitruilbare suur		NVT	NVT	NVT	NVT
Suurversadiging	(%)	NVT	NVT	NVT	NVT
S	($mg \cdot kg^{-1}$)	**8**	**8**	**9**	**9**
P	($mg \cdot kg^{-1}$)	2	**3**	3	5
P (Olsen)	($mg \cdot kg^{-1}$)	-	-	-	-
K	($mg \cdot kg^{-1}$)	73	103	78	145
	K(% van EKUK)	3	2	2	7
Ca	($mg \cdot kg^{-1}$)	724	1310	960	622
	Ca(% van EKUK)	58	53	56	61
Mg	($mg \cdot kg^{-1}$)	285	669	416	188
	Mg(% van EKUK)	38	44	40	30
Na	($mg \cdot kg^{-1}$)	16	21	25	15
	Na(% van EKUK)	1	1	1	1
EKUK	($cmol_c \cdot kg^{-1}$) Bereken	6.2	12.4	8.5	5.1
Ca / Mg		1.5	**1.2**	1.4	2.0
Mg / K		12.5	20.8	17.1	4.2
(Ca + Mg) / K		32	**46**	41	13
Elektriese geleiding	($mS \cdot m^{-1}$)	NVT	NVT	NVT	NVT

Die interpretasie van hierdie analise is na gelang van algemene norme en plek/gewas-spesifieke interpretasie word aanbeveel.

Hierdie laboratorium is ISO/IEC 17025:2005 geakkrediteer deur SANAS (Toets laboratorium No T0466) vir die kwantifisering van Ca, Mg, Na en K in grond.

Ekstraksiemetodes	P - Bray I \ Olsen(pH >= 7.3)	Katione - NH_4OAc

Vormnommer	344857

omnia
NUTRIOLOGY • NUTRILOGIE*
*the science of growing • wetenskap vir groei

LABORATORIUM
ONTLEDINGSVERSLAG

Kliënt	FRANCOIS RALL	Landdrosdistrik	NELSPRUIT
Verteenwoordiger	S W NEETHLING 0834527525	Landboukundige	Johan Campher 0795007514
Monster Datum	2017/03/20	Verslag Datum	2017/04/07

ROETINE GRONDONTLEDING

Plaasnaam		SCHOEMANSKL
Landnommer		5
Lab nommer		15701
Gewas		Algemeen -
Hektaar		1.0
Monsterdiepte		Bo-grond
Kleur		Dnker Br
Brutodigtheid	($kg \cdot m^{-3}$)	1195
pH	(KCl)	5.1
Uitruilbare suur		NVT
Suurversadiging	(%)	NVT
S	($mg \cdot kg^{-1}$)	**5**
P	($mg \cdot kg^{-1}$)	**3**
P (Olsen)	($mg \cdot kg^{-1}$)	-
K	($mg \cdot kg^{-1}$)	75
	K(% van EKUK)	5
Ca	($mg \cdot kg^{-1}$)	492
	Ca(% van EKUK)	60
Mg	($mg \cdot kg^{-1}$)	168
	Mg(% van EKUK)	34
Na	($mg \cdot kg^{-1}$)	15
	Na(% van EKUK)	2
EKUK	($cmol_c \cdot kg^{-1}$) Bereken	4.1
Ca / Mg		1.8
Mg / K		7.2
(Ca + Mg) / K		**20**
Elektriese geleiding	($mS \cdot m^{-1}$)	NVT

Die interpretasie van hierdie analise is na gelang van algemene norme en plek/gewas-spesifieke interpretasie word aanbeveel.

Hierdie laboratorium is ISO/IEC 17025:2005 geakkrediteer deur SANAS (Toets laboratorium No T0466) vir die kwantifisering van Ca, Mg, Na en K in grond.

Ekstraksiemetodes	P - Bray I \ Olsen(pH >= 7.3)	Katione - NH_4OAc